Fish Passage at NSBL&D
Engineering Appendix – Attachment 4

Fixed Weir Pool Simulation - After Action Review

Background

In February 2019 the Corps conducted a simulation of the with-project conditions for the recommended fixed-weir fish passage structure at New Savannah Bluff Lock & Dam. The recommended plan, Alternative 2-6D, is an environmental mitigation feature of the Savannah Harbor Expansion Project, and is required mitigation in accordance with the Endangered Species Act. The purpose of the simulation was to allow members of the public and stakeholders along the Savannah River to view and experience the conditions they could expect with Alternative 2-6D, a fixed weir structure, in place of the current lock and dam.

There were several objectives for the simulation:

1. Demonstrate to the public and stakeholders in the Augusta and North Augusta area the anticipated pool level and extent with a fixed crest weir in place of the NSBLD during average flow conditions (between 5,000 and 8,000 cfs).
2. Verify the 2018 hydraulic analysis and calculations that concluded lowering the pool causes no issues with municipal and industrial water intakes located along the river within the pool.
3. Verify the predictions made with the riverine model for the depth attenuation through the pool.
4. Measure the depth of water over the training wall to ensure there is no hazard to navigation for recreational boats.
5. Capture aerial imagery of the simulated pool to further improve the shoreline mapping tool. The shoreline mapping tool was presented during a public meeting in November 2018 and can be found online at: http://water.sas.usace.army.mil/nsbld/.

Normal Lock and Dam Operations

Currently, under normal project operations, the pool upstream of NSBLD is maintained by Corps personnel between elevations 112.5 and 114.5 ft NGVD29 by adjusting the gate settings as specified in the 1996 Savannah River Basin Water Control Manual. Typically, under low and average flow conditions, the target pool elevation is between 1114 and 114.5 ft NGVD29 as measured at a river stage gage maintained by the USGS which is located just upstream of the NSBLD structure (02196999).

The elevation of the pool impounded by the NSBLD is currently managed by adjusting the gates at the dam. The NSBLD gates are adjusted throughout the day to keep the pool within its normal operating range, based on inflow to the dam. Inflows to the dam are a function of releases from J. Strom Thurmond Dam (which are reregulated by Stevens Creek Dam), tributary inflows, and diversions to the Augusta Canal. During extreme storm events, the spillway gates controlling the pool are eventually raised completely out of the water to allow the high water to flow to pass.

Operations during Simulation

During the simulation normal operations were suspended, and the gates opened to hit the target pool elevation to simulate pool conditions for the recommended plan. The target pool level for the simulation was elevation 111 ft NGVD29 as measured and observed at the USGS gage located just above the NSBLD (02196999). This is 1.5 feet below the normal minimum operating range at the NSBLD.

Adjustments to the NSBLD pool level began on February 9th, with the pool being lowered 0.5 feet each day over a period of about 5 days until the target pool elevation was reached on February 13th. Lowering the pool slowly helped ensure the river bank remained stable during the simulation. Bank sloughing can occur when pools drop too quickly resulting in the collapse of saturated banks. Dropping the pool slowly, as prescribed for this simulation, allowed the saturated banks to drain greatly reducing the chance of bank failure or collapse. Once the target pool elevation was achieved, gate openings were adjusted periodically, throughout each day, as needed to maintain the desired elevations for the simulation.

During the drawdown period from February 9th to the end of the simulation on February 15th, the average daily discharge from Thurmond Dam was approximately 5,000cfs.

Upon conclusion of the simulation operators adjusted the gates to raise the pool level back into the normal operating range. Raising the pool in a safe manner can occur more quickly as compared to the slow rate required to lower the pool. Over the course of approximately 12 hours, the pool was raised from the target elevation to the normal pool elevation of 114 and normal operations resumed.

