Lower Yellowstone Intake Diversion Dam Fish Passage Project, Montana

FINAL - APPENDIX C

Lower Yellowstone Intake Fish Passage EIS Section 404(b)(1) Analysis

OCTOBER 2016

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List of Acronyms and Terms

AAHUs – Average annual habitat units
Anthropogenic—Related to human activities
ARM—Administrative Rules of Montana
BRT – Biological Review Team
CEA—Cumulative Effects Assessment
CE/ICA – Cost effectiveness and incremental cost analysis
CFR—Code of Federal Regulations
cfs—cubic feet per second
CWA—Clean Water Act
dBA—A-weighted decibels; an expression of the relative loudness of sounds in air as perceived by the human ear
EA—Environmental Assessment
EPA— U.S. Environmental Protection Agency
ESA—Endangered Species Act
fps—feet per second
GIS—Geographic information system
HEC-RAS—Hydrologic Engineering Center River Analysis System
ITA—Indian trust assets
IWR – U.S. Army Corps of Engineers Institute for Water Resources
LYP—Lower Yellowstone Irrigation Project
MFWP—Montana Fish, Wildlife and Parks
MTDEQ—Montana Department of Environmental Quality
NHPA—National Historic Preservation Act
NRCS—Natural Resources Conservation Service
NRHP—National Register of Historic Places
O&M – Operation and maintenance
PED/CM – Planning, engineering and design/construction management
ppm—parts per million
Reclamation—Bureau of Reclamation
Service – U.S. Fish and Wildlife Service
SHPO— State Historic Preservation Office
TDS— Total dissolved solids
Corps—U.S. Army Corps of Engineers
USGS—U.S. Geological Survey
YRCDC—Yellowstone River Conservation District Council

1.0 Introduction

This Clean Water Act Section 404(b)(1) Analysis has been prepared to evaluate compliance with the Section 404(b)(1) Guidelines for the Lower Yellowstone Intake Diversion Dam Fish Passage Project.

Section 404 of the Clean Water Act (CWA) regulates the discharge of dredged and fill material into waters of the United States per 40 Code of Federal Regulations (CFR) Parts 230 and 232. The Yellowstone River is a navigable waterbody and a water of the U.S. Section 404(b)(1) requires that alternatives be considered that could avoid or minimize adverse impacts to aquatic resources and waters of the U.S. for any project that results in the discharge of dredged or fill material. This document evaluates the alternatives that have been considered and documents the potential effects on characteristics of the aquatic ecosystem.

The purpose of the proposed action is to improve fish passage for pallid sturgeon and other native fish at Intake Diversion Dam, continue the viable and effective operation of the Lower Yellowstone Project (LYP), and contribute to ecosystem restoration. The proposed project is located between the communities of Glendive and Sidney in Section 36, Township 18 North, Range 56 East in Dawson County, Montana (Figure 1-1).

The U.S. Army Corps of Engineers (Corps) and the U.S. Bureau of Reclamation (Reclamation) have prepared a Final Environmental Impact Statement (EIS) to analyze direct, indirect, and cumulative effects associated with alternative actions to improve fish passage at the Lower Yellowstone Intake Diversion Dam, in Dawson County, Montana.

1.1 BACKGROUND

The LYP was authorized by the Secretary of the Interior on May 10, 1904. Construction of the LYP began in 1905 and included Intake Diversion Dam, which is a wood and stone diversion weir that spans the Yellowstone River and diverts water into the main irrigation canal. The LYP was authorized to provide a dependable water supply sufficient to irrigate over 58,000 acres of land on the west bank of the Yellowstone River. Reclamation and the four irrigation districts that support the LYP hold unadjudicated water rights in the state of Montana totaling 1,374 cubic feet per second (cfs).

The U.S. Fish and Wildlife Service (Service) listed the pallid sturgeon as endangered under the Endangered Species Act (ESA) in 1990. The best available science suggests that Intake Diversion Dam impedes upstream migration of pallid sturgeon and their access to spawning and larval drift habitats. The lower Yellowstone River is considered by the Service to provide one of the best opportunities to contribute to recruitment and recovery of pallid sturgeon.

Section 7(a)(2) requires each Federal agency to consult on any action authorized, funded, or carried out by the agency to ensure it does not jeopardize the continued existence of any endangered or threatened species. The Revised Pallid Sturgeon Recovery Plan (USFWS 2014a) specifically identifies providing passage at Intake Diversion Dam as important to protect and restore pallid sturgeon populations. By improving passage at Intake Diversion Dam, approximately 165 river miles of potential spawning and larval drift habitat would become accessible in the Yellowstone River and additional miles in major tributaries such as the Powder River.

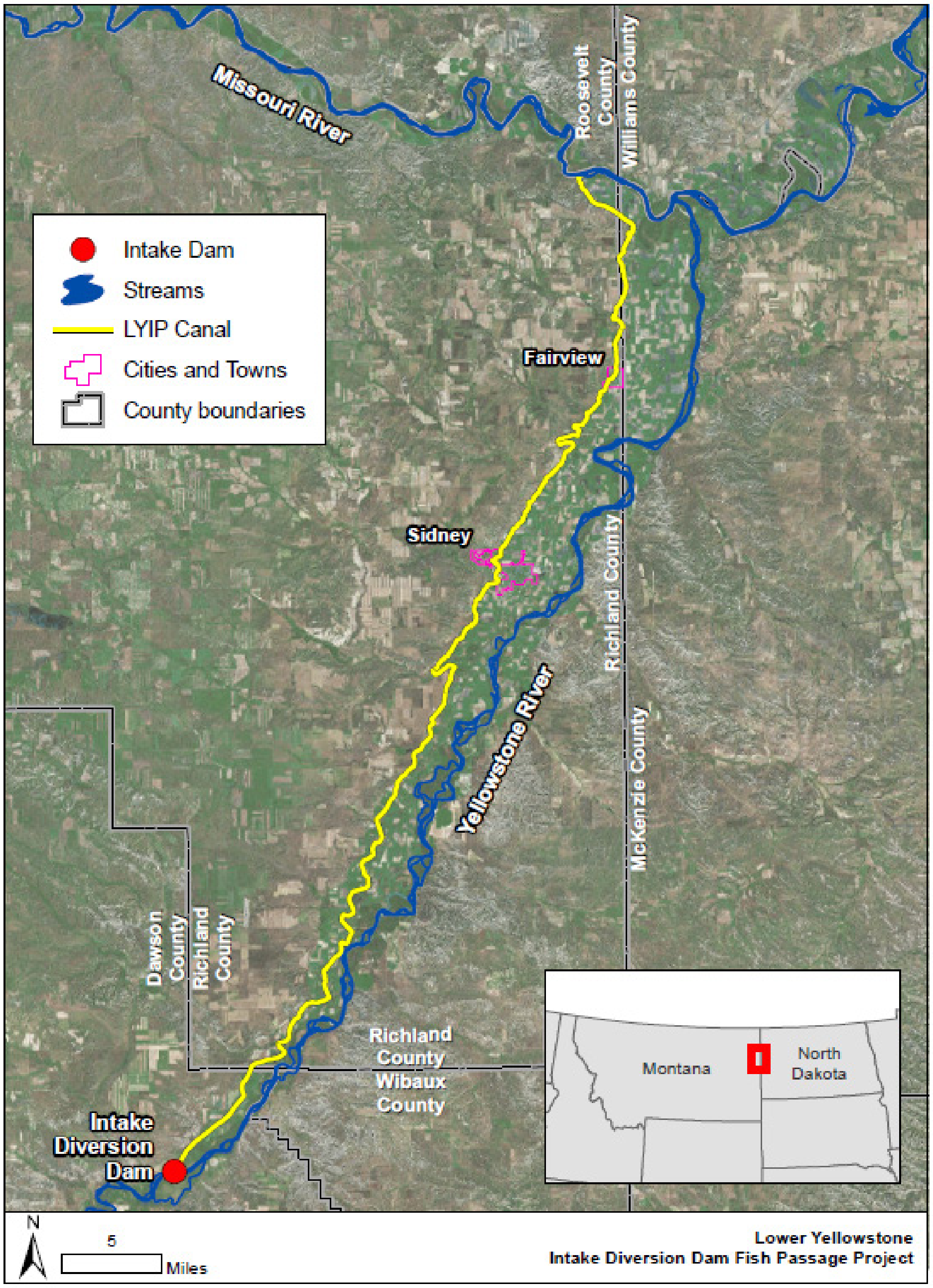

Figure 1.1 Overview of the Study Area

Section 3109 of the 2007 Water Resources Development Act authorized the Corps to use funding from the Missouri River Recovery and Mitigation Program to assist Reclamation in the design and construction of fish passage improvements at Intake Diversion Dam for the purpose of ecosystem restoration.

The Reclamation Act/Newlands Act of 1902 (Pub. L. 161) authorized Reclamation to construct and maintain the facilities associated with the LYP, which includes actions or modifications necessary to comply with Federal law such as the ESA.

1.2 PROBLEMS, OPPORTUNITIES, CONSTRAINTS AND OBJECTIVES

It is important to identify up front the planning goals, objectives, and constraints for the project in order to formulate a range of alternatives that can meet the goals and objectives. When identifying and evaluating alternatives it is also important to obtain input from Federal and state agencies, Tribes, cooperating entities, and the public.

This section summarizes the problems and opportunities assessed during the plan formulation process. The existing and expected future without-project conditions in the study area were evaluated using data and information from on-going research on pallid sturgeon being conducted by a variety of agencies and from information developed for the Missouri River Management Plan and overall pallid sturgeon recovery program. In the planning setting, a problem can be thought of as an undesirable condition, while the objective is the statement of overcoming the problem, and the opportunity is the means for overcoming that problem. Identification of problems and opportunities gives focus to the planning effort. Problems and opportunities can also be viewed as local and regional resource conditions that could be modified in response to public concerns.

1.2.1 Problems and Opportunities

1. Intake Diversion Dam is a barrier to upstream fish passage.

Intake Diversion Dam has impeded upstream migration of pallid sturgeon and other native fish for more than 100 years. The best available science suggests that the weir is likely a total barrier to the endangered pallid sturgeon, due to turbulence and high velocities at the existing weir and in the rock rubble field immediately downstream from the weir (Helfrich et al. 1999, White and Mefford 2002, Bramblett and White 2001, Fuller et al. 2008; Delonay et al. 2014). Opportunities exist for modifications to the existing weir and/or construction of a fish passage project that would provide the opportunity for pallid sturgeon and other fish species to pass upstream of the Intake Diversion Dam.

2. Fish passage is only intermittently provided by the existing side channel.

During high flows occurring in 2014 and 2015, seven wild adult pallid sturgeon utilized the existing side channel around Joe's Island to successfully bypass the weir (Rugg 2014, 2015; Rugg et al. 2016). While this evidence suggests that pallid sturgeon can use this side channel to bypass the weir, the side channel only conveys flows when river flows exceed 20,000 cfs, which does not occur every year. Passage in 2014 and 2015 only occurred at flows greater than 40,000 cfs in the river, which is approaching a 2-year flood (50% probability of occurrence in any given year). Tracking of radio-tagged pallid sturgeon over several years indicates that pallid sturgeon migrate up to Intake Diversion Dam, but do not pass the weir and return downstream to spawn in the lower Yellowstone River, such as near river mile (RM) 10 (Delonay et al. 2014, 2015; Bramblett 1996; Allen et al. 2015, Elliott et al. 2015).

Modifying the existing side channel or existing weir or constructing another type of fishway would provide the opportunity for pallid sturgeon and other fish to pass upstream of Intake Diversion Dam on an annual basis.

3. *Larval drift distances are insufficient for survival when spawning occurs below the Intake Diversion Dam.*

If spawning occurs below Intake Diversion Dam, newly hatched pallid sturgeon (free embryos) likely drift into Lake Sakakawea before they are able to settle into suitable habitat. Biologists believe that like other river spawning species, pallid sturgeon need a river environment to survive (Braaten et al. 2008). The model developed by Kynard et al. (2007) indicates that total drift distance is a limitation on natural recruitment. If these young fish reach the lake environment, their survival rate is believed to be very low because of unsuitable habitat (Kynard et al. 2007). Recent research indicates oxygen levels and substrate conditions in the headwaters of reservoirs such as Fort Peck and Lake Sakakawea are unsuitable for free embryos or larval pallid sturgeon to survive (Guy et al. 2015; Bramblett & Scholl 2016).

Improvements to fish passage at Intake Diversion Dam would provide the opportunity for pallid sturgeon to spawn in potentially suitable habitats for up to 165 additional miles of the Yellowstone River upstream of the weir. The distance between the next upstream barrier on the Yellowstone River, Cartersville Diversion Dam, and Lake Sakakawea is about 258 miles. This substantial increase in free-flowing river habitat likely would provide adequate drift distance for at least a portion of the larvae to settle out into suitable rearing habitats prior to reaching Lake Sakakawea. Access to tributaries, such as the Tongue and Powder Rivers, would provide additional spawning habitat and could increase larval drift distance even further. Five wild adult pallid sturgeon were documented in the Powder River in 2014 and spawning appeared to have occurred (Rugg 2014).

1.2.2 Constraints and Other Considerations

1. *Provide water to the Lower Yellowstone Project through a viable and effective operation.*

Reclamation has contractual obligations to deliver the water right to continue viable and effective operation of the LYP. The Lower Yellowstone Irrigation Districts operate and maintain the irrigation system and will inherit that responsibility for any modifications, so consideration of long-term operation and maintenance costs and feasibility and the capabilities of the irrigation districts was a critical constraint during project formulation.

2. *Provide adequate passage to endangered pallid sturgeon through proper engineering.*

Any passageway recommended would be designed to meet physical and biological criteria developed by the Service's Biological Review Team (BRT) to maximize the potential for effective upstream passage of pallid sturgeon, including appropriate depths, velocities, and attraction flows.

1.2.3 Objectives

1. Improve Fish Passage

Since Intake Diversion Dam is an impediment to successful upstream and downstream movement of pallid sturgeon and other native fishes, modifications are needed to allow fish passage at this structure.

2. Continue Viable and Effective Operation of the Lower Yellowstone Project

The LYP diverts water from the Yellowstone River into the main irrigation canal on the north side of the river immediately upstream of the Intake Diversion Dam. The system conveys water to irrigate over 58,000 acres within the LYP. Water rights are jointly held by the districts and Reclamation. Any proposed modifications need to maintain the viable and effective operation of the LYP by meeting the full water right obligation to the irrigation districts in a manner that is affordable and sustainable over the long-term.

3. Ecosystem Restoration

Improvements to fish passage at Intake Diversion Dam will support migration for numerous fish species and contribute to the sustainability of fish populations in the Yellowstone River. This project will support ecosystem functions by restoring access to a large area of suitable habitat throughout the Lower Yellowstone River ecosystem.

1.3 DEVELOPMENT AND EVALUATION OF ALTERNATIVES

This section presents the plan formulation process used in the development and screening of alternatives to meet the project objectives. Alternatives screened out earlier in the study are described in the Lower Yellowstone Intake Diversion Dam Fish Passage Project EIS (Corps and Reclamation 2016).

1.3.1 No Action

Under the No Action Alternative, Reclamation would continue present operation of Intake Diversion Dam and headworks to divert water from the Yellowstone River for irrigation purposes, as authorized. Under this scenario, Reclamation would be obligated to reinitiate consultation with the Service under Section 7(a)(2) of the ESA, to evaluate the impacts to pallid sturgeon from the LYP. Continued O&M would include annual placement of rock on the existing weir crest and maintenance of the headworks, screens, irrigation canals, pipes, and pumps. In addition, the trolley system that is used to place rock on the weir crest will likely require repair or replacement in 5-10 years. The continued annual placement of rock on the existing weir crest would require a Section 10 permit under the Rivers and Harbors Act.

1.3.2 Rock Ramp Alternative

The Rock Ramp Alternative would leave the existing rock and timber crib structure at Intake Diversion Dam in place, but incorporate it into a replacement concrete weir and bury it under a shallow-sloped, un-grouted boulder and cobble rock ramp. The rock ramp would mimic natural riffles and cascades and would have reduced velocities compared to existing conditions so that migrating fish could swim up the ramp and pass over the weir, thereby improving fish passage.

The new concrete weir would be located approximately 28 feet upstream of the existing weir, and would be constructed to an elevation of 1991.0 feet. A low-flow notch would be constructed at an elevation of 1989 feet and would have an 85 foot bottom width and an approximately 125 foot top width to concentrate flows during low flows. The downstream side of the weir would tie directly into a low-flow channel in the rock ramp to provide a seamless transition and unimpeded fish passage as fish migrate upstream.

The rock ramp would be constructed downstream of the replacement weir by placing large rock and cobble over a length of 1,200 feet with a slope ranging from 0.2 to 0.7 percent with a deeper low-flow channel designed into the ramp that would connect to the low-flow notch on the concrete weir.

1.3.3 Bypass Channel Alternative

The Bypass Channel Alternative would construct a 11,150 foot long bypass channel with a slope of 0.07 percent on Joe's Island from the inlet of the existing side channel and rejoin the river just downstream of the rock rubble field below the existing weir. It would also leave the existing Intake Diversion Dam in place and incorporate it into the replacement concrete weir with rock/cobble fill placed upstream and downstream of the replacement weir. The replacement weir would be at the same average height of the existing weir, with rock placed on top, to continue providing sufficient head to divert the full water right through the headworks and screens. The replacement weir would include a low-flow notch at elevation 1889 feet. Construction work and the primary elements of this alternative would be located on Joe's Island and at the weir location. Additional features in this alternative include buried rock grade controls at the upstream and downstream ends of the bypass channel to maintain desired flow splits and channel elevations, placement of fill and grading along both the right and left banks at the downstream outlet to reduce the eddy that forms below the weir and to direct flows from the channel towards the main river channel, and two additional buried grade controls and bank armoring in select locations in the channel. The upper 1.5 miles of the existing side channel would be filled with the excavated material to ensure the appropriate flow volumes into the bypass channel when river flows are in the 30,000 to 63,000 cfs range. This alternative is designed to meet the Service's BRT criteria for flow volumes, depths, and velocities at all but the lowest flows in the river (Table 1-1).

Table 1.1Service's BRT Design Criteria for a Bypass Channel

Criteria	7,000 – 14,999 cfs	15,000 – 63,000 cfs
Bypass Channel Flow Split	≥12%	13% to ≥15%
Bypass Channel Cross-sectional Velocities (measured as mean column velocity)	2.0 – 6.0 ft/s	2.4 – 6.0 ft/s
Bypass Channel Depth (minimum cross-sectional depth for 30 contiguous feet at measured cross-section)	≥4.0 ft	≥6.0 ft
Bypass Channel Fish Entrance (measured as mean column velocity)	2.0 – 6.0 ft/s	2.4 – 6.0 ft/s
Bypass Channel Fish Exit (measured as mean column velocity)	≤6.0 ft/s	≤6.0 ft/s

This alternative also includes continued O&M of the LYP irrigation system.

1.3.4 Modified Side Channel Alternative

The Modified Side Channel Alternative is intended to improve passage for pallid sturgeon around Intake Diversion Dam by modifying the existing side channel around Joe's Island to meet the BRT criteria. Pallid sturgeon were documented to have passed upstream of Intake Diversion Dam through the side channel during both the 2014 and 2015 spring runoff seasons (Rugg 2014, 2015) at flows greater than 40,000 cfs (approximately a 2-year flood event). The intent behind this alternative is that with more frequent flow in the side channel, the side channel would have sufficient attraction flows and would be passable during all years as well as providing year-round fish habitat.

The proposed features for the Modified Side Channel Alternative are summarized as follows:

- 6,000 feet of new channel at three bend cutoffs,
- 14,600 feet of channel modification to lower the existing side channel,
- Three backwater areas at the bend cutoffs,
- 4,500 feet of bank protection,
- Five buried grade control structures,
- One 150 foot single span bridge, and
- Placement of 50,000 cubic yards of channel cobble substrate to simulate a natural channel bed and bed/bank edges.

Required water surface elevations for diversions into the irrigation canal would be met through continued routine rock placement on the existing weir as described for the No Action alternative. Note that the continued placement of rock on the existing weir will likely also require repair or replacement of the trolley system by the LYP, similar to the No Action Alternative. This alternative also includes continued O&M of the LYP irrigation system. Rock for the existing weir is quarried on private land located south and east of Joe's Island and transported to the site by driving across Joe's Island. Because the Modified Side Channel Alternative would result in a deeper channel with essentially year-round water, a bridge would be constructed to provide for vehicle and equipment access to Joe's Island. This alternative includes a 150-foot prefabricated clear span truss bridge with abutments set outside of the main channel banks to minimize encroachment into the side channel. The new bridge would be set with a low chord elevation two feet above the 100-year water surface in accordance with the State of Montana and the National Flood Insurance Program criteria.

1.3.5 Multiple Pump Alternative

The Multiple Pump Alternative would remove the Intake Diversion Dam and the rock rubble field downstream of the weir and construct five pumping stations on the Yellowstone River to deliver water to the LYP. The pumping stations would be designed to fully meet the LYP's water right with a total diversion capacity of 1,374 cfs. The pumping stations would be constructed at various locations along the Lower Yellowstone River between the headworks and about 20 miles downstream.

The five sites should be located on the outside of meander bends to minimize the chances they would be blocked by bar formation and maximize the depth of flow from the Yellowstone River towards the pumps. Both of these factors would improve reliability of the diversion and reduce maintenance associated with sediment removal. The downside is that the outside of the bends are also the most likely areas to erode in the immediate future. To minimize this potential two additional factors were accounted for in siting the pumping stations; the bends were evaluated and the stations were sited at bends that have been relatively stable over many years and the pumping stations were set back approximately 1,000 feet from the channel bank where possible. This placed them at or just inside the outer edge of the channel migration zone (CMZ) (DTM Consulting and AGI 2009). The five potential locations have been numbered from upstream to downstream along the river and are generally located as described in Table 1-2 below.

Table 1.2 Pump Station Locations

Site	Approximate Location
Site 1	Just downstream of Intake Diversion Dam
Site 2	8 miles downstream from Site 1, near Idiom Island
Site 3	3 miles downstream from Site 2, near Mary's Island
Site 4	0.2 miles upstream of Savage
Site 5	0.3 miles downstream of Savage

Each of the five pumping stations would be designed for a capacity of 275 cfs. Water would be drawn from the river through a feeder canal to a fish screen structure. The motors and electrical equipment in both the fish screen structure and the pump station would be located above the 100-year flood elevation. Fish not screened out would be returned to the river through a fish-friendly return pump at the end of the canal, while irrigation water would pass through the fish screen and flow into the pumping station. Discharge pipes would convey the irrigation water to the main irrigation canal.

1.3.6 Multiple Pumps with Conservation Measures Alternative

The Multiple Pumps with Conservation Measures Alternative includes four primary components including removal of Intake Diversion Dam and removal of the rock rubble field downstream of the weir, implementation of water conservation measures, supplemental irrigation water supply using Ranney wells, and use of wind energy to more affordably provide electricity for Ranney well pumping. The removal of the weir would allow natural fish passage on the Yellowstone River, and the other components would provide a continued, but reduced, water supply to the LYP of only 608 cfs. This reduced volume of water would not meet the crop irrigation needs during peak demand times (i.e. August and September) and thus, may not maintain the viable and effective operation of the LYP. The components of this alternative are described in the subsections below.

1.3.6.1 Conservation Measures

Installing water conservation measures throughout the system is proposed to reduce the amount of water needed by the project; both by reducing inefficiency and losses in the delivery system and on individual farms. Table 1-3 below includes a proposed list of conservation measures and the estimated amount of water that could be conserved. These were proposed by Defenders of Wildlife (Defenders) and Natural Resources Defense Council (NRDC) by letter dated February 17, 2016 (Defenders and NRDC 2016). Although the conservation estimates are based upon a conservation plan (LYIP 2009) and a value planning study (Reclamation 2005, 2013), the estimates included in those documents were not field verified. In fact, the value planning study noted that "cost and demand reduction estimates are currently at a low level of confidence and need to be field evaluated and refined."

The concept as proposed has been further developed into a conceptual design and cost estimate to allow alternative comparison.

Table 1.3 Water Conservation Measures and Estimated Savings (cfs)

Component	Description	Estimated conservation (cfs)
Check Structures	Installation of check structures in the canal for water control	61.5
Flow measuring devices	Measuring devices installed on the canals	18.5
Laterals to pipe	Convert laterals to pipe	255.8
Sprinklers	Install center pivot sprinklers	160
Lining main canal/laterals	Line main canal and laterals with concrete	200
Control over checking	Operational change to water levels in the canals	20.6
Groundwater pumping	Install groundwater pumps	49.5
	Total Savings	**765.9 cfs**

The conceptual alternative proposes that diversion requirements could be reduced by 766 cfs by the conservation measures described above. This would leave the required water delivery to the project of 608 cfs. The alternative proposes that this 608 cfs be accomplished through gravity diversions during high flows and then supplemented with pumping during most of the irrigation season. It is proposed that seven pumping stations using Ranney Well technology, which pump shallow groundwater, could provide up to 608 cfs when gravity diversions are insufficient to provide this volume. Due to the significant electricity needed to use these pumping stations, an alternate source of energy using a wind farm is proposed.

1.3.7 Alternatives Analysis

For an ecosystem restoration project such as this fish passage project, there is no monetary measure of benefits to compare alternatives in a traditional cost-benefit ratio. However, if benefits can be quantified in some dimension, cost effectiveness and incremental cost analysis can be used as one consideration in selecting a preferred plan. For this purpose, the potential benefits of the alternatives have been quantified using the Fish Passage Connectivity Index (FPCI), which is described below (also see Appendix D of the EIS for more details).

