

**Summary of the Biological Review Team's comments on  
Lower Yellowstone River Irrigation Project Fish Screening  
Preliminary Design.**

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## *Executive Summary*

In 2006, the US Fish and Wildlife Service convened a Biological Review Team comprised of pallid sturgeon experts (Appendix A) to review preliminary fish protection design options for the Lower Yellowstone River Irrigation Project. The Team initially met 17 and 18 August 2006 in Billings, Montana to review the Lower Yellowstone River Intake Dam Fish Passage and Screening Preliminary (10%) Design Final Report (US Army Corps of Engineers 2006). The results of this meeting were summarized (Biological Review Team 2006) and presented to the US Fish and Wildlife Service, US Army Corps of Engineers, and US Bureau of Reclamation. In response to the Biological Review Team's concerns and recommendations the US Army Corps of Engineers and US Bureau of Reclamation conducted additional feasibility studies incorporating the suggested design considerations to the canal headworks and the proposed in-canal screen structure. In addition to refining the design outlined in the Preliminary Design Report a conceptual design for a new fish screening alternative was proposed and developed for consideration. These efforts were conducted to address the Biological Review Team's concerns (Biological Review Team 2006) and recommendations regarding the 10% designs for fish screening (US Army Corps of Engineers 2006).

In 2008, the Review Team convened 12 February 2008 in Billings, Montana to evaluate the revised fish screen options being developed for the Lower Yellowstone River Irrigation Project. Following is a summary of the discussions and subsequent recommendations.

## ***Background***

Beginning in the late 1990's, the US Bureau of Reclamation (Bureau) entered into informal consultation with the US Fish and Wildlife Service (Service) concerning the potential effects of the Bureau's Lower Yellowstone Project (Project) on the federally-endangered pallid sturgeon *Scaphirhynchus albus* (US Bureau of Reclamation 2005a). In 2000, the Bureau proposed conservation measures including an in-canal fish screen in the main irrigation diversion canal (Main Canal) and a constructed bypass channel at the site of the irrigation diversion dam (Intake Dam), both of which serve as protection measures to mitigate Project operation effects on pallid sturgeon (US Bureau of Reclamation 2000). During subsequent evaluation of these measures, concerns were raised regarding the adequacy and efficiency of the proposed bypass channel. The development of additional alternatives was requested. Options presented by the US Army Corps of Engineers (USACE) included nature-like fishways, baffled fishways, elevator fishways, dam removal and replacement with an infiltration gallery, and dam removal and replacement with a collapsible gate system (US Army Corps of Engineers 2002). In 2002, the Bureau conducted a value engineering study that implemented the Value Method decision making process to insure that all feasible passage alternatives were considered. This process included representatives from the USACE, Bureau, Lower Yellowstone Irrigation Project Board of Control, University of Idaho, and the Service. The study generated ten proposals/recommendations for consideration to improve fish passage (US Bureau of Reclamation 2002). On 8 July 2005, a Memorandum of Understanding (MOU) was developed to formalize the commitment among signatory partners on development of adequate fish passage alternatives for the Project. Signatory parties include: USACE, Bureau, Service, Montana Fish Wildlife and Parks (MFWP), and The Nature Conservancy (TNC). Following the signing of the MOU, a value study team (MOU Team) was developed with members representing the Bureau, USACE, Service, TNC, and MFWP. This MOU Team implemented the Value Method decision making process to identify all possible fish passage options. This generated approximately 110 possible passage alternatives that were ultimately narrowed down to nine (US Bureau of Reclamation 2005b). During subsequent meetings of the MOU Team, the list of nine possible alternatives was narrowed down to three. The three options for passage included: (1) removing the dam and moving the canal intake upstream, (2) removing the dam and installing a large pump facility, and (3) developing a full channel width rock ramp. Later meetings of the MOU Team determined that option (2) was not a viable alternative since anticipated operation and maintenance of a pumping facility were considered too burdensome for irrigators. The MOU Team requested that the two remaining upstream passage alternatives, as well as the in-canal fish screen be developed to a ten percent design level so that they could be evaluated in greater detail. The USACE completed the ten percent design in July 2006 and produced the Lower Yellowstone River Intake Dam Fish Passage and Screening Preliminary Design Report-Final Report (US Army Corps of Engineers 2006).

Upon receipt of this report, the Service commissioned a group of pallid sturgeon experts (Appendix A) to review the fish passage and screening alternatives developed therein, and to evaluate the likelihood that these fish passage options would adequately pass and protect pallid sturgeon. This Biological Review Team (Team) was asked to provide suggestions or modifications, where appropriate, to improve the designs under consideration.

