United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

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Memorandum

To: Area Manager, Billings, Montana
Bureau of Reclamation

From: Assistant Regional Director, Ecological Services

Subject: Consultation on Effects from Interim and Future Operation and Maintenance of the Lower Yellowstone Irrigation Project and Construction of Fish Passage

This memorandum responds to the Bureau of Reclamation's (Reclamation) request for consultation with the Fish and Wildlife Service (Service) on effects of the subject project to species and habitats listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; [Act]). Reclamation's request dated April 14, 2015, and received electronically on April 15, 2015 included a biological assessment entitled *Amended Biological Assessment for Interim and Future Operation and Maintenance of the Lower Yellowstone Irrigation Project and Construction of Fish Passage with Conservation Measures (*Assessment), dated March 2015. Through the Assessment, the Reclamation determined that the subject project may affect several listed species. On June 2, 2015, Reclamation updated and clarified their determination for the Northern long-eared bat. Reclamation's final determinations are presented below.

Species	Listing status	Determination
Pallid sturgeon (*Scaphirhynchus albus)*	endangered	likely to adversely affect
Interior least tern (*Sterna antillarum athalassos*)	endangered	not likely to adversely affect
Whooping crane (*Grus Americana*)	endangered	no effect
Red knot (*Calidris canutus*)	threatened	no effect
Northern long-eared bat (*Myotis septentrionalis*)	threatened	not likely to adversely affect
Greater sage-grouse (*Centrocercus urophasianus*)	candidate	not likely to adversely affect
Sprague's pipit (*Anthus spragueii*)	candidate	not likely to adversely affect

The Service has prepared a biological opinion with a finding that the proposed project is not likely to jeopardize the pallid sturgeon and has attached it to this memo. We also concur (below) with Reclamation's determinations for the tern and bat.

For the remainder of the species, we acknowledge your determinations, but neither 7(a)(3) of the Act, nor implementing regulations under section 7(a)(2) of the Act require the Service to review or concur with the Reclamation's remaining effect determinations; therefore the Service will not address them further. However, we do appreciate you informing us of analysis for these species even if not required to do so under the Act.

Concurrence for Interior least tern

Though least terns are not known in the action area, the action area is within their broad range and use of the limited but suitable habitat could occur (Assessment p. 57). If terns were nesting on the river, changes in water elevation could flood nests. The proposed action will not result in any change from baseline of the amount of flow or water elevations in the action area, thus even if terns nests were present, the likelihood of effects are discountable.

The bypass channel is not anticipated to degrade any existing tern habitat around the project site. It may create additional habitat for nesting in the future by natural sandbars and gravel substrates naturally forming over time. If additional habitat is created, least tern nests may be encountered when conducting project activities on the bypass channel. However, the likelihood is discountable. In the remote chance that nesting terns are found, Reclamation will buffer them from activities by 0.25 miles or line of sight (Assessment p. 57) thereby minimizing any effects to an insignificant level.

Annual project operation and maintenance activities are not likely to have any impact on tern habitat along the Yellowstone River, because the majority of the activities are within the Lower Yellowstone Irrigation Project lands off of the river. These areas are not likely to have habitat for terns and likelihood of effects is discountable.

Based on Service review of the Assessment, we concur with Reclamation's determination that the project outlined in the Assessment and this memorandum, may affect but is not likely to adversely affect the Interior least tern.

Concurrence for Northern long-eared bat

The Lower Yellowstone Irrigation Project is on the very western edge of the species range with only one known sighting in Montana (Richland County, abandoned mine). Suitable habitat in the form of large hardwood trees is very limited. Approximately two acres of mature cottonwood trees will be removed from Joe's Island for the construction of the new bypass channel. That removal will occur between September 30 and January 31. This period is outside of summer nesting and roosting period and is consistent with Service guidance. No winter hibernacula habitats are known from the area.

Because the likelihood of the species even occurring in the action area is very low and the timing restrictions on removal of trees, the likelihood of an effect to the bat is discountable and any effects that could occur are likely to be insignificant. Therefore the Service concurs with Reclamation's determination that the project outlined in the Assessment and this memorandum, may affect but is not likely to adversely affect the Northern long-eared bat.

This concludes consultation for the Interior least tern and northern long-eared bat. Further consultation pursuant to section 7(a) (2) of the Act is not required. Reinitiation of consultation on this action may be necessary if new information reveals effects of the action that may affect listed species or designated habitat in a manner or to an extent not considered in the assessment, the action is subsequently modified in a manner that causes an effect to listed species that was not considered in the analysis, or a new species is listed or critical habitat is designated that may be affected by the proposed action.

Attachment

cc: Montana FWS Field Office, Helena, Montana

BIOLOGICAL OPINION
On effects to the pallid sturgeon from the Lower Yellowstone Irrigation Project and construction of fish passage In Montana and North Dakota

TAILS No. 06E00000-2015-F-004

© JOSEPH R. TOMELLERI

Pallid sturgeon (*Scaphirhynchus albus)*

FISH AND WILDLIFE SERVICE
Mountain Prairie Region
Denver, Colorado

Assistant Regional Director for Ecological Services _____

Date July 10, 2015

Introduction

The pallid sturgeon is a large river fish that can reach six feet in length, weigh up to 80 pounds and live 50 years, perhaps longer. For thousands of years it has lived, fed, and bred in the large rivers of the West – the Missouri, Yellowstone, and Mississippi. Just over 100 years ago, humans began placing barriers in many of these rivers to collect and manage water to control flooding and to irrigate crops. This greatly impeded, and in some cases entirely blocked the sturgeon from free movement in the rivers, which in turn, impaired the sturgeon's ability to carry out its full complement of biological functions necessary for its long term survival. The existing Intake Diversion Dam, which supplies water to the Lower Yellowstone Irrigation Project, is one of those barriers.

The barriers in the large rivers led to a precipitous decline in the numbers of pallid sturgeon; so much so that in 1990 they were listed as endangered under the Endangered Species Act of 1973. Fish raised in hatcheries have been introduced and there are now hundreds of them that have survived and are just now reaching spawning age. As for wild (non-hatchery) sturgeon, only 125 are believed to inhabit the area below the Intake Diversion Dam, and none currently in the Yellowstone River above the dam. Every year adult sturgeon swim up to the existing barrier from farther down the Yellowstone and the Missouri River in an attempt to pass upriver to their likely historical spawning grounds, but the dam blocks movement of the adults as it will the maturing hatchery fish. As time passes, the number of wild, spawning adults grows older and some die, causing the already small wild population to dwindle to even lower numbers.

Now, the United States Bureau of Reclamation with assistance from the United States Army Corps of Engineers is proposing to alter the existing dam, allowing sturgeon to move upstream of the structure and again have access to an additional 165 miles of habitat. This habitat was likely used previously by the sturgeon for many life history behaviors. If successful, it will be the first time in approximately a hundred years that the sturgeon will have consistent ability to move

beyond the dam and to access new habitat. This would be a substantial step forward in assisting the long term survival and recovery of the sturgeon because it is expected to allow access to spawning habitat and provide sufficient drift distance for developing larvae.

As perhaps a harbinger of that future condition, in 2014 there was an unusually high run-off flood event and five tagged sturgeon were able to find their way past the dam by using a temporary and rarely occurring high-flow channel. One of those fish was a female with eggs. Three of these fish, the female and two males, were later located in the Powder River, a tributary to the Yellowstone River. The female was captured shortly after her return to the Yellowstone, and her lack of eggs confirmed that she had likely spawned upriver of the Intake dam, perhaps in or near the Powder River. After spawning, the fish returned to the Yellowstone River below the dam. This is the first time the likelihood of spawning has been documented above the dam.

A necessary step in the process of implementing this important recovery project is meeting a consultation requirement from the Endangered Species Act. In that Act, Congress required that every federal agency must insure that any action "*...authorized, funded, or carried out...is not likely to jeopardize the continued existence of any endangered or threatened species...*". To meet this requirement, Congress required that the action agencies request assistance from the United States Fish and Wildlife Service and seek their biological opinion regarding whether the proposed action is likely to jeopardize the continued existence of a listed species.

This document, then, is the Endangered Species Act's required examination of the Bureau of Reclamation's proposed action at the Intake Diversion Dam and the Fish and Wildlife Service's biological opinion on the proposed action's effects to the pallid sturgeon. In this document, the Fish and Wildlife Service finds that though there are some limited minor adverse effects to the sturgeon, the action is not likely to jeopardize the continued existence of the pallid sturgeon. And in fact, we believe the proposed action constitutes a substantial improvement to the outlook for the survival and recovery of this ancient fish.

Purpose of this Consultation

This consultation examines whether the proposed action is likely to jeopardize the continued existence of the pallid sturgeon. This biological opinion does not address critical habitat for pallid sturgeon because none has been designated.

Background

In 2003, the U.S. Fish and Wildlife Service (Service) completed the biological opinion on the U. S. Army Corps of Engineers (Corps) operation of the Missouri River main stem reservoir system, operation and maintenance of the Missouri River bank stabilization and navigation project and operation of the Kansas River reservoir system. The Service concluded that the Corps proposed action would be likely to jeopardize the pallid sturgeon. The Service provided a reasonable and prudent alternative (RPA) to the action (Service 2003). The RPA described the framework for an adaptive management approach to the Corps' river operations and maintenance along the Kansas and Missouri rivers to avoid jeopardy to listed species and facilitate their eventual recovery.

Following completion of the 2003 biological opinion and in consideration of the rapidly advancing understanding of pallid sturgeon life history needs and management opportunities in the Upper Missouri River, several amendments were made (Service 2015, p. 6-15). These amendments were consistent with the RPA adaptive management framework.

After agreement from the Service to look at the RPA in light of new Corps authorities (under Section 3109 of the 2007 Water Resources Development Act), the RPA was amended in 2009 to substitute Intake Diversion Dam modifications for measures that were to be taken at the Ft. Peck Dam (Service March 30, 2015, p.10). This substitution was consistent with the findings of the Intake Diversion dam Modification, Lower Yellowstone Project Science Review Report (Reclamation 2009).

Subsequent to our amendment in 2009 the Service worked closely with the Corps and Reclamation on the formulation of alternatives that would effectively provide passage for pallid sturgeon. Through the course of those discussions the Corps and Reclamation developed an Environmental Assessment that looked at those alternatives for not only fish passage but also in meeting the agencies other statutory obligations. The current alternative subject to this consultation is the result of the scientific development of a fish passage alternative that is consistent with Corps and Reclamation mission and obligations and provides effective fish passage and serves as a suitable substitute for the relevant RPA elements from the 2003 biological opinion.

Consultation History

This consultation is the most recent in a long history of activities regarding the Missouri and Yellowstone rivers and the pallid sturgeon. A detailed discussion of this history can be found in

The U.S. Bureau of Reclamation's (Reclamation)'s 2015 amended biological assessment (Assessment), pages 21 through 24. The most recent actions are listed below.

- On December 14, 2014 the Service received an initial assessment regarding the impacts of the proposed action.
- After discussions with the Service, Reclamation transmitted an amended assessment to the Service on April 14, 2015.
- On March 30, 2015, the Service sent a letter (Service 2015) to Mr. David Ponganis of the Corps outlining our understanding of the biology of the pallid sturgeon relative to the bypass channel, our belief that it was the best alternative to recover the pallid sturgeon, and support for the project in lieu of the original Fort Peck reasonable and prudent alternative in the 2003 biological opinion.

The Service and Reclamation staffs have worked closely to share information on the project, sturgeon life history, monitoring and associated topics. Records of that coordination are included in our consultation file.

1.0 PROPOSED ACTION

The proposed action is the interim and future operation and maintenance of the Lower Yellowstone Irrigation Project (Irrigation Project) in eastern Montana and western North Dakota, the construction of a new weir to replace the existing weir at Intake Diversion Dam, construction of a new fish bypass channel, and future operation and maintenance of the of the new weir and bypass channel (Assessment pp. 5-9).

For simple organization, the proposed action can be broken into 8 main activities.

1. Short term maintenance of the current rock dam (two - three years)
2. Construction and maintenance of a new weir with downstream fish passage notch
3. Construction and maintenance of a fish passage channel around the new weir
4. Maintenance and operation of the existing headgates and fish screens
5. Canal and lateral ditch operation and maintenance in the Irrigation Project
6. Supplemental pumping of water to supply irrigation
7. Water conservation activities on Irrigation Project lands
8. Monitoring and adaptive management

For assessment and analysis, the major activities were further subdivided into approximately 59 sub activities. An entire list can be seen in Table 2 in Appendix A and is not reproduced here. Additional information on these activities can be found in the Assessment (pp. 5-9). During all these activities, general conservation measures such as working behind coffer dams and doing instream work outside of the pallid sturgeon's migration and spawning period will be employed to reduce the likelihood and significance of effects to all life stages of the pallid sturgeon (Assessment pp. 51-52).

1.1 Action Area

The description of action area is informed by the following definitions.

Action – "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies….. or (d) actions directly or indirectly causing modifications to the land, water, or air." 50 CFR 402.02

Action Area – "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." 50 CFR 402.02

Indirect Effects – "…Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." 50 CFR 402.02

Based on the area where "modifications to the land, water, or air" (directly or indirectly) from this proposed action occur and can be perceived, the action area for this biological opinion covers approximately three miles upriver from the existing Intake Diversion Dam, approximately three miles downriver below the existing dam and boulder field, the area encompassing the current high water channel, "Joe's Island", the lands occupied by the Irrigation Project infrastructure (canals, ditches, etc.). It is impossible to precisely describe the exact area encompassing the impacted area, but beyond the described area, modifications to the land, water and air occur are unlikely to be able to be reasonably predicted or discerned.

2.0 STATUS OF THE SPECIES

Information in this section is drawn largely from the Service's Environmental Conservation Online System http://ecos.fws.gov/ecos/home.action, Reclamation's 2014 initial biological assessment (pp. 29-36), Reclamation's 2010 Environmental Assessment (Reclamation 2010), Reclamation's 2015 amended biological assessment and the Service's Revised Pallid Sturgeon Recovery Plan (Service 2014).

2.1 Legal status

The sturgeon was listed as endangered under the Endangered Species Act of 1973 (as amended (16 U.S.C. § 1536)) [Act] on September 6, 1990. No critical habitat for this species has been designated under the Act.

2.2 Description

The sturgeon is a large river fish that can reach six feet in length, weigh up to 80 pounds and can live 50 years and perhaps much longer. For thousands of years it has lived, fed, and bred in the large rivers of the West – the Missouri, Yellowstone, and Mississippi. They are a bottom-oriented, large river obligate fish. They are similar in appearance to the more common shovelnose sturgeon. Both species inhabit overlapping portions of the Missouri and Mississippi river basins. Floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters formed the large-river ecosystem that met the habitat and life history requirements of

sturgeon and other native large-river fishes. Sturgeon have been documented over a variety of available substrates, but are often associated with sandy and fine bottom materials.

2.3 Habitat

Research into habitat use produced useful insights for many portions of the sturgeon's range. However, much of these data are based on habitat characterizations in altered environments, in some cases substantially altered environments, including an altered hydrograph and temperatures, suppression of fluvial processes, stabilized river banks, loss of natural meanders and side channels, fragmented habitats, and increased water velocities. Thus, information and current understanding of habitat use may not necessarily reflect preferred habitats for the species, but rather define suitable habitats within an altered ecosystem.

Sturgeon primarily utilize main channel, secondary channel, and channel border habitats throughout their range. Juvenile and adult sturgeon are rarely observed in habitats lacking flowing water which are removed from the main channel (i.e., backwaters and sloughs). Specific patterns of habitat use and the range of habitat parameters used may vary with availability and by life stage, size, age, and geographic location. In the upper portions of the species' range, juvenile hatchery-reared sturgeon select main-channel habitats (Gerrity 2005). In the Yellowstone and Platte rivers, adult sturgeon select areas with frequent islands and sinuous channels while rarely occupying areas without islands or with straight channels (Bramblett and White 2001; Snook et al. 2002; Peters and Parham 2008). In the middle Mississippi River, sturgeon select for areas downstream from islands that are often associated with channel border habitats and select against main-channel habitats (Hurley et al. 2004). Other Mississippi River capture locations tend to be near the tips of wing-dikes (an engineered channel training structure), steep sloping banks, and channel border areas (Killgore et al. 2007b; Schramm and Mirick 2009).