Cost effectiveness analysis evaluates which alternatives are the least-costly way of attaining the project objectives. Incremental analysis is then used to evaluate the change in cost from each measure or alternative to the next to determine their incremental costs and incremental benefits.

This type of analysis helps identify which measures or alternatives provide the most benefit for the lowest cost and can be used as one element in selecting a preferred plan.

Following completion of the cost effectiveness analysis, all of the alternatives were further compared and ranked using a number of factors including cost, constructability, sustainability, practicability, effects to the LYP, cost effectiveness, and the range of potential environmental impacts.

1.3.7.1 Fish Passage Connectivity Index

The FPCI was developed to evaluate ecosystem outputs (i.e. benefits) of alternative measures for fish passage improvements on the Upper Mississippi River for cost effectiveness and incremental analysis (Corps 2010). The model has subsequently been approved for use in this study. The FPCI is a simple arithmetic index that is calculated as:

$$\text{Є} = \frac{\Sigma\, i \ldots n\ [(E_i \times U_i \times D_i)/25]}{n}$$

Where,

- Є = Fish Passage Connectivity Index.
- i = a migratory fish species that occurs in the reach below the dam.
- n = number of fish species included in the index.
- E_i = Chance of encountering the fishway entrance is a calculated value ranging from 1 to 5, where 5 = highly likely; 3 = moderate probability; 1 = unlikely.
- U_i = Potential for species i to use the fish passage pathway or fishway (5 = Good, 3 = Moderate, 1 = Poor, 0 = None) considering adult fish swimming performance and behavior (i.e. bottom oriented, shoreline oriented) and hydraulic conditions within the fish passageway.
- D_i = Duration of availability for fish passage is an estimation of the fraction of the time during the typical upriver migration period for fish species i that the passage pathway is available. This is based on the anticipated depths and velocities available in the passage pathway during the typical flows in the migration season.

Although the model was developed to measure benefits of fish passage in the Upper Mississippi River, the model is applicable (with slight adjustments) to fish passage projects on other large river systems, especially those with very similar fish communities. This model, with minor adjustment, was used as a planning tool for comparing benefits of alternative measures for providing fish passage at Intake Diversion Dam. Additional background and data used for this calculation is provided in Appendix D of the Intake EIS.

A total of fourteen native fish species were included in the FPCI for the Intake Diversion Dam project including shovelnose sturgeon, pallid sturgeon, paddlefish, goldeye, smallmouth buffalo, blue sucker, white sucker, river carpsucker, shorthead redhorse, channel catfish, smallmouth bass, walleye, sauger, and freshwater drum. The FPCI is calculated as an index value (between zero and 1) for each species. The index value is then multiplied by the potential acres of suitable habitat upstream of Intake Diversion Dam for each species to yield habitat units. The habitat units are then averaged across all 14 species to yield average annual habitat units (AAHUs) for each alternative, which are used in the cost effectiveness and incremental cost analysis described below.

1.3.7.2 Cost Effectiveness, Incremental Cost Analysis (CE/ICA)

The CE/ICA analysis utilized the Corps IWR Planning Suite model. The Corps-certified model provides a systematic method for testing all possible combinations of ecosystem restoration measures to identify combinations of measures (alternative plans) which are cost effective, and then ranks cost effective plans according to their efficiency to identify "best buy" plans. Because this analysis considered six complete alternatives that were mutually exclusive, no alternatives were created from the combination of measures in the model. Instead, the software identified which plans were cost effective, and then ranked the cost effective plans by efficiency to identify "best buy" plans. The CE/ICA model required the following inputs:

- <u>Average annual habitat units for each alternative</u>: Because habitat benefits are non-monetary, the outputs are referred to as "units" of output. In order to compare action alternatives to the No Action Alternative, AAHUs are typically converted to "net AAHUs," which is the change in habitat units as compared to no action. Thus, the No Action Alternative is always entered as zero net AAHUs, and each alternative is entered as the additional AAHUs that would be generated compared to no action. AAHUs were developed using the FPCI Model.
- <u>Average annual cost for each alternative</u>: Costs used in the analysis included construction, Planning, Engineering , and Design/Construction Management (PED/CM), real estate, monitoring and adaptive management, interest during construction, and Operations and Maintenance (O&M). Annualized costs are presented at an FY16 price level, amortized over a 50-year period of analysis using the FY16 Federal interest rate for Corps of Engineers projects of 3.125%.

Cost Effectiveness Analysis

Cost effectiveness analysis is a form of economic analysis designed to compare costs and outcomes (or effects) of two or more courses of action. This type of analysis is useful for environmental restoration projects where the benefits are not measured in monetary terms but in environmental output units such as the AAHUs developed in this study. The purpose of the cost effectiveness analysis is to ensure that the least cost alternative is identified for each possible level of environmental output; and that for any level of investment, the maximum level of output is identified. Per IWR 95-R-01, an alternative is <u>*not*</u> to be considered cost effective if any of the following rules are met:

- The same output level could be produced by another plan at less cost;
- A larger output level could be produced at the same cost; or
- A larger output level could be produced at less cost.

Table 1-4 provides the results of the cost effectiveness analysis sorted by increasing output.

Table 1.4 Cost Effectiveness by Alternative

Alternative	Total First Cost[1] ($1,000s)	Annual Cost ($1,000s)	Net AAHUs	Cost per AAHU ($)	Cost Effective?
No Action	$0	$0	0	$0	Yes
Rock Ramp	$90,454	$3,903	4,333	$901	No
Bypass Channel	$57,044	$2,527	7,417	$341	Yes
Modified Side Channel	$54,441	$2,494	6,795	$367	Yes
Multiple Pump	$132,028	$7,868	11,456	$687	Yes
Multiple Pumps with Conservation Measures	$477,925	$23,247	11,456	$2,029	No

1 – Includes construction, design, construction management and real estate costs

As shown in the table, alternatives were identified as cost effective only when no other alternative provided *the same output* for less cost, and no other alternative provided *larger output* at the same or less cost. The No Action, Bypass Channel, Modified Side Channel, and Multiple Pump alternatives were identified as cost effective. The Rock Ramp Alternative is not cost effective because the bypass channel alternative provides greater output for less cost. The Multiple Pumps with Conservation Measures Alternative is not cost effective because the Multiple Pump Alternative provides the same level of output for less cost.

Figure 1-2 provides a graph of the total output and annualized costs for each of the alternatives while differentiating the cost effective plans from the non-cost effective ones. Per IWR 95-R-01, any alternatives that are not found to be cost effective "should be dropped from further analysis" in the CE/ICA process. Therefore, the Rock Ramp, Modified Side Channel, and Multiple Pumps with Conservation Measures alternatives were dropped from further analysis and are not included in the ICA analysis that follows.

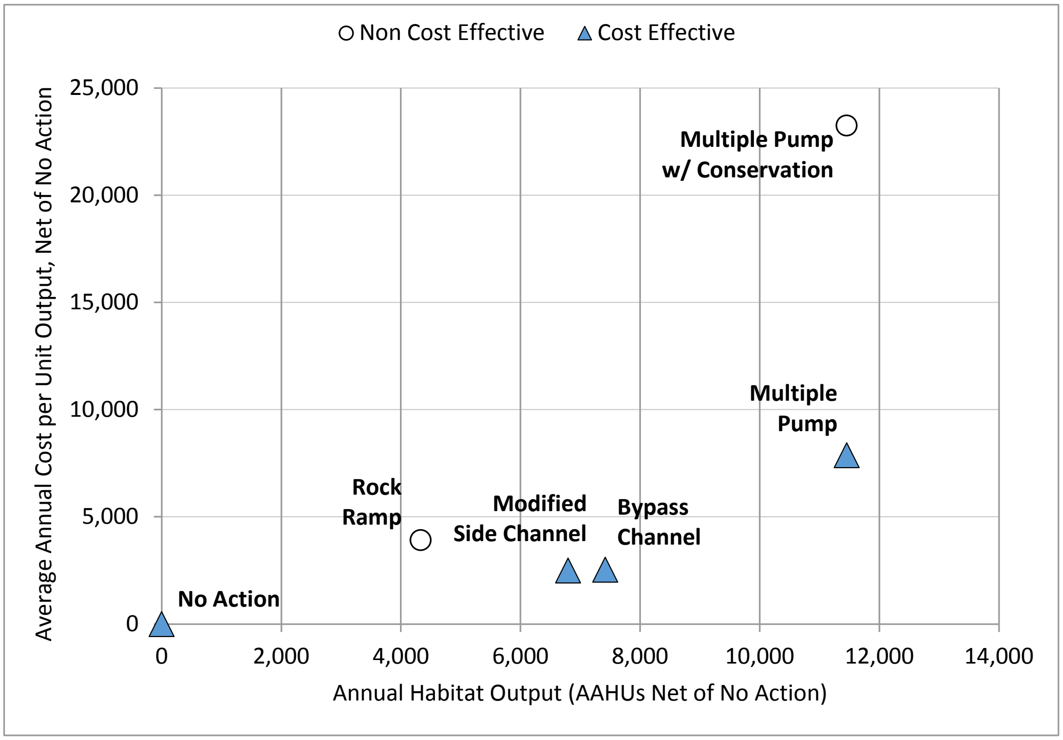

Figure 1.2 Cost Effective Analysis Graph

Incremental Cost Analysis

Subsequent incremental cost analysis of the cost effective plans is conducted to reveal changes in costs as output levels are increased. Only plans that were deemed as cost effective in the CE analysis have been advanced to ICA. These cost effective plans are the No Action, Bypass Channel, Modified Side Channel, and Multiple Pump alternatives. During the ICA, the cost effective plans are examined sequentially (by increasing scale in terms of net AAHUs produced) to ascertain which plans are most efficient in the production of additional environmental benefits.

The first step is to "smooth out fluctuations in incremental costs per unit as project scale increases such that incremental cost per habitat unit are continuously increasing." This is first completed by calculating the incremental cost per unit for each plan over the "baseline condition," which is the No Action Alternative. Once the incremental costs per unit are calculated and sorted by increasing output, the alternative with the lowest incremental cost per unit will be selected as the first "best buy" alternative. Table 1-5 shows the calculation of the incremental costs per unit with the no action alternative set as the baseline for the cost effective alternatives.

Table 1.5 Identification of the First Best Buy Plan

Alternative	Annual Cost ($1000)	Net AAHUs	Incremental Output	Incremental Cost	Incremental Cost per Unit Output
No Action	$0	0	0	n/a	n/a
Modified Side Channel	$2,494	6,795	6,795	$2,494	$367
Bypass Channel	$2,527	7,417	7,417	$2,527	$341
Multiple Pump	$7,868	11,456	11,456	$7,868	$687

Table 1-5 indicates that the Bypass Channel Alternative is the first best buy alternative because it has the lowest incremental cost per unit of output. At this step of the ICA the incremental cost per unit is equal to the average annual cost per unit values calculated in Table 1-4 because the complete alternatives are being compared, not combinations of measures.

After selection of this best buy alternative, all alternatives with lower average annual output are removed from further iterations of the incremental cost analysis. Thus, the No Action and Modified Side Channel alternatives are removed from further analysis and are not considered best buy plans.

Next, the incremental process should be started anew by comparing the next alternative with the first best buy plan. Thus, the Bypass Channel Alternative is set as the new baseline. However, for this study only the Multiple Pump Alternative is remaining, and it is therefore a best buy plan as well since, no other plans can produce more output for lower incremental cost per unit. Thus the calculations and values in Table 1-6 show the incremental cost per unit output between the Bypass Channel and No Action, and then between the Multiple Pump Alternative and the Bypass Channel Alternative.

Table 1.6 Incremental cost analysis summary

Best Buy Alternative	Annual Cost ($1000)	Net AAHUs	Incremental Output	Incremental Cost	Incremental Cost per Unit Output
No Action	$0	0	0	n/a	n/a
Bypass Channel	$2,527	7,417	7,417	$2,527	$341
Multiple Pump	$7,868	11,456	4,039	$5,341	$1,322

This table shows that the most efficient plan above no action is the Bypass Channel Alternative that provides 7,417 additional habitat units at a cost of $341 each. If more output is desired, the next most efficient plan available is the Multiple Pump Alternative that provides an additional 4,039 habitat units, at a cost of $1,322 dollars for each additional unit. Figure 1-3 provides a visual representation of this increase in incremental cost. The figure graphically illustrates the incremental cost and output differences between the two best buy action alternatives. The width of each box in the chart represents the incremental output of that plan, and the height of each box shows the incremental cost per unit of that output. The relatively wide box for the Bypass Channel Alternative shows that it provides about 65% of the total output possible at a cost of approximately $341 per unit. The box for the Multiple Pump Alternative shows that to achieve the remaining 35% of total possible output would be nearly four times as expensive per unit as the first 65%. Such breakpoints in incremental cost per unit typically require a higher level of justification based upon benefits or other considerations not accounted for with the fish passage index if the study team is to recommend the larger output plan that has much higher costs.

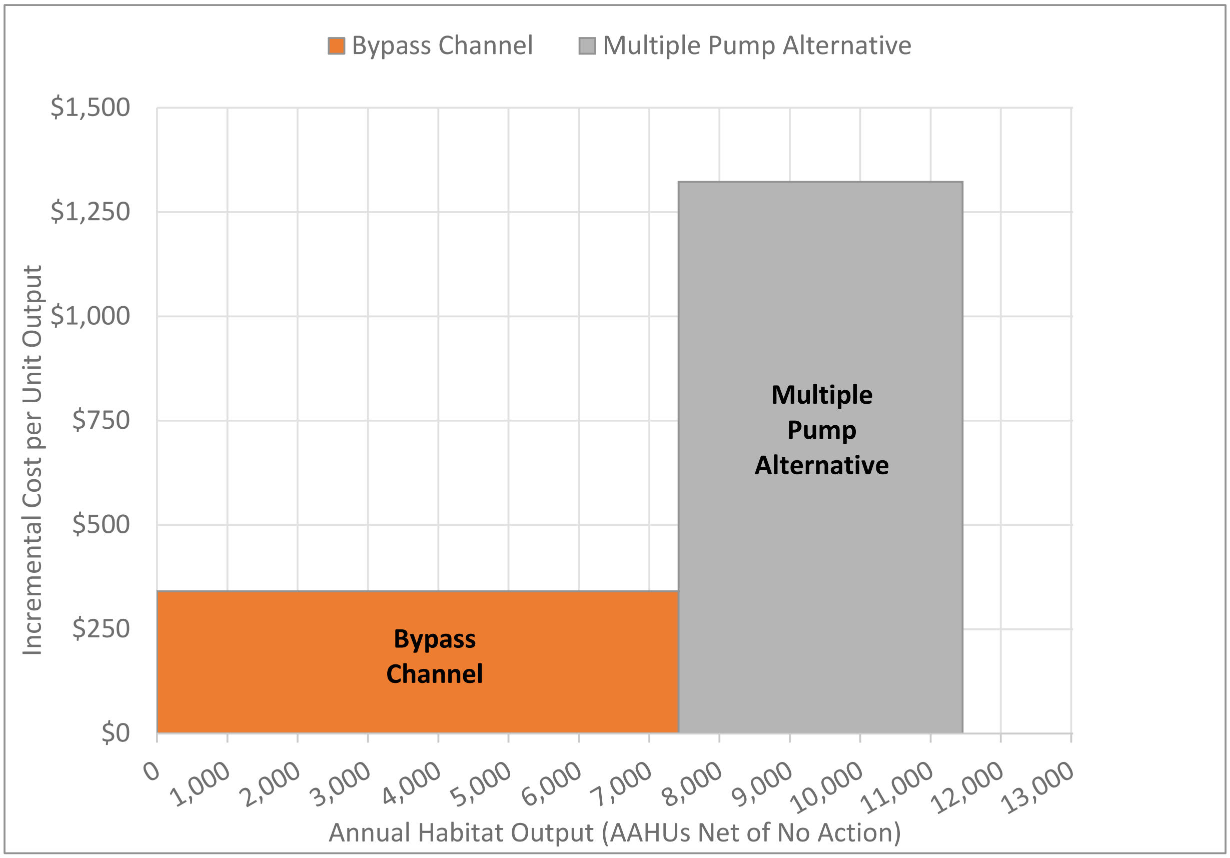

Figure 1.3 Incremental Cost Analysis Chart

Summary of Conclusions
Following completion of the CE/ICA, the project team further evaluated the alternatives in a multi-objective scoring matrix (Table 2-30 in the Intake EIS) based on other factors such as practicability, constructability, risk, total costs, and overall environmental impacts. The results of this comparison were:

- The No Action Alternative ranked lowest as it does not meet the project purpose and need and maintains the fish passage barrier, although it requires no construction and maintains the existing operation of the LYP.
- The Rock Ramp Alternative ranked and is tied for the second lowest as it has very difficult construction and future O&M as it may not withstand ice damage. While it maintains the existing operation of the LYP, it is not cost effective with a high total cost ($83.6 million), requires relocation of the fishing access and has the largest adverse changes to the river channel and substrate by placing such a large quantity of very large rock in the river.
- The Bypass Channel Alternative ranked highest as it is fairly easily constructed, would have reduced O&M with a replacement weir that will maintain the existing operation of the LYP, is cost effective and a best buy with the lowest incremental cost and low total cost (~$56 million), meets the Service's BRT criteria for pallid sturgeon passage and is

designed using the best available science regarding pallid sturgeon passage. It has adverse impacts to the existing side channel and wetlands from placement of fill, but results in a net increase of 39 acres of side channel habitat and maintains 30 acres of the existing side channel as backwater habitat, providing more diversity of riverine habitat and reducing future placement of rock in the river.

- The Modified Side Channel Alternative ranked in the middle as it is easily constructed, would have the same O&M as the No Action Alternative and maintain the existing operation of the LYP. It is cost effective with a relatively low total cost (~$55 million), meets the Service's BRT criteria for pallid sturgeon passage but is located where pallid sturgeon may have difficulty finding it, would change the existing function of the side channel and would have continued rock placement at the weir.
- The Multiple Pump Alternative ranked second highest as it is easily constructed, would remove the weir and rock rubble field, thus restoring natural channel conditions and fish passage to the river. It was considered both a cost effective and a best buy plan as it provided more benefits at a lower cost than the Multiple Pumps with Conservation Measures Alternative. However, it has a very high total cost (~$133 million) and would have very high O&M costs and effort required for operating and maintaining large pumps and requiring over 10 gigawatts of electricity. While it would deliver the full water right for the LYP, it may be too costly for some farmers to remain viable. Further, it also has the potential for substantial adverse cultural resources impacts and would have the highest potential for entrainment of fish because of the multiple surface water pumps.
- The Multiple Pumps with Conservation Measures Alternative ranked and is tied for the second lowest as it has difficult and complex construction that could take approximately 8 years to construct. While it would remove the weir and rock rubble field returning more natural channel conditions and fish passage to the river, these elements could not be constructed until the other features are complete, possibly too late for wild pallid sturgeon population to spawn and contribute to recovery. It would have high O&M costs, is not cost effective with very high total cost (~$482 million), would not deliver the full water right for the LYP and thus, would not meet crop needs even with water conservation. This alternative has the potential for substantial cultural resources impacts, would substantially reduce wetlands that exist from irrigation seeps or surface flows, and would have the most adverse effects to existing farmland, incomes, and cropping patterns.

Specific to the analysis required under the Section 404(b)(1) guidelines, a comparison of effects to waters of the U.S. is shown in Table 1-7.

Table 1.7 Effects on Waters of the U.S. from each Alternative

Alternative	Temporary Impacts	Permanent Impacts (over 50-year planning horizon)
No Action	• No effect	• Continued placement of rock on the weir crest and movement of that rock downstream would increase quantities of riprap over the existing 5 acre rock rubble field and likely expand the size of the rock rubble field by up to 2 acres
Rock Ramp	• 24 acres of river disturbed during construction • 31 acres of grassland disturbed during construction • 8 acres of riparian habitat disturbed/cleared during construction	• 24 acres of river filled with riprap and cobbles and concrete for replacement weir and ramp; would remain riverine, with changed substrate • 39 acres restored/reseeded to grassland
Bypass Channel	• 3 acres of river disturbed/filled during construction for replacement weir • Up to 45 acres of riparian forest disturbed during construction • Up to 200 acres of grassland disturbed during construction	• 2 acres of river filled with riprap and cobbles and concrete for replacement weir; would remain riverine • 2 acres of river filled to reduce downstream eddy and at scour hole; converted to uplands • 66 acres of existing side channel filled and converted to uplands (25 acres seasonally inundated; 41 acres backwater) • 1 acre of palustrine emergent filled; converted to uplands • 64 acres of new perennial side channel created from grassland and riparian forest • ~30 acres of existing side channel converted to perennial backwater channel with fringing palustrine emergent wetland • 200 acres restored/reseeded to grassland • 10 acres of riparian forest restored/replanted
Modified Side Channel	• 52 acres of existing channel disturbed/excavated during construction • 80 acres grassland disturbed in spoil area	• 0.75 acre palustrine emergent filled • 0.75 acre palustrine emergent converted to channel • 52 acres of existing riverine/side channel filled • 8 acres of new palustrine emergent created (backwaters) • 47 acres of new channel created from grassland • 14 acres riparian forest converted to riverine due to channel widening and bend cutoffs • 9 acres of riparian scrub shrub lost to access roads and bend cutoffs • 65 acres of grassland converted due to channel widening • 83 acres of grassland converted due to channel cutoffs

Alternative	Temporary Impacts	Permanent Impacts (over 50-year planning horizon)
Multiple Pump	• ~20 acres of river disturbed during construction for weir and rock removal • ~20 acres of floodplain disturbed for pump station construction	• 0.1 acre palustrine emergent converted to backwater canal • 0.5 acre palustrine scrub/shrub converted to backwater canal • 8 acres of upland converted to backwater canal • 0.6 acre of river filled for bank protection • 10 acres of riparian forest converted to grassland at pump sites • 2 acres of riparian scrub shrub converted to grassland at pump sites
Multiple Pumps with Conservation Measures	• ~20 acres of river disturbed during construction for weir and rock removal • ~ 2 acres of riparian disturbed for Ranney well construction	• 0.5 acre riverine (lateral canals) filled for access roads • Unidentified loss of wetland acres from >50% reduction in irrigation canal flows • 1.2 acres of riparian forest converted for pump construction • 0.2 acres of riparian scrub shrub converted for pump construction

All of the alternatives have temporary and permanent effects on the Yellowstone River and wetlands. The Bypass Channel Alternative results in the largest increase in waters of the U.S. with 64 acres of new perennial side channel created that would have much greater functionality for many fish species, mussels, and macroinvertebrates as water would be present year-round. There would be 66 acres of less functional existing seasonal or backwater side channel habitat filled. The evaluation of other factors indicates that the Bypass Channel Alternative balances all factors the best and is highly cost effective with a much lower total cost than the other best buy alternative (Multiple Pump Alternative). The new bypass channel would provide year-round functional side channel habitat for a variety of fish, mussels, and macroinvertebrates and the lower half of the existing side channel would remain as backwater habitat that may transition to palustrine emergent wetland habitat providing a higher diversity of habitat types in the vicinity of Joe's Island for fish and macroinvertebrates that use backwater habitats as well as waterfowl and wildlife.

Therefore, the recommended plan is the Bypass Channel Alternative, since it meets the project objectives of improving fish passage and maintaining reliable irrigation diversions at a reasonable cost to maintain viable and effective operation of the LYP, and is constructible, operable, and has a similar scale of environmental impacts as the other alternatives.

2.0 Summary of Proposed Action

The proposed action is to construct a replacement concrete weir for the existing Intake Diversion Dam rock weir, to excavate a new bypass channel to provide fish passage upstream of the weir, and to fill portions of the existing side channel in order to meet the Service's BRT fish passage criteria to maximize potential fish use of the new bypass channel. Details are provided below in Sections 2.3-2.6.

2.1 PURPOSE AND NEED

The purpose of the proposed action is to improve passage of the endangered pallid sturgeon and other native fish at Intake Diversion Dam in the lower Yellowstone River while continuing a viable and effective operation of the Lower Yellowstone Project. Both Reclamation and the Corps have a general responsibility under Section 7(a)(1) of the ESA to use their authorities to conserve and recover federally listed species and ecosystems upon which they depend. Both agencies also need to avoid jeopardizing the pallid sturgeon in funding or carrying out any agency action per 7(a)(2) of the ESA.

2.2 WATER DEPENDENCY OF THE PROPOSED ACTION

As the purpose of the project is to provide fish passage, the project will necessarily occur in the Yellowstone River and its associated floodplain habitats, including wetlands. Measures of the proposed project that will occur within the waters of the U.S. include; 1) construction of a replacement concrete weir with cobble/rock fill, 2) connection of a constructed bypass channel to the Yellowstone River after a bypass channel is excavated in the dry, and 3) infill of the upper portion of the existing side channel.

Measures that will not require excavation or fill in waters of the U.S. include; 1) excavation of the new bypass channel, 2) relocation of the historic south rocking tower and boiler building on Joe's Island, 3) clearing and grubbing for staging areas and access, and 4) revegetation after construction completion.

2.3 DESCRIPTION OF PROPOSED PROJECT

The recommended restoration plan is presented in this section by key design element.

