



Case Study by CART



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Upgrading Water Infrastructure to Improve Fish
Passage and Habitat in the Yolo Bypass

A Case Study on Habitat Connections

August 21, 2023



Introduction

Levees and dams within California's Central Valley have diminished crucial fish habitat, causing a decrease in many native fish populations. Formerly, floodplains and wetlands within the valley were inundated by storms and snow melt in the winter. This provided food-rich habitat in the Sacramento River that supported juvenile salmonids on their migration to the ocean. However, water conveyance and flood control infrastructure have disrupted this river-floodplain connection. This has led to declines of native fish species like the federally- and state-listed [Sacramento River winter-run Chinook](#) (*Oncorhynchus tshawytscha*), [Central Valley steelhead](#) (*Oncorhynchus mykiss*), and [southern Distinct Population Segment North American green sturgeon](#) (*Acipenser medirostris*).

The Yolo Bypass is the largest contiguous floodplain left in the Central Valley. The Bypass is a leveed 59,000-acre engineered floodplain constructed in the 1900s by California and the U.S. Army Corps of Engineers to protect Sacramento and the Central Valley from floods. In addition to providing salmonid habitat through regular flooding, the Bypass also provides waterfowl habitat and is used for agriculture. Water spills into the Bypass during atmospheric river events through the Fremont Weir, a stretch of levee designed to keep the Sacramento River from overflowing. When the Sacramento River's waters reach 32 feet, it flows over the weir (an event referred to as overtopping) into the Bypass, through the Tule Canal, and back into the river. Overtopping provides some connectivity between the Sacramento River and its historic floodplain habitat within the Bypass, allowing juvenile salmonids access to ideal rearing

habitat. However, overtopping during flooding also attracts adult salmonids and sturgeon into the Bypass. When waters recede, these adult fish may be stranded in the Bypass, miles from a viable migration corridor to spawning habitat.

In 2009, a biological opinion released by the National Marine Fisheries Service (NMFS) determined operations of the Central Valley Project and State Water Project were likely to jeopardize the continued existence of the aforementioned listed fish species. NMFS identified the Yolo Bypass as an ideal site for habitat restoration to ease pressure on these species. In response, the U.S Bureau of Reclamation (Reclamation) and California Department of Water Resources (DWR) have partnered to improve habitat in the Yolo Bypass through the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project. Part of this effort is the Big Notch Project, which will reconnect floodplain habitat, increase floodplain inundation, and improve fish passage for salmonids and sturgeon.

The Big Notch Project will cut a “notch” into the Fremont Weir and install a new gated headworks structure. Operation of the structure, seasonally from November 1 to March 15, will allow water and fish from the river into the Bypass when waters rise to an elevation of 14 feet. As the river approaches overtopping, the gates will begin to close, allowing a maximum flow of 6,000 cubic feet per second (cfs) through the gates. Additionally, the Big Notch Project will eliminate several adult fish passage barriers in the downstream channel. Construction began in 2022, and the modified weir is on track to be fully operational by winter of 2023.



Key Issues Addressed

This project will expand rearing habitat for juvenile fish by increasing floodplain connectivity at lower flow rates. Juvenile salmonids who develop in the floodplain habitat grow larger and survive longer than juveniles that stay in the river's main channel. The shallower, slower, warmer waters of the floodplain provide better-quality food and there is less predation. Fish brought into the bypass through flow from the main channel also avoid the interior Sacramento-San Joaquin River Delta, where many fish end up dying through multiple factors. Existing flood control structures prevent juveniles from rearing in the bypass very often or for very long. The Big Notch project will mimic this critical natural inundation process more frequently and for a longer duration, improving connectivity within the Bypass and the Sacramento River.

The Fremont Weir poses a migration barrier into the Bypass for adult salmonids and sturgeon. Adult salmon and sturgeon are attracted to the Bypass during overtopping events by the combination of flow and scent on the way to the streams they were born in. However, they often become stranded in the stilling basin as the river drops, some even as far as 40 miles upstream. There is only one fish ladder providing passage for adults that opens once overtopping of the weir has stopped. Insufficient flow to the fish ladder fails to attract fish to the ladder, impeding passage.

The Yolo Bypass is an important area for many groups, presenting a coordination challenge when it comes to modifying flow of water in the landscape. The Fremont Weir Wildlife Area borders the weir and is used by the public for hunting, wildlife viewing, and educational tours. Farmers grow rice within the Bypass. The wetland habitat is managed for waterfowl and is inhabited by other sensitive wildlife under federal protection. Private ownership of land in the Bypass requires agencies to obtain flowage easements if they are to change the timing and duration of water released within the Bypass. Even though the Bypass is a flood protection feature with a design capacity of nearly 350,000 cfs, flowage easements to allow release of water into the bypass for fish purposes are necessary to justly compensate landowners in the Bypass for effects to agricultural and recreational use from this novel release of water into the Bypass.

