

Sustainable Rivers Program

Salt River

Environmental Flows for Lake Sturgeon

2022



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Above: Re-regulation dam below Mark Twain Lake (USACE photo)

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1 Introduction and Project Area

The Salt River, located in northeast Missouri, is an important tributary of the Mississippi River. The river was dammed in 1984 by the construction of Clarence Cannon Dam, which impounds Mark Twain Lake. The dam has 2 hydropower turbines and is jointly operated by the U.S. Army Corps of Engineers (USACE) and the Southwestern Power Administration (SWPA). Flows out of the dam are regulated in accordance with the USACE water control plan and the needs of hydropower generation. In addition, there is a re-regulation dam below Mark Twain Lake that allows for pump back capability for the hydropower plant (Figure 1). While pump back has not been utilized other than during capability tests, re-regulation of the Salt River is common with outflows from Mark Twain Lake and the re-regulation pool being reshaped in ways that significantly alter the hydrograph thereby affecting aquatic species of the lower Salt River. Flows below the re-regulation dam directly influence a number of species of state interest including paddlefish, walleye, sauger, channel and flathead catfish, and lake sturgeon. Secondly, the river below Mark Twain Lake has productive mussel beds, which are a resource of concern in the Mississippi River basin.



Figure 1. Salt River re-regulation dam and tailwater area.

Of particular interest is lake sturgeon, once nearly extinct in Missouri, the species has been subject to an extensive reintroduction effort by the Missouri Department of Conservation (MDC) since the 1980's. Lake sturgeon is a long-lived fish which takes upwards of 20 years to reach sexual maturity. MDC has noted the recent repeated aggregation of lake sturgeon below the re-reg dam in the Salt River during spawning season (2016-2021). They believe the aggregations are related to attractive flows out of the re-regulation dam. MDC biologists approached USACE with a request to evaluate velocity and flows to facilitate sturgeon aggregations, and to assess stage fluctuations, which they believe may be negatively influencing successful spawning and reproduction in the Salt River. Any efforts to benefit the lake sturgeon would also be expected to benefit a host of other riverine fish species, similarly utilizing the area for spawning. 2022 was the first year Salt River was involved with the Sustainable Rivers Program.

2 Accomplishments in 2022

Environmental efforts of the Sustainable Rivers Program (SRP) are typically defined in documents called scopes of work. The scope of work for Salt River supported by SRP in 2022 had one task with three parts: Outreach and coordination, environmental flow modeling, and monitoring.

2.1 Outreach and Coordination (Task 1a)

1. On April 6, 2022, staff from USACE Water Control, USACE Environmental Planning, MDC, and SWPA met at the M.W. Boudreaux Memorial Visitor Center at Mark Twain Lake to discuss the SRP program, provide background information on Lake Sturgeon, and then visited the re-regulation dam to view various discharge flows and how the tailwater reacted to the varying gate settings.

During the onsite meeting four conditions were tested at the re-regulation dam tailwater to visually evaluate the resulting hydraulic conditions, with the intent of determining which scenarios would provide the most ideal spawning conditions for the lake sturgeon within the rip rap armored area. According to MDC fisheries staff, the ideal condition is a minimum of 1.5 ft/s flowing over rocky surfaces (i.e., rip rap). Two areas were focused on, the immediate gate outlet area near the re-regulation dam, and the area where the armored tailwater bottlenecks (see Figures 1 and 5).

- **500 cfs (0.5 ft gate #1):** This appeared to push the flow to one side at the gate outlet and the velocities immediately dissipated within about a hundred feet prior to reaching the rip rap armoring. It took several minutes (~10-15 min) but velocities started to pick up at the bottleneck, area of the re-regulation tailwater armored area. This is likely the minimal acceptable condition at the bottleneck area, so this would be the minimum effective flow.
- **1,000 cfs (0.5 ft gate #1 & #2):** This made the velocities more uniform at the gate outlet area, but velocities still dissipated within about a hundred feet prior to reaching the rip rap armoring. However, velocities within 10-15 min appeared to be ideal at the bottleneck area of the tailwater. These flows seemed to be ideal all along the bottleneck area.
- **2,000 cfs (1.0 ft gate #1 & #2):** Much like the previous scenario this made the velocities more uniform at the gate outlet area, but velocities still seemed to dissipate before reaching the armored area near the gate outlet. However, velocities within 10-15 min appeared to be ideal at the bottleneck area of the tailwater. These flows seemed to create similar conditions as the previous scenario, but with higher velocities, which the group felt was a good outcome.
- **4,000 cfs (2.0 ft gate #1 & #2):** This scenario seemed to start getting velocities farther from the gate outlet and drastically increased velocities in the bottleneck area. With these outflow conditions, MDC staff thought sturgeon could find several areas within the tailwater area, but also if held this high they would find additional areas in the Lower Salt River.

After observing all scenarios, it was agreed that 500 cfs is the lowest effective flow to create velocities for spawning conditions and that somewhere between 1,000 cfs and 2,000 cfs would create the most ideal conditions in the re-regulation tailwater area. The higher flow scenarios (>2,000 cfs) would still support spawning, but it was conveyed that this scenario would only be sustainable during flood operations (i.e., one unit running around the clock).