2.5 Food

Data on food habits of age-0 sturgeon are limited. In a hatchery environment, exogenously feeding fry (fry that have absorbed their yolk and are actively feeding) will readily consume brine shrimp suggesting zooplankton and/or small invertebrates are likely the food base for this age group. Data available for age-0 Scaphirhynchus indicate mayflies and midge larvae are important. Juvenile and adult sturgeon diets are generally composed of fish and aquatic insect larvae with a trend toward eating fish as they increase in size. Based on the above diet data and habitat utilization by prey items, it appears that sturgeon will feed over a variety of substrates, however, the abundance of Trichoptera (insect group including caddis flies) in the diet suggests that harder substrates like gravel and rock material may be important feeding areas.

2.6 Life cycle

Between March and July reproductive adult sturgeon (15-20 years old) swim upstream in search of a suitable areas to spawn, carry out spawning and return downriver. The environmental cues for this movement are the rising and peaking river hydrograph and water temperature, approximately late May in the Yellowstone. Spawning areas tend to be where firm river bottom

substrates occur in deeper water with relatively fast turbulent water flow (without the correct conditions spawning success is reduced). Sturgeon do not create a redd (or nest) in the gravel for the eggs. Spawning takes place when the female sturgeon releases eggs into the river current and nearby males immediately fertilize the eggs by releasing milt directly into the flowing current of the river containing the eggs. The largest upper Missouri River fish can produce as many as 150,000-170,000 eggs, whereas smaller bodied females in the southern extent of the range may only produce 43,000-58,000 eggs. Female sturgeon appear to spawn every two or three years (Service 2014, p. 9).

Once released, the eggs float downstream, sink and stick to objects on the river bed to incubate. The incubation period for sturgeon eggs is about 5-7 days. The exact period is determined by water temperature. At hatching, newly hatched free embryos are less than ½ inch in length and have a yolk sac attached to their stomach which provides food for approximately the first week (depending on temperature). Once the free embryos completely absorb their yolk sac, they start to feed on tiny aquatic animals and plants. At this point in their development they are typically referred to as larvae.

During this time, the hatched free embryo and larvae are predominantly pelagic with very weak swimming ability, drifting in the currents for 11 to 13 days in which time they can drift several hundred miles downstream from spawn and hatch locations hoping to end up in optimal habitats. About 20-30 days after hatching, sturgeon larvae are considered "young of the year" and look like miniature adult fish. After about a year, the young sturgeon are referred to as juveniles until they reach sexual maturity at15 to 20 years of age. Free embryos need to have enough distance to drift and become larvae, so that they are mobile and can seek out suitable habitat. Without enough drift distance, they can be passively swept into unsuitable habitat and die. Drift distance is critically important for survival. [1]

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[1] The Service is aware of a draft U. S Geological Survey report regarding modeling of larval drift (Missouri River Pallid Sturgeon Effects Analysis: Integrative Report 2015 draft). The report is noted by the USGS as "Draft – not for citation or distribution". It has not been peer reviewed, finalized or released for use. The Service has given it a preliminary review (L. Gamble, Service, pers. comm. June 26, 2015). The Service notes that one of the models used to inform and derive the USGS report, was used to describe larval drift in the Missouri River downstream from Yankton, South Dakota, to the confluence with the Mississippi river in St. Louis, Missouri. It is questionable whether a model used for the highly manipulated and less complex habitat present in the Missouri river can appropriately inform our understanding of larval drift in the largely uncontrolled and more complex habitat of the Yellowstone River.

The report also cites specific information that pallid sturgeon free-embryos have some ability to position themselves in the river. Yet, for modeling purposes they are treated as passive drifting particles. The report specifically acknowledges "Treatment of free embryo dispersion as a passive transport process is a broad assumption that may be discarded as more information becomes available." This statement brings into question the validity of the models and subsequent conclusions. The report also assumes that spawning will occur only as far upstream as Miles city, Montana rather than the Cartersville Dam (perhaps a more plausible location). This has the effect of truncating the distance available for free embryo drift. Additionally the report does not appear to acknowledge approximately 176 miles of seasonal and perennial secondary side channels which add distance and slower drift speeds.

The report seems focused on pointing out uncertainties regarding passage at Intake Dam resulting in successful maturation of free embryos and recruitment into the population, but the Service believes for the above reasons (and others), the preliminary conclusions from the report regarding passage at Intake Dam may not be valid or supported

2.7 Reproductive Strategy

The sturgeon has evolved a breeding strategy where the reproducing adult commits no parental care to eggs or offspring. This results in a naturally high mortality of the early life stages (egg, free embryo and larvae). Under normal conditions, this strategy is successful and can tolerate a high level of mortality, because the large spawning adults produce as many as 170,000 eggs and can be reproductive for decades. Thus as long as the regular opportunity exists for spawning, and an opportunity for larval drift to allow for transformation of a free embryo into larvae or young of the year, the success rate for a particular single egg or free embryo or larvae can be extremely low and still support a population capable of long term survival.

This strategy allows for long term success under widely variable natural conditions. However, having the capability to migrate to desired spawning areas and then having a long enough drift distance for free embryos to transform is key to reproductive success. This breeding strategy is thwarted when its migration routes are routinely (or completely) blocked. This also degrades the sturgeon's long term viability.

2.8 Population Distribution

2.8.1 Historic Distribution

The historic distribution of the sturgeon includes the Missouri and Yellowstone rivers in Montana downstream to the Missouri-Mississippi confluence and the Mississippi River possibly from near Keokuk, Iowa downstream to New Orleans, Louisiana. Sturgeon also were documented in the lower reaches of some of the larger tributaries to the Missouri, Mississippi, and Yellowstone rivers including the Tongue, Milk, Niobrara, Platte, Kansas, Big Sioux, St. Francis, Grand, and Big Sunflower rivers. The total length of the sturgeon's range historically was about 3,500 river miles.

2.8.2 Present Distribution

Since listing in 1990, wild sturgeon have been documented in the Missouri River between Fort Benton and the headwaters of Fort Peck Reservoir, Montana; downstream from Fort Peck Dam, Montana to the headwaters of Lake Sakakawea, North Dakota; downstream from Garrison Dam, North Dakota to the headwaters of Lake Oahe, South Dakota; from Oahe Dam downstream to within Lake Sharpe, South Dakota; between Fort Randall and Gavins Point Dams, South Dakota and Nebraska; downstream from Gavins Point Dam to St. Louis, Missouri; in the lower Milk and Yellowstone rivers, Montana and North Dakota; the lower Big Sioux River, South Dakota; the lower Platte River, Nebraska; the lower Niobrara River, Nebraska; and the lower Kansas River, Kansas. The contemporary downstream extent of sturgeon ends near New Orleans, Louisiana. Additionally, the species has been documented in the lower Arkansas River (Kuntz in litt., 2012), the lower Obion River, Tennessee (Killgore et al. 2007b), as well as navigation pools 1 and 2, downstream from Lock and Dam 3, in the Red River, Louisiana (Slack et al. 2012).

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by the data presented. Therefore, those conclusions do not alter our view of the potential for spawning and recruitment presented in this this biological opinion.

2.9 Population numbers

In 1995, a preliminary estimate found about 45 wild sturgeon existed in the Missouri River upstream of Fort Peck Reservoir (Gardner 1996). More recent data suggest that substantially fewer wild fish remain today. An estimated 125 wild sturgeon remain in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea including the lower Yellowstone River (Jaeger et al. 2009).

Since 1994, the Sturgeon Conservation Augmentation Program (augmentation program) has released hatchery-reared sturgeon within the Missouri River, portions of the Yellowstone River, and sporadically in the Mississippi River (Service 2013). Hatchery-reared sturgeon are the offspring of wild sturgeon that have been captured. Hundreds of thousands of fish have been released since augmentation began. In Recovery Priority Management Areas 1, 2 and 3 (upper Missouri and Yellowstone Rivers) of the Great Plains Management Areas, as many as 52,000 fish (greater than 1 year of age) are reported to be present (Rotella 2015, p. 104).

While current abundance estimates are lacking for the entire Missouri River downstream of Gavins Point Dam, Steffensen et al. (2012), generated annual population estimates for both wild and hatchery-reared sturgeon for the reach of the Missouri River extending from the Platte River confluence downstream (50 river miles). Their results estimated wild sturgeon at 8.7 to 14.3 fish/river miles and hatchery produced sturgeon at 46.1 to 52.0 fish/river miles. Extrapolating these estimates to the entire lower Missouri River suggests that the wild population may consist of as many as 5,991 mature individuals (Steffensen et al. 2013). The total population in the lower Missouri River may be larger as a result of the augmentation program, but is currently neither self-sustaining nor viable (Steffensen 2012; Steffensen et al. 2013), because limited spawning is not resulting in young of the year fish recruitment into the population.

Garvey et al. (2009) generated an estimate of 1,600 (0.8 fish/river miles) to 4,900 (24.5 fish/river miles) sturgeon for the middle Mississippi River (i.e., mouth of the Missouri River Downstream to the Ohio River confluence). In 2009, a sturgeon survey in the Upper Mississippi River captured a single sturgeon below lock and dam 25 near Winfield, Missouri (Herzog in litt., 2009). No estimates are available for the remainder of the Mississippi River.

2.10 Recovery and Management

The primary strategy for recovery of sturgeon is to: 1) conserve the range of genetic and morphological diversity of the species across its historical range; 2) fully quantify population demographics and status within each management unit; 3) improve population size and viability within each management unit; 4) reduce threats having the greatest impact on the species within each management unit; and, 5) use artificial propagation to prevent local extirpation within management units where recruitment failure is occurring (Service 2014).

In 1993, the Service established six recovery priority management areas to focus recovery efforts at locales believed to have the highest recovery potential (Service 1993). Since that time, the understanding of the species has improved and warranted redefining those management areas into four management units.

The management units identified in the revised Pallid Sturgeon Recovery Plan (Service 2014) are described below

- The Great Plains Management Unit is defined as the Great Falls of the Missouri River, Montana to Fort Randall Dam, South Dakota. This unit includes important tributaries like the Yellowstone River, as well as the Marias and Milk rivers. The upper boundary is at the Great Falls of the Missouri River as this is a natural barrier above which sturgeon could not migrate historically. The lower boundary was defined as Fort Randall Dam to ensure consistent management practices on an inter-reservoir reach of the Missouri River. The Intake Project falls within this unit.
- The Central Lowlands Management Unit is defined as the Missouri River from Fort Randall Dam, South Dakota to the Grand River confluence with the Missouri River in Missouri and includes important tributaries like the lower Platte and lower Kansas rivers.
- The Interior Highlands Management Unit is defined as the Missouri River from the confluence of the Grand River to the confluence of the Mississippi River, as well as the Mississippi River from Keokuk, Iowa to the confluence of the Ohio and Mississippi rivers.
- The Coastal Plain Management Unit is defined as the Mississippi River from the confluence of the Ohio River downstream to the Gulf of Mexico including the Atchafalaya River distributary system.

The Action area for the proposed action is located in the Great Plains Management Unit.

2.11 Climate Change

The potential impact of climate change on the sturgeon's environment is very difficult to assess. We reviewed the National Oceanic and Aeronautic Administration's (NOAA), Technical Report Regional Climate Trends and Scenarios for the U.S. National Climate Assessment (NOAA 2013). Specifically, we examined Part 4 of that report which focused on climate of the U.S. Great Plains. The action area and a large portion of the species range is within that geographic area.

The report makes it clear that the scientific information available and used for the report is **not** predictive. "*The future climate scenarios are intended to provide an internally consistent set of climate condition that can serve as inputs to analysis of potential impact of climate change. The scenarios are not intended as projections as there are no established probabilities for their future realization.*" (NOAA 2013, p. 1) However, the scenarios presented give us our best glimpse at whether models agree in showing a significant change from the past and if they agree in the direction of that change.

For the first period reported by the report (2021-2050) more than 50% of the models show a significant difference in temperature and more than 67% agree that the change is to a higher temperature in the action area and larger surrounding areas. The difference expressed is 1.5 to 2.5 degrees Fahrenheit (NOAA 2013, p. 37).

For the same period changes in average annual precipitation are more mixed with less than 50% of the models showing a statistically significant change (NOAA 2013, p. 55). As the models are pushed out into periods 2041-2070 and 2071-2099, they generally show increased annual average precipitation in the northern Great Plains and decrease in the southern part of the region (NOAA 2013, p. 55).

Given that the sturgeon lives in river systems influenced by winter precipitation (snow pack), we examined the report's information regarding differences in annual and seasonal precipitation. Less than 50 % of the models showed statistically significant change to annual precipitation in our area of interest in the Great Plains region for 2021-2050. For the period 2041-2070 as with the annual precipitation change, less than 50% of the models show a statistically significant change in any of the seasons (NOAA 2013, p. 57).

Under the scenarios produced by the models, the Service's assessment is that a change in temperature consistent with the scenarios do not present changes in the within the extent of the models that can be reasonably expected to impact the status of the sturgeon. Sturgeon are not cold water dependent fish and in fact if air temperatures were to increase the temperature of the water, one could hypothesize a quicker maturation time of the free embryos. An increase of the maturation rate would reduce the distance needed to drift before maturation. The models didn't produce statistically significant scenarios that would alter the precipitation rate and therefore no effect to the sturgeon can be reasonably inferred.

2.12 Summary of Status of the Sturgeon

Since listing, the status of the species appears to have stabilized. While the numbers of wild sturgeon collected in the Missouri, Mississippi and Atchafalaya rivers are higher than initially documented when listed and evidence for limited recruitment exists for the lower Missouri and Mississippi rivers, the population has not been fully quantified. Population estimates for wild sturgeon within some inter-reservoir reaches of the Missouri River indicate the extant wild populations are declining or gone. Recruitment of young (from limited natural spawning) into the population in the Lower Yellowstone River and Missouri River below Fort Peck is almost non-existent. Augmentation of the wild fish with hatchery raised sturgeon is supporting continued presence of sturgeon in many reaches of the Missouri River. Many of the fish released through augmentation are reaching the age where they are expected to begin spawning, while existing wild adult fish are reaching an age of increased mortality.

3.0 BASELINE CONDITION in and near the ACTION AREA

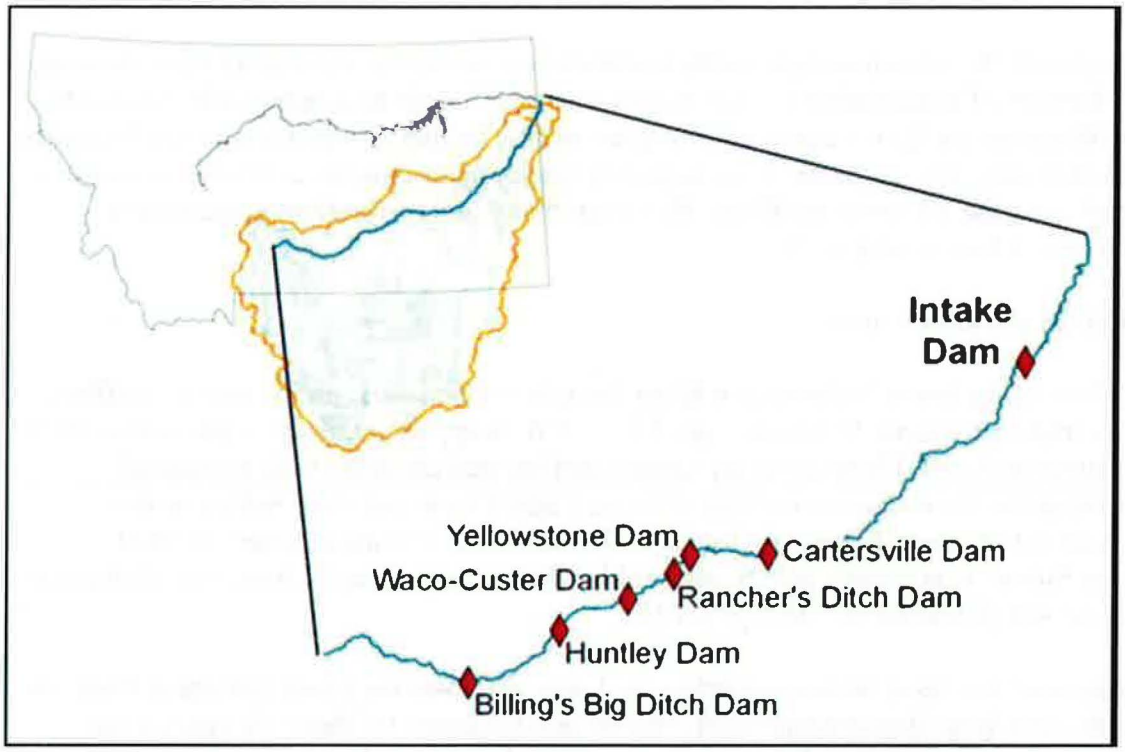
Most of the information below was drawn directly from Reclamation's 2010 EA and the Reclamation's amended Assessment.