Project Goals

- Increase access to and acreage of seasonal floodplain rearing habitat for juvenile salmonids
- Improve connectivity between the Sacramento River and Yolo Bypass for passage of adult salmonids and sturgeon
- Coordinate with local interested parties to minimize negative impact on existing land uses while still maximizing benefits to

fishes

Image Caption: *Model Rendering of the Big Notch Project in the Fremont Weir State Wildlife Area. Courtesy of Kelly M. Grow, California Department of Water Resources.*



Project Highlights

REDUCE, REUSE, REGRAVEL

Rock waste, specifically fish-friendly rounded river rocks from the nearby American River, was repurposed for this project.

- **Headworks Structure Installation:** Contractors will install a gated headworks structure in the notch to the east side of Fremont Weir to control flow from the Sacramento River into the Yolo Bypass. There are three bays in the headworks of different sizes and heights for flexibility. The biggest and lowest bay is 18 feet below the top of the weir, allowing water

to inundate the floodplain when the river reaches 15 feet instead of the previous 32 feet needed for overtopping. By winter of 2023, this headworks structure will be operational. Water will flow through the notch more frequently and for longer durations from November 1 to March 15, when the gates are operating. This increased inundation will improve juvenile salmonid rearing habitat.

- **Improved Fish Passage:** Construction crews will excavate a bypass channel bed that parallels the existing levee, connecting the weir to a pond that provides the most direct access to Tule Canal for migrating fish. The new gated notch will allow through flow at lower elevations to provide open channel flow for adult fish passage for more of the year. Given the limited length of the Fremont Weir, a supplemental fish passage structure is also being added to the west side of Fremont Weir. Berms on the agricultural road crossing that currently pose a fish passage barrier will also be removed or have culverts added.
- **Public Access:** The Fremont Weir Wildlife Area sits at the north end of the Yolo Bypass next to the Fremont Weir and is used for recreation and educational tours. The Big Notch Project will partially block public access across the Fremont Weir during certain flow conditions. For that reason, the Big Notch Project includes building a pedestrian bridge to maintain existing public access to the wildlife area.
- **Real Estate Acquisition:** Much of the Yolo Bypass is on private land used for recreation, hunting, and agriculture. The project involves changing water flow on that privately owned land, requiring the project team to work with landowners to acquire numerous flowage easements.

Image Caption: *Processing of gravel at Mississippi Bar to produce large rounded cobble for use at the Big Notch Project. Courtesy of Bryan Perrin*



Lessons Learned

Project managers coordinated with federal agencies, the Central Valley Flood Protection Board, and local landowners to obtain necessary real estate rights, specifically numerous flowage easements. While the project team initially attempted to work collaboratively with all landowners, some were unwilling to sell. However, the project team still ensured all interested parties' concerns were heard and made compromises where they could. Earlier coordination with federal agencies could have made the real estate process and acquisition of flowage easements more efficient. Monthly meetings were held to update all interested parties, which helped the project timeline stay on track.

Construction cannot be done during the flood season without authorization, and migratory bird and fish patterns further limit when work can be done to not disrupt key habitats. As a result,

there is a small window for construction. The project team was able to overcome this challenge to some extent by coordinating with the Flood Board and being proactive in their planning. They held weekly meetings with the Flood Board to discuss intended actions and concerns and worked with the Flood Board to obtain variances that allowed them to work for two-week increments at a time into the flood season. The project team also minimized scheduling issues by doing a prep contract that readied the site for construction. Additionally, construction crews cleared woody material to deter nesting birds that would limit the construction period.

Image Caption: *Construction underway on the Big Notch Project.*
Courtesy of California Department of Water Resources



Next Steps

- Continue construction, including finishing the new headworks structure and adding gravel to the newly excavated channel.
- Evaluate how well adaptive management plan targets are being met through monitoring: A mark-recapture study with fishery-raised fish will be done to monitor entrainment, the amount of juvenile fish who enter the Bypass versus those that remain in the river. An ARIS sonar imaging camera will also be built into the headworks to document what fish are able to access the headworks's opening.
- Take near-surface groundwater readings from local groundwater wells to determine effects from construction and changes in water flow.
- Gather feedback from local groups to understand how they feel about project impacts.

Image Caption: Water is seen overtopping the Fremont Weir in Yolo County. Courtesy of Andrew Innerarity, California Department of Water Resources



Resources

August 2023 Case Study Handout

Collaborators

- [California Department of Water Resources](#)
- [United States Geological Survey](#)
- [U.S. Department of the Interior](#)
- [United States Fish and Wildlife Service](#)
- [National Oceanic and Atmospheric Administration](#)
- [United States Army Corp of Engineers](#)
- [California Department of Fish and Wildlife](#)
- [Yolo Basin Foundation](#)
- [Yolo County](#)
- [Delta Stewardship Council](#)

Resources

- [Bureau of Reclamation Yolo Bypass Fact Sheet](#)
- Bureau of Reclamation. (2012, September). [Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan](#). *U.S. Department of the Interior*.
- Martinez, J. (2023, January 12). [Fremont Weir Big Notch Project Flyway Nights Jan 2023](#) [Webinar]. *Yolo Basin Foundation*.
- U.S. Army Corps of Engineers (n.d.) [Flowage Easements](#).

Photo Gallery

- [Photo Album and Credits](#)

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Video Caption: *Big Notch Project construction from September 2022 next to a 3D rendering of the finished construction in late 2023. Courtesy of California Department of Water Resources.*

More Information on CART