On 17 and 18 August 2006, the Team met with Bureau and USACE representatives in Billings, Montana to review the design options presented. After review of the designs as presented, the Team expressed serious concerns regarding the current screen design and both of the proposed upstream passage alternatives. In response, the Team outlined a series of design considerations for incorporation into subsequent and final fish passage and screen designs. Recommendations from this group can be found in “Summary of the Biological Review Team’s comments on Lower Yellowstone River Intake Dam Fish Passage and Screening Preliminary Design Report” (Biological Review Team 2006).

In late 2007, the Team was asked to reconvene in order to evaluate design changes to the in-canal fish screen that incorporated a trashrack on the river side of the canal headworks (US Bureau of Reclamation 2008a), as well as a new conceptual in-channel design that incorporates cylindrical screens on the river side of the headworks negating the in-canal screen (US Army Corps of Engineers. 2008).

### ***In-canal Fish Screen option***

The in-canal fish screen consists of a “v-shape” screen located in the Main Canal approximately 500 feet from the diversion control structure. The screen material, as specified, is 0.069 inch (1.75 mm) stainless steel wedge-wire with screen panels resting on 12 inch concrete sills. The screen facility incorporates a trash barrier device at the screen entrance consisting of 8 inch bar spacing. A more detailed description of the screen facility can be found in the Lower Yellowstone River Intake Dam Fish Passage and Screening Preliminary (10%) Design Final Report (US Army Corps of Engineers 2006). Given the paucity of fish screen design criteria for warm water fishes, the Biological Review Team (2006) recommended that project partners fund a study that would utilize larval and juvenile shovelnose sturgeon *Scaphirhynchus platorynchus* to compare impingement survival differences on wedge wire screen at approach velocities of 0.3 and 0.4 feet per second (fps). Additional recommendations were made to consider elevating water intakes 4 feet above the existing intakes and incorporation of a 2 inch bar mesh “trash rack” and self cleaning mechanism on the riverward side of the canal intake to prevent larger juvenile and adult pallid sturgeon from entering the ditch.

Results from the impingement study conducted with pallid sturgeon *S. albus* suggest that approach velocities of 0.4 fps are adequate to minimize impingement of pallid sturgeon (Brent Mefford, US Bureau of Reclamation, personal communication, 2008).

An assessment study to evaluate the Team’s recommendation for elevated water intakes concluded that elevating the intake tubes was not a viable alternative (US Bureau of

Reclamation 2008b).

An appraisal study was completed by the Bureau to address the Team's recommendation to include a trash rack to reduce initial entrainment of larger juvenile and adult pallid sturgeon (US Bureau of Reclamation 2008a). The conceptual design derived from this study included a series of removable trashrack panels with 2 inch openings, a hoist structure to facilitate panel placement and removal, a redundant rack guide to allow for repairs, and an automated trash rake to keep the structure free from debris accumulation. Detailed information on design and materials can be found in "Intake Diversion Dam trashrack appraisal study for Intake headworks" (US Bureau of Reclamation 2008a).

Based on the information provided, the Team believes the in-canal fish screen (US Army Corps of Engineers 2006) combined with the trashrack (US Bureau of Reclamation 2008a) will function to protect all but the smallest life stages of pallid sturgeon and other fish species.

### ***In-channel Fish Screen option***

The in-channel fish screen option is a new concept that was not originally evaluated by the Biological Review Team in 2006. This option was developed as an alternative screening mechanism to address the in-canal fish screen concerns and would negate the need to include a trash rack on the existing diversion headworks. Implementation of this screening option would require construction of a new canal headworks consisting of fourteen intake tubes. Each intake tube would be fitted with a coarse trash rack and individual drum screens that can be lowered in front of the intake tubes. Approach velocities would be approximately 0.4 fps over the screen area. Detailed information on design and materials can be found in "*Lower Yellowstone project fish screening and sediment sluicing preliminary design report*" (US Army Corps of Engineers 2008).

Recommendation:

The Biological Review Team recommends inclusion of an internal backwash system in future in-channel fish screen designs.

Based on the information provided, the Team believes the in-channel fish screen (US Army Corps of Engineers 2008) will function to protect all but the smallest life stages of pallid sturgeon and other fish species. Additionally, the Team identified the in-channel fish screen as the better of the two screen options.

### ***Preliminary Sluiceway Design***

The Biological Review Team was also presented with three designs to facilitate or "sluice" sediments away from the canal headworks (US Army Corps of Engineers 2008). These designs are believed necessary to actively transport sediments based on the assumptions that the incorporation of a trashrack to the in-canal screen or the in-channel screen option may effectively reduce existing sluicing forces resulting in sediment deposition. This deposition of sediments is expected to negatively affect either screen

option.