3.1 General Description of Yellowstone River Basin Condition

The Yellowstone River is not impounded by storage reservoirs, and the mainstem of the river is not regulated. Therefore, it is considered to be essentially free-flowing. However, there are six

diversion dams upstream of the current Irrigation Project dam (also known as Intake) on the Yellowstone River.

Figure 1. Diversion Dams along the Yellowstone River (Assessment p. 26)



The uppermost diversion dam is Billings Big Ditch Dam. The next dam downstream is the Huntley diversion and is Reclamation-owned and managed by the local irrigation district, while the middle four (Waco, Rancher's Ditch, Yellowstone, and Cartersville) are privately-owned and managed by local irrigation districts. Intake is Reclamation-owned and managed by the local irrigation district. All six dams present varying degrees of impediment to fish passage. The extent of fish blockage at these dams depends on river stage and the swimming ability of the various species trying to negotiate the dams. Currently, several agencies are working on resolving fish passage issues at Cartersville (165 miles upstream from the Intake dam) and Huntley Dams, and a fish screen has been installed at the Shirley Unit of the Buffalo Rapids project (Assessment p.27).

The Bighorn and Tongue Rivers are major tributaries to the Yellowstone River. Reclamation currently operates Yellowtail Dam and Afterbay Dam on the Bighorn River while the Montana Department of Natural Resources and Conservation operates the Tongue River Dam on the Tongue River. Yellowtail Dam was constructed for the production of power, flood control, and the storage of water for irrigation. The Tongue River Dam was constructed primarily for irrigation purposes.

Bank stabilization projects have proliferated over the years, and the action area contains some of these projects. In addition, the action area has a total of five man-made structures that stabilize

the river channel. These structures are the existing headworks, the new headworks, the diversion dam, a boat ramp, and a field of boulders extending about 300 feet downstream of the diversion dam. The boulders originally served as a means to raise the water surface elevation for diversion into the Irrigation Project main canal, but have been pushed downstream due to ice and high flows.

Conservation groups have been working with landowners to conserve and restore riparian areas. The Natural Resource Conservation Service continues to work with landowners adjacent to the Yellowstone River on a wide variety of conservation efforts including water and natural resource conservation. Recently, the Corps has been requiring screening to minimize fish entrainment in irrigation intakes on the Yellowstone River. However, many older irrigation projects have unscreened intakes (Assessment p. 28).

3.2 Habitat in the action area

Instream habitats of the lower Yellowstone River include main channel pools, runs and riffles, side channels, and backwaters. Most pools are 5 ft. - 10 ft. deep, although some are at least 18 ft. deep during summer flows. There are many islands and braided channels with associated backwaters, except in the reaches from Miles City to Cedar Creek and from Sidney to the confluence with the Missouri River. The lower Yellowstone River main channel riverbed upstream from Sidney is primarily gravel and cobble. Downstream from Sidney, the substrate is mainly sand and silt (Reclamation 2010 p. 3-19).

Fifty-two species of fish have been recorded in the lower Yellowstone River (Montana Fisheries Information System, http://fwp.mt.gov/fishing/mfish/default.aspx). Of these, 31 species are native and 21 species are introduced. Native species considered abundant include the blue sucker, channel catfish, emerald shiner, flathead chub, goldeye, longnose sucker, paddlefish, river carpsucker, sauger, shortnose redhorse, shovelnose sturgeon, smallmouth buffalo, stonecat, western silvery minnow, and white sucker (Montana Fisheries Information System, http://fwp.mt.gov/fishing/mfish/default.aspx)(Assessment p. 29).

Based on the information reported above, aquatic habitat in the action area appears to be in adequate condition to generally support all the life history needs of the sturgeon, except successful reproduction (due to migration barrier at the dam and short free embryo/larva drift distance below the weir).[2]

[2] In January 2015, a crude oil pipeline ruptured in the Yellowstone River approximately 30 miles upstream of Intake Dam. It is estimated that 38,000 gallons of crude oil was released into the Yellowstone River under winter ice. Samples of fish tissue (including tissue from shovelnose sturgeons) were taken for fish consumption testing as well as fish health survey sampling. Fillet tissues sampled contained concentrations of polcyclic aromatic hydrocarbons above human consumption guidelines. More sampling was performed in the spring of 2015, but data and analysis are not available at this time.

3.3 Value of the action area for the conservation needs of the sturgeon

Restoring habitat connectivity where barriers to fish movement occur is considered priority level 1 in the pallid sturgeon recovery plan (Service 2014, p. 77). Priority 1 actions are considered "... actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future." (Service 2014, p. 75).

The most important value of the action area for the conservation of sturgeon is to provide an area where adequate numbers of sturgeon can breed, feed and shelter. Currently the habitat likely supports feeding and sheltering, but breeding is effectively precluded above the dam, because fish are unable to move successfully through or over the rock in the dam or the rock debris field. The lower Yellowstone River upstream of the dam contains what is expected to be some of the best remaining habitat for successful spawning (Service 2000a, Service 2003). Because the spawning strategy used by sturgeon relies partially on free embryo/larval drift (anywhere from 152 – 329 miles depending on velocity and water temperature), passage at the dam is crucial to take advantage of the river's unregulated flow. The further upstream sturgeon are able to spawn, the longer the number of days drifting free embryo and larval fish have to develop and locate suitable habitat before entering Lake Sakakawea (which is largely unsuitable habitat for development). Though observations are limited, there have been multiple observations of pallid sturgeon during spawning season, at least 112 miles above the Intake Dam (Assessment, p. 32). This indicates the drive for spawning sturgeon to move substantial distance above the dam to find appropriate spawning areas. Suitable spawning habitat is much more prevalent above the dam. The ability to spawn as far upstream as habitat and conditions permit may be critical to development and survival of larval and immature fish and to survival, recruitment, and recovery of the species. Providing passage at the dam would open approximately 165 miles of additional habitat (between Intake dam and Cartersville dam – the next potential barrier) in the Yellowstone River to sturgeon, as well as providing access to the confluences of the Powder and Tongue rivers (Reclamation 2010). Combined with the 90 miles or current habitat below Intake dam the total habitat would be approximately 255 miles.[3] That distance is significant because it is believed to provide sufficient time for a portion of the embryos to drift, mature, and find suitable habitat before reaching Lake Sakakawea (Assessment p. 33).

3.4 Reproduction, numbers and distribution

3.4.1 Reproduction in the action area

Except as described below, reproduction above the weir is currently thought to be sporadic to nonexistent because adult wild fish are typically unable to move above the Intake Diversion Dam and spawn. Evidence strongly suggests that sturgeon spawning occurs in the lower 6-9 river miles below the dam in the Yellowstone River (Assessment p. 33). The evidence for spawning below the dam includes many fish moving into the lower Yellowstone River during spawning season, ripe fish occurring in the Yellowstone River, and fish aggregating during the spawning

[3] The first potential impediment in the Tongue River is twenty miles from its confluence with the Yellowstone. The Powder River is largely unblocked and several hundred miles long, but it is unknown how much of this is potential sturgeon habitat. Pallid sturgeon were observed twenty miles up the Powder River in 2014.

season (late May and early June). Despite this evidence of spawning in the lower Yellowstone River (below the dam), there are no detectable levels of recruitment occurring (Assessment p. 33). Braaten et al. (2008) suggests larval drift distance presently available below the dam (about 90 miles) is insufficient in length and settling habitat (Assessment p. 33). As a result of this short available distance, larvae could drift into Lake Sakakawea and die due to unsuitable habitat conditions there (Assessment 33). The potentially lethal conditions include lack of food, predation and low oxygen levels. With a longer drift distance it is more likely that a portion of the free embryos would be able to mature enough to be able to move into suitable habitat before reaching the lake (Assessment p. 33).

Recent spawning - In a recent unusual event, an egg-bearing adult female and four adult males used a four and a half mile long high water channel to migrate upstream of Intake Diversion Dam in June 2014 (Assessment p. 32). Three of these fish – the gravid female (egg bearing) and two males - were later located in the Powder River. The gravid female moved approximately 20 miles up the Powder River and spent approximately six days there (D. Trimpe, Bureau of Reclamation, pers. comm. March 5, 2015). The two males moved between five and eight miles up the Powder River. The other two males moved upstream of the Intake Diversion Dam where one stayed in the general vicinity and the other moved upstream to near Glendive, Montana. The female was captured shortly after her return to the Yellowstone River and no longer had eggs. Telemetry data regarding her movements (and percentage of time spent in the Powder River) suggest that she is likely to have spawned in or near the Powder River. Later, all three fish passed the Intake Diversion Dam, (telemetry data indicates they did not use the high water channel) and returned to the lower Yellowstone River (D. Trimpe, Bureau of Reclamation, pers. Comm. March 5, 2015).

3.4.2 Numbers in the action area

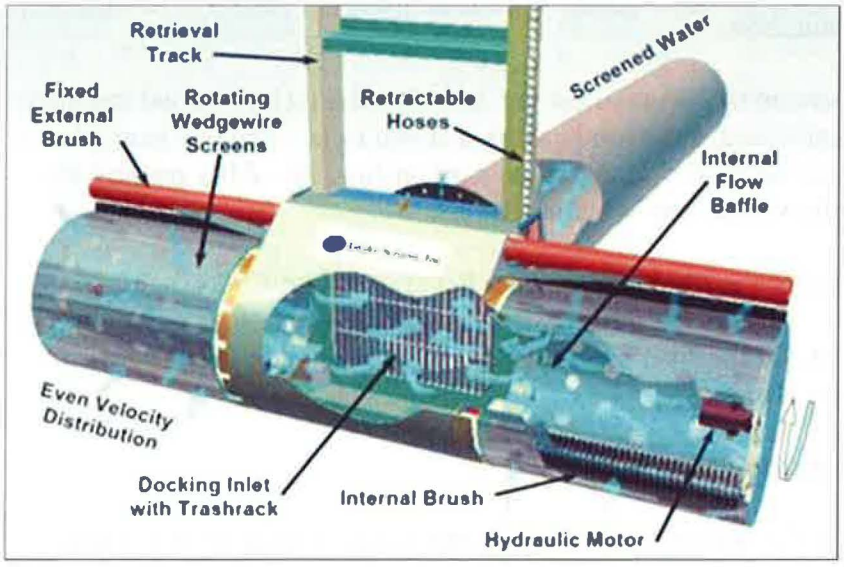
Since 1994, the augmentation program has released hatchery-reared sturgeon within the Missouri River, portions of the Yellowstone River, and sporadically in the Mississippi River. Thousands of fish have been released. Supplementation data are summarized within the stocking plan (Service 2008). Early stocking took place throughout the Yellowstone and Missouri Rivers and included some broad stocking of hatchery larvae greater than 1 ½ inches above the Intake Diversion Dam, but most limited stocking now takes place below the dam. Stocking typically took place in the fall (September and October) of the year.

Recent survey and modeling information (Rotella 2015 p. 80) in the area of Recovery Priority Management Area 2 (Missouri River below Ft. Peck down to Lake Sakakawea) found that "*When summarized by age class, the estimates indicate that 43,012 of the 243,934 fish that were released from hatcheries from 1998 through September of 2013 in RPMA 2 were still alive in September of 2013.*" Estimates are that 15,455 of these fish are aged 6-8 years and 1,981 are greater than 9 years of age. Assuming no large mortality event or an unexpected increase in the natural mortality rate, this means that over the next 15 years, almost 18,000 sturgeon in this group will be reaching maturity and the capacity to reproduce (at age 15-20 years). In addition to the augmented fish, an estimated 125 wild sturgeon remain in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea including the lower Yellowstone River

(Jaeger et al. 2009). Members of this number are aging and natural mortality is slowly reducing their numbers every year.

In 2011 fish screens were installed on the Intake Diversion Dam headgates leading to the main canal to reduce the number of fish (all species) entrained into the Irrigation Project.[4] This reduction in entrainment increased the numbers of fish in those populations. Before the current screens were in place it was estimated that about 500,000 fish of 36 species were annually entrained into the main canal, of which as many as 8% were sturgeon (Assessment p. 29). (The sturgeon were not separated to species, but given the species distribution and the lack of fish passage, most were probably shovelnose sturgeon.) The loss of fish for decades (up until the screens were installed) may have also included any life stage of pallid sturgeon, including any free embryos produced sporadically throughout the decades, juveniles that happened to have been above the weir and even potentially some adults. The screens perform two functions that reduce fish loss. They are designed to prohibit passage of fish larger than 1 ½ inches and the screens change the characteristics of the approaching water velocity so it is less likely for small fish (even for fish small enough to potentially pass through the screens) to be drawn near the screen-channel interface. The installation of the screens has all but eliminated loss of fish through entrainment and will substantially improve the survival of any fish in the future that are exposed to the area near the headgates. This essentially eliminated a long-existing source of loss of pallid sturgeon that made it up river past the dam. The screens significantly improved the current environmental baseline condition for fish of all species including the pallid sturgeon. In the future, when adult sturgeon are able to move upriver beyond the new weir and spawn, some free embryos maybe entrained by the screens, but the screens will protect a portion of them, resulting in higher survival rates for embryos.

Figure 2. Diagram of removable drums screen (from Assessment p. 8).



[4] Consultation on the effects of installation of the screens was completed in April 2010 with a concurrence letter from the Service. As such it has been included in the environmental baseline.

3.4.3 Distribution, timing, and life history in the action area

Currently the distribution of adult and hatchery fish is limited to about a 70-mile stretch of Yellowstone below Intake Diversion Dam and the Missouri below Fort Peck Dam. Wild and hatchery fish are mixed and spend July through April in the lowest part of the Yellowstone and Missouri rivers. As mentioned above estimates are that approximately 43,000 augmentation fish (various age classes) currently exist in this area.

As the river rises due to snowmelt, the ascending limb of the hydrograph apparently cues the adults in the Missouri River and Yellowstone River below the dam to move upstream to spawn. These fish arrive at the dam in late May or early June; historically they would probably have moved beyond the area of the dam and spawned in or near the tributary rivers (Tongue, Powder, etc.).

Adult sturgeon migrate upstream to the dam each year, however, very few sturgeon have been documented above the dam (see previous section for sturgeon above the dam in 2014) (Assessment p. 33). Before the passage in 2014, there are four additional confirmed observations of wild adult pallid sturgeon collected upstream of Intake dam; one in 1950 in the mouth of the Tongue River and one in 1991 near Fallon, Montana (Brown 1955, Watson and Stewart 1991). In addition, one hatchery released fish was found above the dam in 2011 and 2013. It is unknown if these fish migrated upriver over Intake dam or around it in the natural existing channel (Service 2015, p. 14). However given the water velocity, debris field and the rock dam it seems unlikely that they passed over the dam. The high water channel and conditions that allowed documented passage in 2014 are relatively rare and short-lived. The Service estimates that it occurs only for about 7 days, every 5 out of 10 years (Service 2015 p. 14). The rarity of this condition means the current dam presents what is essentially a complete barrier to upstream movement of sturgeon.

Juveniles are unlikely to move upstream to the area near the dam due to a lack of sexual maturity to respond to natural cues. After spawning, sturgeon head back down river. The one example from 2014 showed a spawned female and a few males at the dam on June 20. After passing the dam they returned to the lower Yellowstone and Missouri Rivers.

Free embryos from a spawning area (for example the Powder River) would drift downstream to the new weir area in approximately 2-4 days (D. Trimpe, Bureau of Reclamation, pers. comm. March 24, 2015) then drift further down the river and transition to larvae and later life stages in the lower Yellowstone and Missouri rivers.

3.4.4 Climate change in the action area

The Service discussed various scenarios for climate change in the Status section (2.11). Those scenarios included the action area. In that section we found that the climate change scenarios do not present changes that would be reasonably expected to impact the status of the sturgeon. There are no more specific or refined scenarios for the action area, therefore that conclusion holds for the action area also.

3.5 Summary of baseline condition

Currently there are approximately 125 wild pallid sturgeon adults and 43,000 hatchery fish (including 15,455 aged 6-8 years and 1,981 greater than 9 years of age) distributed below the Intake Diversion Dam in the lower Yellowstone and Missouri Rivers. Approximately 125 adults of spawning age are currently available to migrate upriver to spawn. Any that do are essentially blocked from passing by the existing dam. Sturgeon that spawn below the dam in the Yellowstone or Missouri rivers have not been successful. Recruitment of fish into the population is non-existent. This lack of success is likely a result of not enough larval drift distance below the dam before free embryos or larvae would reach Lake Sakakawea. Fish screens at Intake Diversion Dam have largely eliminated the risk of any fish upstream of the dam being entrained. The group of hatchery fish below the dam is reaching potential spawning age. If passage can be built around the dam, and spawning age fish pass above it, the condition is set for a population response.