2.3.1 Replacement Concrete Weir

A replacement concrete weir is proposed approximately 28 feet upstream from the existing timber and rock weir with a crest elevation of 1991.0 feet (NAVD 88) in order to provide sufficient water surface elevations to divert the full irrigation diversion through the headworks and screens. A rendering of the replacement weir is shown in

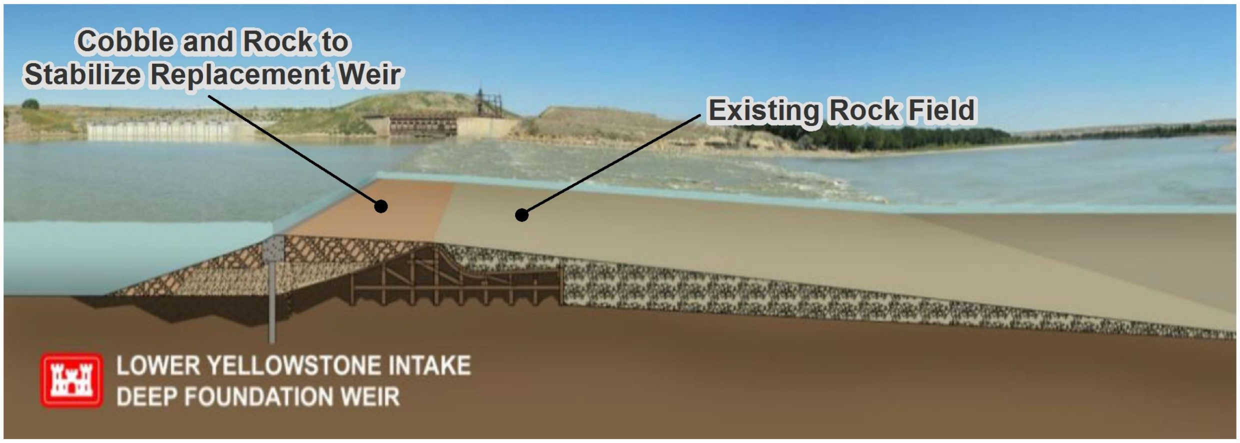

Figure 2.1 Rendering of replacement concrete weir

The weir structure would consist of a deep foundation of driven piles with a concrete cap. The concrete weir would require approximately 680 cubic yards of concrete, which would be trucked from Glendive and pumped to the site. The top of the structure would allow for a smooth crest surface for ice and water to pass over. Rock fill would be placed between the new weir and the existing weir to stabilize both structures. Cobble fill would also be placed upstream of the weir structure and sloped to pass flows and ice more smoothly over the weir crest. The weir crest will include a low-flow notch for fish passage at elevation 1889 feet with a bottom width of 85 feet and a top width of 125 feet. It is likely that occasional maintenance of the riprap between the old and new weirs would be necessary over the long term. However, the rock placed between weirs would not be subject to the same level of displacement experienced with the current weir since it will not be subject to direct impact from ice flows.

Construction of the replacement weir would begin on the north side of the river with up to one-half of the weir being constructed at a time. The immediate construction area would be dewatered, as needed, using a sheet pile coffer dam, with piles driven below grade into coarse alluvium material to reduce under seepage. Once the weir section is complete, the coffer dam sheet piles would be removed. Coffer dam installation and removal would occur during summer, but would not occur during the pallid sturgeon migration period (mid-April to July) to minimize fish impacts. During construction of the replacement weir and bypass channel, the LYP would need to maintain the existing weir. During construction, additional rock would continue to be placed on top of the existing weir to maintain diversions into the main canal. Rock would be placed on top of the existing weir as has occurred historically up to elevation 1991.0 ft. Once construction of the replacement weir is completed, there will be no need to place rock on the weir crest to maintain diversions into the main canal.

An access road and staging area would be constructed along the north side of the river to allow access for heavy equipment during construction. Following completion, the road would likely be left in place for long-term operation and maintenance use. In addition, the road between Highway 16 and Intake FAS will be resurfaced. Existing access roads to Joe’s Island would be improved as needed to facilitate construction access. Access by motor vehicles across the newly constructed bypass channel would be limited at most flows.

2.3.2 Excavation of New Bypass Channel

The bypass channel is designed to meet criteria developed by the Service's Biological Review Team (BRT) to divert 13-15% of total Yellowstone River flows (Table 1-1). As shown in the table, the bypass is designed for cross-sectional velocities between 2 and 6 feet/second and minimum depths of 4 to 6 feet, depending on the flow.

While the channel will typically divert 13% of the total flow from the main channel during typical spring and summer discharges, diversion percentages would vary from 10% at extreme low flows (below 7,000 cfs) on the Yellowstone River to 16% at extreme high flows (Table 2-1). The geometry of natural side channels on the Yellowstone River near Intake varies greatly. The geometry of the proposed bypass channel falls within the range of all parameters evaluated for observed natural side channels.

Table 2.1 Analysis of Bypass Channel Flow Splits

Discharge at Sidney, Montana USGS Gage (return period) cfs	Split Flows			
	Flow into the bypass channel cfs	Flow remaining in the Yellowstone River cfs	Percent of flow in the bypass channel versus Yellowstone River percent	USFWS and BRT criteria percent
7,000	1,100	5,900	16	≥12
15,000	2,200	12,800	15	13 to ≥ 15
30,000	4,100	25,900	14	13 to ≥ 15
54,200 (2-yr)	7,500	46,700	14	13 to ≥ 15
63,000	8,700	54,300	14	13 to ≥ 15
74,400 (5 yr)	10,700	53,700	14	-
87,600 (10 yr)	12,900	74,700	15	-
128,300 (100 yr)	20,000	108,300	16	-

The excavation of the bypass channel would remove approximately 869,000 cubic yards of earthen material from Joe's Island. The proposed bypass channel alignment extends approximately 11,150 feet in length at a slope of approximately 0.07 percent. The channel cross section would have a bottom width of 40 feet, a top width of 150-250 feet, and side slopes varying from 1V:8H to 1V:4H. The excavated material would be disposed of in one of three locations. The majority of the excavated material would likely be disposed of in the upstream portion of the existing side channel. Some material would likely be disposed of in the spoil area on the south side of the new channel. Additionally some material would be placed to even out low banks along the channel.

The construction work zone would be isolated by coffer dams at the upstream and downstream ends of the proposed bypass channel, which would be constructed early in the construction sequence. The coffer dams will consist of sheet piles driven below grade into the coarse alluvium material to prevent under seepage. Some of the rock placement on the new channel side slopes will be placed after the coffer dam removal. Grade control structures are included at the downstream and upstream ends of the bypass channel as well as at two intermediate locations to prevent channel bed erosion that could affect passage success. The proposed grade control structures would be composed of buried riprap covered with gravel/cobble.

Additionally, bank riprap is proposed at four outside bends where velocities are higher to minimize the risk of major changes in the bypass channel planform that might reduce the capability to meet the Service's BRT criteria. Approximately 110,000 CY of riprap would be required for the bypass channel.

Modeling indicates the bypass channel could be subject to bed erosion. Therefore, construction of an armor layer is proposed. The armor layer would consist of large gravel to cobbles, similar in size to the naturally occurring coarse channel material found on Yellowstone River point and mid-channel bars and similar to what would be expected to occur naturally over time. Approximately 28,000 cubic yards of armor layer material would be screened from the alluvial material excavated from the bypass channel and placed in the channel bottom to achieve final design grade.

To ensure the desired 13-15 percent split of flows into the constructed bypass channel the placement of fill in the upstream end of the existing side channel is required. Material excavated from the bypass channel would be placed as fill in approximately the first 1.5 miles of the existing side channel. This fill material would be compacted, sloped and reseeded for stability. This plug would not allow any water to be diverted into the upstream end of and flow through the existing side channel under most flow conditions. It is possible that under extreme flood conditions water could flow overland into the lower part of the side channel; however, the only water that would regularly enter the high flow channel would be via a backwater effect at the downstream end. This would maintain similar backwater conditions as currently occurs in the lower portion of the side channel when river flows are below 20,000 cfs.

2.4 CONSTRUCTION METHODS

Both in-water and upland construction would be required for the various actions. Specific equipment used would depend on contractor preferences and experience. Equipment may include, but is not limited to, the following:

- Cranes: for lifting and placing materials
- Pile installation equipment: vibratory driving of piles
- Excavators: long-reach excavators for excavating channel and placing rock
- Dozers: for grading of slopes and access routes

2.4.1 General Construction Sequencing

The likely sequencing of construction elements will be:

a) Site Preparation
   a. Close Joe's Island and provide detours, signage, fencing, etc.
   b. Conduct pre-construction biological surveys and relocate fish and wildlife from the construction work zones

c. Establish erosion controls in channel and spoils area
d. Prep haul roads and staging areas

b) Weir Construction
a. Establish haul roads, access ramp, and barge inlet
b. Install sheet pile coffer dam
c. Install support pilings for new weir
d. Pour concrete for new weir
e. Place rock and cobble fill upstream and downstream of new weir
f. Remove sheet pile

c) Bypass Channel Inlet Structure
a. Install coffer dam around upstream inlet
b. Excavation and riprap placement

d) Bypass Channel Outlet Structure
a. Install coffer dam around outlet
b. Excavate outlet
c. Import and place outlet riprap

e) Channel Excavation
a. Excavate channel from outlet to downstream outer bend protection
b. Excavate channel between inlet and outlet
c. Screening and placement of channel bottom armor
d. Haul and place excavated material in existing side channel
e. Place instream bypass channel protection and grade controls

f) Site Restoration
a. Mulch, seed, and revegetate all disturbed areas
b. Remove north side access crossings and culverts
c. Demobilization of equipment, fencing, signage, etc.

2.4.2 Sediment Quality

In 2009, when the initial alternatives were evaluated for fish passage at the Intake Dam, a series of representative sediment samples were collected at points upstream and downstream of the Intake Diversion Dam to determine if the proposed soils and sediment disturbance would introduce contaminants into the water column (Corps 2009). This analysis was conducted in accordance with the guidance prepared jointly by EPA and the Corps for the evaluation of dredged material proposed for discharge into inland waters of the United States (1998). A total of eight locations were sampled and evaluated for potential contamination via an elutriate analysis. Three samples were taken downstream of the weir and five were taken from upstream of the weir. Two of the upstream samples came from an island and the rest were from the riverbed.

Results showed that no pesticides or PCBs were in the samples and that, in general, nutrient concentrations in the samples were similar to ambient concentrations in the river. This means that sediment disturbance under any proposed alternative would not be likely to introduce pesticides, PCBs, or nutrients into the water (Corps 2009).

Arsenic, lead, zinc, iron, manganese, aluminum, and ammonia were detected in one or more samples; although at levels below Montana water quality standards, except for iron and manganese, which were present at levels well above state standards. However, in the case of iron, manganese, and aluminum, these minerals likely represent a natural condition associated with the geology and soils in the basin (Corps 2009). Similarly, for arsenic, lead and zinc, the levels detected appear to be associated with the geology and soils in the basin (Corps 2009).

2.5 TIMING OF DISCHARGE AND FILL

In-water work would be minimized with coffer dams, which will allow the construction of the weir and bypass channel to occur isolated from the river. The placement of fill into waters of the U.S. would occur at the existing Intake Diversion Dam to create the replacement weir, as well as at the upstream end of the existing side channel. This work would largely occur during summer low flows or other periods outside of the spring runoff and fish migratory period (mid-April to July).

2.6 SOURCES AND GENERAL CHARACTERISTICS OF DREDGE/FILL MATERIALS

All fill material will come from two sources: 1) on-site reuse of materials excavated from the new bypass channel; or 2) a commercial source that meets the standards for suitability of clean material. This would generally mean that any materials imported to the project area would have low or non-detectable levels of contaminants that are not expected to have significant adverse impacts on water quality or biota in the short or long term.

3.0 Evaluation Criteria

The 404(b)(1) Guidelines require evaluation of the aquatic impacts associated with the discharge of dredged or fill material. The purpose of the CWA Section 404 as per 40 CFR Section 230.1(a) "is to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material." Specifically, 40 CFR Section 230.1(c) states that "dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact."

Section 230.11 of Subpart B of the Guidelines provides the following four conditions that must be satisfied in order to make a finding that a proposed discharge complies with the requirements described in 40 CFR Section 230:

1. No discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental impacts (see Sections 4, 5, and 6).
2. No discharge of dredged or fill material shall be permitted if it violates any water quality standards, jeopardizes any endangered or threatened species, or disturbs any marine sanctuaries (see Sections 4, 5, and 6).
3. No discharge of dredged or fill material shall be permitted that would result in significant degradation of any waters of the United States, including adverse effects on human health or welfare, effects on municipal water supplies, aquatic organisms, wildlife, or special aquatic sites (see Sections 4, 5, 6 and 7).
4. No discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken that would minimize potential adverse impacts (see Sections 8, 9, and 10).

The potential impacts of the proposed actions are evaluated based on conditions set forth in 40 CFR Subpart B Section 230.11, and the factual determination and discussion of conditions for compliance are provided in Sections 11 and 12. Findings of compliance or non-compliance with the restrictions on discharge, pursuant to 40 CFR 230.12, are provided in Section 13.

Sections 4, 5, 6, and 7 below describe the potential effects of the selected Bypass Channel Alternative on aquatic habitats, and fish and wildlife. The Intake EIS describes the potential impacts of each of the alternatives, but specifies the selected alternative as the most cost effective, practicable, and beneficial. In the following sections, the effects of the selected alternative are compared to the potential effects of taking no action.

4.0 Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)

4.1 SUBSTRATE

4.1.1 Existing Conditions

The Yellowstone River channel boundaries are generally within alluvium consisting primarily of sand and gravel. Channel bed materials consist of gravel, cobble, and sand. The channel migrates within the alluvial materials and occasionally comes in contact with bedrock.

4.1.2 Potential Impacts

4.1.2.1 No Action Alternative

The No Action Alternative would not have any new construction elements and would therefore have no impact on substrate. The continued operation of the existing weir requires annual placement of rock on the weir crest. This activity would continue for the No Action Alternative and would thus, continue increasing the volume of rock present in the river, causing a larger rock/rubble field over time.

4.1.2.2 Proposed Bypass Channel Alternative

There would likely be some minor erosion and scour of the channel substrate and/or banks due to the placement of coffer dams around the weir construction area. The coffer dam could temporarily cause a rise in water surface elevations, primarily along the right bank on Joe's Island as a result of confining the flows, including for the 100-year and other flood flows, if they were to occur during construction. The coffer dam could also cause additional head at the headworks and screens and may slightly affect velocities. Based on 2D modeling results, the area of influence from the screen extends approximately 50 feet into the Yellowstone River during river flows of 24,000 to 25,000 cfs (C. Svendson personal communication 2016). This is a relatively small area of influence, as the Yellowstone River would still be 400-500 feet wide even with a portion of the channel coffer dammed. At a higher water surface elevation, this area of influence would be expected to decrease, thus any effects on velocities is likely to be minimal.

The coffer dams at the proposed bypass channel location would not affect any river flows unless there was a flow higher than a 2-year event during construction, which could overtop the coffer dams and could cause some minor erosion/scouring at the coffer dam locations.

The new weir will include the placement of riprap and cobbles both upstream and downstream of the new weir to stabilize the structure. This will be a permanent addition of coarser substrate to the river channel. This material will be far more stable than the rock that is currently placed on the weir crest, so will not likely move downstream.

The placement of fill into the existing side channel would change its substrate to a mix of both coarse and fine materials placed to match the surrounding elevation on Joe's Island. Conversely, the excavation of the new bypass channel would change the current island surface to a coarse cobble/gravel channel. The following actions are recommended to minimize effects to surface water during construction and during the long-term operation and maintenance:

- Design coffer dams to obstruct the least amount of the channel or floodway to minimize the potential for affecting flood flows or ice jams or causing scour.

4.2 SUSPENDED PARTICULATES/ TURBIDITY

4.2.1 Existing Conditions

Based on measurements at the Sidney gage (USGS Gage No. 06329500) and at the study area, silt and clay are the predominant suspended load. Bed material loads (sediment sizes found in appreciable quantities in the channel bed) are predominantly sand with small amounts of gravel. Near Sidney, the median suspended sediment concentration is 82 mg/L, but the concentration varies greatly from 1 mg/L to over 4,700 mg/L. Suspended sediment concentration is generally highest in the spring and early summer, corresponding with runoff. Streambank erosion and runoff from adjacent agricultural lands also affect suspended sediment concentrations. Nearly a third of the annual sediment load in the Yellowstone River near Sidney comes from the Powder River Basin (though it contributes less than 5% of the annual Yellowstone stream flow).

The lower Yellowstone River is a naturally turbid, or highly sediment-laden, system, and the warmwater fishery has adapted to these conditions. Sedimentation or siltation has occurred behind the weir, however, which may be reducing the natural turbidity in downstream reaches. Turbidity data collected at the Sidney gage between 1998 and 2001 ranged from to 2.8 to 1,600 nephelometric turbidity units (NTUs). The median value was 65 NTUs. (USGS 2016)

4.2.2 Potential Impacts

4.2.2.1 No Action Alternative

Under the No Action Alternative, there would be no changes to the existing Intake Diversion Dam configuration, and there would be negligible effects to suspended particulates or turbidity from continued annual placement of rock on the crest of the weir.

4.2.2.2 Proposed Bypass Channel Alternative

Construction of the replacement concrete weir, excavation of the new bypass channel, and installation of a temporary bridge or culverts spanning the main irrigation canal all have the potential to re-suspend or release sediment into the water column. Excavation of a new bypass channel will be isolated from the river, with coffer dams used at the upstream and downstream ends of the bypass to keep flows from entering the channel throughout the construction period, ensuring that only negligible effects will result to water quality. Construction staging and access would be located on Joe's Island adjacent to the proposed Bypass Channel. Silt fences and other erosion control measures would ensure that sediment and contaminants did not wash into the water from staging and access zones. Stockpile areas will not be located in wetlands and will be covered as appropriate during construction to prevent erosion and reseeded at the completion of construction to prevent wind and water erosion.

Measures to minimize effects include:

- Conduct all filling activities while isolated from the river (i.e. behind coffer dams) to the maximum extent practicable.
- Implement erosion control measures to reduce the potential for sediment-laden stormwater runoff during construction.

4.3 WATER QUALITY

4.3.1 Existing Conditions

The Administrative Rules of Montana designate the Yellowstone River as Class B-3 waters (ARM 17.30.611). Water quality standards for Class B-3 waters (ARM 17.30.625) include Montana numeric water quality standards from Circular DEQ-7 (MTDEQ 2012). Class B-3 waters are suitable for the following beneficial uses:

- Drinking water, including culinary use and food processing purposes after conventional treatment.
- Primary contact recreation, including bathing, swimming, and recreation
- Aquatic life, including the growth and propagation of nonsalmonid fishes and associated aquatic life, waterfowl, and furbearers
- Agricultural use, including industrial water supply.

The river currently supports the beneficial uses for agriculture, drinking water, and recreation, while not fully supporting beneficial uses for aquatic life (MTDEQ 2014). Causes for non-support of aquatic life result from the presence of the Intake Diversion Dam, which is a fish passage barrier, the alteration in streamside vegetation cover, presence of chromium, copper, lead, and high levels of nitrogen, phosphorous, sediment, TDS, and pH. Many of these are currently listed as 303(d) impairments, shown in Table 4-1.

The Yellowstone River is designated water quality Category 5, defined as waters where one or more applicable beneficial uses have been assessed as being impaired or threatened. The Yellowstone River between the Intake Diversion Dam and the North Dakota border has eight water quality parameters that are consistently not meeting regulatory state water quality standards: chromium, copper, lead, nitrogen, phosphorous, sedimentation or siltation, TDS, and pH. Each of these has been reported as a separate 303(d) listing under the CWA.

Table 4.1 CWA Section 303(d) listed impairments and causes in the Yellowstone River study area

Impairment	Probable Source	Total Maximum Daily Load Study Completed
Chromium (total)	Sources are unknown	No
Copper	Natural or unknown sources	No
Fish Passage Barrier	Impacts from hydrostructure flow regulation and modification	No
Lead	Sources are unknown	No
Sedimentation/Siltation	Rangeland grazing, irrigated crop production, streambank modifications and destabilization, hydrostructure flow regulation and modification, and unknown sources	No
Total Dissolved Solids	Natural or unknown sources	No
pH	Natural or unknown sources	No
Nitrogen (Total)	Irrigated crop production, streambank modification and destabilization, and unknown sources	No
Phosphorous (Total)	Irrigated crop production, rangeland grazing, streambank modifications and destabilization, and unknown sources	No
Alteration in Streamside or Littoral Vegetative Covers	Irrigated crop production, rangeland grazing, streambank modifications and destabilization	No

4.3.2 Potential Impacts

4.3.2.1 No Action Alternative

No construction activities or changes in operation and maintenance would occur under this alternative and therefore, no impacts would result. Continued rocking maintenance of the weir would result in temporary slight increases in turbidity each year, which would not be a significant effect on water quality.

4.3.2.2 Proposed Bypass Channel Alternative

No substantial changes in water quality are anticipated to result from construction, aside from minor increases in turbidity, which are discussed above. Measures to avoid contamination of water during construction would be employed and only clean fill materials used. Since placement of rock on the weir crest would no longer be necessary, minor turbidity increases associated with maintenance of the weir would be reduced as compared to no action.

The proposed Bypass Channel Alternative will create a fish passable channel around Intake Diversion Dam, thus greatly reducing the fish passage barrier that is one of the 303(d) listings for the lower Yellowstone River.

Measures to minimize effects to water quality include:

- Implementation of a pollutant prevention plan during construction addressing all potential contaminants that may be present on site.

4.4 CURRENT PATTERNS, WATER CIRCULATION, AND FLUCTUATIONS

4.4.1 Existing Conditions

The Yellowstone River is one of the longest free-flowing rivers in the lower 48 states, draining about 70,000 square miles as it flows more than 600 miles from its origin east of Yellowstone National Park, Wyoming, through Montana to the confluence with the Missouri River in North Dakota (Chase 2014). At the Missouri River confluence, the Yellowstone River contributes more than 50% of the average annual flow (Corps 2010).

The Intake Diversion Dam is located near the town of Intake in Dawson County, Montana. Built over 100 years ago, it is the most downstream and largest in a series of six diversion structures on the Yellowstone River downstream of Billings, Montana.

The Corps analyzed the flow records at the Sidney Montana gage (USGS Gage No. 06329500) located 36 miles downstream of the Intake Diversion Dam, and at the Glendive Montana gage (USGS Gage No. 06327500) located 18 miles upstream of the Intake Diversion Dam. Flows at the Sidney gage are affected by operations at Yellowtail Dam, which is located on the Bighorn River in south central Montana, approximately 90 miles upstream of the confluence with the Yellowstone River. Yellowtail Dam regulates 28% of the base flows upstream of Sidney, and reservoir operations can alter the flow regime (Corps 2006). Thus, two periods were assessed:

- The full period of record—Water years 1911 – 2005
- The period following the construction of Yellowtail Dam—Water years 1967 – 2005.

USGS analyzed the Yellowstone River flow records for two scenarios:

- Unregulated stream flow, representing flow conditions that might have occurred if there had been no water-resources development in the basin
- Regulated stream flow, representing flow conditions if the level of water resources development that existed in 2002 was in place during the entire study period.

The period of study was water years 1928 – 2002. Daily stream flows were modified to represent unregulated and regulated stream flow conditions. Statistical summaries were calculated for each set of conditions.

The Corps recommended using the flow frequency and flow duration values for the regulated conditions developed by USGS for the design and evaluation of the proposed bypass channel (Corps 2015a). The regulated flow frequency values are provided in Table 4-2 (highlighted in green) and the flow duration values are provided in Table 4-3. Table 4-2 also provides discharges developed by the Corps using post-Yellowtail Dam data through 2005 for use in the evaluation of construction timelines.

Table 4.2 Flow Frequency

Percent Chance Exceedance	Return Period (yrs)	Discharges (cfs) for various scenarios. Recommended values are Annual Post Yellowtail Dam; seasonal values used in evaluation of various construction timelines to lower risk. Study was conducted using data through 2005.						2013 USGS Study **	
		Seasonal: Aug-Feb	Seasonal: Aug-Mar	Annual (period of record)	Annual-Post Yellowtail Dam	Winter (1Jan-15Apr) Post Yellowtail Bulletin 17b	Winter (1Jan-15Apr) Post Yellowtail Top Half	Unregulated	**Regulated**
0.2	500	128,507	192,400*	192,400	114000	249000	213000	174800	**156200**
0.5	200	96,637	172,300*	172,300	105000			157600	**140200**
1	100	77,223	148,907	156,900	97200	128000	123000	144900	**128300**
2	50	61,117	114,710	141,400	89400	94600	94100	132300	**116200**
5	20	43,967	78,968	120,600	78700	61500	62800		
10	10	33,515	57,696	104,200	70100	43100	43800	103000	**87600**
20	5	24,764	40,334	86,900	60600			89800	**74400**
50	2	14,982	21,709	60,400	45300	14900	12300	69600	**54200**
80	1.25	9,961	12,688	41,200	33300				
90	1.11	8,334	9,886	33,400	28200				
95	1.05	7,314	8,171	28,000	24500				
99	1.01	5,949	5,925	19,800	18600				

* Discharges reduced to not exceed annual discharges

** "Streamflow Statistics for Unregulated and Regulated Streamflow Conditions for Selected Locations on the Yellowstone, Tongue, and Powder Rivers, Montana and Wyoming 1928-2002" (USGS)

Source: Corps 2015a

Table 4.3 Flow Duration

Regulated Data from "Streamflow Statistics for Unregulated and Regulated Streamflow Conditions for Selected Locations on the Yellowstone, Tongue, and Powder Rivers, Montana and Wyoming 1928-2002" (USGS 2013)					
	Discharge (cfs)				
Percent Time Flow Equaled or Exceeded		Fall (OCT-DEC)	Winter (JAN-MAR)	Spring (APR-JUN)	Summer (JUL-SEP)
1	56,800	13,700	35,300	66,600	55,500
2	49,500	12,500	25,000	60,500	46,200
5	36,900	11,300	17,000	52,000	35,300
10	25,800	10,400	12,400	43,500	26,900
15	18,700	9,740	10,500	36,800	21,100
20	14,500	9,230	9,500	31,600	16,600
25	12,200	8,840	8,800	27,500	13,700
30	10,700	8,510	8,250	23,800	12,000
40	9,030	7,890	7,500	18,000	9,700
50	7,990	7,300	6,810	14,300	8,230
60	7,070	6,730	6,130	11,500	6,860
70	6,210	6,050	5,560	9,110	5,680
75	5,780	5,660	5,250	8,230	5,150
80	5,350	5,300	4,970	7,500	4,600
85	4,880	4,850	4,560	6,640	4,010
90	4,270	4,320	4,120	5,860	3,460
95	3,440	3,490	3,510	5,220	2,550
98	2,520	2,610	2,830	4,530	1,940
99	2,060	2,200	2,560	3,620	1,550

Source: Corps 2015a

Daily flows were also calculated by the Corps for the period of record at Sidney, Montana for the 5th, 10th, 25th, 75th, 90th, and 95th percentiles. The resulting hydrographs show a spring time pulse in mid-March through mid-April, which occurs in about 50% of the years, and a larger rise starting in early May, peaking in late June and receding by early August (Figure 4-1).