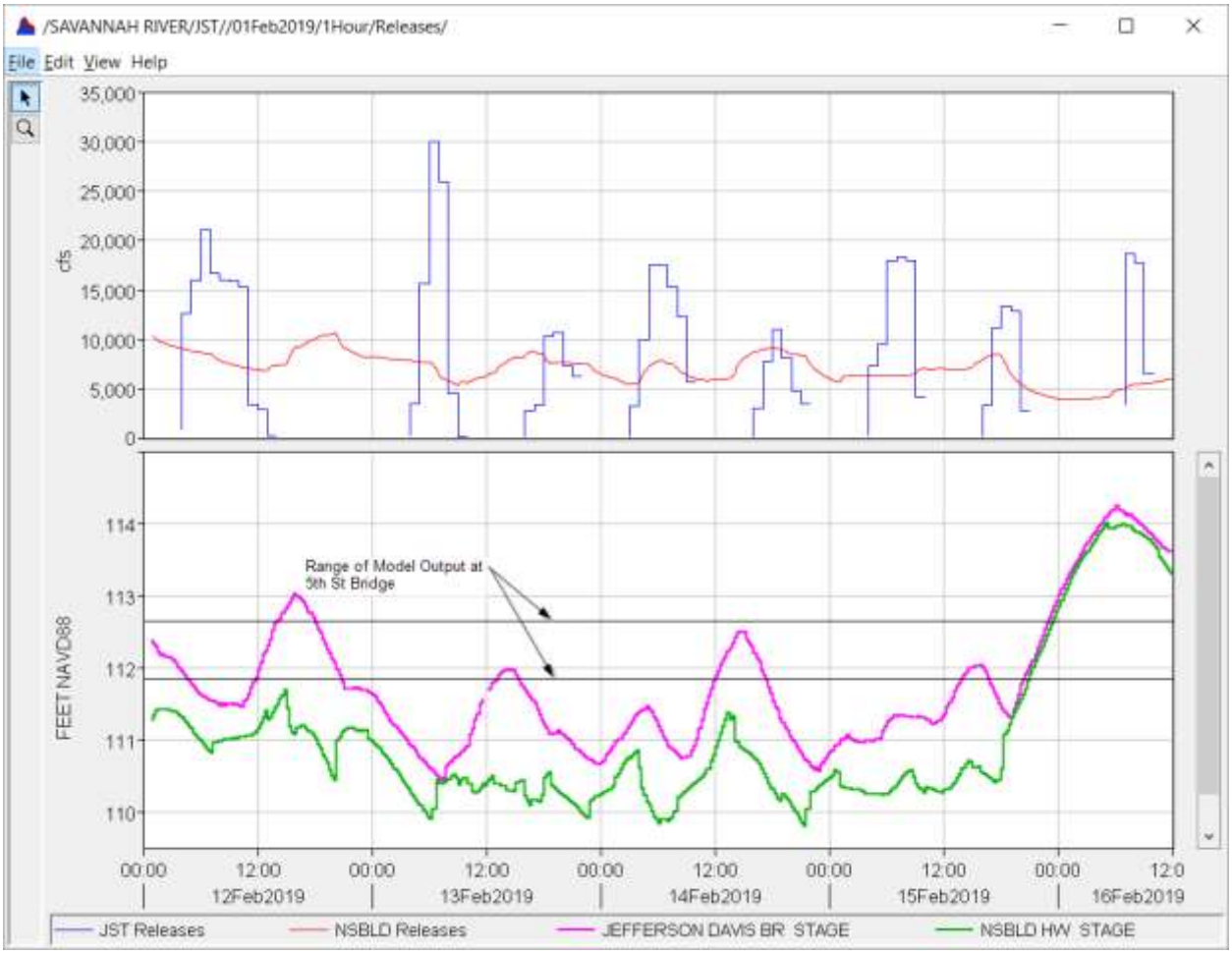
Objective 1 – Demonstrate with-project Conditions

The conditions seen during the simulation were not entirely representative of conditions we would expect to see under the recommended plan. Prior to the simulation, releases from Thurmond Dam were relatively high due to sustained rainfall during the preceding months. These high flows (and resulting higher pools levels) prior to the simulation made the impacts of the simulated 5,000cfs appear more dramatic by comparison.