4.0 EFFECTS OF THE ACTION

4.1 Analytic Approach

The Service deconstructed the proposed action into 8 major activities and then further subdivided them into approximately 59 sub-activities. We arranged those into an exposure table (Appendix A, Table 2). This table was used as an organizing tool to eliminate sub-activities that the species would not be likely to be exposed to. That filter was based on the spatial arrangement of the activity and the species in the action area, the life history of the species, timing of the sub activity, and implementation of any conservation measures or best management practices (Appendix A, Table 1).[5]

The remaining sub activities that it would be reasonably likely for the species to be exposed to were carried forward into another table to determine if the exposure produced a likelihood of a response and effect and if so, the magnitude or significance of that effect (Appendix A, Table 3). If a response and effect was unlikely to occur, the effect was considered to be discountable. If the effect was considered to be small enough that its effects to the species could not be meaningfully measured, detected, or evaluated it was considered insignificant. The rationale for those findings was noted in Table 3 (Appendix A).

Those activities and our rationale for their being discountable or insignificant are incorporated by reference as a part of the effects of the action section. The remaining activities and their sub activities, where effects or responses were likely and NOT insignificant, were brought forward to be discussed further in this effects section. Those activities are 1) the continued operation of the fish screens, 2) the physical presence of the new weir (with notch and bypass channel) in the river, including closure of the high water channel, 3) maintenance of the existing dam for

[5] During all these activities, general conservation measures such as working behind coffer dams and doing instream work outside of the pallid sturgeon's migration and spawning period will be employed to reduce the likelihood and significance of effects to all life stages of the pallid sturgeon (Assessment pp. 51-52).

approximately two years until the new weir and bypass are operational, and 4) monitoring and adaptive management. These are discussed individually below.

4.2 Activities and sub activities that are likely to have adverse effects

4.2.1 Continued presence of the current dam

The current dam is used to deliver specified amounts of water to the Irrigation Project as originally authorized (Assessment p. 19). To provide water and allow for fish passage, the proposed action is to build a new weir and fish bypass channel. The construction timing and phasing of a complex project in a river environment is driven by many environmental considerations such as ice, high water, irrigation season, access, etc. Reclamation has determined that it will take 2-3 years to complete the project. In the intervening period of time, Reclamation will continue to maintain the current dam to provide water to the irrigation project. Though the physical action of maintaining the dam (adding rock to the existing dam) is not likely to produce adverse effects (appendix A, table 3), its presence in the river will.[6] Those effects are that any spawning adult sturgeon that attempts to pass the dam will be thwarted. This will be the situation for 2-3 years and is similar to the situation that has existed for decades.[7] After the new weir and fish passage channel is built, any spawning sturgeon that attempts to pass the new weir (every year) will have the opportunity to pass upriver through the new bypass channel and downstream through the channel or weir notch (see discussion in later section).

Data on approximately how many sturgeon are likely to be adversely affected by the dam doesn't exist, but can potentially be inferred from data from the Comprehensive Sturgeon Research Project (CSRP). The CSRP is a multiyear, multiagency collaborative research framework developed to provide information to support pallid sturgeon recovery and Missouri River management decisions (DeLonay et. al. 2014, p. 1). The research consists of several interdependent and complementary tasks that engage multiple disciplines.

The CSRP have developed effective telemetry tagging and tracking methodology to relocate individual fish over long periods of time. Fish selected for tagging are male and female sturgeon in reproductive condition. Between 2006-2010 approximately 70 pallid sturgeon were tagged (DeLonay et. al. 2014, p. 15). Monitoring stations at the confluence of the Missouri and Yellowstone Rivers identify tagged fish that move into the Yellowstone River from the Missouri River and another monitoring station at the dam identifies individuals that are in the immediate area of the dam.

The 2014 report showed that between 2005 and 2011 the percentage of total telemetered fish that migrated into the Yellowstone River ranged from 60 to almost 90 percent (DeLonay et. al. 2014, p. 64). Specific to the Irrigation dam, Braaten et. al. (2014. p. 6) reported that eight pallid sturgeon were identified at the dam in 2011, and five were identified there in 2012. In those

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[6] It is questionable whether the existence of this dam, which was built prior to the enactment of the Act, is an effect of the proposed action, but the Service has nevertheless analyzed the effects of its future existence and maintenance in this biological opinion.

[7] As mentioned earlier, there have been pallid sturgeon found upstream, but those documented cases are rare and considered atypical. In most cases it is unknown exactly what path they took around the dam (Assessment p. 32).

years, this represented 25.8 and 12.2 percent of the telemetered population respectively (Braaten et. al. 2016, p. 6). Braaten et. al. (2014, p. 9) infers from their study that "...12-26% of the population may possess the motivation to migrate beyond the reach."

Additional information shows seven pallid sturgeon (12 percent of the tagged population) at the dam in 2013 and five (unknown percentage) in 2014 (D. Trimpe, Bureau of Reclamation, pers. comm. June 22, 2015). Those in 2014 are the ones that passed above the dam via the high water channel. The additional numbers reported from 2013 and 2014 are reasonably consistent with Braaten et. al. previous numbers and percentages.

The tagging effort for wild pallid sturgeon continues each year as a part ongoing monitoring, but because of battery loss, fish mortality and difficulty in capturing individuals in a small population, approximately 45 individuals carry active telemetry at any given time (D. Trimpe, Bureau of Reclamation, pers. comm. June 23, 2015).

If we assume that on average approximately 32 percent of the wild population (45 of 125) are telemetered this means that 68 percent are not telemetered. That implies that for each telemetered fish known to have reached the Intake dam, it may represent two others that have also reached the dam, but are not detectable. Without any more specific or conclusive data, and based on a relatively small sample size (3 years), this suggests that in any given year, as many as 26% (approximately 32 fish) of the wild population migrate from the lower Yellowstone River and the Missouri River and are kept from passing above the Intake dam.. The Service considers this to be an injury to those individuals by impairment of their reproduction for that year.

4.2.2 Operation and maintenance of fish screens

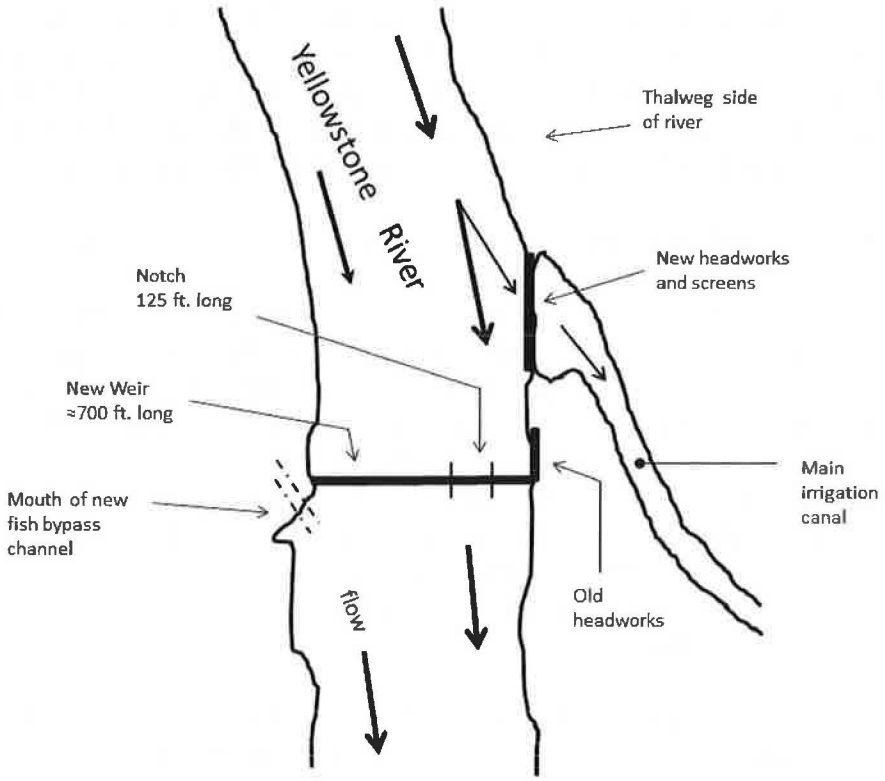
As part of the proposed action the fish screens on the headgates will be in operation reducing entrainment of fish into the irrigation project's canals. Before the current screens were in place it was estimated that 500,000 fish of 36 species were annually entrained into the main canal at Intake Diversion Dam, of which as many as 8% were sturgeon (Reclamation 2010). These screens installed in 2011 are designed to meet salmonid criteria established by the Service and the National Marine Fisheries Service (Assessment p. 7). The current fish screens are expected to all but eliminate entrainment of fish larger than 40 mm (approximately 1½ inches). (Recent data suggest the number of entrained fish behind the screens is orders of magnitude less than the previous estimate.)[8] Depending on maturity, some sturgeon embryos are smaller than this size and therefore some may be entrained.

The adverse effects from the screen presence are likely to occur to only very small fish (less than approximately 1 ½ inches) that can pass through the screen and be entrained, or small fish that become trapped against the screen by mild suction and then are brushed off the screen by the screen wipers (Assessment p. 54-55).

[8] Raw data from monitoring in 2014 suggest that in approximately 18 days of monitoring (variable sampling duration) approximately 1,700 fish were captured behind the screens (D. Trimpe, Bureau of Reclamation, pers. Comm. July 7, 2015).

Once the fish bypass channel is operational, sturgeon are predicted to pass by the weir and spawn many miles upstream. (For example, in 2014 a spawning female spent several days 20 miles up the Powder River – approximately 98 river miles above the dam.) Though adult fish will be at no risk of effect from the screens, free embryo drifting downstream after hatching may be. If spawning takes place in the Powder River, within about 2-4 days free embryo would arrive at the weir. Because free embryo are weak swimmers and generally are moved by the river current, there will only be a short period of days when free embryo are passing through the portion of the river that contains the screens. The screens are located slightly upstream of the weir and to the side of the river channel. This position is influenced by the thalweg of the channel. (The thalweg is the deepest part of the channel in cross section and is typically found on outside bends of the river.) Free embryo will be distributed throughout the width of the river, but because of hydraulic flow of the river, may be disproportionally prevalent in the thalweg and screen side of the river (Assessment p. 54). See Figure 3 below.

Figure 3. Schematic of project area (approximately to scale).



At the time of the free embryo's passage, the portion of water being withdrawn from the river is relatively small compared to the river's total volume (Assessment p. 55). This circumstance reduces the likelihood for the water withdrawal to have a disproportionate physical "draw" for the free embryo passing by the screens. In addition, the screens were designed to have a very

low "approach velocity" further reducing the area at the screen which would draw fish and free embryo passing by.[9]

For all these reasons, the Service expects the number of free embryo exposed to the screens to be relatively low, and the number killed or injured by that exposure to be small compared to the total number of free embryo in the water column. However, all free embryo coming in direct contact with the screen are likely to be killed or injured by the trauma of passing through the screen or being impinged against it and then wiped off.

The Service cannot predict the exact number of free embryos that will be exposed to the screens. This is due to the size of the free embryo as it develops, the volume of water passing through the screens, and the withdrawal of water for the main canal. Likewise, the Service cannot estimate the number of those free embryos exposed to screens that will be injured or killed. We discuss this issue later in section 4.3.

4.2.3 Physical presence of the new weir and bypass channel

The physical presence of the weir in the river potentially affects adult sturgeon in two ways -- by impeding upstream migration for spawning and impeding downstream migration following spawning.

Upstream effects to adults from presence of new weir and bypass channel - For moving upstream, the new weir will have a constructed bypass channel on the south side of the river. This channel was specifically engineered with appropriate flow volume and velocity to allow for a fish to move up and around the weir, and also a flow that can be sensed by fish in the area of the weir and serve as an attractant to the bypass channel (Assessment p. 11). Based on experience with fish bypass channels and the design of this bypass, it is expected that even if fish are moving upstream and encounter the weir, fish cued to move up the river to spawn, will explore the weir, find the channel and move upstream. This sensing ability was demonstrated in 2014 when 5 adult sturgeon found a natural bypass channel and moved upstream above the weir (Assessment p. 32). The new bypass channel mouth will be located about 1,900 feet upstream from the previous high water channel mouth. This position puts it much closer to the barrier represented by the new weir. To make it even more likely for the sturgeon to find the bypass channel, the engineered channel will carry 13-15 percent of the total river flow as opposed to the approximately 5% carried sporadically by the natural channel (Assessment p. 52). In addition, while the highwater channel is approximately 23,438 feet (4.45 miles) long, this bypass channel is substantially shorter at approximately 11,150 feet (2.17 miles) long (Assessment, p. 13).

Therefore, the Service expects spawning sturgeon to be fully able to move upriver beyond the weir. Any delay to moving upriver is expected to be temporary and not represent an impairment of breeding or reproduction that leads to actual injury or death. (See section 4.2.4 for monitoring

[9] Approach velocity is determined by taking the flow of the river, the diversion amount at that flow and designing the screens such that both the angle of the flow toward the screen and the strength of that flow act in concert to reduce the "draw" toward the screen – making an interaction with the screen much less likely. It also lowers the flow's energy at the screen, so that fish interacting with the screen are more likely to move across the face of the screen without becoming impinged.

this aspect of the project and adaptive management approach to act on observations.) The ability to pass upstream through the bypass channel is expected to improve spawning opportunities resulting in greater reproduction and recruitment of young fish.

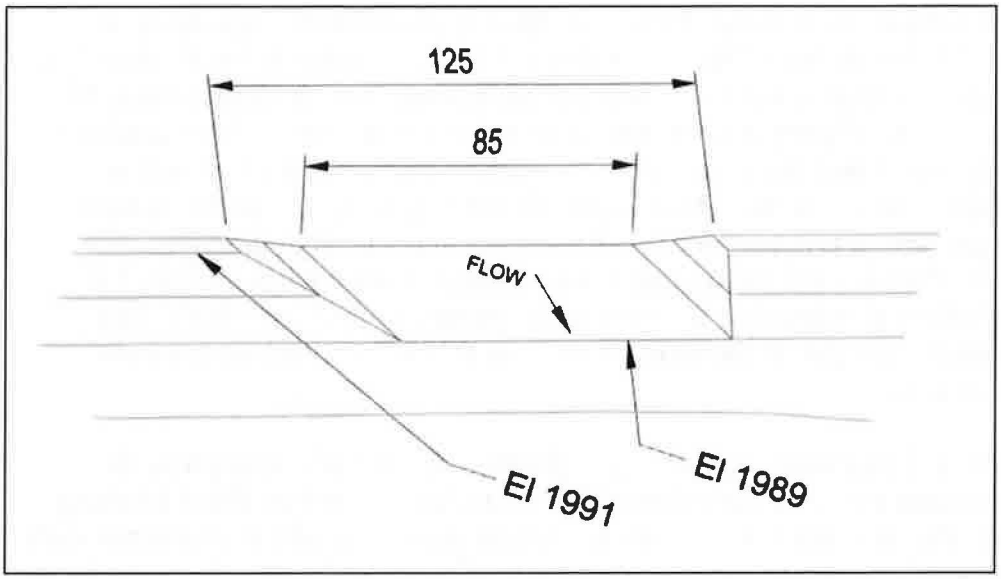
Downstream effects to adults – At the time of fish movement downstream (late June and early July), the water is predicted to be approximately 5.5 to 4.5 feet deep over the top elevation of the weir. This should make passage downstream for all life stages relatively easy. The weir design also includes a gradually sloping approach to the weir (from upstream) making the hydraulics less likely to impede passage (Assessment p. 10). In addition, fish can use the bypass channel on the south side of the river (that the sturgeon would have likely used to pass above the weir).

The weir is also constructed with a tapered notch in the weir (125 foot at the top and 85 feet at the bottom) which is not centered in the weir but is oriented further toward the thalweg side of the river (Assessment p. 10, and Figure 3). The current dam has a wooden structure that is at an elevation of 1989 feet. For appropriate irrigation flow, an additional two feet of rock are added for a total elevation of 1991. The new weir top will be built to the same elevation (1991 feet). The bottom of the new weir's notch will be the same elevation as the old structure (without the additional rock height) 1989 feet (Figure 4). In addition, the rock fill immediately downstream from the notch will also be at 1989 feet providing a slight channel downstream of the new weir notch (D. Trimpe, Bureau of Reclamation, pers. comm. July 2, 2015). At the typical time of passage (high water) the water is approximately 7.5 feet over the bottom of the notch (D. Trimpe, Bureau of Reclamation, pers. comm. May 5, 2015 – email including *Lower Yellowstone – Intake Bypass Channel ADH (2-D) Downstream Focus Model, Summary of Initial Results – Notch Comparison*). Given that in 2014 one of the sturgeon that moved upstream beyond the dam found its way back down over the existing dam and rocks below, it is expected that future passage downstream over an improved weir and notch will be even easier.[10]

Again, any delay to moving downstream is expected to be temporary (even less than when moving upstream) and will not likely represent an impairment of breeding or reproduction that leads to actual injury or death for adult sturgeon.