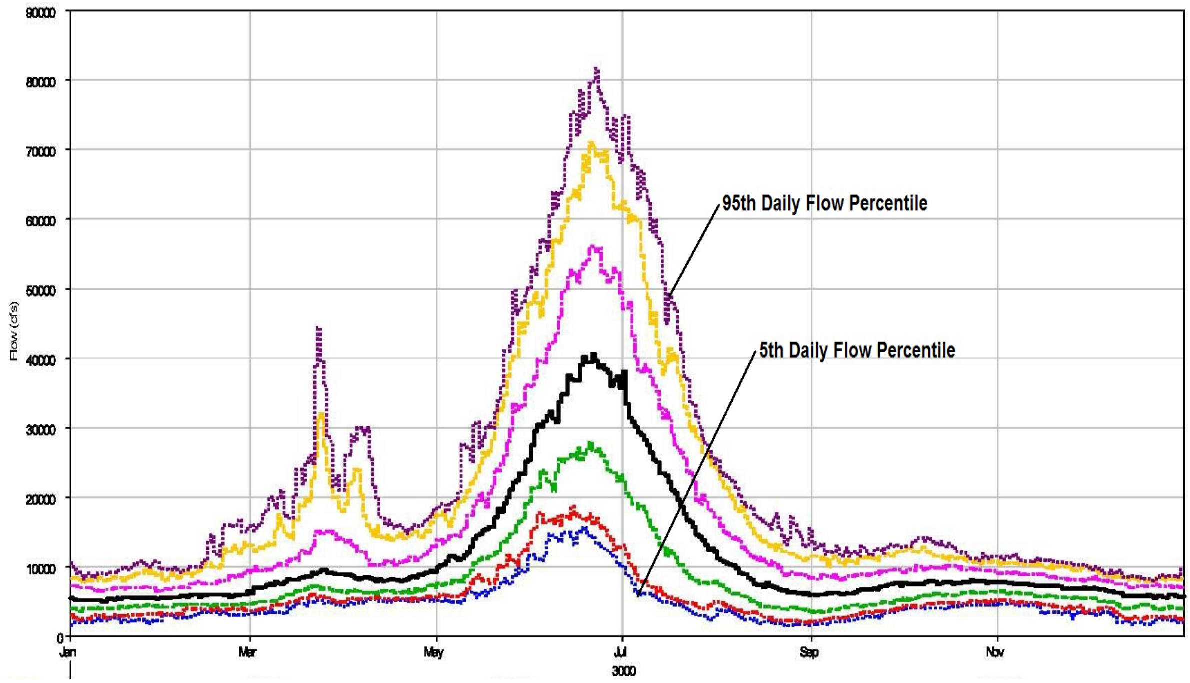

Figure 4.1 5th, 10th, 25th, 50th, 75th, 90th, and 95th, Daily flow Percentiles for Period of Record Water Years 1911 1934, and Water Years 1934-2005, Sidney, MT (USGS Gage No. 06329500) (Corps 2006)

The first rise is generally driven by snowmelt and rain in the plains region of the watershed. The second rise is primarily driven by mountain snowmelt (Corps 2006).

In 2011 and 2012 the Corps Engineering Research and Development Center/Cold Regions Research and Engineering Laboratory provided an assessment of ice impacts and design guidance on the Intake Diversion Dam and headworks structure and the proposed bypass channel (Tuthill and Carr 2012; Reclamation and Corps 2015). The report notes that ice breakup on the Lower Yellowstone River typically progresses downstream from warmer to colder climates (southwest to northeast) in a series of ice jams and releases. These jams tend to increase in severity as the breaking front encounters stronger, thicker ice. Jams in the main channel push flow and ice into side channels and onto the overbanks, leaving behind ice pieces. Historically when these jams form, the wide floodplains in the lower Yellowstone River system serve as a relief mechanism for collecting and storing ice. The overbank velocities of the ice pieces are low, (typically less than 2 feet/second at 40,000 cfs as calculated using HEC-RAS).

The main canal was constructed beginning in 1905. The canal is 71.6 miles long and conveys water along the north side of the Yellowstone River until it discharges to the Missouri River near the confluence of the Yellowstone and Missouri Rivers (Reclamation 2013). The canal has a design capacity of 1,400 cfs. The canal slope is 0.0002 feet/foot. The channel has a bottom width of 30 feet and 1.5H:1V side slopes. The canal is approximately 10 feet deep at the design capacity. Diversions are made into the canal typically from May through the end of September. Water diverted at the Intake Diversion Dam is measured daily at a bridge on the main canal, 2.8 miles downstream of the headworks. The annual diversions range from approximately 234,000 acre-feet to 378,000 acre-feet, with an average of 327,000 acre-feet.

The hydrologic assessment prepared by the Corps (Corps 2006) included the development of a 5-year moving average of flow. The analysis indicates an overall increase in flows during the winter but an overall annual decrease in flow. The report notes that while this may intuitively seem to be due to irrigation diversions and reservoir operation—with higher summer flows diverted or held in storage and winter flows augmented with reservoir releases—the trends are not pronounced enough to determine if these trends are due to irrigation and reservoir operations or other factors such as climatic trends. More recent analysis in the CEA indicate a similar pattern of hydrologic trends, with decreasing August flows over the period of record (Corps and YRCDC 2015). The CEA also notes that there is strong evidence of decreasing annual flow, decreasing annual minimum discharge, and decreasing peak discharge.

4.4.2 Potential Impacts

4.4.2.1 No Action Alternative

Under the No Action Alternative, river flows are not impeded by the Intake Diversion Dam. High flow events would overtop the banks and flows would occur through the existing side channel. The No Action Alternative would maintain the continued barrier of upstream passage of pallid sturgeon due to factors such as high velocities, turbulent flows, and low depths over the weir.

Climate change effects that may occur for the No Action Alternative include potential declines in snowpack in the mountains, potential increases in precipitation falling as rain, and increased air temperatures (Reclamation 2016). In addition, more extreme weather events such as floods and droughts are likely to occur more frequently. These factors would likely continue the trend of earlier and lower peak flows from snowmelt and potentially higher peak flows in winter and early spring from rainfall.

4.4.2.2 Proposed Bypass Channel Alternative

During construction of the proposed Bypass Channel Alternative, when the coffer dams are in place, the river flow would have roughly half the width, and approaching double the depth, with increased velocities through the reach. For example, during a flow of 15,000 cfs, the existing depth and velocity over the weir is 2.6 feet and 7.6 feet/second; if the width were reduced by 300-350 feet, the depth could potentially be 4 feet and the velocity could be 9.9 feet/second (similar to depths and velocities at a doubled flow, 30,000 cfs under existing conditions) during the two years of constructing the new weir. There could likely be some erosion and scour of the channel substrate and/or banks, primarily along the right bank on Joe’s Island as a result of confining the flows and it could temporarily cause a rise in water surface elevations, including for flood flows. The coffer dam could also cause minor changes to water surface and velocities at the headworks and screens at the Main Canal.

During ice break-up, the presence of the various coffer dams would likely affect where ice would flow and deposit in the floodplain and could cause the potential for an ice damming effect at the weir as there would be a reduced width for flow, temporarily raising water surface elevations upstream of the weir. This effect could extend for up to 1.8 miles to the first side channel, which is the existing side channel, where ice is often pushed out of the main channel as the ice dam moves upstream.

Once the new weir is completed, it would maintain the same water surface elevation at the Main Canal headworks to fully divert the 1,374 cfs without the need for rock. There would not be any effects to flood water surface elevations from the new weir. Modeling of the low-flow notch in the weir indicates that there would be increased depths of flow through this notch as compared to the existing weir and reduced velocities. This may facilitate passage by native fish species that currently occasionally pass upstream of the weir.

The completed bypass channel would divert 13-15% of the river flow, thus reducing flow slightly in the main channel over the approximately half-mile distance between the upstream and downstream ends of the channel. Further, the bypass channel is designed to provide optimal depths and velocities for pallid sturgeon migration over the range of flows in the river from 7,000 to 63,000 cfs. Depths will range from 4 to 10 feet and velocities will range from 2 to 6 feet/second.

A long-term advantage of a bypass channel that functions over a wide range of flows is that even with projected climate change effects on flows, the bypass channel would likely convey appropriate percentages of the river's flow and provide suitable depths and velocities for fish passage.

4.5 SALINITY

Salinity is not applicable for the Yellowstone River.

5.0 Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D)

5.1 THREATENED AND ENDANGERED SPECIES

5.1.1 Existing Conditions

Based on letters from the U.S. Fish and Wildlife Service, nine species that are listed under the Endangered Species Act (ESA) may occur within the proposed study area (USFWS 2016a, USFWS 2016b, Table 5-1). Of those species, only five are known or reasonably likely to be present, including the northern long-eared bat, least tern, piping plover, whooping crane, and pallid sturgeon.

Table 5.1 Federally Listed or Proposed Species in Montana and North Dakota and Presence in Study Area

Common Name	Scientific Name	MT[b]	ND[b]	ESA Status	Likely Presence in Study Area
Mammals					
Black-footed ferret	*Mustela nigripes*		X	Endangered	Not present
Gray wolf[a]	*Canis lupus*		X	Endangered	Not likely to be present
Northern long-eared bat	*Myotis septentrionalis*		X	Threatened	Potentially present
Birds					
Least tern	*Sternula antillarum*	X	X	Endangered	Likely to be present
Piping plover	*Charadrius melodus*	X	X	Threatened	Likely to be present
Rufa Red knot	*Calidris canutus rufa*		X	Threatened	Not present
Whooping crane	*Grus americana*	X	X	Endangered	Likely to be present
Fish					
Pallid sturgeon	*Scaphirhynchus albus*	X	X	Endangered	Present
Insects					
Dakota skipper	*Hesperia dacotae*		X	Threatened	Not present

a. Gray wolf has been delisted in Montana and is considered in recovery; it remains endangered in North Dakota.
b. Checked boxes indicate the species is federally listed for protection within that state, according to USFWS 2016a and USFWS 2016b.

5.1.2 Potential Impacts

5.1.2.1 No Action Alternative

The No Action Alternative would have no new construction, thus there would be no effects on Federal or state listed species or species of concern. Operational effects would occur from the continued operation and maintenance of the LYP.

Federally Protected Species

Northern Long-Eared Bat

The No Action Alternative would be unlikely to have any operational effects on northern long-eared bats from rock replacement at the weir or operation and maintenance of the headworks, screens, or irrigation system as they are not known to be present in any of these locations.

Least Tern

The No Action Alternative would be unlikely to have any operational effects on least terns as all activities would occur in highly disturbed areas where least terns have not been observed.

Piping Plover

The No Action Alternative would be unlikely to have any operational effects on piping plovers as all activities would occur in highly disturbed areas where piping plovers have not been observed.

Whooping Crane

The No Action Alternative would be unlikely to have any operational effects on whooping crane as all activities would occur in highly disturbed areas where whooping cranes are unlikely to occur and work primarily occurs after the spring migration and before the fall migration of whooping cranes.

Pallid Sturgeon

Under the No Action Alternative, the presence of the Intake Diversion Dam would continue to block pallid sturgeon passage, most likely due to high velocities and turbulence. The existing side channel is available for passage when river flows exceed 20,000 cfs (approximately 7 days in 5 out of 10 years). This barrier to fish passage limits access to additional potential spawning habitat that may be far enough upstream to allow suitable drift distance for sturgeon larvae to settle out before reaching Lake Sakakawea, thus contributing to the lack of recruitment in the Great Plains population of pallid sturgeon.

Several of the future O&M activities would result in short-term disturbance and turbidity in the Yellowstone River, including lowering and raising screens, screen cleaning/maintenance, gate maintenance, inspections, installing/removing supplemental pumps, and frequent replacement of rock on the existing weir. The majority of these activities would occur outside of the pallid sturgeon migratory and spawning season (i.e. either before April 15 or after July 1), thus adult pallid sturgeon are unlikely to be present and would be unlikely to experience disturbance.

Operation and maintenance of the headworks and screens would continue, as would the continued annual rock replenishment at the weir crest, and other ongoing maintenance activities of the irrigation system. These maintenance measures do not reflect a change in current conditions. Previous issues with fish mortality resulting from being entrained by the headworks into the Main Canal have been substantially reduced by the replacement of the headworks and the installation of the new fish screens (installed in 2011). The screens are designed to prevent entrainment of most fish larger than 40 mm. Monitoring data from 2012-2014 has indicated that entrainment is significantly reduced. There does appear to have been a change in the species composition and size of entrained fish in 2012 with 99 percent of the larval fish captured in the canal belonging to the Cyprinidae and Catostomidae families (predominantly minnows and carp) and <10 mm (typically in the 4-8 mm size range; Horn and Trimpe 2012). Raw data from 2013 and 2014 monitoring indicates similar results as in 2012. Free embryo or larval pallid sturgeon could be present upstream of Intake Diversion Dam for the No Action Alternative (i.e. a small number of adult pallid sturgeon have passed through the existing side channel), none are known to have been entrained at the headworks/screens.

With the existing Intake Diversion Dam in place, upstream and downstream passage occurs for some species, including the limited passage of pallid sturgeon in 2014 and 2015. All tagged fish in recent monitoring passed downstream over the weir with no reported problems (Rugg 2014, 2015; Rugg et al. 2016). One fish was initially believed to have died since it could not be found; however, later monitoring found this fish upstream of the Yellowstone River confluence on the Missouri River, unharmed. No pallid sturgeon larvae have ever been sampled in the vicinity of Intake Diversion Dam, so it is not known if the ongoing presence of the weir would affect downstream passage of larvae. The existing weir and rock rubble field have similar velocity and turbulence characteristics to bluff pools and rapids that drifting embryos encounter naturally on the Yellowstone River. A preliminary laboratory evaluation of the potential effects of riprap on white sturgeon larvae indicated no differences in injury or mortality to fish drifting past riprap versus a control group (Kynard et al. 2014). Intuitively, considering that free embryos and larvae are neutrally buoyant and are present in the lower part of the water column where velocities are lower, it is less likely they would be adversely affected when drifting past the existing weir.

Rock replenishment occurs during summer low flows and is not known to pose an immediate direct threat to protected fish or wildlife in the area, since they would easily be able to move away from the activity. Over time, indirect effects of continued rock placement could include the continued accumulation of large rock that is not natural within the river downstream of the dam that may slightly raise the elevation of the river bed and create a larger zone of turbulence, resulting in further limitations on fish passage conditions, damage to aquatic habitat, or a reduction in the availability of habitat.

From a recovery perspective, the No Action Alternative continues the present barrier to pallid sturgeon passage and would not contribute to recovery and may hinder recovery. Adult pallid sturgeon were observed to pass upstream of the Intake Diversion Dam via the existing side channel in 2014 and 2015 (Rugg 2014, 2015) when river flows generally ranged from 40,000 to 70,000 cfs. Pallid sturgeon presumably have passed through this route in previous years as 2014 was the first year that fish movement was tracked in the existing side channel with radio telemetry equipment. However, to date, there has been no documented recruitment of wild pallid sturgeon from the Yellowstone River.

Under No Action, the lack of recruitment of wild pallid sturgeon implies the potential for decline to fewer than 50 wild adults by 2023 (assuming a 5-percent adult mortality per year), which may be too low for effective reproduction. An estimated 43,000 juvenile hatchery-produced pallid turgeon are estimated to be present in the Upper Missouri River below Fort Peck Dam (Rotella 2015). It is unclear if future recruitment based entirely on hatchery-derived fish would create a sustaining naturally spawning population..

The No Action Alternative was evaluated using a Fish Passage Connectivity Index (FPCI; see Appendix D of the EIS). The resulting index value for an alternative is based on the probability of fish encountering the fish passageway, the potential for the species to use the passageway considering adult swimming performance and hydraulic conditions, and duration of time that the passageway is available during the migration period. The No Action Alternative merited a low index score of 0.08 (out of a maximum scope of 1.0) because there is very little potential for pallid sturgeon and other benthic oriented fish to pass over the existing dam because of its high velocities, shallow depths, and turbulent flows.

If no action were taken, Reclamation would need to reinitiate ESA consultation for their operation and management of the Intake Diversion Dam and the LYP. A future biological opinion would likely require other future activities to reduce the effects on listed species, but these are unknown at this time. Reclamation is continuing to conduct monitoring of entrainment at the headworks for the No Action Alternative and would continue to fund various other studies including the telemetry and tracking of pallid sturgeon and other fish species for at least 8 more years. To date, there have been no known adverse effects to pallid sturgeon from the various monitoring studies and protocols to avoid and minimize harm to pallid sturgeon would continue to be implemented.

Species of Concern
The No Action Alternative would be unlikely to have any operational effects on wildlife species of concern as the vast majority are not present in proximity to the weir, quarry, or irrigation system.

Under the No Action Alternative, the presence of the Intake Diversion Dam would continue to at least partially block passage for native fish species of concern, due to high velocities and turbulence. The existing side channel is available for passage when river flows exceed 20,000 cfs (approximately 7 days in 5 out of 10 years). However, many of the fish species of concern have been documented to occur in similar numbers both upstream and downstream of the weir (Helfrich et al. 1999; Rugg 2014, 2015).

Operation and maintenance of the headworks and screens would continue, as would the continued annual rock replenishment at the weir crest, and other ongoing maintenance activities of the irrigation system. These maintenance measures do not reflect a change in current conditions. Previous issues with fish mortality resulting from being entrained by the headworks into the Main Canal have been substantially reduced by the replacement of the headworks and the installation of the new fish screens (installed in 2011). The screens are designed to prevent entrainment of most fish larger than 40 mm. Monitoring data from 2012-2014 has indicated that entrainment is significantly reduced. There does appear to have been a change in the species composition and size of entrained fish in 2012 with 99 percent of the larval fish captured in the canal belonging to the Cyprinidae and Catostomidae families (predominantly minnows and carp) and <10 mm (typically in the 4-8 mm size range; Horn and Trimpe 2012). Raw data from 2013 and 2014 monitoring indicates similar results as in 2012. Larvae or juveniles of the fish species of concern are now much less likely to be entrained at the headworks/screens.

With the existing Intake Diversion Dam in place, upstream and downstream passage occurs for some species of concern. In 2014 and 2015, a large number of fish passed downstream over the weir with no reported problems (Rugg 2014, 2015; Rugg et al. 2016). Shovelnose sturgeon larvae have presumably passed downstream of the weir since it was constructed and there is no known effect on larvae. The existing weir and rock rubble field have similar velocity and turbulence characteristics to bluff pools and rapids that drifting embryos encounter naturally on the Yellowstone River. A preliminary laboratory evaluation of the potential effects of riprap on white sturgeon larvae indicated no differences in injury or mortality to fish drifting past riprap versus a control group (Kynard et al. 2014). Intuitively, considering that free embryos and larvae are neutrally buoyant and are present in the lower part of the water column where velocities are lower, it is less likely they would adversely affected when drifting past the existing weir.

Rock replenishment occurs during summer low flows and is not known to pose a direct threat to protected fish or wildlife in the area, since they would easily be able to move away from the activity. Over time, indirect effects of continued rock placement could include the continued accumulation of large rock that is not natural within the river downstream of the dam that may slightly raise the elevation of the river bed and create a larger zone of turbulence, resulting in further limitations on fish passage conditions, damage to aquatic habitat, or a reduction in the availability of habitat.

5.1.2.2 Proposed Bypass Channel Alternative

During construction of the Bypass Channel Alternative, the new weir would require installation and removal of coffer dams and placement of rock and cobbles in the river. These activities would likely result in minor effects to pallid sturgeon and other sensitive fish species from elevated noise levels from pile driving for coffer dams (would occur outside of the pallid sturgeon migration season) and moderate effects on pallid sturgeon and state fish species of concern by further reducing passage over the Intake Diversion Dam during the construction period of 28 months and by blocking the existing side channel for alternate passage.

Construction of the bypass channel and stockpile of excavation materials, however, would expand the potential area of impact to Joe's Island, where more types and area of habitat are available, such as for terrestrial wildlife.

The effects on federal and state listed species and actions that could be taken to avoid and minimize effects on each of these protected species are provided below.

Federally Protected Species
Federally protected terrestrial species that may occur in the bypass channel area include the northern long-eared bat, least tern, piping plover, whooping crane and pallid sturgeon. There is no known permanent population of terns, plovers, or cranes within the proposed project footprint for the Bypass Channel Alternative, but each have been observed in the area regularly and recently. If these species did arrive in the area during construction, they would be expected to naturally relocate to avoid disturbance. The construction of this alternative does not occur in areas considered critical habitat for any of the federally protected terrestrial species. Furthermore, though the project reach has been known to support migrating and/or nesting of least tern, piping plover, and whooping crane, the construction and access footprint of the Bypass Channel Alternative is relatively small in comparison to the surrounding available habitat and generally not located in potentially suitable habitats for these species (i.e. most of the

construction footprint is main channel, the adjacent river banks, grassy or disturbed uplands (including existing dirt roads), and the existing side channel. Therefore, only minor effects on any of these species would occur, limited to temporary disturbance from noise and human presence for an estimated 28 months.

Construction of the bypass channel and filling in the upper portion of the existing side channel would have a direct effect on species using Joe's Island and the existing side channel habitats, which differ from those that may be present in the main river channel or immediately around the Intake Diversion Dam. Species that may be present at Joe's Island and in the existing side channel include the northern long-eared bat and pallid sturgeon. Of these species, it is highly unlikely that northern long-eared bats would be present, since they are very rare in the area and there are no suitable hibernacula within a suitable distance.

Northern Long-Eared Bat
Construction of the bypass channel would only have the potential to disturb this bat species if it were found roosting under the existing Main Canal bridge or in trees to be cleared during construction, which is considered unlikely. Also, trees would only be removed from September 15 – January 31st, further reducing the chances of impacts to the species. Pre-construction surveys should be conducted to document if this bat is present. If found onsite, consultation with the Service would determine appropriate actions to protect individuals.

The Bypass Channel Alternative would be unlikely to affect northern long-eared bats from operation and maintenance of the bypass channel, headworks, screens, or irrigation system as they are not known to be present in any of these locations. Noise and disturbance on Joe's Island could potentially disturb individuals, if present, but this would be short-term and focused near the bypass channel and would not require removal of trees.

Least Tern
Interior least terns have been regularly reported to use the sandy shorelines of the Yellowstone River for nesting and foraging. Pre-construction surveys should be conducted to identify if any birds/nests are present. If active nests are found, they should be protected during the nesting season with temporary fencing or flagging for a ¼-mile buffer around the nest to prevent access and disturbance.

Operation and maintenance of the Bypass Channel Alternative would be unlikely to affect least terns as all activities would occur in disturbed areas where least terns have not been observed. Noise and disturbance on Joe's Island could potentially disturb individuals that might pass through the area or be on sand/gravel bars in proximity to the site. The work would occur during low flows and would generally occur after the nesting season for least tern.

Piping Plover
Piping plovers have been regularly reported to use the sandy shorelines of the Yellowstone River, including areas near the Intake Diversion Dam. However, effects on plovers could be minimized by conducting pre-construction surveys and by protecting nests with temporary fencing or flagging within ¼ mile of any active plover nests during the nesting season.

Operation and maintenance of the Bypass Channel Alternative would be unlikely to affect piping plovers as all activities would occur in disturbed areas where piping plovers have not been observed. Noise and disturbance on Joe's Island could potentially disturb individuals that might pass through the area or be on sand/gravel bars in proximity to the site. The work would occur during low flows and would generally occur after the nesting season for piping plover.

Whooping Crane
Whooping cranes are rare visitors to the Yellowstone River corridor and would be unlikely to occur. However, whooping crane sighting reports would be monitored before and during construction to determine if cranes are in the construction area. If any are sighted, construction managers would consult with the Service to determine if any actions to minimize effects are warranted.

Operation and maintenance of the Bypass Channel Alternative would be unlikely to affect whooping crane as all activities would occur in disturbed areas where whooping cranes are unlikely to occur and work primarily occurs after the spring migration and before the fall migration of whooping cranes.

Pallid Sturgeon
Operation and maintenance of the existing diversion structure would be required until the construction of the new weir was completed. This would include the annual placement of rock on the existing weir crest up to elevation 1991.0 feet. This rock is needed to maintain water surface elevations so the LYP can divert their full water right down to 3,000 cfs in the Yellowstone River. The physical placement of rock would not affect adult pallid sturgeon as this activity occurs outside of pallid sturgeon migration (migration period April 15 – July 1). The Intake Diversion Dam is already impassable to pallid sturgeon so the continued maintenance and rocking activities during construction does not represent a loss of habitat or change in accessibility to habitat.