While the Team understands the concerns related to sediment, the major issue with the three proposed preliminary options is the amount of water required for them to effectively operate. Initial estimates targeted a sluiceway velocity of 6 fps. This would equate to approximately 2000 cubic feet per second (cfs) of water in the sluiceway (Greg Johnson, US Army Corps of Engineers, personal communication, 2008). Concerns about the amount of water believed necessary to operate any of the sluiceway options were raised. The primary concern is that during low flow periods (3000 cfs or less) sluiceway operation would effectively result in the remaining volume of river being directed into the sluice. This could result in a dry upstream fish passage structure, potentially for several months, in the late summer and fall. This would negate the year-round benefit of the upstream passage and is unacceptable. Additionally, concerns were raised about the concrete sluiceway bisecting the campground and boat launch area as well as inclusion of a “concrete wall” in the river not being aesthetically acceptable.

At this time the Biological Review Team recommends more detailed sediment load and transport analysis to more accurately estimate the amount of water and size of sluiceway structure required to reduce sediment concerns. Further the team requests that these studies also determine 1) If sedimentation is actually going to result in substantial deposition in front of the canal headworks, 2) If mechanical removal of accumulated sediments is a suitable option to rectify depositional loads, 3) If alternative sluiceway designs can be developed that would utilize considerably less water and 4) If sluiceways can be designed in a fashion that reduces aesthetic and visual impacts, and does not impair river access.

### **Conclusions:**

The Biological Review Team believes that both the in-canal fish screen in conjunction with a trashrack and the in-channel screen concepts are viable solutions to address pallid sturgeon and other fishes’ entrainment losses associated with the Lower Yellowstone Irrigation Project’s diversion point at Intake Dam (Heibert et al. 2000, Matt. Jaeger, Montana Fish Wildlife and Parks, personal communication, 2006). However, the Biological Review Team identified the in-channel screen concept as the preferred design for the following reasons:

- 1) This design prevents fish from entering the canal and as such, fish are only exposed to a single velocity gradient at the screen. The in-canal screen/trash rack option would expose fish to at least three major changes in velocity gradients.
- 2) The in-channel screen has less opportunity for fish to become impinged.
- 3) The in-channel screen offers a greater likelihood of survival if fish are impinged as there is a reduced chance that an impinged fish will encounter a cleaning brush.
- 4) The in-channel screen does not result in fish being concentrated at an outlet structure as would occur with the in-canal screen design (i.e., the potential for predation on disoriented fish is reduced).

Biological Review Team. 2006. Summary of the Biological Review Team's comments on Lower Yellowstone River Intake Dam Fish Passage and Screening Preliminary Design Report. US Fish and Wildlife Service. Billings, Montana.

Hiebert, S. D., R. Wydoski, and T. J. Parks. 2000. Fish entrainment at the lower Yellowstone diversion dam, Intake Canal, Montana, 1996-1998. USDI Bureau of Reclamation Report. Denver, Colorado.

US Army Corps of Engineers. 2002. Lower Yellowstone River Intake Dam fish passage alternatives analysis. US Army Corps of Engineers, Omaha District. Omaha, Nebraska.

US Army Corps of Engineers. 2006. Lower Yellowstone River Intake Dam fish passage and screening preliminary design report-Final Report. US Army Corps of Engineers, Omaha District. Omaha, Nebraska.

US Army Corps of Engineers. 2008. Lower Yellowstone project fish screening and sediment sluicing preliminary design report. Final Report. US Army Corps of Engineers, Omaha District. Omaha, Nebraska.

US Bureau of Reclamation. 2000. Intake Diversion Dam, Yellowstone River, Montana: Fish protection and passage concept study report. US Bureau of Reclamation Water Resources Research Laboratory. Denver, Colorado

US Bureau of Reclamation. 2002. Intake Diversion Dam fish passage concept design, Lower Yellowstone Project. US Bureau of Reclamation Water Resources Research Laboratory. Denver, Colorado.

US Bureau of Reclamation. 2005a. Draft Biological Assessment: Future operation of the Lower Yellowstone Project with proposed conservation measures. US Bureau of Reclamation, Montana Area Office. Billings, Montana.

US Bureau of Reclamation. 2005b. Lower Yellowstone fish passage alternatives value planning study. conservation measures. US Bureau of Reclamation, Montana Area Office. Billings, Montana.

US Bureau of Reclamation. 2008a. Intake Diversion Dam trashrack appraisal study for Intake headworks. US Bureau of Reclamation, Montana Area Office. Billings, Montana.

US Bureau of Reclamation. 2008b. Intake Diversion Dam assessment of high elevation intake gates Lower Yellowstone Project Montana-North Dakota. US Bureau of Reclamation, Montana Area Office. Billings, Montana.

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