[10] In July of 2014 the pattern of radio telemetry signals from an adult sturgeon passing over the Intake Diversion Dam and through the debris field raised the possibility that the sturgeon had died. Telemetry data from May of 2015 shows the fish to be alive and it has migrated to the area of the dam (D. Trimpe, Bureau of Reclamation, pers. comm. June 4, 2015)

Figure 4. Notch dimensions (in feet) and elevations (above sea level).



Downstream effects to free embryo - Recently hatched free embryo will also meet the new weir as they drift downstream. The weir is not constructed like a dam where water flow is stalled by an abrupt vertical wall. The weir is more of an instream "hump" that checks the flow in such a way as to create a slightly higher water surface elevation. This "bulge" of water behind the weir acts as a very small pool to assist in supplying the correct amount of water to the screens and headgates.

Free embryos moving downstream are not capable of swimming well and are largely dependent on the current. Since the weir is designed for smooth water flow over the top of the weir (Assessment p. 10) it seems unlikely to trap or significantly stall free embryo. At the time of passage (late June and early July), the water is predicted to be approximately 5.5 to 4.5 feet deep over the top elevation of the weir.

Free embryos may also pass through the bypass channel or the notch in the weir (described above). Given this information, the Service expects the free embryo to encounter the weir, and associated water bulge, and pass over the weir without great delay. (Arguably, if they were delayed slightly by the weir without incurring injury, it could be advantageous by acting as additional maturation time before moving down river.) Free embryos passing over this new weir, which is designed for smooth flow, will be less likely to be injured than if they had to pass over the current dam/rock structure.

Upon floating over the weir crest, the free embryo will encounter faster flowing and more turbulent water immediately below the weir (though not a drop typical of a dam). This condition will vary along the weir depending on location and water level. Also, they may encounter scattered rocks (debris from the current dam) in the river current directly downstream of the weir. It is possible that some of the free embryo moving over the weir, that are unfortunate enough to encounter the worst of the turbulence, and then also strike rocks could be injured or

killed. (In the future, since rocks will not simply be piled to produce the dam, the high water and ice will disperse the existing debris field and potential for injury will be further reduced.) The Service knows of no information that could allow us to develop a reasonable approximation of that number, but given the distribution of the free embryo in the water column, the height of the water over the weir, and the variability of the turbulence and obstructions, it seems reasonable that it would be only a very small portion of the total free embryo in the water. Sturgeon have evolved in river systems that often have rock, riffles, tree debris, etc. in them and it seems unlikely that through adaptation these would have caused mortality risks beyond the sturgeon's breeding strategy. Regardless, it is reasonable to assume some small level of mortality. Unfortunately, like the earlier discussion on estimates for impacts from the fish screens, the Service does not have information to allow for an accurate prediction of the number of free embryo killed or injured by exposure to the weir. Later in section 4.3 we explore this issue regarding estimating impacts.

Upstream effects to adults from closure of high water channel - As part of creating a stable bypass channel, the upstream mouth of the existing high flow channel must be filled, blocking potential access to fish. Partially this is a necessity to prevent the uncontrolled water in the high flow channel from potentially undermining the construction of the new channel. As noted by the Service earlier, this high flow channel passed fish in 2014, but is not a dependable fish passage channel.

In 2014, the Yellowstone River was flowing at approximately 47,000 cfs when the first fish was documented using the existing high flow channel (D. Trimpe, Bureau of Reclamation, pers. Comm. May 22, 2015). If flows of this magnitude are needed to pass pallid sturgeon in the existing high flow channel during May 15 – June 15, then this condition would be expected to occur only 7 days in 5 out of 10 years (Service 2015). The new bypass channel is being designed to pass pallid sturgeon down to 15,000 cfs in the Yellowstone River. From May 15 to June 15 the Yellowstone River is expected to flow 15,000 cfs or greater for 25 days in 10 out of 10 years greatly increasing passage success around the dam. The new channel will pass more water and provide greater depths than the high flow channel, will be more stable, is of known design, and can be more easily modified for performance if monitoring indicates modification is needed.

Therefore, given the uncertainty of adequate flows in the high flow channel and the channel's limited availability when adequate flows are present, the Service believes the effects of blocking the high flow channel are not certain enough to be considered an actual injury through breeding impairment during the 2-3 years of construction.

4.2.4 Monitoring and adaptive management [11]

Though the best engineering approach has been used for the weir and bypass channel, there are uncertainties regarding the performance and passage consequences of the new weir and bypass

[11] We discuss the potential effects the monitoring and adaptive management plan could have to individual pallid sturgeon. This plan is an important tool to gain information on the physical and biological performance of project, however the fact that a plan is in place is not used in our eventual conclusion regarding the likelihood of whether this proposed action is likely to jeopardize the pallid sturgeon. That conclusion is based on the described effects of the proposed action.

channel. Therefore, Reclamation has established a monitoring and adaptive management plan to monitor that performance and has outlined potential responses to correct any deficiencies that are discovered (Assessment-Appendix E, p.4 and 9). This adaptive management plan is a framework for the program and is not an exhaustive or prescriptive approach. It is however, a commitment to take appropriate action based on explicit monitoring goals. The Service, Montana Fish Wildlife and Parks Department (MTFWP), United States Geological Survey (USGS) and technical teams will contribute to this plan.

As described below, this monitoring may have some adverse effects to individual sturgeon or free embryos, however the monitoring is targeted at the very effects the Service is exploring and analyzing in this biological opinion. It is aimed at providing direct information on many of the uncertainties regarding the type and degree of effects that the Service is predicting. The monitoring is designed to provide information on two important, but different aspects of the project – physical performance and biological performance.

Physical

1) Are the physical features of the bypass channel consistent with design and construction?
2) Do the physical features produce the expected hydraulic characteristics in the channel and at the upstream and downstream mouths?

Fish passage

1) Are adult spawning sturgeon able to pass the weir going both up and down river?
2) Do free embryos pass downriver past the weir?
3) What is the impact of the fish screens to sturgeon free embryos?

Reclamation has described an adaptive management strategy aimed at identifying performance issues based on monitoring results (Assessment-Appendix E, p. 9). Circumstances may require modifications, the scope of which is unknown at this time. Should modifications be necessary, the particular modification alternative implemented will be based on the best available information and take into account funding and feasibility.

The effects from the monitoring activities and potential adaptive management solutions are discussed below.

Are the physical features of the bypass channel consistent with design and construction?
Monitoring to determine this facet of the project is straightforward using standard observation, inspection, and measuring techniques for structures and water flow. These are not intrusive and the probability of any effects to sturgeon is discountable. Alternatively, any effects that do occur are expected to be insignificant.

Adaptive management to address any construction issues found through monitoring includes modifications to control structures, lateral stability structures, etc. (Assessment-Appendix A, p. 9). If construction modifications are necessary, typically Reclamation uses a construction window (Assessment – Appendix E, p. 61) that takes into account the life cycle of the sturgeon, so that probability of effects to sturgeon is discountable and if any effects do occur they are expected to be insignificant.

Do the physical features produce the expected hydraulic characteristics in the channel and at the upstream and downstream mouths?
Monitoring to determine these parameters will use standard observation and measuring techniques for water flow. These are not expected to be intrusive and the probability of any effects to sturgeon is discountable or any effects that do occur are expected to be insignificant.

Adaptive management to address any performance issues found through monitoring includes modifications to control structures, lateral stability structures, etc. (Assessment- Appendix A, p. 9). Similar to the construction performance described above, modifications are not expected to be needed.). If construction modifications are necessary, typically Reclamation uses a construction window (Assessment – Appendix, p. 61) that takes into account the life cycle of the sturgeon, so that probability of effects to sturgeon is discountable and if any effects do occur they are expected to be insignificant.

Are adult spawning sturgeon able to pass the weir going both up and down river?
Monitoring designed to answer this question will be done by capturing and tagging adult and juvenile sturgeon (Assessment - Appendix E, p.7). Telemetry stations established above and below the new weir, along the bypass channel, and near the headgates/screens will detect fish that approach the weir and determine whether those fish move above (and then back down past) the weir. Though the detection will be done with radio telemetry tags, capture and insertion of those tags are an adverse effect. This tagging effort is currently performed by the Service, U.S. Geological Survey (USGS) and Montana Fish, Wildlife and Parks (MTFWP) and the effects are analyzed and anticipated through existing Service section 10(a)(1)(A) permits and a section 6 agreement with the state of Montana.

Adaptive management actions necessary to alter the performance of the weir, notch and bypass channel for moving spawning sturgeon past the weir (upstream and downstream) are not expected. If monitoring shows passage is not occurring (Assessment – Appendix E, p. 11), a wing wall or training structure may be used to passively move fish toward the notch (Assessment- Appendix E, p. 9). Also, adjustments to earthen fill near the fish passage channel will be considered (Assessment- Appendix E, p. 9).

Do sturgeon free embryos pass downriver past the weir? As described earlier, the new weir is designed specifically to allow for smooth water flow over the top which will facilitate movement of free embryos (and other life stages) of sturgeon over the weir rather than potentially impairing their movement or stalling them behind the weir. Also, the notch in the weir and the bypass channel provide additional avenues for free embryos to pass the weir. When telemetry monitoring indicates that spawning sturgeon have moved past the weir, Reclamation will arrange monitoring at fish screens and below the weir to detect presence of free embryos (Assessment- Appendix A, p. 8). In addition to monitoring for sturgeon, other fish with similar life histories may be caught. If so, this would indicate that the weir is likely not impairing movement of fish (including sturgeon). In the process of netting and capturing free embryos, some may be injured or killed. This monitoring effort will be performed in cooperation with the Service, USGS and MTFWP and effects are analyzed and anticipated through existing Service section 10(a)(1)(A) permits and a section 6 agreement with the state of Montana.

Adaptive management necessary to alter the performance of the weir, notch and bypass channel for moving fish and free embryos past the weir is not expected. If monitoring shows that fish are not passing these structures or are suffering a higher mortality than expected (see discussion later on surrogacy), a wing wall or training structure to move fish away from screens and over the weir will be considered. Similar to the construction performance described above, modifications are not expected to be needed. If construction modifications are necessary, typically Reclamation uses a construction window (Assessment – Appendix, p. 61) that takes into account the life cycle of the sturgeon, so that probability of effects to sturgeon is discountable and if any effects do occur they are expected to be insignificant.

What is the impact of the fish screens to sturgeon free embryos? Data from monitoring of fish and free embryos will inform Reclamation and the Service on the hydraulic performance of the screens and their screening effectiveness. This information could inform potential implementation of screening criteria on other diversions in the Yellowstone and Missouri Rivers. As described earlier, the fish screens are designed to exclude fish greater than about 1 ½ inches from passing through the screen to the network of irrigation channels and ditches. Past monitoring by Reclamation in 2012 and 2013 has shown effectiveness at screening large fish out of the canal behind the screens (D. Trimpe, Bureau of Reclamation, pers. comm. May 5, 2015a). However as discussed earlier in section 4.2.2, free embryos are small enough to pass through the screen.

Adaptive management necessary to alter the screens or hydraulic performance of the headgates is very unlikely given performance demonstrated by past monitoring. If monitoring determines that a greater amount of sturgeon are being impacted by the presence of the screen (see earlier effects discussion on screen effects and section 4.3 below for baseline and), a wing wall or other such structure to move fish away from screens and over the weir will be considered as a remedy(Assessment- Appendix E, p. 9). Similar to the construction performance described above, modifications are not expected to be needed. If they are necessary, typically Reclamation uses a construction window (Assessment – Appendix, p. 61) that takes into account the life cycle of the sturgeon, so that probability of effects to sturgeon is discountable and if any effects do occur they are expected to be insignificant.

4.3 Estimating number of free embryos injured or killed in the future by screens and weir

4.3.1 Uncertainty and lack of information

We find that it is likely that some sturgeon free embryos will be entrained through the screens and injured or killed passing over the new weir. As a part of the effects analysis, typically the Service is able to enumerate the number of a particular life stage of the affected species that will be affected. This number can be useful in making a conclusion regarding the likelihood of the effects resulting in jeopardy to the species. In this case, the effects are in the future after the weir and fish bypass are constructed and the Service has no information that would allow for making a reasonable estimate. However we do know that the reproductive strategy of sturgeon generally accepts very high mortality of eggs and early life forms without detriment at a population level.

Also, in 2009, Reclamation convened a scientific panel to review the available science surrounding the Lower Yellowstone Intake Project. In their final report (Reclamation 2009, p.25) they concluded that "*the net benefit of passage and spawning upstream from Intake Dam is likely to be significant even if a portion of the reproduction is the subject to entrainment losses as long as associated diversion fractions are not excessive.*"

Even without specific information, the Service believes that by using a surrogate species we may be able to assess the magnitude of impact to determine any changes to the population. The Service's Endangered Species Handbook (Service 1998) outlines the Service's policy for use of surrogates when describing effects and incidental take.

"*In some situations, the species itself or the effect on the species may be difficult to detect. However, some detectable measure of effect should be provided. For instance, the relative occurrence of the species in the local community may be sufficiently predictable that impacts on the community (usually surrogate species in the community) serve as a measure of take, e.g., impacts to listed mussels may be measured by an index or other censusing technique that is based on surveys of non-listed mussels. ... Similarly, if a sufficient causal link is demonstrated (i.e. the number of burrows affected or a quantitative loss of cover, food, water quality, or symbionts), then this can establish a measure of the impact on the species or its habitat and provide the yardstick for reinitiation.*" Service 1998, p 4-47

In addition, the Service recently promulgated regulations (Service 2015a) confirming the use of surrogate species for describing the amount or extent of take.

50 C.F.R. §402.14 (i)(1)(i) – " *Specifies the impact, i.e., the amount or extent, of such incidental taking on the species (A surrogate (e.g., similarly affected species or habitat or ecological conditions) may be used to express the amount or extent of anticipated take provided that the biological opinion or incidental take statement: Describes the causal link between the surrogate and take of the listed species, explains why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the listed species, and sets a clear standard for determining when the level of anticipated take has been exceeded.*)"

4.3.2 Surrogacy

We intend to use the shovelnose sturgeon as a surrogate for describing (and in the future measuring) the scale of impact to pallid sturgeon free embryos and confirming our view on what that impact means to the population. Below, we outline the assumptions and rationale for use of this surrogate. There are inherent risks with making simple assumptions, but without more specific information, or a more practical manner of approximating the scale of impacts, we feel it is the most reasonable biological approach at this time. We discuss below why the shovelnose sturgeon is likely to make a good biological surrogate. During the 2-3 years between now and when the weir and bypass channel are in place and the impacts to pallid sturgeon actually occur, the Service will work with Reclamation to explore whether a more accurate or precise method for approximating impacts exists; if one is found the Service can revise this method through common agreement.

The shovelnose sturgeon is considered abundant in the Yellowstone River and does not have protected status under Montana state law. Fishing is allowed and there is no information that suggests the population is not stable and self-sustaining.

We believe shovelnose sturgeon will work as an effective surrogate for pallid sturgeon based on the following assumptions:

Assumption 1 – the life history, reproduction strategy and free embryo drift characteristics of shovel nose sturgeon are very similar to those of the pallid sturgeon.

Assumption 2 – the shovelnose sturgeon population in the area above the current dam is relatively stable and self-sustaining.

Assumption 3 - this assumed stability of the shovelnose sturgeon population occurs in an environment that included an open diversion at Intake Diversion Dam (before 2012 screen installation) and the presence of the current dam and rubble field, which presents greater hazard than will exist after the new weir and passage channel are constructed. Therefore, shovelnose will present a steady surrogate in a changing environment.

Based on these assumptions we predict that the scale or magnitude of impacts likely to be experienced by the future pallid free embryos is similar (proportionally to the population densities) to what has been experienced by shovelnose sturgeon and that like the shovelnose sturgeon, these impacts will not result in a negative population response.

In order to confirm the reasonableness and validity of these assumptions, the Service will work with Reclamation to design a monitoring and sampling effort behind the screens, below the weir and the bypass channel. (Some informal coordination has already taken place.) This monitoring and sampling will work to establish baseline information on entrainment and mortality for shovelnose sturgeon and develop efficient monitoring techniques. This effort in the next 2-3 years will prepare for monitoring spawning activity of pallid sturgeon and impacts to free embryo once the new weir and bypass channel are complete. In the incidental take statement we characterize the goal and approach of that monitoring. We also establish December of 2015 as the date by which this approach needs to be established. This information could also help in developing information regarding screening criteria for other diversions in the Yellowstone and Missouri Rivers.