This annual placement of rock would continue to affect the 12-26 percent (25 to 32 individuals) of spawning ready wild adult pallid sturgeon that migrate up to Intake Diversion Dam. It is likely that some or all of these fish would continue to spawn in habitats downstream of Intake Diversion Dam, but any resulting free embryos/larvae would almost certainly perish due to inadequate drift distance downstream before entering Lake Sakakawea.

The rock would also continue to prevent upstream passage by juvenile pallid sturgeon, although it is not known if juveniles are motivated to move upstream. Rugg (2014, 2015) documented three individual juvenile pallid sturgeon that had passed upstream of Intake Diversion Dam, including one documented to have passed through the existing side channel. Thus, it is presumed the annual placement of rock affects at least a small number of juvenile pallid sturgeon that are motivated to find suitable habitat upstream. It is not possible to know how many individuals this affects as a very small percentage of these juveniles are tagged and tracked each year. However this effect appears to be minor as there appears to be suitable habitat available below Intake Diversion Dam and in the Missouri River as many hatchery juvenile pallid sturgeon are surviving and maturing successfully in the GPMU (Rotella 2015).

During construction, there would be temporary and minor increases in turbidity on multiple occasions over the 28 month construction period from installation and removal of coffer dams, dewatering for new weir construction, placement of rock and cobbles at the new weir, connection of the bypass channel to the river and placement of rock at the upstream/downstream ends of the bypass channel. But these increases in turbidity should rapidly mix and be diluted, and pallid sturgeon are adapted to high turbidity environments.

Elevated noise levels from sheet pile driving for coffer dams may disturb pallid sturgeon and other fish and wildlife species. Noise attenuates through water in a straight line and dissipates when it encounters land. Thus, in a meandering river, the distance that noise would propagate is limited to the first bend upstream and downstream of the construction. It is anticipated that any fish within close proximity would immediately flee the area once construction equipment was mobilized to the site and activities such as moving rocks began to occur. Thus, injury is not anticipated. To minimize the potential for effects on pallid sturgeon and other native migratory fish species, no sheet pile driving or other in-river work would occur during the pallid sturgeon migration period (April 15 – July 1) to minimize the potential that any adult pallid sturgeon would be present in the vicinity and that if any larval pallid sturgeon were possibly present, they would drift downstream past the work zone before pile driving began. Juvenile pallid sturgeon have been stocked upstream of Intake Diversion Dam for monitoring studies (Jaeger et al. 2004, 2005, 2006), but most of these fish appear to have migrated downstream of the dam. Due to the turbulence around Intake Diversion Dam and the rock rubble field, juveniles would be unlikely to be present in the immediate vicinity. Any present upstream of the dam could move away upstream to avoid pile driving noise. Vibratory driving would be also used if practicable to minimize noise levels.

During construction, the existing side channel would be blocked off at the upstream end and about 1.5 mile downstream and filled using materials excavated for the new bypass channel. Because excavated materials need to be deposited almost immediately after excavation begins, it is anticipated that infill of the existing side channel would be concurrent with excavation of the bypass and occur over most of the 28-month construction duration. The bypass channel would be constructed in the dry, with cofferdams at the up and down stream ends of the bypass. This means there would be a period of time when the bypass channel is not completed and the existing side channel is also blocked, which would likely prevent pallid sturgeon passage upstream of the Intake Diversion Dam. As the existing side channel only begins to convey flows when river flows are above 20,000 cfs, and passage has only been documented at flows above 40,000 cfs (approaching a 2-year flood; Rugg 2014, 2015), which does not occur every year, it is likely that the blockage of the side channel would only prevent passage in one runoff season during construction. To date, only one female and 6 males have been documented to have migrated upstream through the existing side channel, although other non-telemetered fish may have passed in previous years or even in 2014 and 2015. Of the telemetered wild adult pallid sturgeon that migrate to Intake Diversion Dam, (estimated 12 to 26 percent of total wild adults, up to 32 fish; Braaten et al. 2015), 50 and 14 percent passed through the existing side channel in 2014 and 2015, respectively. This could translate to 5 to 16 fish being blocked from migrating upstream through the existing side channel during construction in the estimated one year when passage could be possible. This would be considered a short-term adverse effect during the two years of construction. To offset this effect, a catch and haul program would be implemented to provide passage for the adult pallid sturgeon that migrate up to the Intake Diversion Dam and may have passed using the existing side channel. The catch and haul program would be discontinued once construction was completed.

Operation and maintenance of the Bypass Channel Alternative would no longer require the placement of rock on top of the weir crest as the replacement weir would be high enough to fully divert the 1,374 cfs water right into the Main Canal down to flows of 3,000 cfs in the river. This would result in much less future maintenance occurring in the river channel as periodic supplementation of rock at the replacement weir would occur much less frequently and require much less rock placement, thus reducing disturbance to fish species in the river.

Several of the future O&M activities would result in short-term disturbance and turbidity in the Yellowstone River, including lowering and raising screens, screen cleaning/maintenance, gate maintenance, inspections, installing/removing supplemental pumps, occasional replacement of rock on the outside bends or at buried sills in the bypass channel and removal of sediment and debris, and infrequent replacement of rock at the replacement weir. The majority of these activities would occur outside of the pallid sturgeon migratory and spawning season (i.e. either before April 15 or after July 1), thus adult pallid sturgeon are unlikely to be present and would be unlikely to experience disturbance.

Even though there should be improved adult passage and spawning upstream, it would be highly unlikely that eggs would be present during future O&M as it would occur after eggs have hatched and any drifting eggs would already be dead. Free embryos/larvae could be present, but the future O&M activities would occur before or after drifting occurs, thus, effects to free embryos/larvae are not expected or negligible.

Juveniles may be present as they have been documented in the Yellowstone River both upstream and downstream of Intake Diversion Dam, but not in immediate proximity to the weir (Jaeger et al. 2006, 2008; Rugg 2014, 2015). As the immediate work areas at the headworks and on the replacement weir are likely to be unsuitable habitat due to higher velocities and do not include bluff or terrace pools, there are not likely to be any juvenile pallid sturgeon present that could be disturbed by localized and short-term in-water work at the headworks or weir.
Irrigation diversions of up to 1,374 cfs would continue to occur from approximately April 15 to October 15. The screens at the headworks were designed to minimize entrainment of fish, including pallid sturgeon, larger than 40 mm into the Main Canal. A small percentage of pallid sturgeon less than 40 mm, could potentially be impinged on the screen or entrained through the screen into the Main Canal. If spawning occurs near or upstream of the Powder River, similar to the presumed spawning that occurred in 2014 (approximately 80 miles upstream from Intake), the free embryos would be approximately 9-12 mm in size when drifting through the Intake area (P. Braaten, personal communication 2015). Work done by Mefford and Sutphin (2008) showed that pallid sturgeon free embryos (13-18 mm) could pass directly through a 1.75 mm wedgewire screen, which is the current design of these screens. Thus, if free embryos encounter the screen at Intake, they can be impinged or entrained.

Information from drift studies (Kynard et al., 2002, 2007; Braaten, 2008, 2010, 2012), indicates that most pallid sturgeon free embryos drift in the lower 0.5 m (1.6 feet) of the water column, but a few will be caught in the upper portions of the water column, depending on turbulence and secondary currents (P. Braaten, personal communication 2015). When in use, the headworks screens are located approximately 2 feet above the river bottom and have an approach velocity of 0.4 meters per second (1.3 feet/second) and a sweeping velocity of 2-4 feet/second, which helps sweep small non-swimming fish past the screens and reduces the chance of larvae and small fish being impinged upon the screens or entrained into the canal.

The vast majority of pallid sturgeon free embryos drift in or adjacent to the thalweg where velocities are high. Although a few free embryos will drift in regions of lower velocity (for example, along inside bends), most will be concentrated in the higher velocity regions. On river bends (similar to where the Intake screens are located), very high concentrations of drifting free embryos can be found in the region that extends from about mid-channel through the thalweg to the outside bend of the channel (Braaten et al. 2012).

Free embryo pallid sturgeon drift occurs during mid-June through mid-July each year, which is typically the peak run off months for the Yellowstone River. During June the average discharge is 38,200 cfs and in July is 22,000 cfs. Because the LYP is diverting only 3- 6 percent of the average total river flows during this time, a corresponding small percentage of the total number of pallid sturgeon free embryos would likely be impinged or entrained.

Based on 2D modeling results, the area of influence from the screen extends approximately 50 feet into the Yellowstone River during river flows of 24,000 to 25,000 cfs (Figure 12; C. Svendson personal communication 2016). This is a relatively small area of influence as the Yellowstone River is approximately 700 feet wide at Intake. As flows increase in the Yellowstone River during runoff conditions, this area of influence would be expected to decrease, decreasing the likelihood of entrainment. Additionally the thalweg is located approximately 100 -150 feet away from the headworks which is outside of the area of influence further reducing that chances of entrainment or impingement.

It is impossible to estimate the number of pallid sturgeon free embryos that could be entrained but some factors are reasonable to predict: the percentage of larvae passing near the screens will be small given their expected distribution across the river and in the water column and the relatively small amount of water being diverted relative to the total volume of river water indicate relatively few larvae would encounter the screens.

Overall, because free embryo or larval pallid sturgeon would likely only be present drifting in the river from mid-June to mid-July, when typically less than 5% of the river flow is being diverted into the headworks, a small percentage of the total number of pallid sturgeon free embryo and larvae could be impinged or entrained. However, pallid sturgeon free embryos would likely be larger than 8 mm by the time they reached the headworks and the vast majority would be drifting below the level of the screens, as recent monitoring indicates most larval fish that have been entrained since the screens were installed were in the 4-8 mm size range (Horn & Trimpe 2012, Reclamation unpublished data). The mortality of pallid sturgeon from egg to age-0 has been estimated at over 99.9% (Caroffino et al. 2010; Rotella 2012; Delonay et al. 2016). These fish have evolved to produce very large numbers of eggs to compensate for the low survival of eggs/free embryos (i.e. R-selection), so the potential entrainment of pallid sturgeon larvae would be a minor adverse effect.

Adult and juvenile pallid sturgeon have swimming capabilities much greater than the approach or sweeping velocities of the screens and are thus unlikely to be impinged and are much too large to be entrained. Thus, the diversions into the Main Canal are unlikely to affect adult and juvenile pallid sturgeon.

If the LYP is not able to divert their entire water right due to debris in or near the headworks, plugged screens, or gate failure, they may lift screens one at a time until they are able divert their full water right down to river flows of 3,000 cfs measured at the Sidney gage. Under such circumstances, adult and juvenile pallid sturgeon are subject to entrainment into the Main Canal, resulting in an increased risk of potential injury or mortality. This action would only be undertaken in an emergency situation and would require coordination with the Service. Also, before any screens are lifted, the Service and MFWP would be contacted and methods to minimize effects to sturgeon would be identified.

Also, it is very likely that the LYP would need to divert unscreened water into the Main Canal during the start of the irrigation season to sluice sediment away from the gates and screens. This action would occur during early April, which is outside of pallid sturgeon migration and spawning, so no effects to adult pallid sturgeon are expected.

The LYP uses five small surface water pumps to supplement diversions in the Main Canal during peak demand times. Four pumps are located on the Yellowstone River downstream of Sidney and one is located on the Missouri River. Currently, these pumps have two–inch wide trash racks and operate occasionally during May, July, and August. The trash racks largely eliminate the chances of adult and juvenile pallid sturgeon from becoming entrained. There would still be potential for free embryo and larval sturgeon in both the Missouri and Yellowstone rivers to be entrained in these pumps, but the likelihood is quite small as these pumps are only operated intermittently, divert a small portion of the Yellowstone and Missouri rivers, and do not occur on outside bends where free embryos and larvae are most likely to be concentrated. Further, free embryo and larval sturgeon would only likely be present in the river in July and these surface pumps are used less frequently in this month when flow diversions at the headworks are typically high.

The bypass channel alternative would likely substantially improve passage for pallid sturgeon and other aquatic species compared to No Action. The bypass channel is designed to meet the BRT criteria for optimal pallid sturgeon passage and would be accessible over a much wider range of flows than the existing side channel that has only been documented to pass pallid sturgeon when flows exceed 40,000 cfs (approaching a 2-year flood). It is anticipated that a majority of pallid sturgeon that swim up to the weir would encounter the bypass channel as its entrance would be located close to the weir, thus a likely majority of pallid sturgeon would find and could use the channel. Passage upstream would extend the available spawning habitat to pallid sturgeon, potentially up to the Cartersville Diversion Dam, adding over 165 miles of potential spawning habitat and the lower 20 plus miles of tributaries such as the Powder River. Currently, a small percentage of the pallid sturgeon in the Yellowstone River use the existing side channel to pass above the Intake Diversion Dam and the bypass channel would likely allow the majority of the pallid sturgeon to pass upstream. The fish passage benefits would likely provide a major benefit to pallid sturgeon. The existing side channel would be filled at the upstream end and would no longer be accessible for upstream passage, but the greater likelihood of passage in the bypass channel would outweigh the benefits of the existing side channel that a smaller percentage of fish used.

In order to maintain the bypass channel to BRT criteria a temporary blockage of the channel may be required for major maintenance activities such as sediment removal, channel realignment or riprap replacement. These activities would all occur during low summer flows and outside of the pallid sturgeon migration and spawning period and last only a couple of weeks. Juveniles could be present in the bypass channel, but as work would occur at low flows, it is likely that any juveniles would have moved upstream or downstream prior to the work. Any short-term blockage of the bypass channel would not affect adults, but may have a short-term discountable effects on juveniles. Further, any short-term turbidity generated from these activities is likely to be well within the naturally high turbidity levels of the Yellowstone River which pallid sturgeon are adapted to.

For those pallid sturgeon that fail to find or use the proposed bypass channel, the new concrete weir, existing diversion structure, and rock field would continue to be an upstream barrier in the main stem of the Yellowstone River. However, velocity and depth conditions with the proposed replacement weir and low-flow notch would be an improvement compared to existing conditions (Table 5-2). Also, the smooth surface of the replacement weir would not cause turbulent flows, although the continued presence of the rock field downstream of the weir would still create turbulent conditions. It is still unlikely that adult or juvenile pallid sturgeon would pass upstream over the existing weir, rock field and replacement weir, but other native fish species may have improved passage.

Table 5.2 Comparison of Depths and Velocities over Existing vs. Proposed Weir.

Structure	Depths and Velocities at 15,000 cfs	Depths and velocities at 30,000 cfs
Existing Intake Diversion Dam	2.1-2.9 feet, 8 ft/sec	4 feet, 10 ft/sec
Replacement Weir Notch	3.5 feet, 5 ft/se	5.4 feet, 6.8 ft/sec

Adult and juvenile pallid sturgeon have been documented to have passed successfully downstream of the existing weir without any observable injury (Jaeger et al. 2004, 2005; Rugg et al. 2016), and downstream passage past the replacement weir should be improved compared to existing conditions. The replacement weir would have a smooth concrete top and a low-flow notch located approximately 100 feet out from the left bank, near to the channel thalweg. Rock and cobble will be placed sloping up to the new weir from the upstream side and between the replacement weir and existing weir. This will smooth out flows and reduce turbulence at the weir.

It is anticipated that there would be limited potential for injury or mortality of free embryos/larvae passing downstream. The replacement weir would be similar to rapids that drifting embryos encounter naturally on the Yellowstone River. A preliminary laboratory evaluation of the potential effects of riprap on white sturgeon larvae indicated no differences in injury or mortality to fish drifting past riprap versus a control group (Kynard et al. 2014). Intuitively, considering that free embryos and larvae are neutrally buoyant and are present in the lower part of the water column where velocities are lower, it is less likely they would be adversely affected when drifting through the Project Area.

The Bypass Channel Alternative was evaluated using the FPCI (Chapter 2 and Appendix E). The resulting index value for an alternative is based on the probability of fish encountering the fish passageway, the potential for the species to use the passageway considering adult swimming performance and hydraulic conditions, and duration of time that the passageway is available during the migration period. The Bypass Channel Alternative merited an index score of 0.67 (out of a maximum score of 1.0) because there is a high likelihood of fish encountering a passageway that occurs immediately downstream of the dam and it would be accessible and meet BRT criteria for pallid sturgeon passage at all flows at or above 7,000 cfs in the river.

There are still uncertainties over whether a majority of pallid sturgeon would actually pass through the bypass channel as there are no other examples of similar natural-type channels designed for non-jumping benthic fish. However, because it would mimic the characteristics of the existing side channel and other natural side channels with much more attraction flow, it is reasonable to assume that a majority of fish would find and use the channel. To address these uncertainties Reclamation and the Corps would implement a Monitoring and Adaptive Management Plan (AMP; see Appendix E of the EIS). This AMP takes into account the physical and biological criteria that were provided by the Service's Biological Review Team (Service 2013, 2016) and potential adaptive management measures that could be implemented if a problem was identified. Reclamation would continue to conduct monitoring of entrainment at the headworks and the monitoring identified in the AMP would occur for at least 8 years. To date, there have been no known adverse effects to pallid sturgeon from the various monitoring studies and protocols to avoid and minimize harm to pallid sturgeon would continue to be implemented.

Species of Concern

Wildlife species of concern that are likely to be present in the Bypass Channel Alternative construction area include hoary bat, little brown myotis, bald eagle, black-billed cuckoo, chestnut collared longspur, great blue heron, loggerhead shrike, long-billed curlew, red-headed woodpecker, yellow-billed cuckoo, veery, plains spadefoot, snapping turtle, and spiny softshell. Most of these species are associated with riparian or shoreline habitats and could be present along the Yellowstone River or existing side channel or riparian areas on Joe's Island. In order to ensure protection of sensitive wildlife species, it is recommended that a pre-construction survey be conducted to identify if any of these species are present. If any are discovered that cannot easily fly or move away, they should be relocated downstream of the construction zone. This would ensure that there are only minor effects on sensitive wildlife species.

The Bypass Channel Alternative would be unlikely to have any operational effects on wildlife species of concern as the vast majority are not present in proximity to the weir, Joe's Island, the quarry, or irrigation system.

Fish species of concern known to be present include blue sucker, paddlefish, sauger, shortnose gar, sicklefin chub, and shovelnose sturgeon, sturgeon chub. These species could be moderately affected during construction as the use of cofferdams that increase water velocities may reduce passage at the dam during the 28 month construction period. Also, the existing side channel would not be available for passage around the dam, thus resulting in a moderate adverse effect on these species. Installation of the small cofferdams to isolate the bypass channel and existing side channel would be driven out-of-water and would have only a minor effect on fish in the river from either noise or turbidity.

The bypass channel would have deeper depths and substantially lower velocities than those at the existing weir that would allow for sensitive fish species to move upstream, particularly strong-swimming species such as blue sucker, paddlefish, and sauger, providing a major benefit to these species. The existing side channel would no longer be accessible for passage, although only small numbers of sensitive fish species have have been documented to use the side channel (Rugg et al. 2016). The new weir may also improve passage over the weir for species that currently sometimes pass over the weir. Operation and maintenance of the headworks and screens would continue and other ongoing maintenance activities of the irrigation system. These maintenance measures do not reflect a change in current conditions. Entrainment at the headworks has been much reduced as described above for pallid sturgeon and entrainment of other native fish species is likely to be substantially reduced.

None of the insect species of concern are likely to be present in the bypass channel construction work zone, thus no effects are expected to these species.

None of the plants classified as species of special concern in Montana have been observed in recent years in the study area and they are unlikely to be present. However, to ensure protection of rare plants, it is recommended that a survey be conducted prior to construction to identify any plant species of concern in the area. If any are present, they should be fenced off and protected during construction. Pre-construction surveys would ensure that effects on protected plant species would be negligible. If any of these species are discovered in the first survey, additional surveys may need to be conducted each spring as construction is reinitiated.

A number of measures can be employed to minimize effects to listed and sensitive fish and wildlife species, including:

- Conduct pre-construction surveys within the construction footprint for listed and sensitive wildlife and plant species and fence and protect any listed plant species observed.
- All surface-disturbing and construction activities will be prohibited from occurring within 0.25 mile of any existing and active least tern or piping plover nest within the dates of May 15 to August 15.
- If any whooping cranes are sighted during the project construction, the on-site manager will immediately notify Corps/Reclamation environmental staff to consult with the USFWS regarding appropriate actions.
- Construction activities within the wetted perimeter of the active channel will be observed and monitored by a qualified fisheries biologist during the first day of in-water work for each activity to determine if there is potential for direct harm or harassment of pallid sturgeon. This will include coordination with MFWP to make sure radio-tagged pallid

sturgeon and other monitored native fish continue to be monitored, especially during the construction season.

- All pumps used in the river during construction will use intakes screened with no greater than 0.25 inch mesh when dewatering coffer dam areas in the river channel. Pumping will continue until water levels within the contained areas are suitable for salvage of any juvenile or adult fish occupying these areas. All fish will be removed by methods approved by the USFWS and MFWP prior to final dewatering.
- Care will be taken to prevent any petroleum products, chemicals, or other harmful materials from entering the water.
- All work in the waterway will be performed in such a manner to minimize increases in suspended solids and turbidity that could degrade water quality and damage aquatic life outside the immediate area of operation.
- All areas along the bank disturbed or newly created by the construction activity will be seeded with vegetation native to the area for protection against subsequent erosion and the establishment of noxious weeds.
- Clearing vegetation will be limited to that which is absolutely necessary for construction of the project.
- Any in-stream construction activity will be conducted during periods least likely to impact the pallid sturgeon or other sensitive fish species.
- Sheetpiles will be installed using vibratory equipment to the maximum extent practicable to minimize noise levels and potential effects to fish.
- At the start of pile driving each day, conduct a low-energy ramp up with reduced noise levels to allow fish the opportunity to move from the area.
- A monitoring and adaptive management plan will be implemented for the preferred alternative to document fish passage, entrainment, and success of the project in meeting physical and biological objectives (see Appendix E).

5.2 AQUATIC FOOD WEB

5.2.1 Existing Conditions

The aquatic community includes fish, mussels, macroinvertebrates, and aquatic vegetation. The Yellowstone River still has relatively pristine character (Jaeger et al. 2006). However, several anthropogenic factors influence the aquatic ecosystem, including alterations to the hydrograph, geomorphology, riparian vegetation and wetlands, river and tributary connectivity, and water quality, as well as introduction of non-native species and pressure from recreational fishing (Corps 2015b).

5.2.2 Potential Impacts

5.2.2.1 No Action Alternative

No changes to the existing aquatic food web would occur under the No Action Alternative.

5.2.2.2 Proposed Bypass Channel Alternative

During construction, the placement of fill in the existing side channel could bury mussels that utilize side channel habitat. Giant Floaters (*Pyganodon grandis*) are a species that utilizes backwater habitat, but has not been found in the Yellowstone River. Giant Floaters have only been found in three Yellowstone River Tributaries (O'Fallon, Little Porcupine, and Tongue Rivers). Since the existing side channel is not known to provide habitat for native mussels, impacts would be minor.

In the main channel, construction in the river could result in the loss of mussels. Surveys found Fatmucket densities in the Missouri River and Marias River averaging between 7-8 mussels per hour. The Yellowstone River has a much lower mussel density overall, with survey rates for Fatmuckets averaging around one mussel per hour (Stagliano 2010). The estimated number of mussels between the boat ramp and the Intake Diversion Dam was 24 individuals which is an insignificant numberfor the population as a whole.

Maintenance of the new weir would only occur occasionally so impacts to mussels would be minimal. Operation and maintenance of the bypass cannel would include occasional rock replacement at the bends and along the banks. This could bury mussels that have started to utilize side channel habitat (Giant Floaters, *Pyganodon grandis*, in particular), thus burying affected individuals. The number of affected individuals is likely to be low, so impacts would be minor.

Construction and fill in the river and in the existing side channel could result in the direct burial and mortality of macroinvertebrates. This is anticipated to be a minor, temporary effect and the new substrate in the river and the bypass channel would be rapidly colonized by macroinvertebrates once construction is complete. Installation and removal of coffer dams and construction of the new weir could disturb sediments and increase turbidity around the Intake Diversion Dam area. Increased turbidity and suspended sediment could negatively affect macroinvertebrates. Some macroinvertebrates tolerate sediment suspension such as flies *(Diptera),* midges *(Chironomidae)* and earthworms *(Oligochaeta*). However, the mayflies *(Ephemeroptera)* stoneflies *(Plecoptera*), and caddisflies *(Trichoptera)* are not tolerant of sediment suspension. Even with actions to minimize effects, there may be short-term effects near construction activities. These impacts are expected to be minor and temporary, and macroinvertebrate populations should recover quickly.

Rock placement for maintenance along the bends and banks of the bypass channel could disturb sediment and affect macroinvertebrates that are not tolerant of high turbidity. This impact would be localized and temporary and have minor effect.

The new bypass channel would be armored with a layer of large gravel and cobble. This substrate would provide more long-term habitat for macroinvertebrates as the amount of interstitial spaces resulting from the armor layer would likely provide substantial short term improvement for macroinvertebrates. Over time, the interstices could fill in and more likely be similar to substrate conditions in the existing side channel.

Measures to minimize effects to the aquatic food web would include:

- All work in the river will be performed in a manner to minimize increased suspended solids and turbidity including the use of coffer dams to isolate in-water work zones and taking appropriate erosion control measures.
- All areas along the bank disturbed by construction will be seeded with native vegetation to minimize erosion.
- All contractors will be required to inspect, clean and dry all machinery, equipment, materials and supplies to prevent spread of Aquatic Nuisance Species.
- Construction activities will be conducted in accordance with permit conditions, including water quality monitoring, if required. All pumps will have intakes screened with no greater than 0.25-inch mesh when dewatering coffer dam areas in the river channel. Pumping will continue until water levels within the contained areas are suitable for salvage of juvenile or adult fish occupying these areas. Fish will be removed by methods approved by the Service and MFWP prior to final dewatering.
- Reclamation will implement a monitoring and adaptive management plan that will include measures to take if project objectives are not met (see Appendix E).