Lake sturgeon eggs are sticky and remain on the rocks until hatching. Egg hatching is temperature-dependent; incubation is prolonged by cooler water. Hatched larvae settle into the spaces between the rocks. It can take a week or more for a larva to absorb its yolk sac and grow. During this stage in their life history sustained flows and water levels are critical. Flows above 2,000 cfs are in most cases not sustainable and create an inherent risk of dropping water levels post-spawn, which would likely lead to dewatering, exposing, and mortality of freshly deposited eggs. Therefore, flows above 2,000 cfs will not be targeted for spawning purposes.

2. As the spawning season progressed through April, MDC continued monitoring and public outreach efforts at the re-regulation dam. This included placing of signage (Figure 2) and multiple conversations with various anglers that often fish below the re-regulation dam. Monitoring efforts for the 2022 spawning season were fairly limited due to above average precipitation and higher flows, but MDC stated that they felt there was still opportunity for fish to use the area even with the high flow conditions. The chart below shows peaks in flow around the 7,000 cfs range in mid-April on the Salt River gage located on the Highway A bridge approximately 0.6 miles downstream of the re-regulation dam (Figure 3). It is very difficult to successfully place and utilize many of the typical sturgeon sampling gear (gill nets, trotlines, egg mats, larval drift nets) with flows peaking this high.



Figure 2. Signage produced and placed by MDC for their outreach efforts at the re-regulation dam.

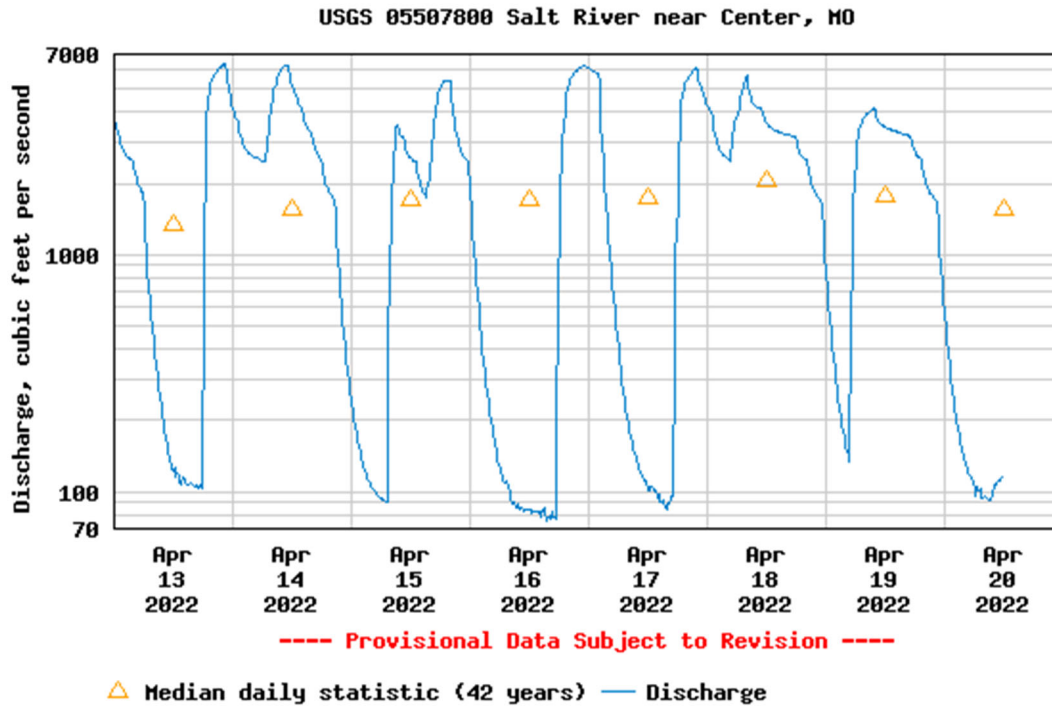


Figure 3. USGS streamflow gage 13 April – 20 April 2022.

3. Results from the outreach effort produced contact from a local angler that caught and released a lake sturgeon on April 19, 2022. The angler did not have a way to weigh or measure the sturgeon but took photos and gave a good description of size to MDC biologists, which estimated the fish to have been approximately 40-53 lbs and between 25 and 35 years old (Figure 4). MDC also estimated that the fish was most likely a mature male but could have also been a first-time spawning female.



Figure 4. Angler caught and released lake sturgeon below re-regulation dam April 19, 2022 (photo by Joey Hall).

4. On November 7, 2022, staff from USACE Water Control, USACE Environmental Planning, USACE Environmental Quality, MDC, and SWPA met once again at the M.W. Boudreaux Visitor Center to discuss water management goals and the potential for incorporation of the SRP Program below the re-regulation dam for future efforts.

Water Control, and Environmental Quality gave presentations on the past year's efforts and the state of low water across the watershed. USACE Environmental Planning and MDC gave some background information on lake sturgeon and described the optimal spawning conditions and flows that would be targets to reach in the spring.