4.4 Effects of Interrelated or Interdependent Actions

The implementing regulations for section 7 consultations define interrelated actions as *"...those [actions] that are a part of a larger action and depend on the larger action for their justification."* 50 CFR § 402.02. Interdependent actions "*...are those [actions] that have no independent utility apart from the action under consideration."* 50 CFR § 402.02. Interrelated or interdependent actions (such as the maintenance of canals and ditches, withdrawal of water, operation of the fish screens, maintenance of the current dam, etc.) have already been

incorporated into the proposed action and are analyzed in the effects of the action section (or incorporated by reference from Appendix A, Tables 2 and 3).

4.5 Summary of Effects from the Action

Most sub activities described in Appendix A, Table 2 present a discountable likelihood of an effect or an effect that is likely to be insignificant (Appendix A, Table 3). As discussed above, until the new weir is complete with the notch and bypass channel (2-3 years), the Service estimates that up to 32 wild adult sturgeon moving to the dam, each year, will be blocked from moving above the dam to spawn. This is a temporary, but significant impairment of breeding and is considered an "injury" to the sturgeon. Because the impairment represents the status quo, it does not actually change the reproduction, numbers or distribution of sturgeon in the action area.

After the new weir and bypass channel are complete, adult sturgeon are likely to be temporarily delayed at the weir as they seek and find the bypass channel to move above and below the weir. This represents an effect that is not insignificant, but is unlikely to represent a significant impairment of breeding, feeding or sheltering that would lead to actual injury or death. This effect is not likely to change the reproduction, numbers or distribution of sturgeon in and near the action area.

Although there may be minor impacts to sturgeon from temporary delays at the weir, there will be a considerable net gain for sturgeon because of access to 165 miles of river from the bypass channel. Increased drift distance will allow sturgeon free embryo/larvae enough time to mature and become mobile (and able to seek suitable habitat) before encountering the less suitable (potentially lethal) conditions in Lake Sakakawea (Assessment p. 33). This represents a appreciable potential improvement in the sturgeon's reproduction, overall numbers (through potential recruitment) and distribution in, and near, the action area.

For free embryos, the Service described the potential injury or death of a portion of the individuals exposed to the headgate screens, and also a portion of the individuals that move over the weir. We also described (using both simple explanation and a surrogate species) our rationale for why we believe the number of that life stage injured or killed is likely to be small compared to the number in the river and why the breeding strategy of the sturgeon allows for survival even in the face of early life stage mortality. Given that discussion, the Service believes that the loss of free embryo described earlier is not likely to have a discernable negative effect on recruitment of fish into the population and thus will not negatively change the reproduction, numbers or distribution of the sturgeon population in the action area.

Overall, the proposed action substantially improves the likelihood of the sturgeon in the action area surviving into the foreseeable future and its long term recovery.

5.0 CUMULATIVE EFFECTS

The implementing regulations for section 7 define cumulative effects as "*...those effects of future State, or private activities, not involving Federal activities that are reasonably certain to occur*

within the action area of the Federal action subject to consultation." 50 CFR § 402.02 No actions, fitting that description have been identified as having effects on the pallid sturgeon. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation.

6.0 JEOPARDY DISCUSSION AND CONCLUSION

Based on the Service's analysis of the status of the species, effects of the action and any cumulative effects, we must render an opinion as to whether the proposed action is likely to jeopardize the continued existence of the relevant listed species. Jeopardy is defined in the regulations as "*...to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.*" 50 CFR § 402.02.

We find that the proposed action is not likely to jeopardize the continued existence of the pallid sturgeon. The proposed action is not reasonably likely, either directly or indirectly, to reduce appreciably the likelihood of both the survival and recover of the pallid sturgeon in the wild by reducing the reproduction, numbers, or distribution of pallid sturgeon. In fact, the proposed action is likely to substantially improve the likelihood of survival and recovery of the species. Our basis for that opinion is summarized below.

6.1 Negative Effects

The baseline reproduction condition of pallid sturgeon in the action area is poor, but contains potential. While the habitat is generally supportive of feeding and sheltering, the current dam blocks spawning in the tributary rivers above the dam. The total population of pallid sturgeon near the action area is estimated to be approximately 43,000. Estimates are that 15,455 of these fish are aged 6-8 years and 1,981 are greater than 9 years of age. However, the number of wild fish in the action area, that are known to be mature enough to spawn, is small (approximately 125) and aging. Where spawning occurs below the dam, there is not enough drift distance for the free embryos and larvae to become mature enough to seek out suitable habitat before entering Lake Sakakawea. Because the lake is very poor habitat for larval survival, if embryos do not mature enough to be able to swim on their own and find suitable habitat before reaching the lake, few if any, will survive. This lack of sufficient larval drift distance is thought to be the main reason that young fish are not being recruited into the population and the most likely impediment to survival and recovery of pallid sturgeon in this area.

Most sub activities (e.g. construction, noise, maintenance, etc.) of this proposed action (described in Appendix A, Table 2) present a discountable likelihood of an effect or an effect that is likely to be insignificant. The remaining effects described in detail in the effects section of this biological opinion do not actually kill adult sturgeon. However for the next 2-3 years, the existing dam will be maintained in the river until the new weir, notch, and bypass channel are constructed. In addition, the high water channel with intermittent suitable flow conditions to move fish upstream beyond the dam will also be closed off. The dam will impair up to 32 pallid sturgeon from passage and spawning above the dam, annually, during the 2-3 year construction

schedule. This can be considered an "injury" to the potential breeding success of the sturgeon. However, it is not actually a change to the sturgeon's condition because the baseline condition is for no passage around the current dam. This is a 2-3 year continuation of a degraded reproduction condition that applies to pallid sturgeon in the action area.

The effects of this proposed action are likely to result in injury and death of a small portion of sturgeon free embryo. As described in the effects summary, those effects are not likely to cause a reduction in the reproduction, numbers, or distribution of the sturgeon in or near the action area. We base that conclusion on our prediction that the loss will represent a small portion of the total number of that life stage present, and sturgeon have a reproductive strategy that tolerates extremely high mortality of early life stages. We are also using successful surrogate species and monitoring to help confirm that conclusion.

6.3 Beneficial Effects

The potential beneficial effect of the action on the long-term survival and recovery of the sturgeon is very high. The action creates the opportunity (and likelihood) of sturgeon spawning above the new weir every year. The design of the weir in concert with the recent fish screens makes it likely that they will impact only an insignificant portion of the free embryos as they drift past the area. By creating opportunity for annual spawning above the weir, the larval drift distance (before Lake Sakakawea) is increased to 258 miles, a distance that makes it much more likely that a portion of larva fish will survive to one year of age (an age class that is currently missing and is thought to be a main cause for lack of recruitment). The potential impact of this new habitat to the sturgeon population is significant. The significance is highlighted by the 2009 Science Review Report. "*...Without the resumption of natural spawning there is no real possibility that the naturally produced (i.e., non-stocked) pallid sturgeon population in RPMA2 will recover from its endangered status...*". (Reclamation 2009, p.15)

A circumstance that acts as a potential multiplier for improvement is the presence of a large cohort of fish from the augmentation program. Estimates are that 15,455 of these fish are aged 6-8 years and 1,981 are greater than 9 years of age. This means that over the next 15 years, almost 18,000 pallid sturgeon in this group will reach maturity and become capable of reproducing (at age 15-20 years). Some of these fish may already be of spawning age, but lack the ability to move beyond the current dam. The bypass channel, new weir and fish screens will allow this potential to be expressed in a pattern of migration and spawning that will hopefully last for decades.

6.4 Synthesis of Effects and Conclusion

In the short term (2-3 years) the poor baseline condition for passage including the lack of spawning above the dam will be maintained. Given the long lived nature of the sturgeon, their reproduction strategy, and the large group of augmentation fish now reaching potential spawning age, the Service does not believe that the short term impacts of maintaining the dam will appreciably reduce the sturgeon's survival and recovery.

In addition, the new weir, notch, and fish bypass channel will provide annual opportunities for passage and spawning for decades to come, unlike the sporadic and brief availability of the high flow channel. The largest direct negative impact of the future condition is anticipated to occur to a portion of free embryos as they move past the screens and over the weir. However, as we described earlier, the reproduction strategy of the sturgeon is a strategy that tolerates heavy mortality in the early life stages. Therefore, taken as a whole, the proposed action of creating fish passage and the opportunity for successful spawning and recruitment, represents a great potential for increasing reproduction, numbers and distribution of the wild pallid sturgeon in the action area. This action is implements an identified priority 1 action from the pallid sturgeon recovery plan "Restoring habitat connectivity where barriers to fish movement occur." (Service 2014, p. 77). Priority 1 actions are considered "... actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future." (Service 2014, p. 75).

The Service finds that the total effect from the proposed action to adult or early life stages of sturgeon is not likely to cause reduction in the reproduction, numbers, or distribution of the sturgeon in or near the action area. In fact, the project is likely to substantially improve the likelihood of survival and recovery of the species in the action area. It follows then, that the proposed action will not appreciably reduce the likelihood of survival and recovery of the pallid sturgeon, at the listed entity scale, by reducing the reproduction, numbers or distribution of pallid sturgeon.

Therefore, the Service finds that the proposed action is not likely to jeopardize the pallid sturgeon.

7.0 INCIDENTAL TAKE STATEMENT

Section 9 of the Act, as amended, and federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service as an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering.

In those cases where the Service concludes that an action and the resultant incidental take of listed species will not violate section 7(a)(2) of the Act, the Service provides an "incidental take statement" with the biological opinion. The incidental take statement exempts the take anticipated as a result of the action. Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by Reclamation so that they become binding conditions for any operation and maintenance activities implemented or by the Lower Yellowstone Irrigation District for the exemption in section 7(o)(2) to apply.

Reclamation has a continuing duty to regulate the activities covered by this incidental take statement. If Reclamation 1) fails to assume and implement the terms and conditions, or 2) fails to require the Lower Yellowstone Irrigation District to adhere to the terms and conditions of the incidental take statement, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation must report the progress of the action and its impacts on the species as specified in the incidental take statement. 50 CFR § 402.14(i) (3).

7.1 Incidental Take Anticipated

7.1.2 Pre Weir and bypass channel completion

Impairment of reproduction - All adult spawning sturgeon blocked from passing and spawning are taken in the form of harm (injury) by having their reproduction potential temporarily impaired. We estimate this harm to occur to 32 adult pallid sturgeon. This is harm is not expected to cause the death any individual sturgeon. It will occur annually for the next 2-3 years.

Monitoring - All juvenile and adult sturgeon captured, and tagged as part of the current monitoring are taken in the form of capture and harm. The capture occurs through the use of nets or other capture devices. The harm occurs through temporary injury of handling and invasive marking procedures and is not anticipated to cause death to any individuals. This take has been anticipated and permitted by existing 10(a)(1)(a) permits or the section 6 agreement with the state of Montana.

7.1.3 Post weir and bypass channel completion

Note: The incidental take described below will only occur in the future after the weir and bypass channel are complete and then only after successful passage of spawning adults and successful spawning above the weir.

No incidental take of adult sturgeon is expected from actions or conditions related to the weir or bypass channel.

Entrainment -Incidental take of sturgeon free embryo is anticipated. It will be in the form of harm from injury and death by free embryo passage through the screens.

Downstream drift - Incidental take of free embryos will occur during downstream drift past the screens and weir. This take will be in the form of harm from injury or death from passing over the weir and impacting rocks below and by impingement of sturgeon free embryos from the river side of the screens.

Monitoring - Incidental take of sturgeon free embryos is anticipated by capture and harm during monitoring for level of incidental take behind the screens, near the front of screens and at the weir. Harm will result from temporary injury during capture and some mortality from capture and handling. This take has been anticipated and permitted by existing 10(a)(1)(a) permits or the section 6 agreement with the state of Montana.

7.2 Amount or Extent of Incidental Take

7.2.1 Adult

Based on past monitoring results the Service estimates that up to 32 sturgeon will be injured through impairment of reproduction (non-lethal). In the effects section we explained that this number was extrapolated from information for the portion of the population that has been detected through telemetry at the Intake dam and its numerical relationship to the estimated total wild population.

For take monitoring, the 32 sturgeon will be represented by a percentage of the telemetered population. Based on past observation we assume that up to 26 percent of the telemetered population could be detected at intake. A detected portion of the telemetered population greater than 26 percent would represent greater take of pallid sturgeon than anticipated.

7.2.2 Free embryos

Free embryos of the pallid sturgeon are the only age class that the Service has predicted will be killed or injured during the proposed action. Calculating the exact number of free embryos taken by an action in the future is extremely difficult and even speculative. This is because the free embryos are less than an inch long, the amount of water moving past the project site is millions of cubic feet, and the pallid sturgeon free embryos will be mixed with millions of shovelnose free embryos. Pallid free embryos cannot be differentiated from shovelnose sturgeon in the field. It would be nearly impossible to count all the free embryos injured, killed, or alive after passage over the weir. For example, it would take 700 feet of fine mesh nets arranged below the weir, held in place against the current, and then monitored for at least a week to count the number of free embryos that pass over the weir. This is logistically impractical and could result in additional embryo mortalities from capture.

In the effects section the Service explained that rather than speculate about specific pallid numbers, we would instead use the shovelnose sturgeon as a surrogate to approximate a magnitude or scale of loss. We chose the shovelnose sturgeon because of its biological similarity to the pallid sturgeon and because its population appears stable even without the benefit of a new weir, weir notch, or bypass channel.

We believe that impacts to shovelnose sturgeon from the screens, weir, and bypass channel are likely to represent the same type of effects experienced by the pallid sturgeon. Though the sampled shovelnose sturgeons will be more numerous, we believe that impacts to shovelnose and pallid will be proportionally similar. This is why the shovelnose sturgeon can act as a reasonable surrogate for pallid sturgeon.

Before the project is implemented, capturing and monitoring of shovelnose sturgeon free embryos (and opportunistically other life stages), will establish a baseline for rate of occurrence, injury and death from the current screens and dam. After project completion, when pallid sturgeon are confirmed to pass above the new weir and spawn, capture and monitoring data on

rate of occurrence, injury and death of pallid sturgeon will be compared to data on shovelnose. Based on our assumptions described earlier regarding surrogacy, we expect the rate to be similar and consistent with our predicted level of effects. Stated another way, we expect the occurrence of pallid sturgeon free embryos (dead, injured or alive) at the monitoring sites to be proportionally the same as the shovelnose sturgeon.

For example if a monitoring site's samples produced 130 shovelnose free embryos and they were distributed as 100 live, 10 dead and 20 injured, then we would expect the total number of pallid free embryos at that site to be distributed very similarly (i.e. a total of 20 pallid free embryos, would be expected to be distributed as 15 live, 2 dead, and 3 injured).

A statistically significant deviation in the survival, death or injured rates between pallid and shovelnose would indicate that the Service's rationale may be invalid. We also believe that using a comparative rate of impact, rather than a specific number will accommodate year to year changes in environmental conditions and changing numbers of spawning individuals.

7.3 Effect of Incidental Take

The Service believes that the effects to free embryos and adults, resulting in the described level of anticipated incidental take, is not likely to jeopardize the continued existence of the pallid sturgeon. Our rationale for this conclusion can be found in the jeopardy discussion and conclusion section.

8.0 REASONABLE AND PRUDENT MEASURES

Because of the commitments already made in the proposed action by Reclamation to reduce the impacts of the proposed action on the pallid sturgeon, the Service has only one reasonable and prudent measure. It addresses the preparation for monitoring and reporting of future incidental take.

The Service realizes Reclamation may develop alternative methods to meet the goal of measuring the take of sturgeon that are different than described in this BO and incidental take statement. In the event of that occurring, Reclamation may request that the Service amend this document.

8.1 Reasonable and prudent measure 1

Work with appropriate parties (including the Service) to establish monitoring plan for incidental take monitoring.

9.0 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Endangered Species Act, Reclamation must comply with the following terms and conditions which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Term and condition 1

Before December 31, 2015, Reclamation will meet with the Service to discuss goals, strategy and logistics of monitoring shovelnose sturgeon for a baseline.

Goals of monitoring should include.

- Monitoring behind the headworks screens to sample shovelnose sturgeon
- Monitoring within the influence of the river side of the screen to sample shovelnose sturgeon
- Monitoring below debris field of future weir site to sample shovelnose sturgeon
- Sampling each monitoring site with techniques appropriate to enumerate species and injury, death rate.