5.3 WILDLIFE

5.3.1 Existing Conditions

Five general habitat types in the study area provide productive ecological support for native terrestrial wildlife: wetland, woody riparian, barren land, shrubland, and grassland. These habitats are utilized by frogs, toads, snakes, lizards, bats, large and small mammals, songbirds, waterfowl, wading birds, shorebirds, and insects.

5.3.2 Potential Impacts

5.3.2.1 No Action Alternative

No impacts to wildlife would occur from the No Action Alternative.

5.3.2.2 Proposed Bypass Channel Alternative

Loss of a diversity of high-quality habitat patches would occur and potentially affect wildlife under the Bypass Channel Alternative, while disturbance from construction activities, which would last approximately 28 months, would also result in moderate temporary impacts.

Joe's Island would be fundamentally altered by the Bypass Channel Alternative. Joe's Island and the adjacent mainland include all wildlife habitats found in the greater study area. Because they are relatively high in quality, and would experience both short-term and long-term impacts from this action, the resulting effects on wildlife may be locally widespread and substantial, but scaled-down when considering their regional impact.

All anticipated impacts to wildlife from the Bypass Channel Alternative would be concentrated in Dawson County, Montana, and likely cause the degradation of County-regulated and protected wildlife resources, including big game winter range, waterfowl nesting areas, habitat for rare or endangered species, and wetlands (Dawson County, Unknown year; MFWP 2012). Big game winter range for mule deer, white-tailed deer, and pronghorn all occur in the project area and would be degraded by the Bypass Channel Alternative, and are also protected by the State of Montana (MFWP 2012). Impacts would generally be disturbance and elevated noise levels during construction, clearing of riparian trees and shrubs, and conversion of primarily grassland habitats to the new channel.

Wildlife disturbed by the construction activities is anticipated to be displaced from the area unharmed. The wide diversity of habitats that would be disturbed and locally large geographic footprint of the construction area, suggest a wide range of wildlife would be displaced by this alternative. The majority of these effects would occur on Joe's Island, which has a diversity of relatively high quality habitat patches. Because all habitat types identified in the study area would be subjected to construction disturbance, all associated wildlife species have the potential to be effected and displaced by this alternative. Sage grouse, if present, are well known to be sensitive to disturbance by large equipment use and construction activities such as those related to roadwork and rock quarries (summarized in Service 2015). This species, however, is likely not present in the study area (MSGWG 2005) and would not be affected by this alternative.

The presence of the new bypass channel and associated constructed features are the primary source of long-term impacts to wildlife under the Bypass Channel Alternative. Excavation would mostly occur within upland habitats, fundamentally altering their structure and capacity to host wildlife. Because the bypass channel would convey greater flows than the existing side channel, and would be perennial instead of seasonal, the portion of the Island located between it and the main channel would become somewhat isolated from terrestrial wildlife such as big game species, reducing its utility to support those taxa. In contrast, aerial species such as waterfowl and other birds, as well as bats, may benefit from this same isolation by the creation of refuge areas.

The filling of the upper section of the existing side channel would result in the loss of the existing riverine habitat in that area, including woody riparian and wetland, as well as adjacent terrestrial habitats reliant on existing hydrology. The lower section of the existing side channel would become a backwater. This would likely cause changes to vegetation, and the conversion and degradation of existing habitat in and adjacent to the channel. For example, barren land is a prominent feature adjacent to the right streambank of the existing side channel, making it likely to be degraded in quality due to the proposed stream channel alterations. The additional disposal of excavated material in the spoil area would cover and largely eliminate patches of several types of existing upland habitat. Native vegetation would be restored or allowed to reestablish on these disposal sites.

Several existing access roads would be improved under this action, and one that would be constructed along the north side of the river to allow access for heavy equipment during construction would be retained for long-term maintenance. Assuming all road improvements would be permanent, road use and public access under this alternative would likely result in long-term impacts from enhancing the fragmentation of habitats that they cross, because the roads would result in interruptions in otherwise contiguous habitat patches, and would be expected to facilitate vehicle use, increasing likelihood for disturbance and vehicle strikes.

Operation and maintenance activities would be spread through a relatively large and diverse area (specific acreages of loss are provided in Section 4.10), potentially affecting a wide array of wildlife. Maintenance and associated disturbance is likely to occur in all construction areas, where inspections would survey the constructed features for damage from ice and/or the spring freshet, and repairs could occur. Disturbance would extend into the existing rock quarry and access roads used to make needed repairs. Maintenance would also include the periodic removal of sediment deposited in the constructed bypass channel. Maintenance scheduling outside of that for the headworks would be largely as needed, but is anticipated to peak in summer following ice melt and reduction in flows, thus reducing the potential for disturbance during the breeding season. The operation and maintenance of the new headworks would continue to occur unchanged under this alternative, and result in the same negligible impacts on wildlife as those discussed under the No Action Alternative.

Although the bypass channel would be built to specifications established to support native fish species, there are several components that would prevent the final design from providing habitat that would support wildlife after construction, resulting in long-term impacts. These components are explicitly part of the design and collectively intended to ensure the stability of the constructed features. They include the placement of bank armoring riprap at 4 river bends and grade control structures consisting of buried riprap covered by gravel/cobble at the downstream and upstream ends of the bypass channel as well as at two intermediate locations. The fill material placed in the existing side channel would be suitable for the establishment of native upland vegetation. Taken together with the deposition of spoil materials in the spoil area under this alternative, approximately 30 acres of relatively high-quality wildlife habitat on Joe's Island would be degraded and/or eliminated by the excavation and deposition of substrate, resulting in a moderate long-term impact on wildlife.

The new weir would itself have little effect on wildlife. Maintenance of the new weir would be reduced relative to that of the existing structure. This would benefit wildlife by reducing the ongoing disturbance that occurs annually to repair damage caused by ice and/or high flows. This potential reduction in disturbance relative to existing conditions would also extend into the rock quarry that supplies the materials used for these repairs, which need to be accessed less often compared to existing conditions. This would likely also reduce the potential for harm to wildlife from vehicle strikes during maintenance periods.

Actions to minimize effects would include:

- Conduct pre-construction survey for wildlife prior to the start of each year's work. If wildlife are observed, identify the type and timing of use, and important biological information important to minimize impacts.
- If appropriate, establish construction buffers around sensitive wildlife, such as an active bird nests.
- At the start of construction, a wildlife biologist would provide awareness training to the construction crew to educate them on sensitive wildlife resources they may encounter during construction, and provide a protocol and contacts to call if any listed species or other sensitive wildlife are observed on site during construction.

- Areas potentially hazardous to wildlife will be adequately protected (e.g., fenced, netted) to prevent access that could lead to their harm.
- To protect wildlife and their habitats, project-related travel will be restricted to existing roads and easements. No off-road travel would occur, except with prior approval. Speed limits will be followed at all times and drivers should be cognizant of safely avoiding vehicle strikes. Species at particular risk to vehicle strikes include ungulates during crepuscular hours, various bird species, snakes, and small and mid-sized mammals. Driver safety remains paramount, and would be maximized by following this guidance for minimizing vehicle strikes of wildlife.
- Removal and/or degradation of specific habitat features identified as important to wildlife would minimized to the extent possible. Examples include large snags, patches of mature riparian forest, and native grassland and shrubland habitat.
- Wildlife-proof fencing will be used on reclaimed areas, if it is determined that wildlife species and/or livestock are impeding successful vegetation establishment.
- All riverbank disturbance areas will be inventoried for potential turtle nesting habitat. If turtle nesting habitat or evidence of turtle nesting is found in construction areas, construction in these areas will be restricted during June and July, or approved mitigation measures will be implemented.
- Effort would be made to reestablish native vegetation and habitat comparable to that disturbed and/or destroyed by construction activities. This would include minimizing the establishment of invasive plant species, which greatly degrade the quality of native habitats.

6.0 Potential Impacts on Special Aquatic Sites (Subpart E)

6.1 SANCTUARIES AND REFUGES

6.1.1 Existing Conditions

There are no sanctuaries or refuges in the study area.

6.2 WETLANDS

6.2.1 Existing Conditions

A diversity of wetland types are found within the study area, and are classified according to Cowardin et al. (1979). Floodplain and depressional wetlands have formed primarily from alluvial processes. Willow shrublands are found in floodplains, around beaver ponds and lakes, and non-willow shrublands are found in springs and seeps along streams (Jean and Crispin 2001).

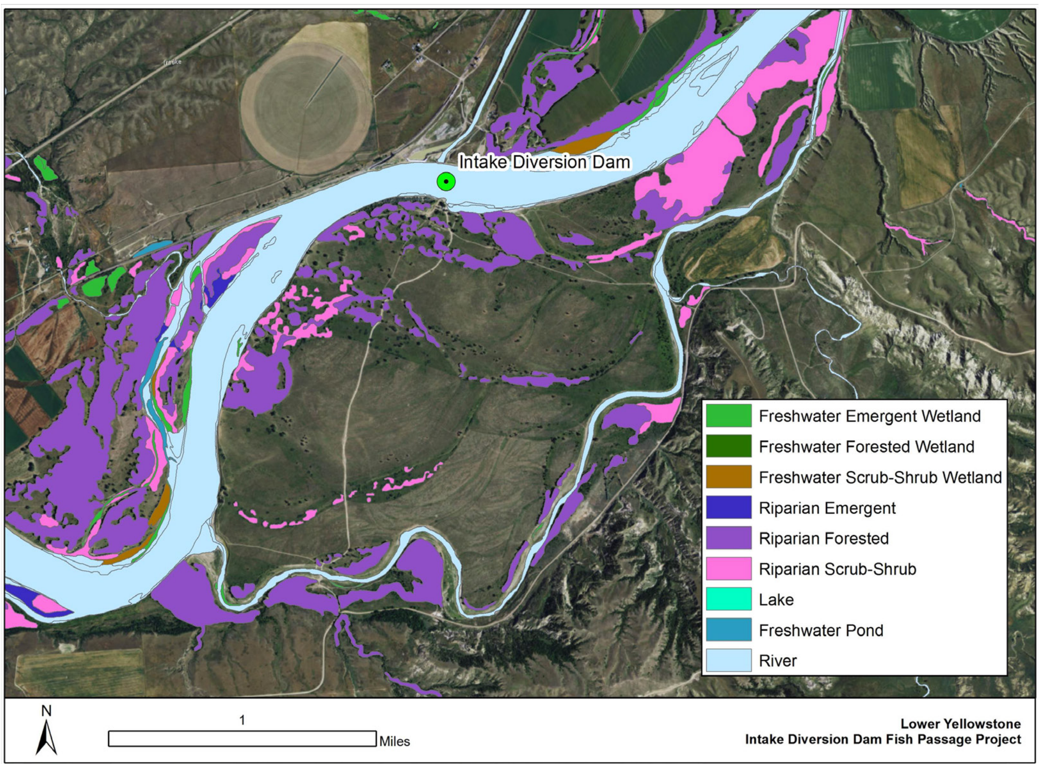

Figure 6.1 Riparian Areas and Wetlands in the Study Area

Palustrine emergent wetlands are the most common type of wetlands in the study area and typically contain persistent erect, rooted herbaceous vegetation. Depressional wetland can be either open or closed, depending on whether the water source is connected to groundwater or surface draining systems or completely isolated from drainage systems (McIntyre et al. 2010).

Dominant graminoids found in these types of wetlands include foxtail barley (*Hordeum jubatum*) and western wheatgrass (*Pascopyrum smithii*) on drier sites; and bulrush (*Schoenoplectus* spp.), sedges (*Carex* spp.), cattails (*Typha* spp.), and bluejoint reedgrass (*Calamagrostis canadensis*) on wetter sites (Corps and YRCDC 2015). Halophytic species such as saltgrass (*Distichlis spicata*) and Nuttall's alkaligrass (*Puccinellia nuttalliana*) occur on sites with saline soils.

Palustrine scrub-shrub wetlands are associated with streams and rivers within the study area. These types of wetlands are dominated by woody vegetation less than 20 feet tall. Native species in scrub/shrub wetlands are red-osier dogwood (*Cornus sericea*), chokecherry (*Prunus virginiana*), western snowberry (*Symphoricarpos occidentalis*), silver buffaloberry (*Shepherdia argentea*), silverberry (*Elaeagnus commutata*), sandbar willow (*Salix exigua*), peach-leaf willow (*Salix amygdaloides*), several cottonwood species (*Populus* spp.), and Rocky Mountain juniper (*Juniperus scopulorum*) (Corps and YRCDC 2015). In many cases, this wetland type represents transitional plant communities of younger age classes of forest communities.

Palustrine forested wetlands are dominated by trees taller than 20 feet and are typically classified as seasonally flooded. Cottonwood species are the tallest and most visible native woody species, Great Plains cottonwood (*Populus deltoides*) being the dominant species. Other native woody species such as peach-leaf willow, sandbar willow, yellow willow (*Salix lutea*) and green ash (*Fraxinus pennsylvanica*) are present throughout (Corps and YRCDC 2015).

Riverine wetlands include lower perennial unconsolidated bottom wetlands which are low gradient and have a slow water velocity. Substrates in this system are predominantly sand and mud and floodplains are usually well developed. Also present are lower perennial unconsolidated shore wetlands which are the shorelines to low gradient rivers that have less than 75% areal cover of stones, cobbles, boulders or bedrock and less than 30% vegetative cover. These shorelines are also irregularly exposed due to flooding and drying.

Mountain alder (*Alnus incana*), water birch (*Betula occidentalis*), and Western snowberry (*Symphoricarpos occidentalis*), silver sagebrush (*Artemisia cana*), chokecherry, and red-osier dogwood are common along riverine floodplains (Corps and YRCDC 2015).

The Corps conducted a wetland delineation in the study area in 2012 (Corps 2015c). This field investigation confirmed the presence of a seep spring, wetlands, and intermittent waterway near the western boundary of the waste pile site in a drainage way that connects to a side channel of the Yellowstone River. The side channel of the Yellowstone River that flows around Joe's Island had a gravel/cobble bed that was intermittently exposed and contained patchy emergent wetlands. Flow was not apparent during the investigation.

6.2.2 Potential Impacts

6.2.2.1 No Action Alternative

There would be no effects on wetlands resulting from the No Action Alternative.

6.2.2.2 Proposed Bypass Channel Alternative

Impacts to wetlands or waterbodies adjacent to the Yellowstone River would include the construction of the new weir upstream of the existing weir, excavation of the bypass channel, bank modifications near the downstream entrance to the bypass channel, and filling of upstream portions of the existing side channel.

Weir construction would result in disturbance of approximately 3 acres of the river with riprap and cobble fill being placed in the river to stabilize the existing and new weirs. This impact on the riverine habitat will be minimal, as there is already large rock present in the low quality riverine habitat at the existing weir area, which would be converted to a shallower smaller rock substrate. There will be temporary effects on velocities and depths as the river is diverted from one side to the other with coffer dams.

Bank modifications on both the right and left banks of the downstream portion of the bypass channel would result in approximately 2 acres of fill being placed in the Yellowstone River at the scour hole and where the current eddy forms on the south bank of the river – this fill is to send the flow from the bypass channel towards the main channel and reduce the eddy in the river. The placement of the excavated material from the bypass channel as fill in the existing high flow channel would eliminate approximately 66 acres of existing seasonal riverine side channel and backwater habitat. These acres will be offset by the creation of approximately 64 acres of year-round riverine habitat that will be created by the excavation of the new channel. The bypass channel habitat will be more functional for fish, mussels, and macroinvertebrates as there will be year-round flow.

Approximately 1 acre of palustrine emergent wetlands would be permanently filled by the placement of fill in the existing side channel. This acre of palustrine emergent wetlands will be offset by the development of up to 30 acres of backwater emergent wetland habitat along the downstream portion of the existing side channel.

For operation and maintenance actions on the new weir and bypass channel, temporary access would occur on existing access routes, thus effects on wetlands would be negligible. The impacts would be minor to riverine habitat associated with temporary disturbance by occasionally placing rock at the new weir. The need for rock replenishment would be substantially reduced from the existing condition resulting in much less frequent maintenance activities.

Periodic replacement of riprap along the banks and bottom of the bypass channel could have temporary impacts on riverine habitat and adjacent wetlands by placement of riprap. The area of impact would be minimal and infrequent as the rock is designed to withstand expected velocities. Bypass channel maintenance may require a temporary coffer dam for removal of accumulated sediment. Temporary coffer dams could temporarily impact riverine habitat and wetlands, but the impact would be minor.

Actions taken to minimize effects would include:

- The disposal of waste material, topsoil, debris, excavated material or other construction related materials within any wetland, drainage way, stream or aquatic system would be minimized to the extent possible.
- Discharges of fill material associated with unavoidable crossings of wetlands or intermittent streams will be minimized to the maximum extent practicable.
- Low pressure equipment or pressure-spreading mats will be used as feasible to minimize compaction of wetland soils during construction.
- Rock quarry materials will come from approved upland sites.

6.3 MUDFLATS

There are no mudflats within the study area as defined in 40 CFR §230.42 as "broad flat areas along the sea coast and in coastal rivers to the head of tidal influence and in inland lakes, ponds, and riverine systems."

6.4 VEGETATED SHALLOWS

Vegetated shallows are defined in 40 CFR §230.43 as "permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation, such as turtle grass and eelgrass in estuarine or marine systems as well as a number freshwater species in rivers and lakes." All existing vegetation in the study area would be considered emergent rather than rooted aquatic vegetation.

6.5 CORAL REEFS

There are no coral reefs in the study area.

6.6 RIFFLE AND POOL COMPLEXES

6.6.1 Existing Conditions

The Yellowstone River has naturally wide, shallow flows over sand and gravel substrate. Pools and riffles are formed by the natural hydrograph of high velocity spring flows interacting with the channel bed and shoreline. The presence of the Intake Diversion Dam alters that natural pool and riffle formation process, creating one large backwater pool behind the weir and one long riffle extending 300 feet downstream and spanning the 700 foot width of the river.

6.6.2 Potential Impacts

6.6.2.1 No Action Alternative

Under the No Action Alternative, the existing Intake Dam would continue to create a backwater pool behind the weir. The annual placement of rock along the weir crest would ensure continued presence of the rock/rubble field riffle.

6.6.2.2 Proposed Bypass Channel Alternative

Replacement of the existing weir with a concrete weir would not change the configuration of pools and riffles in the main channel.

Placement of fill in the existing side channel would eliminate side channel habitat and therefore any riffle and pool complexes present in this channel. However, this channel only conveys flows occasionally (at or above 20,000 cfs in the river), so if any riffle and pool complexes are present, they are likely to be of low quality due to sediment deposition and only occasional inundation. Construction of the new bypass channel would generally be similar to substrate and channel configurations present in natural side channels in the Yellowstone River.

7.0 Potential Effects on Human Use Characteristics (Subpart F)

7.1 MUNICIPAL AND PRIVATE WATER SUPPLIES

7.1.1 Existing Conditions

7.1.1.1 Lower Yellowstone Irrigation Project (LYP)

These districts and Reclamation jointly hold the following unadjudicated irrigation water rights in the state of Montana totaling 1,374 cubic feet of water per second (cfs):

- 1,000 cfs (Water Right No. 42M 40806-00)
- 300 cfs (Water Right No. 42M 40807-00)
- 18 cfs (Water Right No. 42M 40808-00)
- 42 cfs (Water Right No. 42M 40809-00)
- 14 cfs Provisional Permit (Savage Irrigation District only; Permit No. 97792-42M)

The period of use on the LYP water right is April 15 - Oct. 15, and Savage Irrigation District from April 1 - Oct. 31 (MDNRC, 2016). The oldest of these claims has a Priority Date of 1905 and a flow rate of 1,000 cfs. In addition to the 1,374 cfs claimed, LYP claims an additional 62.49 cfs for other water rights at Intake that include Stock watering and Domestic and Industrial Use.

The Intake Diversion Dam is maintained and operated by the Board of Control of the LYP. The LYP provides irrigation to about 58,000 acres of farmland along the Lower Yellowstone River. Acreage irrigated by the LYP is generally located between the main canal and the river in the Montana counties of Dawson and Richland, we well as in McKenzie County, North Dakota. The majority of the water is diverted between April 15 and October 15 each year.

The LYP facilities are owned by the Bureau of Reclamation but are operated and maintained by the water users via irrigation districts and the Board of Control of the LYP. The members of the Board of Control include Intake Project (Intake Irrigation District), Savage Unit of the Pick-Sloan Missouri Basin Program (Savage Irrigation District), and the Lower Yellowstone Irrigation Project Divisions One and Two (Lower Yellowstone Irrigation Districts One and Two). All of the irrigation districts obtain water from the LYP's main canal.

Most of the land that can by irrigated by the LYP is between the canal and the river. Since the early 1950s, both the agricultural economy and lands served by the LYP have remained relatively stable. In contrast to a dry-land farming trend towards larger, consolidated farms, the number of farm units on the LYP has dropped only slightly. Until recently, the primary irrigated crop was sugar beets with some small grains, alfalfa, and corn. Recently commodity prices have caused a shift to more corn and small grain production, with a corresponding decline in sugar beet acreage, though sugar beets are still the highest value crop, accounting for over half the total crop revenue in 2014 (Lower Yellowstone Project Board of Control 2009).

7.1.1.2 Tribal Water Rights

The United States government has recognized through the Winters Doctrine that tribes in the western United States (west of the Mississippi) may hold rights to water in streams running through or alongside the boundaries of their reservations (U. S. Supreme Court decision *Winters v. United States,* 1908). The Winters Doctrine will apply to any Indian water rights in Montana or along the Missouri River. When a reservation is established with expressed or implicit purposes beyond agriculture, such as to preserve fishing, then water may also be reserved in quantities to sustain use (U.S. Supreme Court *Arizona v. California* 1963). The Court held that tribes need not confine the actual use of water to agricultural pursuits, regardless of the wording in the document establishing the reservation. However, the amount of water quantified was still determined by the amount of water necessary to irrigate the "practicably irrigable acreage" on a reservation. The Court also held that the water allocated should be sufficient to meet both present and future needs of the reservation to assure the viability of the reservation as a homeland. Case law also supports the premise that Indian reserved water rights are not lost through non-use.

7.1.2 Potential Impacts

Under either the No Action or Bypass Channel Alternatives, Tribal water rights and irrigation needs would be protected as required.

7.2 RECREATIONAL AND COMMERCIAL FISHERIES

7.2.1 Existing Conditions

Recreation in the vicinity of Intake Diversion Dam and downstream to the Missouri River includes hunting, fishing, boating, camping, picnicking, walking/hiking, and scenic and wildlife viewing within recreation areas located along the river. Recreation facilities range from open space with no amenities to established camping areas water and vault toilets.

Game fish in the Lower Yellowstone River include paddlefish, shovelnose sturgeon, walleye, sauger, catfish, bass, and trout. The protected pallid sturgeon must be released if caught. Fishing is a popular activity on the river along the whole length between Intake and the state line. The City of Sidney has two annual catfish tournaments, and two additional tournaments were proposed in 2015, one at Miles City, and one at Savage (Corps and YRCDC 2015).

The most popular game fish is the paddlefish, with nearly half of the annual visitation to the site occurring during the paddlefish season, which occurs during May and June. Visitors enjoy paddlefish snagging as a family tradition, and visitors come from all over, including other states, to participate in paddlefish snagging.

Paddlefish anglers come from all over the state to participate in the sport at Intake. Paddlefish congregate on the downstream side of the Intake Diversion Dam, presenting a very accessible location for paddlefish snagging. Fishing by boat is prohibited within a quarter-mile downstream of the weir during paddlefish season.

The MFWP monitors the number of paddlefish caught and closes the season when the quota is met. In 2015, the total quota was 1,000 paddlefish caught in the Missouri River downstream of

Fort Peck Dam and the Yellowstone River. Intake FAS has its own annual limit of 800 fish. In 2015, the harvest season lasted from May 15 through June 3, with catch-and-release closing on June 13 (Stuart 2015). The 2015 season was atypically long at Intake. In some years, the quota is met in a week (Reclamation and Corps 2015).

Montana law prohibits commercialization of fish and wildlife; however, special state legislation authorizes a MFWP-designated Montana non-profit corporation to accept paddlefish roe donations and process and market the roe as caviar. The MFWP issues a yearly memorandum of understanding to one non-profit corporation for this opportunity, which has been the Glendive Chamber of Commerce and Agriculture since the inception of the program in 1990.

7.2.2 Potential Impacts

7.2.2.1 No Action Alternative

Future recreational fishing activities will remain the same without the proposed project.

7.2.2.2 Proposed Bypass Channel Alternative

The Bypass Channel alternative would have a variety of adverse effects on recreation resources in the study area during construction, most of which are concentrated at Intake FAS and Joe's Island. Temporary effects on the quantity and quality of recreation from the presence of construction activities are judged to minor to moderate, and less than significant. To the extent possible, construction activities will be minimized within, or occur outside of, the Intake FAS area during the paddlefish season.

From the perspective of effects on recreation, the operation of the Bypass Channel would result in mostly beneficial effects. Beneficial effects on recreation from the Bypass Channel include the creation of additional channel area that would be open for recreation use, including boating. A navigable bypass channel would also provide boaters easier access to the upstream side of the Intake Diversion Dam from the Intake FAS boat ramp. Visitation to Joe's Island may also increase in the short term as visitors explore the new channel.