The group toured the re-regulation dam (Figure 5) and the hydroelectric plant before returning to the M.W. Boudreaux Visitor Center for a public outreach meeting. During the public outreach meeting, presentations from Dam and Levee Safety, Water Control, and Environmental Planning were given.

One member of the public who attended, stated that he was the President of the Lower Salt River Basin Coalition; and expressed concerns of the direction of the project's management goals. He articulated that the Project Purpose was for flood control, and not for spawning fish (In actuality, the authorized purposes of the project are flood risk management in the Salt River Basin, hydroelectric power generation, water supply, fish and wildlife conservation, recreation, and incidental navigation). USACE staff addressed his concerns by explaining that the SRP focus was to adjust downstream flows for sturgeon on an opportunistic basis, and do not intend to deviate or take precedence over flood risk management and hydropower actions. It was further explained that sturgeon e-flows would not be primary project priorities, but an opportunity to provide more favorable conditions when water levels and power generation needs provide the opportunity to do so.

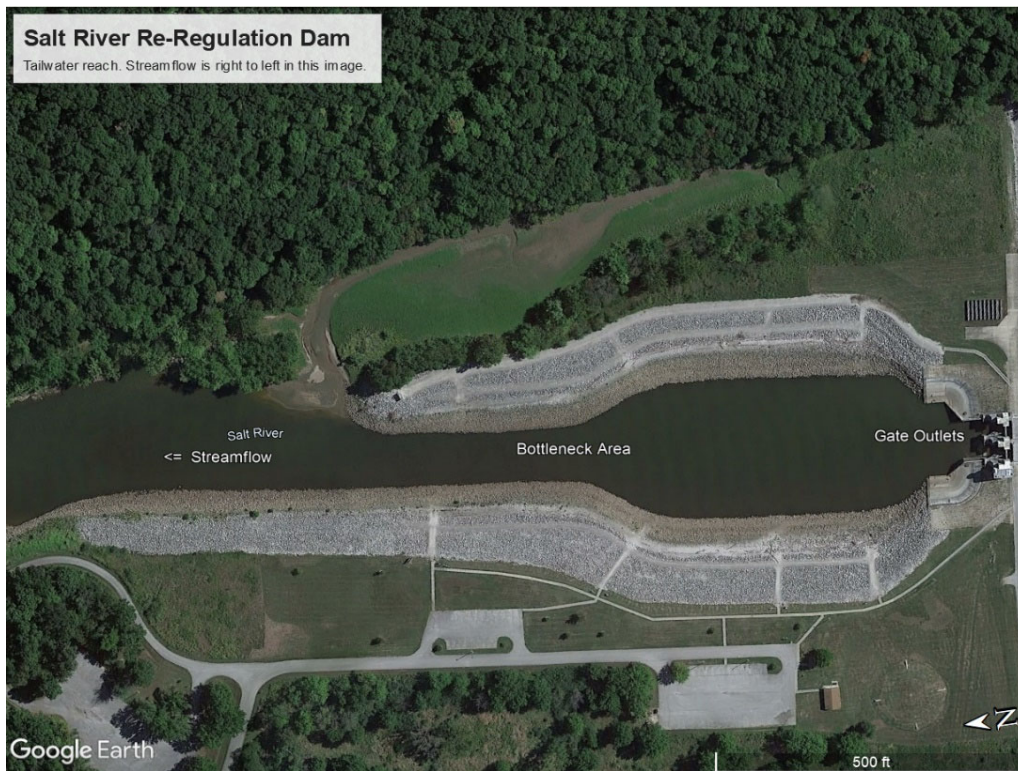


Figure 5. Salt River re-regulation dam outlet and bottleneck portion of tailwater area. Streamflow is right to left in this image.

2.2 Environmental Flow Modeling (Task 1b)

Using observations and feedback from the site visit on April 6, 2022, USACE Water Control staff have begun looking at generation schedules and the potential to modify re-regulation dam schedules. The scope of work called for development of a Salt River HEC-ResSim model to evaluate under what conditions it would be possible to maintain a constant flow condition for an extended period of time. That modeling effort began in mid-2022, with an anticipated completion date in early calendar year 2023, followed with pilot testing of the model in spring 2023.

2.3 Monitoring (Task 1c)

Although no e-flows were employed in 2022, primarily due to above average precipitation and higher flows, MDC still conducted minimal monitoring and outreach efforts to watch for sturgeon below the re-regulation dam. Informational banners placed below the re-regulation dam led to reports being called in by anglers and MDC following up with those anglers to document the presence of sturgeon. No fish were tagged or measured by MDC in the 2022 season, although a lake sturgeon was caught and released on April 19, 2022, and reported to MDC as a result of the outreach efforts, as described above in Section 2.1.

Had conditions been more amenable, a coordinated monitoring and tagging effort between MDC and USACE was anticipated to expand numbers of tagged, local fish with resulting data helping inform future e-flow strategies and monitoring efforts.