Term and condition 2

Based on the monitoring in term and condition 1, if the impact exceeds the levels expressed in this opinion's analysis, Reclamation shall immediately convene an interdisciplinary group (biologists, engineers, etc.) to examine and implement actions from the adaptive management plan to reduce those impacts.

Term and condition 3

Reclamation will compile information enumerating how many telemetered sturgeon are present at the Intake Diversion dam.

Term and condition 4

Reclamation will compile information enumerating how many telemetered sturgeon pass into the Yellowstone River from the Missouri river.

Term and condition 5

Report results of monitoring and project progress to the Service on an annual basis by March 1.

10.0 CONSERVATION RECOMMENDATIONS

Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans or to develop information. The Service recommends that Reclamation partner with the Montana Fish, Wildlife and Parks, Upper Basin Pallid Working Group, and the Service to identify and

investigate other opportunities to improve fish passage or reduce entrainment at other Reclamation facilities.

11.0 REINITIATION

This concludes formal consultation on Reclamation's proposed action for the Lower Yellowstone River Irrigation Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action.

If, during implementation of the proposed action, changes in circumstances, situation, or information regarding this proposed action occur, Reclamation will assess the changes and any potential impacts to listed species, review the re-initiation triggers above, coordinate with the Service's Prairie Mountain Regional Office (if needed) and make a determination as to whether re-initiation is necessary.

12.0 LITERATURE CITED

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13.0 PERSONAL COMMUNICATIONS

Gamble, L. June 26, 2015. Fisheries Geographic Supervisor for U.S. Fish and Wildlife Service, Region 6. Email to Michael Thabault, Assistant Regional Director, U.S. Fish and Wildlife Service, Region 6. Subject: Comments on the Pallid Sturgeon Effects Analysis, with attachment.

Trimpe, David. March 24, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachments) to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Information on several questions including drift speed of sturgeon.

Trimpe, David. May 5, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachments) to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Information on projected flow over new weir and notch.

Trimpe, David. May 5, 2015a. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachments)to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Entrainment data.

Trimpe, David. May 22, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachments)to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Comments on Draft Biological Opinion.

Trimpe, David. June 4, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Suspected pallid sturgeon mortality.

Trimpe, David. June 22, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachments) to Doug Laye U.S. Fish and Wildlife Service, Region 6. Subject: Clean numbers.

Trimpe, David. June 23, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Pallid numbers at Intake #2.

Trimpe, David. July 2, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Notch height.

Trimpe, David. July 7, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachment)to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Entrainment and river miles.

Table 1. Likelihood of sturgeon distribution (by life stage) in the action area and project footprint (pre project and post project).

Life Stage	River Channel immediately above current weir	River Channel immediately below current weir	Screen/Headgate Area of river channel	Site of bypass channel mouth in river channel
Egg	**Pre Project** None - because rare spawning events takes place miles above this location **Post Project -** None – spawning occurs well below Intake (First 10 miles of Yellowstone River) or well above Intake (Powder River)	**Pre Project** None – spawning occurs well below Intake (First 10 miles of Yellowstone River) or well above Intake (Powder River) **Post Project** None – spawning occurs well below Intake (First 10 miles of Yellowstone River) or well above Intake (Powder River)	**Pre Project** None – spawning occurs well below Intake (First 10 miles of Yellowstone River) or well above Intake (Powder River) **Post Project** None – spawning occurs well below Intake (First 10 miles of Yellowstone River) or well above Intake (Powder River)	**Pre Project** None – spawning occurs well below Intake (First 10 miles of Yellowstone River) or well above Intake (Powder River) **Post Project** None – spawning occurs well below Intake (First 10 miles of Yellowstone River) or well above Intake (Powder River)
Free Embryo/Larvae	**Pre Project** Very unlikely given rarity of spawning above Intake and dispersion of floating free embryo **Post Project** Likely – assumed spawning would occur much more often than what is currently occurring. Free embryo could also float down the bypass channel. Exposure would be limited to short time period (days)	**Pre Project** Very unlikely given rarity of spawning above Intake and dispersion of floating free embryo **Post Project** Likely – assumed spawning would occur much more often than what is currently occurring. Free embryo could also float down the bypass channel.	**Pre Project** Very unlikely given rarity of spawning above Intake and dispersion of floating free embryo **Post Project** Likely – assumed spawning would occur much more often than what is currently occurring. Free embryo could also float down the bypass channel.	**Pre Project** Very unlikely given rarity of spawning upstream of Intake and dispersion of floating free embryo **Post Project** Likely – assumed spawning would occur much more often than what is currently occurring. Free embryo could also float down the bypass channel.
Juvenile	**Pre Project** None – there are no juvenile upstream of Intake. **Post Project**	**Pre Project** Very unlikely – several fish migrate up to Intake ever year but most are	**Pre Project** None – there are no juvenile upstream of Intake.	**Pre Project** Very unlikely – fish migrate up to Intake ever year, but most are adults **Post Project**

Life Stage	River Channel immediately above current weir	River Channel immediately below current weir	Screen/Headgate Area of river channel	Site of bypass channel mouth in river channel
Juvenile	Very unlikely – juveniles are not likely to be cued to migrate upstream and even less so to move above weir	adults **Post Project** Very unlikely – juveniles are not likely to be cued to migrate upstream	**Post Project** Very unlikely – juveniles are not likely to be cued to migrate upstream and even less so to move above weir	Very unlikely – juveniles are not likely to be cued to migrate upstream
Adult	**Pre Project** Very unlikely - weir blocks passage, but unusual passage through high flow channel could result in adults being near channel for short period of time May - June and again at late June – early July during passage and return. **Post Project** Likely – assumed passage would be achieved ever year if they move up the Yellowstone River. Adults would encounter this area on their downstream migration (June – early July)	**Pre Project** Likely – adult pallid sturgeon migrate up to Intake most years (May – June) **Post Project** Likely – it is assumed that fish would continue to migrate upstream to Intake (May – June) most years. They would likely encounter this area again migrating downstream (June – early July)	**Pre Project** Very unlikely -weir blocks passage, but unusual passage through high flow channel could result in adults being near headworks late June – early July **Post Project** Likely – it is assumed that if fish successfully pass they would encounter this area migrating downstream (June – early July). Fish could also use the bypass channel to migrate downstream	**Pre Project** Likely – adult pallid sturgeon migrate up to Intake most years (May – June) **Post Project** Likely – it is assumed that fish would continue to migrate upstream to Intake (May – June). They could encounter this area again migrating downstream if they chose to migrate downstream in the bypass channel instead of the main river channel (June – early July)

Table 2. Species potential exposure directly or indirectly to a sub activity.

(Potential exposure does not determine actual expected exposure or response or effect.)

1 Short term maintenance of the current rock weir (two years)	**Sub Activity**	**Potential exposure?**	**Rational for exposure determination**
	Rock is excavated from a nearby rock quarry on the south side of the river	NO EXPOSURE	Quarry is not connected to river or channel
	Rock is trucked across the existing side channel onto Joe's Island. Rock is not trucked across the existing side channel until it become inactive during the low summer flows and has had a chance to dry.	NO EXPOSURE	River side channel is dry at time vehicles cross
	Rock is placed next to the south rocking tower and then placed in the river via the existing trolley system.	NO EXPOSURE	Rock storage is in upland above river channel
	Trolley system carries 2 to 3 large boulders at a time and sets them in a straight line across the top of the existing weir. This typically takes place in July – August for about 1 week depending on the amount of rock loss from the previous year. Some years the district has had to place rocks 2 or 3 times because the river levels were extremely low.	YES – POTENTIAL EXPOSURE	Rocks are placed on the weir which is in the river channel occupied by the species
Existence of current rock weir for next two years	None	YES – POTENTIAL EXPOSURE	Rock weir will be in river when fish are migrating upriver
2 Construction and maintenance of a new weir with downstream fish passage notch			
Construction	Establishment of road on north side of river for construction and maintenance access	NO EXPOSURE	Road is in the upland
	All material will be staged and brought in on Joe's Island.	NO EXPOSURE	Activity on the island does not have method to impact river channel
	Install Trestle to support access for weir sheet pile installation, weir	YES – POTENTIAL EXPOSURE	Sheet piles will be in the river channel which is occupied by the

	construction and sheet pile removal. Structure likely to be built by driving large sheet piles into the river and then building some kind of decking on top of the piles. Structure likely to be removed once the construction of the weir is complete. Trestle likely to be built during low summer flows (July - August) when there is little risk of losing the structure due to flooding/ice.		species
	Install (drive) sheet piles into river bottom, upstream and downstream of the new weir site for coffer dam (1/3 of river width at a time)	YES – POTENTIAL EXPOSURE	Sheet piles will be in the river channel which is occupied by the species
	drive main support pilings into river bed inside coffer dam	NO EXPOSURE	Pilings will be driven into the river bed "in the dry" of the cofferdam
	Build forms inside of coffer dam (around main support pilings	NO EXPOSURE	Construction will take place inside the dams where it is dry
	Pour concrete in forms on top of main support pilings	NO EXPOSURE	Concrete pouring will take place inside the dams where it is dry
	Once the concrete has cured the upstream and downstream coffer dam sheet pilings will be completely removed.	YES – POTENTIAL EXPOSURE	Sheet pilings are interface with river flow occupied by species.
	Placement of rock to fill gap between new weir and old weir, placement of rock upstream and downstream of notch using an overhead trolley system or a barge.	YES – POTENTIAL EXPOSURE	Rock is placed on weir which is in the river channel which is occupied by the species
Maintenance	On rare occasion - rock placement between old and new weir or rock placement above and below notch using overhead trolley system or barge	YES – POTENTIAL EXPOSURE	Rock is placed on weir which is in the river channel which is occupied by the species
	Access road maintenance, typically just grading of the road or placement of new material that has washed out.	NO EXPOSURE	Road is in the upland
	Routine visual inspections	YES – POTENTIAL EXPOSURE	Inspections likely performed from boat, boat is in river channel occupied by species.
	Replacement of concrete cap if needed (rare event, every 30-50 years)	YES – POTENTIAL EXPOSURE	Replacement would take activities in the river channel which is occupied by the species
	Removal of large debris from crest and notch. This would be a rare and unpredictable circumstance – method for removal undetermined.	YES – POTENTIAL EXPOSURE	Activity could take place when fish are near the weir
Physical structure presence	Presence of Weir in river	YES – POTENTIAL EXPOSURE	Structure stretches across the river where species occurs

	Notch – upstream and downstream approach	YES – POTENTIAL EXPOSURE	Notch is in the river where species occurs
3 Construction and maintenance of a fish passage channel around the new weir			
Construction	Place coffer dam at mouth of existing high flow channel	YES – POTENTIAL EXPOSURE	Dam will be placed in area immediately adjacent to the flowing river channel and incidental fish passage will be blocked
	Backfill behind dam	NO EXPOSURE	Activity will take place behind coffer dam in the dry
	Fill one and a half miles of existing channel	NO EXPOSURE	Activity will take place in dry channel
	Excavate new channel and mouth behind coffer dam	NO EXPOSURE	Activity will take place in upland
	Place rip rap at upstream channel mouth	YES – POTENTIAL EXPOSURE	Most rip rap will be placed behind coffer dam, but **after** dam is removed additional rip ram may be needed to protect mouth of channel where dam was.
	Channel banks and bends will be stabilized with riprap and bottom sill will be over excavated and hidden below the "armor layer" that will line the entire channel.	NO EXPOSURE	Activity will take place in the dry new channel
	Place rip rap at downstream channel mouth, the sill will be over excavated and hidden below the natural "armor layer"	YES – POTENTIAL EXPOSURE	Most rip rap will be placed behind coffer dam, but **after** dam is removed additional rip ram may be needed to protect the channel interface with the river where dam was.
	Placement of fill within the Yellowstone River (south side) to reduce eddy formation and to enhance attraction flows for the bypass channel. Fill will be placed immediately downstream of the downstream bypass channel entrance. Fill will be compacted and stabilized with riprap. This would likely be completed in the wet but outside of the May – July 1 time frame.	YES - POTENTIAL EXPOSURE	Activity will take place in the river channel occupied by species
	Remove upstream coffer dam and start water flowing through new bypass channel	YES - POTENTIAL EXPOSURE	Activity takes place in the river column
	Place some rip rap at the mouth of new bypass channel	YES - POTENTIAL EXPOSURE	Rocks will be placed in the river flow occupied by the species
Maintenance	Riprap replacement, stabilization activities and debris removal in the	YES - POTENTIAL EXPOSURE	Debris removal will occur in the bypass channel which is

	bypass channel conducted from the banks - **without** coffer dam. A coffer dam will not be utilized in the bypass channel unless: - a large amount of debris is collecting within the channel that might compromise the design or passage - if the Irrigation Project needs access across the channel to maintain the weir - if sediment becomes an issue and needs to be removed - if an outside bend needs to be armored or reinforced It is assumed that we would restrict the district from blocking the flow in the channel during the pallid sturgeon migration period (May – July 15th) unless there are unforeseen circumstances.		connected to the river where species occurs
	Maintain road crossing	NO EXPOSURE	Road crossing maintenance done in the dry behind coffer dam at mouth
	Riprap replacement, stabilization activities, and debris removal in the bypass channel - **with** coffer dam. A coffer dam will not be utilized in the bypass channel unless: - a large amount of debris is collecting within the channel that might compromise the design or passage - if the Irrigation Project needs access across the channel to maintain the weir - if sediment becomes an issue and needs to be removed - if an outside bend needs to be armored or reinforced - If work needs to be done on the north side for the channel the channel will likely need to be dammed to provide access for the Irrigation Project. It is assumed that we would restrict the district from blocking the flow in the channel during the pallid sturgeon migration period (May – July 15th) unless there are unforeseen circumstances.	NO EXPOSURE	Activities will occur behind coffer dam in the dry.
	Place coffer dam in mouth of channel to dewater channel for maintenance, reshaping, and road crossing This will likely be completed during low summer flows, which would also be outside of the pallid sturgeon migration. It is assumed that we would restrict	YES – POTENTIAL EXPOSURE	Coffer dam will be placed in area immediately adjacent to the flowing river channel where the species occurs.

	the district from blocking the flow in the channel during the pallid sturgeon migration period (May – July 15th) unless there are unforeseen circumstances.		
	Remove rock and debris from mouth of channel with heavy equipment i.e. excavator. This will likely be completed during low summer flows, which would also be outside of the pallid sturgeon migration.	YES – POTENTIAL EXPOSURE	Equipment removing debris in area immediately adjacent to water flowing in channel
	Maintain channel plug in old high flow channel	YES – POTENTIAL EXPOSURE	Activities will be conducted in the area immediately adjacent to the flow in the channel.
	Veg maintenance around channel	YES – POTENTIAL EXPOSURE	Activities will be conducted on the banks immediately adjacent to the flow in the channel.
4 Maintenance and Operation of the Headgate and Fish screen			
	Raise and lower drum screens	YES – POTENTIAL EXPOSURE	Screens are in the river flow
	Adjust headgates for flow	NO EXPOSURE	Headgates are behind fish screens
	Remove water from river from river – 600-1374 cfs	YES – POTENTIAL EXPOSURE	River flow altered
	Remove sediment from in front of headworks in spring (April 15 – May 1) as necessary. Unscreened water used to move sediment into diversion canal out of the way of screens. Wouldn't be necessary for all screens every year. Unscreened water would only be diverted into the canal for a couple of hours.	YES – POTENTIAL EXPOSURE	Action takes place in the interface with the river flow
	Raise screen(s) for maintenance or repair (non-emergency)	YES – POTENTIAL EXPOSURE	Screens are in the river flow
	Lower coffer box for gate maintenance	YES – POTENTIAL EXPOSURE	Screens are in the river flow
	Inspections	NO EXPOSURE	Inspections are visual
5 Canal and lateral ditch operation and maintenance			
Infrastructure	Headgate adjustment for flow into main canal	NO EXPOSURE	Headgates are behind fish screens
	Cleaning removal of sediment via excavator	NO EXPOSURE	Canal and lateral ditches are behind fish screens
	Inspection, typically at the end of the year when the canal is dewatered	NO EXPOSURE	Canal and lateral ditches are behind fish screens
	Upgrading and replacing components of the canal and	NO EXPOSURE	Canal and lateral ditches are behind fish screens

	laterals		
	Weed control (by label and Integrated Pest Management Plan	NO EXPOSURE	Canal and lateral ditches are behind fish screens
6 Supplemental pumping	Operation (water withdrawal), short term, not every year	YES – POTENTIAL EXPOSURE	Pumps are in the river flow
	Cleaning, adjusting and replacing trash racks around pump inlets	YES – POTENTIAL EXPOSURE	Pump inlets and trash racks are in the river flow occupied by the species
	Installation and removal of pumps (pumps are on wheels)	YES – POTENTIAL EXPOSURE	Pumps are in the river flow occupied by the species
7 Water conservation	Converting from flood irrigation to pivot sprinklers	NO EXPOSURE	Activities are on the crop lands and behind fish screens
	Lining canals	NO EXPOSURE	Canal and lateral ditches are behind fish screens
	Converting canals to pipes	NO EXPOSURE	Canal and lateral ditches are behind fish screens
	Check structures for efficiency	NO EXPOSURE	Canal and lateral ditches are behind fish screens
8 Monitoring and Adaptive management			
Monitoring	Netting for free embryos behind fish screens	YES – POTENTIAL EXPOSURE	Nets are in water where free embyros are expected
	Netting below weir for free embryos	YES – POTENTIAL EXPOSURE	Nets are in water where free embyros are expected
	Capture and tagging of adults and juveniles	YES – POTENTIAL EXPOSURE	Direct impact to individuals
Adaptive management	Changing structure to improve passage	YES – POTENTIAL EXPOSURE	Structures changes would take place in the water column where fish may be present
	Adding structures to improve passage	YES – POTENTIAL EXPOSURE	Structures changes would take place in the water column where fish may be present

Table 3. Likelihood and degree of effect from potential exposure to a sub activity.