The bypass channel could also improve fishing opportunities upstream of the Intake Diversion Dam. Paddlefish would still be expected to stack up downstream of the Intake Diversion Dam, but would also have the opportunity to move further upstream. Paddlefish could potentially travel as far upstream as the Cartersville irrigation dam, at Forsythe (RM 238.6). Upstream spawning by paddlefish could result in an increase in paddlefishing opportunities upstream of Intake over the long term, which would in turn increase visitation and use of upstream fishing access sites. In the short term, beneficial effects may be minor to moderate as anglers monitor and adapt to changes in the recreational fishery.

With changes in the location of fishing opportunities, and a potential reduction in the availability of fish at the downstream end of the Intake Diversion Dam, use of the Intake FAS may be reduced. Overall, the adverse operational effects of the selected alternative on recreation would be minor and less than significant, while there would be moderate beneficial effects.

Additional actions to minimize effects identified for the Bypass Channel alternative include:

- Reclamation and MFWP would meet to evaluate and coordinate closures at the FAS and Joe's Island to recreational use, including closure of construction zones to swimming, fishing, boating, hiking, camping, hunting, etc. on one or both sides of the river.

7.3 WATER RELATED RECREATION

7.3.1 Existing Conditions

Boating is allowed on the lower Yellowstone River, and access is provided via boat ramps at the various fishing access sites on the river. The Intake FAS provides a concrete boat ramp below the weir. The nearest upstream access is at the Black Bridge FAS, in Glendive, which has a concrete boat ramp. Downstream of Intake, the Elk Island FAS provides a gravel boat ramp at the downstream end of the site, and an older concrete ramp at the upstream end of the site that may not be usable except during high flows.

Boaters occasionally pass downstream over Intake Diversion Dam. Most boaters launching from the Intake FAS are heading downstream for fishing, hunting, boat touring, or pulling persons on inner tubes or other flotation devices. Waterskiing is not a popular recreational activity at Intake FAS. Intake FAS may also be used by boaters to access Joe's Island.

Activities other than fishing and boating that visitors may engage in at the study area include swimming, wildlife viewing, ice fishing, picnicking, and other general day uses, such as nature appreciation, that are dependent or enhanced by the river's presence. Swimming may be dangerous near Intake due to rough water and submerged obstacles, and is discouraged by posted signs. Picnicking and day use facilities are open to the public at no cost, and may be used throughout the year. While most fishing visitation occurs during the spring, summer, and fall, anglers do engage in ice fishing during the winter. Because of the weir, the river does typically freeze over at Intake FAS, and anglers typically fish upstream or downstream of the weir.

7.3.2 Potential Impacts

7.3.2.1 No Action Alternative

No changes to boating opportunities will result from the No Action Alternative.

7.3.2.2 Proposed Bypass Channel Alternative

During construction, the Intake FAS will remain open to boaters. Following construction, there will be no change in the availability of boat access from the Intake FAS. Navigation above the Intake Diversion Dam will remain available as it is now and safety may be slightly improved with the concrete weir. Boating would also be possible through the bypass channel. During construction, Joe's Island will be closed to visitors, but will reopen after the project is completed.

7.4 AESTHETICS

7.4.1 Existing Conditions

From points on and near the Intake Diversion Dam, views would include the wide, turbid stretch of the Yellowstone River, industrial headworks at the entrance of the main canal and the canal itself, a network of unpaved roadways, lands with exposed dirt, rock and sand shoreline along the river, agricultural lands and sparse cottonwood gallery and other vegetation communities. In winter, snow and ice may cover the area, creating a white expanse dotted by defoliated trees. In summer, the study area has a dichotomy of aesthetics, with areas around the canal and headworks having a barren and industrial appearance in contrast to the river and green cottonwood galleries providing a more natural look. On the south shore of the river, sandy shorelines, grasslands, shrublands, and cottonwood gallery comprise the visual environment. Distant views from higher points within the site are of the low elevation bluffs that are part of the Great Plains Badlands. Joe's Island is directly south of the Intake Diversion Dam and is an approximately 1,400 acre island formed by a side channel to the Yellowstone River. The island topography is shaped by overbank flooding and formation of side channels. Cottonwoods and other riparian trees and vegetation occupy the depressions where these old side channels once flowed, while a combination of native and non-native prairie and shrub steppe occupy the remaining areas. There are no homes, but a modest network of dirt roads provides access to most of the island, including the right bank cableway tower. Distant views of low badlands bluffs can be seen to the south. Visitors to this area would primarily and most often include recreationists.

7.4.2 Potential Impacts

7.4.2.1 No Action Alternative

There would be no changes to the study area under the No Action Alternative, and therefore, no changes to visual resources.

7.4.2.2 Proposed Bypass Channel Alternative

Construction of the new weir for the Bypass Channel Alternative would result in changes to visual conditions during and after construction. These include the temporary presence of mobile and fixed construction equipment onsite at Intake FAS and Joe's Island, for an estimated three years, which would vary with season and would be experienced by a variety of viewer groups. Once construction is complete, most areas disturbed for weir construction would be returned to pre-construction conditions via reseeding and equipment removal. Overall, construction of the Bypass Channel Alternative is expected to have a moderate and less than significant effect on visual conditions.

New permanent features would include the bypass channel with armoring, infill of the existing side channel, placement of spoils, and access roads. The new bypass channel would receive a portion of the Yellowstone River flow on a year round basis. The existing side channel only conveys water during higher flows. In general, the overall visual condition would not change, since one high flow channel is replaced with another, with the new one operating similarly to the old one. Over time, revegetation would obscure traces of channel construction, eventually approaching a more natural appearance.

Measures taken to minimize effects at the project site would include:

- Minimize footprints of construction as much as possible to limit areas of effect.
- Restrict construction or staging from using areas that are subject to erosion.
- Minimize haul and access road use and improve those roads that would become permanent.
- Strategize construction schedule to minimize truck, equipment, and personnel presence.
- Minimize footprint of clearing and grubbing to protect as much existing vegetation as possible.
- Minimize stream crossings and restore shoreline or instream habitat that are damaged.
- Mulch and reseed areas that are cleared after construction is complete to facilitate return to vegetated conditions.
- Limit operation and maintenance to annual or emergency basis to reduce onsite equipment and personnel.

7.5 PARKS, NATURAL AND HISTORIC MONUMENTS, NATIONAL SEASHORES, WILDERNESS AREAS, RESEARCH SITES, AND SIMILAR PRESERVES

7.5.1 Existing Conditions

There are no parks, natural or historic monuments, national seashores, wilderness areas, research sites or other similar preserves within the study area or vicinity.

7.6 OTHER FACTORS IN THE PUBLIC INTEREST

7.6.1 Cultural Resources

7.6.1.1 Existing Conditions

A total of 27 sites have been previously recorded within the study area (Table 7-1), three of which are within the APE of the Proposed Project: 24DW287, 24DW443, and 24DW447. (24DW287 and 24RL204 are both portions of the Lower Yellowstone Irrigation Project main canal in Dawson and Richland counties; however sections in different counties are given different identifying site trinomials.) All three resources are NRHP-eligible and considered historic properties for this analysis. It is unclear at this time if any of the resources recorded within the study area are within the alternatives.

- 24DW287 is the main canal of the Lower Yellowstone Irrigation Project, described above. The site is a contributing element to the Lower Yellowstone Irrigation Project Historic District and is considered an NRHP-eligible historic property.

- 24DW443 is the Lower Yellowstone Irrigation Project Diversion Dam, described above. The site is a contributing element to the Lower Yellowstone Irrigation Project Historic District and is considered an NRHP-eligible historic property.
- 24DW447 is the site of the Lower Yellowstone Irrigation Project Headworks Camp/Gate Tender Residence, described above. The site is a contributing element to the Lower Yellowstone Irrigation Project Historic District and is considered an NRHP-eligible historic property.

Table 7.1 Previously conducted surveys in study area

SHPO Document Number	Author	Date	Title
DW 6 2401	Herbort, Dale P.	1980	Cultural Resource Evaluation Belle Prairie and Box Elder Reservoir
DW 4 2348	Huppe, Katherine M.	1981	Cultural Resource Reconnaissance of a Portion of Montana Department of Highways Project FR20-1(1)19, Glendive-Sidney, and associated Materials Sources
DW 6 2406	Pearson, Jay, et al.	1981	A Class III Intensive Inventory for all Cultural Resources along the Proposed Route of the Montana -Dakota Utilities Cabin Creek to Williston Pipeline From the Sacomorgan Creek Line to the Richland-Dawson County Line
DW 6 2411	Aaberg, Stephen A.	1984	Intake State Recreation Area
RL 6 20052	Davis, Leslie B.	1984	1983 Effort, Nollmeyer (Letter Report to Dr. Ann Johnson, NPS)
RL 4 8931	Wood, Garvey C.	1985	Hilde Construction – Molly Eidness Pit (Pit 136-3)
DW 4 2352	Rossillon, Mitzi	1987	A Cultural Resources Inventory at the Bridge Over the Diversion Canal at Intake
RL 4 30084	Vinson, Edrie L.	1988	Lower Yellowstone Project Main Canal Bridge U.S. Reclamation Service 1907-1908
RL 6 13050	Coutant, Brad A.	1991	Fifteen Assorted Structures on the Lower Yellowstone Irrigation District, Richland County, Montana
DW 6 15872	Tingwall, Douglas, et al.	1994	Intake Fishing Access Site Class III Cultural Resource Survey Results
RL 4 15917	Platt, Steve	1994	District 4 MCS Sites
DW 6 23072a	Kordecki, Cynthia, et al.	2000	Lower Yellowstone Irrigation Project, 1996 and 1997 Cultural Resources Inventory, Dawson and Richland Counties, Montana and McKenzie County, North Dakota
RL 6 23550	Brumley, John H.	2000	A Cultural Inventory of 14 Bridge Projects Areas within Richland County, Montana
ZZ 6 23753a	Kordecki, Cynthia, et al.	2001b	Lower Yellowstone Irrigation Project, 1996 and 1997 Cultural Resources Inventory, Dawson and Richland Counties, Montana and McKenzie County in North Dakota
DW 4 24430	Aaberg, Stephen A. and Chris Crofutt	2002	30 KM Northeast of Glendive Northeast Class III Cultural Resource Survey Results In Dawson County and Richland County Montana
RL 6 24567	Vincent, William B.	2002	Notification of Undertaking – Proposed Replacement of a Deteriorated Chute at the Savage Spillway Structure and Associated Bridge in Richland County Montana
RL 6 30349	Boughton, John, et al.	2008	Williston Basin Interstate Pipeline Company: A Cultural Resource Inventory Along the Cabin Creek-Williston Pipeline, in Richland County, Montana

SHPO Document Number	Author	Date	Title
DW 6 34023a	Vincent, William B.	2009	Test Drilling Near the Lower Yellowstone Diversion Dam and Canal, Dawson County, Montana
DW 6 34030a	Vincent, William B.	2009	Intake Diversion Dam Modification, Lower Yellowstone Project
DW 6 34186a	Toom, Dennis, et al.	2011	Headworks Camp (24DW0447) Historic Site archaeological Excavations, Dawson County, Montana
RL 2 35413	Brooks, Brittany A.	2013	Weber 24-30-1H, 2H, 3H & 4H Well Pad and Access Road: A Class III Cultural Resource Inventory in Richland County, Montana
RL 6 34235	O'Dell, Kevin C.	2013	A Class III Cultural Resource Survey for Mercury Towers' Mt46467 Savage Communications Tower in Richland County, Montana
RL 6 36650	Person, Amanda C. and Wade K. Burns	2013	Lower Yellowstone Irrigation Canal/Drain Crossings: A Class III Intensive Cultural Resource Inventory in Richland County, Montana
RL 6 36909	Littlestrand, Eric and Wade K. Burns	2013	Balducki, Yellowstone Farms, and Oberfall Borehole Locations: A Class III Intensive Cultural Resource Inventory in Richland County, Montana
RL 6 37204	Livers, Michael C.	2013	Lower Yellowstone Irrigation Project PW # 1442 DR 1996: A Cultural Resource Survey for the Lateral HH Replacement Project, Richland County, Montana
ZZ 5 34260	Rennie, Patrick	2013	Cultural and Paleontologic Resources Inventory of Six Parcels of State Land in Custer, Garfield and Richland Counties
RL 2 37039	Brooks, Brittany A.	2014	Asbeck 12-31-1H, Asbeck Federal 13-31-2H, 13-31-3H, and 13-31-4H Well Pad and Access Road: A Class III Intensive Cultural Resource Inventory in Richland County, Montana

a. Survey conducted within APE of Proposed Project.
b. Survey ZZ 6 23753 is listed in SHPO's database with a date of 2001. However, the report title page indicates a date of 2000. Therefore, the report is referenced in this document as Kordecki, et al. (2000).

Kordecki, et al. (2000; Survey Report ZZ 6 23753) documents a survey of the Lower Yellowstone Irrigation Project completed in 1996 and 1997 as part of compliance efforts ahead of the 2010 EA. Kordecki, et al. (2000; Survey Report DW 6 23072), Vincent (Test Drilling Near the Lower Yellowstone Diversion Dam and Canal, Dawson County, Montana 2009), and Vincent (Intake Diversion Dam Modification, Lower Yellowstone Project 2009) are Section 106 consultations that were based on the work of Kordecki, et al. (2000; Survey Report ZZ 6 23753).

The systematic pedestrian survey of Kordecki, et al. (2000; Survey Report DW 6 23072) covered all linear features (i.e. canals and laterals) of the irrigation system as well as all Reclamation-owned and administered lands along the system that had not been previously surveyed. Survey of the system's linear features totaled 288 miles: 71.6 miles of main canal and 202 miles of laterals. The Reclamation-owned and administered lands were surveyed in 12 blocks totaling 3,082 acres. The survey identified a total 12 historic engineering and architectural sites directly related to the Lower Yellowstone Irrigation Project (in addition to several bridges associated with the initial construction of the system) and 25 prehistoric archaeological sites (20 newly recorded and five previously recorded sites that were updated by the survey). The historic sites include the Lower Yellowstone Diversion Dam (24DW443), the Lower Yellowstone Main Canal and Lateral System (24DW287/24RL204/32MZ1174), the Savage Sluiceway (24RL142), the Intake Pumping Plant (24DW446), the Thomas Point Pumping Plant (24RL231), the Savage Irrigation Unit (24RL275), the Headworks Camp/Gate Tender Residence (24DW447), the Crane Canal Rider Residence (24RL277), the Savage Headquarters Camp (24RL209), the Ridgelawn Camp

(24RL80), the Fairview Canal Rider Residence (24RL208), and the Lateral LL Reclamation Building (24RL283). These sites represent a NRHP-eligible historic district, although the pumping plant component of the Savage Irrigation Unit and the Crane Canal Rider Residence are not considered contributing elements to the district.

Toom, et al. (2011; Survey Report DW 6 34186) documents a large-scale data recovery archaeological excavation at the Headworks Camp (24DW447). The excavations were conducted as mitigation for impacts related to the Project as proposed in the 2010 EA and 2015 Supplemental EA and as required by the 2010 memorandum of agreement discussed above. The excavation sought to examine the relationships between structural features, status-diagnostic artifacts, and social stratification within the camp, as reflected in the archaeological record. Although many period artifacts of interest were recovered, very few structural features of original camp buildings, such as foundations, were found, making it impossible for the researchers to achieve their primary goal of answering questions of social stratification.

7.6.1.2 Potential Impacts

No Action Alternative

No changes would result to cultural resources under the No Action Alternative.

Proposed Bypass Channel Alternative

Direct, major impacts are anticipated during construction under this alternative as a result of the excavation of the bypass channel and use of the stockpile area and haul roads. The alignment of the bypass channel would require relocation of the historic south rocking tower and boiler building on Joe's Island, both of which are features of 24DW0443. Although the structure and building would not be destroyed, their removal from their historic location and setting would be considered adverse effects under Section 106 of the NHPA. This impact was considered under the previous Final and Supplemental EAs in 2010 and 2013. Mitigation for the impact was agreed upon in the June 2010 Memorandum of Agreement, which resulted in documentation of the buildings and structures. The parties to the Memorandum were to consult and determine if any additional or different mitigation was warranted. Until the Memorandum is re-initiated and the additional consultations completed, the potential for direct, major impacts remains.

The proposed locations of the coffer dams at the upstream entrance and downstream exit of the bypass channel as well as the around the new weir is unclear at this time. Although impacts at the upstream entrance are not anticipated due to a lack of recorded cultural resources there, impacts at the downstream exit may occur if the coffer dam is placed over and into the existing weir. One of the haul/access roads to be improved passes through the northern boundary of 24DW0296. Although the road is existing, widening of it within the site boundaries may result in adverse effects under Section 106 of the NHPA. Sites 24DW0430, 24DW0431, and 24DW0442 are within the footprint of the stockpile area. Site 24DW0431 is also partially within the staging area, however impacts to this NRHP-ineligible resource would not be considered adverse under Section 106. While capping of sites 24DW0430 and 24DW0442 could be considered beneficial and protective impacts, it also makes access to the resources difficult for future study or traditional use. Further, if construction equipment were to drive across the sites while depositing materials or otherwise disturb the sites, it would be considered an adverse effect under Section

106 of the NHPA. The above described adverse effects would also be considered direct, major impacts under NEPA.

Excavation of the channel would be extensive. Although the entirety of the construction footprint has been surveyed for cultural resources (outside of active river channels), there is potential for intact subsurface archaeological resources to exist within this alluvial island. Disturbance of these potential historic properties would be considered an adverse effect under Section 106 of the NHPA and a direct, major impact under NEPA.

Measures taken to minimize effects to cultural resources would include:

- MM-CR-01: Impacts on Intake Diversion Dam (24DW0443) may be mitigated to minor or moderate through detailed recording of the structure. Engineering drawings and photographs of the dam would be filed with the SHPO and National Archives. If engineering drawings and photographs are unavailable, the dam would be recorded in accordance with the Historic American Buildings Survey and the Historic American Engineering Record.
- MM-CR-02: Impacts on the Old Cameron and Brailey Sub Camp (24DW0298) may be mitigated to no effect through avoidance. If avoidance is infeasible, impacts may be mitigated to moderate through data recovery of the archaeological site under an approved research design.
- MM-CR-03: Potential impacts on unidentified cultural resources in unsurveyed portions of the APE may be reduced to no effect through avoidance of unsurveyed areas. If avoidance is infeasible, impacts may be mitigated to minor or moderate by surveying such areas within the APE. Additional mitigation measures may be necessary to avoid impacts on newly identified resources/potential historic properties as a result of the survey.

7.6.2 Activities Affecting Coastal Zones

There are no coastal zones within the study area.

7.6.3 Navigation

7.6.3.1 Existing Conditions

Recreational boating is allowed on the Yellowstone River. There is no commercial use of the river.

7.6.3.2 Potential Impacts

No Action Alternative

No changes to boating opportunities will result from the No Action Alternative.

Proposed Bypass Channel Alternative

During construction, the Intake FAS will remain open to boaters. Following construction, there will be no change in the availability of boat access from the Intake FAS. Navigation above the Intake Diversion Dam will remain available as it is now and safety is likely to be improved with the new concrete weir. The bypass channel would also be available for boating. Actions taken to minimize effects would be the same as those for Section 7.2 Recreational and Commercial Fisheries.

8.0 Evaluation and Testing of Discharge or Fill Material (Subpart G)

The evaluation procedures and testing sequences outlined in Subpart G are intended to support the determinations concerning the suitability of the material proposed for discharge into waters of the United States.

8.1 GENERAL EVALUATION OF DREDGED OR FILL MATERIAL

All materials discharged as fill would be obtained from on-site or a source that meets the standards for suitability of material. This would generally mean that any materials imported to the project area would have low or non-detectable levels of contaminants that are not expected to have significant adverse impacts on water quality or biota in the short or long term.

9.0 Actions to Minimize Adverse Effects to the Aquatic Environment (Subpart H)

9.1 GENERAL

The overall outcome of the proposed Bypass Channel Alternative is beneficial to the endangered pallid sturgeon, as well as other fish species that would benefit from providing upstream passage above the Intake Diversion Dam. However, there may be adverse effects resulting to aquatic resources as a result of construction or operation. General conservation recommendations include a variety of measures intended to minimize the adverse effects to each of the aquatic environment. Specific measures to avoid or reduce the effects of construction have been included above for each applicable resource area, as described in Sections 4, 5, 6, and 7. General or additional details are provided below.

a. Work Window. To minimize effects to pallid sturgeon or other sensitive fish species, construction shall primarily occur during summer low flows or other low flow periods outside of the migration period (April 15 to July 1).
b. Notice to Contractors. Before beginning work, all contractors working on site shall be provided with a complete list of permit conditions, reasonable and prudent measures, and terms and conditions intended to minimize the amount and extent of take resulting from in-water work.
c. Minimize Impact Area. The applicant will confine construction impacts to the minimum area necessary to complete the project.
d. Fish Capture and Removal. Whenever work isolation is required and ESA-listed fish are likely to be present, the applicant must attempt to capture and remove the fish as follows:
   i. A fishery biologist experienced with work area isolation and competent to ensure the safe capture, handling and release of all fish will supervise this part of the action.
   ii. Any fish trapped within the isolated work area must be captured and released using methods prudent to minimize the risk of injury, then released at a safe release site.
e. Pile Driving. Pile driving will only occur outside of the pallid sturgeon migration season (April 15-July 1) and vibratory pile driving shall be used to the maximum extent practicable.
f. Pollution Control Plan. The applicant will implement a pollution control plan (PCP) to prevent pollution caused by construction activities from entering the river. The PCP must have the following components:
   i. The name and address of the party responsible for accomplishment of the PCP.
   ii. Practices to prevent contaminant releases associated with equipment and material storage sites and fueling staging areas.

iii. A description of any regulated or hazardous products or materials that will be used for the project, including procedures for inventory, storage, handling, and monitoring.
iv. A spill containment and control plan with notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available on the site, proposed methods for disposal of spilled materials, and employee training for spill containment.
v. Practices to prevent debris from dropping into any stream or waterbody, and to remove any material that does drop with a minimum disturbance to the streambed and water quality.
vi. During construction activities, monitoring will be done as often as necessary to ensure the controls discussed above are working properly. If monitoring or inspection shows that the controls are ineffective, work crews will be mobilized immediately to make repairs, install replacements, or install additional controls as necessary.

g. The applicant will maintain an absorptive boom during all in-water activities to capture contaminants that may be floating on the water surface as a consequence of construction activities.

9.2 MONITORING, ADAPTIVE MANAGEMENT, AND MAINTENANCE

In order to ensure the effectiveness of the proposed bypass channel, Reclamation will implement a long-term monitoring and adaptive management plan. A plan was developed in 2015 (Reclamation 2015) and is being implemented to determine the effectiveness of the headworks and screens that were designed to reduce entrainment into the main irrigation canal. The plan developed in 2015 was designed to evaluate key project uncertainties related to the design, performance, and biological response of pallid sturgeon and other fish species. The Service has developed further biological criteria that would indicate success of the proposed bypass channel (Service 2016) based upon the overall goal of unimpeded movement by pallid sturgeon through the free-flowing Lower Yellowstone River. Thus, a revised monitoring and adaptive management plan (see Appendix E of the EIS) has been prepared to address both the physical and the biological criteria that would indicate success of the project and are summarized below.

Objective 1: Construct and maintain appropriate physical criteria parameters that allow pallid sturgeon passage.. The physical criteria are:

Objective 1a - Depth

1) Minimum depths in fish passageway measured at the lower discharge range of 7,000 cfs to 14,999 cfs at any sampled cross-section must be greater than or equal to 4.0 feet across 30 contiguous feet of the measured channel cross section profile.

2) Minimum depths in the fish passageway measured at the discharge range of 15,000 cfs to 63,000 cfs at any sampled cross-section must be greater than or equal to 6.0 feet across 30 contiguous feet of the measured channel cross sectional profile.

Objective 1b - Velocities

1) Mean cross-sectional velocities must be equal or greater than 2.0 feet/second, but less than or equal to 6.0 feet/second over the discharge range of 7,000 cfs to 14,999 cfs (equal to or less than 4.0 feet/second for a rock ramp).

2) Mean cross-sectional velocities must be equal or greater than 2.4 feet/second, but less than or equal to 6.0 feet/second over the discharge range of 15,000 cfs to 63,000 cfs (equal to or less than 4.0 feet/second for a rock ramp).

Objective 2: Upstream and downstream passage of pallid sturgeon

Objective 2a - Upstream Adult Passage

1) Greater than or equal to 85% of motivated adult pallid sturgeon (fish that move up to the weir) annually pass upstream of the weir location during the spawning migration period (April 1 to June 15) within a reasonable amount of time without substantial delay (≥0.19 miles/hour).

Objective 2b - Upstream Juvenile Passage

1) No Criteria Set - Develop decision criteria to trigger adaptive management options to improve passage for juveniles if the lack of juvenile passage is demonstrated to result in negative population level effects.

Objective 2c - Downstream Passage

1) Mortality of adult pallid sturgeon that migrate downstream of the weir location cannot exceed 1% annually during first 10 years. Document any injury or evidence of adverse stress.

Objective 2d – Pallid Sturgeon Free Embryo and Larval Downstream Passage

1) Assess impingement and entrainment of free-embryo, larval, and young-of-year sturgeon at headworks/screens, irrigation canal and downstream of the weir location.

Objective 3: Upstream and Downstream Passage of Native Fish

- Determine if native fish can migrate upstream and downstream of the weir location.

Objective 3a – Native Species Upstream Passage

1) Determine if native fish are migrating upstream of the weir location at a level greater than or equal to existing conditions.

Objective 3b – Native Species Downstream Passage

1) Determine if native fish are migrating downstream of the weir location at a level greater than or equal to existing conditions.