(Likely effects from activities highlighted in gray are not discountable or insignificant and are addressed in the body of the biological opinion)

1 **Short term maintenance of the current rock weir (two years)**	**Sub activity**	**Circumstance leading to potential exposure**	**Rationale for likelihood and degree of effect (any effect that is not discountable or insignificant is bolded)**
	Trolley system carries 2 to 3 large boulders at a time and sets them in a straight line across the top of the existing weir. This typically takes place in July – August for about 1 week depending on the amount of rock loss from the previous year. Some years the district has had to place rocks 2 or 3 times because the river levels were extremely low.	Rocks are placed on the weir which is in the river channel occupied by the species	Egg - No likelihood given distance to egg deposition sites miles above site Free embro/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all Adult - discountable likelihood of effect, fish only pass in rare events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.
Existence of current rock weir for next two years	None	**Weir forms at least partial barrier across river**	Egg - No likelihood given distance to egg deposition sites miles above site Free embro/larvae - discountable likelihood of effect, weir largely blocks spawning behavior above the weir so free embryo unlikely to be present above weir. Juvenile - discountable likelihood of effect, weir largely blocks spawning behavior above the weir so juveniles unlikely to be present above weir. **Adult - adverse effect due to preventing adults from upstream**

			passage and spawning.
2 Construction and maintenance of a new weir with downstream fish passage notch			
Construction	Install Trestle to support access for weir sheet pile installation, weir construction and sheet pile removal. Structure likely to be built by driving large sheet piles into the river and then building some kind of decking on top of the piles. Structure likely to be removed once the construction of the weir is complete. Trestle likely to be built during low summer flows (July - August) when there is little risk of losing the structure due to flooding/ice.	Sheet piles will be in the river channel which is occupied by the species	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all Adult - discountable likelihood of effect, fish only pass in rare events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.
	Install (drive) sheet piles into river bottom, upstream and downstream of the new weir site for coffer dam (1/3 of river width at a time)	Sheet piles will be in the river channel which is occupied by the species	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all Adult - discountable likelihood of effect, fish only pass in rare

			events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.
	Once the concrete has cured the upstream and downstream coffer dam sheet pilings will be completely removed.	Sheet pilings are interface with river flow occupied by species.	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all Adult - discountable likelihood of effect, fish only pass in rare events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.
	Placement of rock to fill gap between new weir and old weir, placement of rock upstream and downstream of notch using an overhead trolley system or a barge. Likely done during low summer flows (July - August)	Rock is placed on weir which is in the river channel which is occupied by the species	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all Adult - discountable likelihood of effect, fish only pass in rare events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.

Maintenance	On rare occasion - rock placement between old and new weir or rock placement above and below notch using overhead trolley system or barge. Likely done during low summer flows (July - August)	Rock is placed on weir which is in the river channel which is occupied by the species	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all Adult - discountable likelihood of effect, fish only pass in rare events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.
	Routine visual inspections	Inspections likely performed from boat, boat is in river channel occupied by species.	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, free embryo only briefly present above weir and dispersion in water column makes presence at specific site of boat use unlikely. Juvenile - discountable likelihood of effect, juveniles unlikely to migrate to weir at all and less likely to be above Adult - discountable likelihood of effect, adults only briefly present at weir and boat traffic unlikely to intersect them.
	Replacement of concrete cap if needed (rare event, every 30-50 years)	Replacement would take activities in the river channel which is occupied by the species	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already

			passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all Adult - discountable likelihood of effect, fish only pass in rare events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.
	Removal of large debris from crest and notch. This would be a rare and unpredictable circumstance – method for removal undetermined.	Debris and weir are in river channel occupied by species	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and only for short period of time making overlap of activity and presence unlikely Juvenile - discountable likelihood of effect, activity takes place in area where juveniles are unlikely to occur any time of the year Adult - discountable likelihood of effect, fish only pass in rare events, unlikely to be near weir and activity takes place at time when adults will already be well below weir lower in the river.
Physical structure presence	Presence of Weir in river	Structure stretches across the river where species occurs	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - insignificant effect, free embryo can move over the weir with the river flow. Impact from doing so not likely adverse Juvenile - discountable likelihood of effect, juveniles unlikely to migrate to weir at all much less attempt to pass Adult – adverse effect, adults migrating up and downstream will likely be temporarily delayed until finding notch or bypass.

	Notch – upstream and downstream approach	Notch is in the river where species occurs	Egg - No likelihood of effect given distance to egg deposition sites miles above site Free embryo/larvae - insignificant effect, free embryo can move over the notch with the river flow. Impact from doing so not likely adverse Juvenile - discountable likelihood of effect, juveniles unlikely to migrate to weir at all much less attempt to pass Adult – insignificant effect, notch can be used to pass downstream, impact from doing so not likely to be adverse.
3 Construction and maintenance of a fish passage channel around the new weir			
Construction	Place coffer dam at mouth of existing high flow channel	Dam will be placed in area immediately adjacent to the flowing river channel	Egg - No likelihood given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below weir. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to weir and juveniles unlikely to migrate to weir at all **Adult – potential adverse effect from no longer having access to channel for incidental fish passage**
	Place rip rap at upstream channel mouth	Most rip rap will be placed behind coffer dam, but **after** dam is removed additional rip ram may be needed to protect mouth of channel where dam was.	Egg - No likelihood given distance to egg deposition sites miles above site Free embryo/larvae -

			discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
	Place rip rap at downstream channel mouth, the sill will be over excavated and hidden below the natural "armor layer"	Most rip rap will be placed behind coffer dam, but **after** dam is removed additional rip ram may be needed to protect the channel interface with the river where dam was.	Egg - No likelihood given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present near this site and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
	Placement of fill within the Yellowstone River (south side) to reduce eddy formation and to enhance attraction flows for the bypass channel. Fill will be placed immediately downstream of the downstream bypass channel entrance. Fill will	Activity will take place in the river channel occupied by species	Egg - No likelihood given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present near this site and

	be compacted and stabilized with riprap. This would likely be completed in the wet but outside of the May – July 1 time frame.		dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to this area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
	Remove upstream coffer dam and start water flowing through new bypass channel	Debris and weir are in river channel occupied by species	Egg - No likelihood given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present above weir and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below this site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to be in area and juveniles unlikely to be able to move past the weir at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below weir lower in the river.
	Place some rip rap at the mouth of new bypass channel	Rocks will be placed in the river flow occupied by the species	Egg - No likelihood given distance to egg deposition sites miles above site Free embryo/larvae - discountable likelihood of effect, project takes place before fish passage so free embryo rarely present near this site and dispersion in water column makes presence unlikely. Also activity takes place at time when free embryo would have already passed below site.

			Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
Maintenance	Riprap replacement, stabilization activities and debris removal in the bypass channel conducted from the banks - **without** coffer dam. A coffer dam will not be utilized in the bypass channel unless: - a large amount of debris is collecting within the channel that might compromise the design or passage - if the Irrigation Project needs access across the channel to maintain the weir - if sediment becomes an issue and needs to be removed - if an outside bend needs to be armored or reinforced It is assumed that we would restrict the district from blocking the flow in the channel during the pallid sturgeon migration period (May – July 15th) unless there are unforeseen circumstances.	Debris removal will occur in the bypass channel which is connected to the river where species occurs	Egg - No likelihood given distance to egg deposition sites miles above bypass channel Free embryo/larvae - discountable likelihood of effect, free embryo unlikely to be present in the bypass. Also activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
	Place coffer dam in mouth of channel to dewater channel for maintenance, reshaping, and road crossing This will likely be completed during low summer flows, which would also be outside of the pallid sturgeon migration. It is assumed that we would restrict the district from blocking the flow in the channel during the pallid sturgeon migration period (May – July 15th) unless there are unforeseen circumstances.	Coffer dam will be placed in area immediately adjacent to the flowing river channel where the species occurs.	Egg - No likelihood given distance to egg deposition sites miles above bypass channel Free embryo/larvae - discountable likelihood of effect, activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be

			well below bypass site lower in the river.
	Remove rock and debris from mouth of channel with heavy equipment i.e. excavator. This will likely be completed during low summer flows, which would also be outside of the pallid sturgeon migration.	Equipment removing debris in area immediately adjacent to water flowing in channel	Egg - No likelihood given distance to egg deposition sites miles above bypass channel Free embryo/larvae - discountable likelihood of effect, activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
	Maintain channel plug in old high flow channel	Activities will be conducted in the area immediately adjacent to the flow in the channel.	Egg - No likelihood given distance to egg deposition sites miles above bypass channel Free embryo/larvae - discountable likelihood of effect, activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
	Veg maintenance around channel	Activities will be conducted on the banks immediately adjacent to the flow in the channel.	Egg - No likelihood given distance to egg deposition sites miles above bypass channel Free embryo/larvae - discountable likelihood of effect, activity takes place at time when free embryo would have already passed below site. Juvenile - discountable

			likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity takes place at time when adults will already be well below bypass site lower in the river.
4 Maintenance and Operation of the Headgate and Fish screen			
	Raise and lower drum screens and screen presence	Screens are in the river flow	Egg - No likelihood given distance to egg deposition sites miles above screens **Free embryo/larvae – adverse effect, free embryo are likely to drift into the screen area and are small enough to be entrained and impinged in the screen.** Juvenile - discountable likelihood of effect, and insignificant effect. Activity takes place in period of time when no fish is likely to be near the screens and juveniles in particular are not likely to pass above the weir to be exposed to the screens. Also the screen and approach velocity are likely to prevent any adverse effect to juveniles. Adult - discountable likelihood of effect, and insignificant effect activity happens over a very short period of time and adults are unlikely to in the immediate area of the screens and given the approach velocities are unlikely to be impacted at all.
	Remove water from river – 600-1374 cfs	YES – POTENTIAL EXPOSURE	Egg - No likelihood given water is withdrawn below egg deposition area Free embryo/larvae – insignificant effect. Water removed is small percentage of total flow (approximately 3-17 percent – Assessment p. 55). Free embryos need enough water to drift downstream and at the time of

			their drifting, this amount is unlikely to alter the river in a way that results in a significant adverse effect. Juvenile - insignificant effect. Water removed is small percentage of total flow (approximately 3-17 percent – Assessment p. 55). This amount is unlikely to alter the river in a way that results in an adverse effect. Adult - insignificant effect. Water removed is small percentage of total flow (approximately 3-17 percent – Assessment p. 55). This amount is unlikely to alter the river in a way that results in an adverse effect. Adult fish head downstream to the larger sections of river where impact will not be measureable.
	Remove sediment from in front of headworks in spring (April 15 – May 1) as necessary. Unscreened water used to move sediment into diversion canal out of the way of screens. Wouldn't be necessary for all screens every year. Unscreened water would only be divert into the canal for a couple of hours.		Egg - No likelihood given distance to egg deposition sites miles above screens and eggs not present at the time of the activity Free embryo/larvae - No likelihood of effect, activity takes place at time before free embryo exist in the system Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to be near the screens and juveniles in particular are not likely to pass above the weir to the screens Adult - discountable likelihood of effect, activity occurs during time that adults are not in the area.
	Raise screen(s) for maintenance or repair (non-emergency)	Screens are in the river flow	Egg - No likelihood given distance to egg deposition sites miles above screens Free embryo/larvae - discountable likelihood of effect, activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate

			to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity happens over a very short period of time and adults are unlikely to in the immediate area of the screens at the same exact moment that screens are raised and lowered.
	Lower coffer box for gate maintenance	Screens are in the river flow	Egg - No likelihood given distance to egg deposition sites miles above screens Free embryo/larvae - discountable likelihood of effect, activity takes place at time when free embryo would have already passed below site. Juvenile - discountable likelihood of effect, activity takes place in period of time when no fish is likely to migrate to bypass area and juveniles unlikely to migrate to bypass area at all Adult - discountable likelihood of effect, activity happens over a very short period of time and adults are unlikely to in the immediate area of the screens at the same exact moment that the coffer box is lowered. Also activity is likely to be performed when adults are not likely to be near site.
5 Canal and lateral ditch operation and maintenance	No Exposure	N/A	N/A
6 Supplemental pumping	Operation (water withdrawal), short term, not every year	Pumps are in the river flow	Amount of water withdrawn compared to baseflow is not great enough to have a predictable or discernable effect to any life stage of fish.
	Cleaning, adjusting and replacing trash racks around pump inlets	Pump inlets and trash racks are in the river flow occupied by the species	Egg - No likelihood given distance to egg deposition sites miles above pumps Free embryo/larvae – discountable likelihood of effect, pumps are close to shore, typically behind trash barriers. The water is very turbid and low oxygen and fish and larvae are

			likely to avoid the area. Juvenile - adverse effect, small juveniles are likely to move into the area of the pumps and become entrained. Adult - discountable likelihood of effect, pumps are small enough that adults are unlikely to be in their area of influence or and adults are strong enough avoid impingement.
	Installation and removal of pumps (pumps are on wheels)	Pumps are in the river flow occupied by the species	Egg - No likelihood given distance to egg deposition sites miles above pumps Free embryo/larvae - discountable likelihood of effect, activity is so brief that it is unlikely that larvae would be exposed and the act of just moving a pump into the eater is unlikely to impact them. Juvenile - discountable likelihood of effect, activity is so brief that it is unlikely that larvae would be exposed and the act of just moving a pump into the eater is unlikely to impact them. Adult - discountable likelihood of effect, activity is so brief that it is unlikely that larvae would be exposed and the act of just moving a pump into the water is unlikely to impact them.
7 **Water conservation**	No Exposure	N/A	N/A
8 **Monitoring and Adaptive management**			
Monitoring	Netting for free embryos behind fish screens	Netting takes place in the river flow and is targeting fish.	Egg - No likelihood given distance to egg deposition sites miles above fish screens Free embryo/larvae – adverse effect, nets are intentionally being used to capture free embryos. Juvenile - discountable likelihood of effect, juveniles are unlikely to be above weir to be exposed to screens.

			Adult – no likelihood of effect. Nets are behind fish screens which prevent adults passing into the canal
	Netting below weir for free embryos	Netting takes place in the river flow and is targeting fish.	Egg - No likelihood given distance to egg deposition sites miles above weir Free embryo/larvae – likely adverse effects because nets are intentionally being used to capture free embyros. Juvenile - discountable likelihood of effect, juveniles unlikely to be below weir near netting activity. Adult - discountable likelihood of effect, nets type and techniques result in a discountable likelihood of capturing an adult sturgeon.
	Capture and tagging of adults and juveniles	Capture takes place in the river channel and is targeting fish	Egg - No likelihood given the activity is not directed at eggs Free embryo/larvae – No likelihood given the activity is not directed at eggs Juvenile – likelihood of adverse effect due to capture and handling. Adult – likelihood of adverse effects due to capture and handling.
Adaptive management	Changing structure to improve passage	Activities take place in the river channel	Egg - No likelihood given distance to egg deposition sites miles above site Typical conservation measures such as project timing (to avoid migration and free embryo drift), use of coffer dams to allow for working in the dry make the likelihood of an effect to free embryos, larva, juvenile or adults discountable.
	Adding structures to improve passage	Activities take place in the river channel	Egg - No likelihood given distance to egg deposition sites miles above site Typical conservation measures such as project timing (to avoid migration and free embryo drift), use of coffer dams to allow for working in the dry make the likelihood of an effect to free embryos, larva, juvenile or adults discountable.