Objective 4: Reliable Delivery of Water for Irrigation (Pumping Alternatives Only)*

1) Determine if 1,374 cfs of water can be reliably diverted (Multiple Pump Alternative).

2) Determine if 608 cfs of water can be reliably diverted (Multiple Pumps with Conservation Measures).

*Objective 4 could be assessed under all alternatives however, past experience has shown that a diversion weir at elevation 1991.0 feet, as proposed under the rock ramp, bypass channel and modified side channel alternatives, generally meets current crop demands and enables 1,374 cfs to be diverted from the Yellowstone River. As discussed below there are questions whether the current design of the pumping alternatives would meet current crop demand or have the ability to divert the water needed by the Lower Yellowstone Project.

10.0 Analysis of Practicable Alternatives

The Lower Yellowstone Intake Diversion Dam Fish Passage Project Environmental Impact Statement provides an analysis of alternatives considered. The purpose of the project is to improve passage for pallid sturgeon, contribute to ecosystem restoration and maintain the viable and effective operation of the Lower Yellowstone Project. The Intake Diversion Dam hinders upstream passage of endangered pallid sturgeon and other native fish species. Sections 10.1 through 10.6 summarize the findings per the CWA Section 404(b)(1) alternatives analysis criteria.

10.1 WATER DEPENDENCE

Intake Diversion Dam and the associated Lower Yellowstone Project are necessarily water dependent as the entire purpose is to divert the water right of 1,374 cfs from the Yellowstone River for the purposes of irrigation to approximately 58,000 acres of farmland. Infrastructure to divert this quantity of water must be within or immediately adjacent to the river to accomplish this diversion. Fish passage is also necessarily water dependent. Any of the alternatives are thus, water dependent.

10.2 SITE AVAILABILITY

Pursuant to the CWA Section 404(b)(1) regulations, an alternative is practicable if it is available to meet and capable of meeting the project purpose, among other considerations. The regulations at 40 CFR 230.1(a)(2) state “an area not presently owned by the applicant, which could be reasonably obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered.” The project area includes the Intake Diversion Dam and the lower Yellowstone River and could not be accomplished at a location distant from the river. All of the alternatives evaluated in detail in the EIS are located within or adjacent to the river.

The Rock Ramp and Bypass Channel alternatives can be constructed entirely on Reclamation owned lands or within the river.

The Modified Side Channel Alternative would require the acquisition of one parcel of land at the downstream end of the side channel (22 acres).

The Multiple Pump Alternative would require purchasing lands at each of the pump station locations and rights-of-way for pipes to deliver the water to the Main Canal (44.3 acres).

The Multiple Pumps with Conservation Measures Alternative would require acquisition of multiple parcels of land to site and install pumps, pipes, access roads, and electrical delivery infrastructure (280 acres). While the acquisition of lands does not render any of the alternatives impracticable, it adds to the time, difficulty, and risk of each of the alternatives that requires land acquisition.

10.3 COST EFFECTIVENESS

Pursuant to the CWA Section 404(b)(1) regulations, a determination of practicability must consider if fill or disposal can be accomplished at a reasonable cost (§230.10(a)(2)). All alternatives evaluated in the feasibility study require excavation, fill, and grading work in and adjacent to the Yellowstone River. To determine cost effectiveness, a cost effectiveness and incremental cost analysis (CE/ICA) was conducted to compare the costs and habitat benefits for each alternative. The proposed Bypass Channel Alternative is the most cost effective alternative to achieve all of the project objectives in a manner that is designed to avoid unacceptable adverse impacts to the aquatic ecosystem and other elements of the environment, and to balance human considerations.

The No Action Alternative does not meet the project purpose and need and continues the impediment to pallid sturgeon passage and does not provide an opportunity for potential spawning and recruitment.

The Rock Ramp Alternative is not cost effective and there are concerns about its effectiveness for fish passage as it does not meet the BRT criteria for depths and velocities that are likely to pass pallid sturgeon during all flows, particularly at flows above 30,000 cfs when pallid sturgeon are typically migrating upstream. Additionally, it is unclear whether turbulence can effectively be reduced to the point that pallid sturgeon would use it.

The Modified Side Channel Alternative was considered cost effective, but not a best buy plan because the bypass channel would provide more fish passage benefit for the cost. There are substantial concerns about its effectiveness for fish passage as the downstream entrance is located nearly 2 miles downstream of the weir and is located behind sand/gravel bars on the opposite bank of the river from the main channel where pallid sturgeon typically migrate.

The Multiple Pump Alternative is a best buy, but is substantially more costly than the next best buy option. While removal of the weir and rock in the river should be effective in providing pallid sturgeon passage, substantial costs and risks with pumps may not maintain a viable Lower Yellowstone Project and could cause substantial economic harm to some farms by doubling the per acre operation and maintenance cost assessment.

The Multiple Pumps with Conservation Measures Alternative was not cost effective or a best buy as the Multiple Pump Alternative would provide the same benefits at a lower cost. There are substantial costs and risks with Ranney Wells and implementation of the conservation measures that would not meet water supply demands. And, reducing the water diversion to 608 cfs would require farmers to shift crops and/or fallow some irrigated lands. In addition, the approximate 60% increase in per acre operation and maintenance cost assessment could cause substantial economic harm to some farms.

10.4 FEASIBILITY

The preferred alternative was determined to be the most practicable alternative considering cost, existing technology, and construction feasibility in light of the overall project purpose and need.

10.4.1 Technical Feasibility

The preferred alternative is constructible using common, existing technology and equipment. The construction contract was advertised and several bids were received in 2015. A construction contract had been let by the Corps for project construction in 2015, which is currently on hold.

The Rock Ramp Alternative has serious practicability concerns regarding the ability to construct and maintain a 1,200 foot long ramp within the river that will be sufficiently stable and durable to resist ice and high flow damages while maintaining the fish passage design features (low-flow channel and reduced turbulence) to allow fish passage.

The Modified Side Channel Alternative is constructible using common, existing technology and equipment.

The Multiple Pump Alternative has multiple practicability concerns, which are reflected in the high risk-based contingency assigned to the costs (35.4%). The existing irrigation canal was designed to be operated on gravity flow from the upstream end and operation with both gravity flows and pumps will be complicated and highly variable from year to year. For example, transferring from gravity inflows to pumped inflows would require highly precise timing on the startup and shutdown of each pump and monitoring the water level change at multiple points in the canal as it progresses downstream to avoid flooding or dewatering the system. Also, rapid drawdowns in the main canal can cause bank failures, so substantial monitoring will be required to prevent bank failures. This is technically feasible with an automated monitoring sensor system, but would result in greater costs and complexity for the irrigation districts and require rapid response to address problems. A recent study of pumping stations on the Yellowstone River (Performance Engineering 2016) indicated that the existing pumping stations have substantial annual damages and problems resulting from channel migration, significant ice flow damages, sediment erosion and deposition and pump wear from high suspended sediment loads. In most cases, water rationing or shutdowns are required during low flows as well. All of these factors require very costly repairs and maintenance on an annual basis. Bank failures, flooding, and other problems occurred recently on the Intake Main Canal that can dewater landowners pumps and shut-down irrigation for days and weeks at a time. There are further practicability concerns with the screens and pumped fish return system at the pumping stations and the frequency of cleaning/maintenance required and whether they can be removed seasonally to prevent ice damage. Due to the known problems already incurred by existing pumping stations and further risks from fish screening, the practicability of this alternative is highly questionable and the costs required for O&M could even be higher than estimated.

The Multiple Pumps with Conservation Measures Alternative has substantial practicability concerns, which are partly reflected in the high risk-based contingency assigned to the costs (50%). The biggest concern is whether there are sufficient locations with coarse alluvial soil that would support pumping up to a total of 608 cfs. A preliminary investigation of geologic and soils conditions indicates that soils may not be sufficiently coarse to provide sufficient connectivity with the river and sufficient water supply (Appendix A2, Attachment 2). Data from other locations has also indicated that Ranney Well performance declines over time due to clogging with fine sediments, which could require flushing or rebuilding the wells. Secondly, the amount of water conservation that can actually be achieved is also of low confidence at this time as it has not been field measured. It is known with certainty that 608 cfs would not supply the current crop demand, so would require a change in crops and likely fallowing some lands, which could substantially change farm profitability.

10.4.2 Administrative Feasibility

Administrative feasibility refers to the requirements associated with coordinating with other offices and agencies, including statutory limits, waivers, and requirements for off-site actions. Overall, the administrative logistics increase as the project area and potential construction duration increases. The agencies believe that the Bypass Channel Alternative is the most administratively feasible alternative to achieve the project purpose in a manner that also minimizes unacceptable adverse impacts to the aquatic ecosystem and other elements of the environment. All elements of the bypass channel are fully within the authority of the agencies.

The No Action Alternative would not meet Reclamation needs for ESA compliance at Intake Diversion Dam, other actions would likely be required. Reclamation would be required to reinitiate consultation.

The Rock Ramp Alternative would be within the authority of the agencies to implement.

The Modified Side Channel Alternative would be within the authority of the agencies to implement, although due to the need to acquire additional lands, it would increase the logistics and duration necessary for implementation.

The Multiple Pump Alternative would be within the authority of the agencies to implement, although due to the need to acquire additional lands and upgrade the power grid, it would increase the logistics and duration necessary for implementation.

The Multiple Pumps with Conservation Measures Alternative would be within the authority of the agencies to implement, although due to the need to acquire significant areas of additional lands, it would substantially increase the logistics and duration necessary for implementation. The installation of conservation measures would also be logistically difficult. Lining of the main canal would either require shutting down of irrigation for the season or require winter construction.

Congressional action could authorize an agency (such as the Corps or Reclamation) to establish a trust fund for OM&R costs. Congressional authority would need to include specific instructions for the establishment, management, and use. Additionally, if the intent is for Federal dollars to be used for the initial investment, authorization for appropriations would also be necessary. The establishment of a trust for the payment of OM&R costs above those of the No Action Alternative could have implications within existing project authorizations. Consistent with the existing authorization for the Lower Yellowstone Project (LYP), project costs, including OM&R, are the responsibility of the LYIP. Thus without specific language establishing appropriated trust funds as non-reimbursable, OM&R costs would remain the responsibility of the LYIP and repayment of the initial trust investment would be anticipated. The purpose of a trust fund for the Lower Yellowstone Intake Diversion Dam Fish Passage Project would be to provide a permanent source of funding to the LYIP for the increased OM&R costs associated with Multiple Pumps and Multiple Pumps with Conservation Measures alternatives which substantially exceed the costs for the No Action Alternative.

10.5 AQUATIC IMPACTS FROM DISPOSAL

Potential aquatic impacts are discussed in more detail in Section 4 of this analysis. The No Action Alternative would continue to prevent pallid sturgeon passage upstream of the Intake Diversion Dam. The No Action alternative would require the annual placement of approximately 1,500 CY of rock fill into the river at the weir, which translates to approximately 75,000 CY of rock over the 50-year planning horizon. It would likely expand the rock rubble field another 2 acres in the river.

The proposed bypass channel would require excavation of 869,000 CY to create 64 acres of new perennial side channel (i.e. the new bypass channel) from uplands. This material would be placed as fill in the existing side channel (both seasonally inundated and backwater areas) and would fill approximately 66 acres (convert to uplands) of seasonal riverine side channel and backwater habitat and place fill in 2 acres of the Yellowstone River at the downstream end of the new bypass channel. Non wetland habitats disturbed during construction (i.e. riparian areas) would be restored and enhanced with native plantings.

The initial fill in the river for the Rock Ramp Alternative is 350,000 CY over 34 acres, plus approximately three acres would be filled associated with the new weir. It is likely that the ramp would require annual maintenance to fix portions of the ramp, thus requiring the placement of additional rock in the river as fill, potentially a similar volume of rock as for the No Action Alternative (up to 75,000 CY over the 50-year planning horizon). Non wetland habitats disturbed during construction (i.e. riparian areas) would be restored and enhanced with native plantings.

The Modified Side Channel Alternative would require excavation of 1,144,000 CY within the existing side channel and uplands (47 acres of upland converted to new perennial side channel), and 365,000 CY of fill placed in bend cutoffs in the existing channel (52 acres filled and converted to upland). Approximately 130,000 CY of cobbles and boulders would be placed in the side channel for substrate and bank protection (remains as perennial side channel with coarser substrate). Eight acres of existing side channel would be converted to palustrine emergent wetland in the bend cutoffs. Non wetland habitats disturbed during construction (i.e. riparian areas) would be restored and enhanced with native plantings.

The Multiple Pump Alternative would convert approximately one acre of wetlands to perennial backwater canals and fill one acre of riverine habitat with riprap for bank protection. Weir and rock removal would permanently remove wood, steel, and rock from six acres of the river.

The Multiple Pumps with Conservation Measures would fill approximately one acre of wetlands for access roads and pump stations. An unknown, but anticipated 10 acres of wetlands fringing along the Main Canal and laterals would be filled associated with canal linings. An unknown, but potentially 100 or more acres of wetlands supported by return flows and seepage would be eliminated by eliminating their hydrology. Non wetland habitats disturbed during construction (i.e. riparian areas) would be restored and enhanced with native plantings.

10.6 CONSERVATION AND RECOVERY

Section 9 of this document provides a detailed set of potential avoidance and minimization measures as well as conservation measures that will reduce effects to ESA-listed species and their critical habitat. Section 9 also includes a description of proposed monitoring actions that would be implemented post-construction.

There is insufficient information at this time to quantify the potential contribution that the proposed project or any of the alternatives would make to recruitment of pallid sturgeon or recovery. However, improving passage of pallid sturgeon

10.7 LIMIT NUMBER OF SITES

The project area comprises the minimum area required to feasibly build a technically sound bypass channel for upstream passage of pallid sturgeon around the Intake Diversion Dam, and all activities are confined to the immediate Intake Diversion Dam and Joe's Island vicinity. The sites selected for placement of fill material included in the proposed plan were determined based on the need to prevent flows into the existing side channel below 63,000 cfs in the river in order to ensure that the 13-15% flow volume into the bypass channel to meet the BRT criteria. Further, if the upper end of the existing side channel is not filled, the risk of main channel avulsion into one of the channels is substantially increased as a substantial portion of the river flow volume could flow into the channels during high flows.

The Rock Ramp and Modified Side Channel alternatives similarly are confined to activities in the immediate Intake Diversion Dam and Joe's Island vicinity. The Multiple Pump and Multiple Pumps with Conservation Measures alternatives would require construction and operation and maintenance at multiple sites along the lower 70 miles of the Yellowstone River.

11.0 Factual Determination

This section provides a summary of the determinations made for each component of the aquatic ecosystem evaluated in previous sections.

11.1 PHYSICAL SUBSTRATE DETERMINATIONS

The physical and chemical substrate conditions are described in Section 2 and Section 4. Potential impacts to the physical and chemical properties of the substrate are discussed in Section 4.1.2. The proposed project would result in temporary impacts to the existing substrate during construction. Measures to reduce effects would be implemented during construction to minimize disturbance to substrate as described in Section 9.

11.2 SUSPENDED PARTICULATES AND TURBIDITY DETERMINATIONS

Suspended particulates and turbidity existing conditions and potential impacts are described in Section 4.2. The proposed project would result in minor temporary and localized increases in suspended particulates in the project area. Measures to reduce effects would be implemented during construction to minimize suspended particulate materials and turbidity, as described in Section 9.

11.3 WATER QUALITY DETERMINATIONS

Water quality existing conditions are described in Sections 2 and 4. Potential impacts to water quality are described in Section 4.3.2. The proposed project would result in minor increases in turbidity and the potential for spills/leaks from construction equipment. Long-term beneficial effects include improvements to beneficial uses for Aquatic Life, specifically through providing upstream fish passage. There are no long-term adverse impacts identified. Measures to reduce effects would be implemented during construction to minimize potential water quality impacts as described in Section 9.

11.4 CURRENT PATTERNS, WATER CIRCULATION, AND FLUCTUATION DETERMINATIONS

Current patterns, water circulation, and fluctuation existing conditions and potential impacts are described in Section 4.4. The proposed project would have minor short-term effects on current patterns or water circulation in the project area due to coffer damming during concrete weir construction. The effects of these actions are anticipated to be negligible because they would be insignificant localized and temporary impacts. The project will result in much improved passage of endangered pallid sturgeon upstream of the Intake Diversion Dam.

11.5 SALINITY DETERMINATIONS

Salinity considerations are not applicable to the Yellowstone River.

11.6 AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS

The aquatic ecosystem and organism existing conditions within the project area are described in Section 5. The proposed construction activities associated with the proposed restoration plan may have short-term impacts on primary and secondary productivity, benthic and epibenthic organisms, from short-term increases in turbidity, excavation and disturbance, foraging disruption, and fish handling and removal. Short-term upland impacts on terrestrial mammals and birds may result from potential increased noise and grading, which may result in disruption of foraging. Long-term effects include the opening of 165 miles of spawning habitat for endangered pallid sturgeon and other Yellowstone River fish. Impacts would be temporary and less than significant and upstream passage above the Intake Diversion Dam would represent a long-term benefit. Measures to reduce effects would be implemented during construction to minimize impacts to the aquatic ecosystem and organisms as described in Section 9.

11.7 RECREATIONAL, AESTHETIC, AND ECONOMIC VALUES DETERMINATIONS

Recreational, aesthetic, and economic existing conditions and potential impacts are described in Section 7. Potential effects of the proposed project on human use characteristics would occur during construction and would be temporary. Impacts to historic and cultural resources are not likely. Recreation in the project area would be temporarily affected during construction on Joe's Island, but the Intake FAS would not be closed. Construction would be minimized or avoided, as possible, during paddlefish season. Impacts would be temporary and localized during construction. The completed project would not interfere with future recreation or navigation within the project area. Therefore, these impacts would be less than significant. Measures to reduce effects would be implemented during construction to minimize construction-related impacts as described in Section 9.

11.8 DETERMINATION OF CUMULATIVE IMPACTS ON THE AQUATIC ECOSYSTEM

Cumulative impacts are impacts on the environment that result from the incremental impact of actions when added to other past, present, and reasonably foreseeable future actions. The implementation of the proposed project would incrementally reverse the cumulative adverse impacts that have occurred to pallid sturgeon and the Lower Yellowstone River by allowing fish passage around the weir that has been a fish passage barrier for 100 years. Impacts from construction are short-term and minor and would not contribute substantially to cumulative effects.

11.9 DETERMINATION OF SECONDARY IMPACTS ON THE AQUATIC ECOSYSTEM

Secondary effects are "associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material" (40 CFR 230.11(h)(1)). Under CWA, secondary impacts are generally interpreted as indirect impacts. Therefore, secondary effects are limited to effects in the aquatic environment that are indirectly related to implementation of the action, such as minor erosion or downstream sedimentation.

12.0 Review of Conditions for Compliance

According to the guidance, "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (40 CFR 230.10 [a]). The potential for significant adverse impacts on the aquatic ecosystems resulting from implementation of the preferred alternative would be mitigated to the extent possible through the application of avoidance and minimization measures described in Section 9. The following subsections contain a review of conditions for compliance for the practicable alternatives assessed under the Yellowstone Intake Diversion Dam Fish Passage Project EIS.

12.1 AVAILABILITY OF PRACTICABLE ALTERNATIVES

Section 230.10 of Subpart B of the Section 404(b)(1) Guidelines further specifies four general conditions that must be met for compliance. These include consideration of practicability, compliance with the ESA, protections for water quality and human uses, and compliance with the avoidance, minimization, and compensatory mitigation requirements. The results of the analyses are summarized below.

12.1.1 Practicability (40 CFR Section 230.10(a))

A practicable alternative according to 40 CFR 230.10 is one that has a reasonable expectation of success in achieving the overall purpose and need, and is feasible to implement in consideration of cost, existing technology, and logistics. The alternatives are evaluated for compliance with the definition of practicability in the EIS and while each were found to be potentially practicable there are substantial concerns with the alternatives that remove the existing weir. The proposed alternative is the most cost effective, constructible, practicable, and sustainable with a high likelihood of success.

12.1.2 Compliance with Water Quality Standards, ESA, and Protection of Habitat (40 CFR Section 2301.10(b))

Based on the evaluation of impacts in Sections 4, 5, and 6 of this document, the alternatives have been assessed for any cause of, or contribution to significant degradation to, waters of the U.S. Under 40 CFR 230.10(c), special emphasis on the persistence and permanence of the effects is considered in making the significant degradation determination. The potential impacts to the chemical and biological characteristics from the proposed restoration plan are generally low. The potential to release pollutants arises from the use of construction equipment (i.e. fuels and oils). Evaluation of the alternatives has indicated that implementation of the proposed project would not result in substantial water quality exceedances, and therefore would not result in significant degradation. The long-term result of the project would be improved fish passage, thus, improving a current 303(d) listing.

Consultation with the Service under Section 7 of the ESA is in process to ensure that this project does not cause jeopardy to any listed species or result in the destruction or adverse modification of critical habitat.

12.1.3 Protections for Water Quality, Special Aquatic Sites, and Human Uses (40 CFR Section 130.10(c))

This criteria involves prevention of significant degradation or significant adverse effects resulting from the discharge of pollutants on water supplies, fish and wildlife, aquatic organisms, and special aquatic sites; significant adverse effects on ecosystem diversity, productivity, or stability through the transfer of pollutants outside of the disposal site; and/or significant adverse effects on human use values (40 CFR 230.10 (c)(1) – (4)).

Based on this analysis, the proposed restoration plan would meet all applicable state water quality standards within appropriate compliance distances and durations and are not expected to violate any toxic effluent standard or prohibition under CWA Section 307.

12.2 COMPLIANCE WITH PERTINENT LEGISLATION

All of the practicable alternatives are expected to comply with pertinent legislation and treaty rights as described below.

- ESA: Formal consultation in process under Section 7 of the ESA.
- Section 106 of the National Historic Preservation Act: Section 106 consultations with the Montana State Historic Preservation Officer is in process.
- Section 401 of the CWA: A water quality certification would be obtained from the State of Montana

12.2.1 Treaty Rights

The proposed work would not affect treaty fishing rights or Indian Trust Assets and may have beneficial effects on overall fish populations.

12.3 POTENTIAL FOR SIGNIFICANT DEGRADATION OF WATERS OF THE UNITED STATES AS A RESULT OF THE DISCHARGE OF POLLUTED MATERIALS

As described in Section 8, any materials imported to the project area would have low or non-detectable levels of contaminants that are not expected to have significant adverse impacts on water quality or biota in the short or long term.

12.4 STEPS TO MINIMIZE POTENTIAL ADVERSE IMPACTS ON THE AQUATIC ECOSYSTEM

Finally, no discharge of fill shall be allowed unless all appropriate and practicable measures have been taken to minimize and avoid and then compensate for potential adverse impacts. Section 9 details the avoidance, minimization and conservation measures that would be applied to the proposed project.

13.0 Findings

This section describes findings of compliance or non-compliance with the restrictions on discharge per 40 CFR Section 230.12. These findings are supported by the factual determinations and conditions for compliance included in Sections 11 and 12.

13.1 ALTERNATIVES TEST

Based on the discussion above, are there available, practicable alternatives having less adverse impact on the aquatic ecosystem?

Yes ☐ No ☒ Not Applicable ☐

Based on the discussion above, if the project is in a special aquatic site and is not water-dependent, has the applicant demonstrated there are no practicable alternative sites available?

Yes ☐ No ☐ Not Applicable ☒

13.2 SPECIAL RESTRICTIONS

Would the project:

Violate state water quality standards?

Yes ☐ No ☒ Not Applicable ☐

Violate toxic effluent standards (under Section 307 of the CWA)?

Yes ☐ No ☒ Not Applicable ☐

Jeopardize endangered or threatened species or their critical habitat?

Yes ☐ No ☒ Not Applicable ☐

Violate standards set by the Department of Commerce to protect marine sanctuaries?

Yes ☐ No ☐ Not Applicable ☒

Evaluation of the information above indicates that the proposed discharge material meets testing exclusions criteria for the following reason(s):

☐ based on the above information, the material is not a carrier of contaminants

☒ the levels of contamination are substantially similar at the extraction and disposal sites and the discharge is not likely to result in degradation of the disposal site and pollutants would not be transported to less contaminated areas

☒ acceptable constraints are available and would be implemented to reduce contamination to acceptable levels within the disposal site and prevent contaminants from being transported beyond the boundaries of the disposal site

13.3 OTHER RESTRICTIONS

Would the discharge contribute to significant degradation of waters of the U.S. through adverse impacts to:

Human health or welfare, pollution of municipal water supplies, fish, shellfish, wildlife, and special aquatic sites?

Yes ☐ No ☒ Not Applicable ☐

Life stages of aquatic life and other wildlife?

Yes ☐ No ☒ Not Applicable ☐

Diversity, productivity, and stability of the aquatic ecosystem, such as the loss of fish or wildlife habitat, or loss of the capacity to assimilate nutrients, purify water or reduce wave energy?

Yes ☐ No ☒ Not Applicable ☐

Recreational, aesthetic, and economic values?

Yes ☐ No ☒ Not Applicable ☐

13.4 ACTIONS TO MINIMIZE POTENTIAL ADVERSE IMPACTS (MITIGATION)

Would all appropriate and practicable steps (40 CFR 23.70-77) be taken to minimize the potential adverse impacts of the discharge on the aquatic ecosystem?

Yes ☒ No ☐ Not Applicable ☐

Based upon this Section 404(b)(1) analysis, I have determined that the proposed action is in compliance with the Section 404(b)(1) guidelines and would not have a significant adverse effect on waters of the U.S.

Date: 02 DEC 2016

John W. Henderson, P.E.
Colonel, Corps of Engineers
District Commander

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