Another factor that made the impacts during the simulation more dramatic was the state of the flashboards at Stevens Creek Dam. Ordinarily the flashboards allow Stevens Creek to even out the flows released from Thurmond's hydropower generation, keeping flows and river levels more consistent over the course of twenty-four hours. The flashboards were not in place during the simulation (the flashboards were being replaced) so the hydropower releases from Thurmond were translated directly downstream to Augusta. Hydropower generation requires high releases from Thurmond Dam, but these releases are only sustained for a short period (for example, JST may release 18,000cfs for one hour). During non-generation periods flows are significantly lower, perhaps only a few hundred cfs. This was the case during the simulation, with high peak flows due to hydropower generation, with periods of very low flows in between. The low-flow periods between hydropower generation are when the water levels were at their lowest during the simulation. Ordinarily Stevens Creek would even things out to produce a "mean daily" flow of around 5,000cfs, unfortunately the flashboards being down resulted in the low flow impacts being magnified downstream in Augusta.

The figure below shows pertinent information regarding river levels and flows measured during the simulation. Releases from JST are seen in blue, and flows measured below NSBLD in red. The pool elevation at 5th Street Bridge is shown in pink and the elevation at NSBLD is in green. The range of

expected pool elevations for the with-project condition for normal flow conditions is also highlighted. A range of values is presented because there is some natural amount of uncertainty in the model used to predict water elevations; model uncertainty is discussed later in this document.



This scenario (lack of reregulation by Stevens Creek) was not clearly communicated prior to the simulation, nor was it documented in the Draft Report or Engineering Appendix made available to the public prior to the simulation. Replacement of the flashboards occurs infrequently (once every 25+ years) and conditions seen when the flashboards are not reregulating flows should not be considered representative of the with-project condition. The flashboards being down during the simulation was very unfortunate timing since the attempt was to demonstrate normal with-project conditions for the public.

Numerous comments regarding the simulation and exposed “mudflats” were received during the public comment period (see photo below). Conditions seen during the simulation were more dramatic than should be expected for the recommended plan, and many of the areas that were exposed during low flows will not be exposed under the recommended plan. However, some areas will see shoreline retreat and additional exposed “mudflats”. These area will likely see vegetation colonize the exposed areas relatively quickly after construction of the fish passage project is completed.

Objective 2 – Impacts to Water Intakes

In the week leading up to the simulation and every morning during the simulation, USACE hosted a conference call with water users and resource agencies to discuss pool levels, flows, and activities from the previous 24 hours. No significant concerns regarding water intake performance were provided to USACE during these calls, even with pool elevations being below what was anticipated prior to the simulation (see the discussion above on flashboard reregulation). One user expressed concern that the simulated pool levels with 5,000cfs did not stress their intake system as much as a drought flow level of 3,600cfs would, but the lack of reregulated flows at Stevens Creek likely caused flow in the river (and resulting pool elevation) to be less than what would be experienced during drought conditions with Stevens Creek flashboards in place. Overall, the simulation validated our expectations that water intakes would not be adversely impacted under the recommended plan.

Objective 3 – Validate hydraulic model

The simulation provided an opportunity to validate the hydraulic model used to predict pool elevations for the recommended plan. There is uncertainty in any model, and the aphorism that *all models are wrong, but some are useful* applies to the HEC-RAS model used to determine with-project pool elevations for SHEP Fish Passage.

One factoring contributing to the uncertainty in the fish-passage hydraulic model (HEC-RAS) is the availability of bathymetric data in the area. Cross section data spaced every 1000 feet were used in the model, which does not capture some features that may have an impact on water surfaces (e.g. sandbars, scour holes, etc). Secondly, there is not a significant period of record with observed pool

elevation that could be used for model calibration (the gage at 5th Street Bridge only goes back to late 2016). This was one reason USACE was in favor of the simulation, so that real world data during low flow and low pool conditions could be used to better inform modeling.

There is room for improvement with the hydraulic model; however, its purpose was never 100% accuracy in all areas. It represents average conditions under average flows, whereas real-world conditions for pool elevations and incoming flows vary a good bit throughout the day based on generation at Thurmond, tributary inflow, reregulation at Stevens Creek Dam, and diversions to the Augusta Canal. The model simplifies some of this intra-daily variation and presents and "average daily" value only. This is partly to simplify communication of the anticipated impacts for the recommended plan, and partly due to the lack of available data needed for a more detailed accounting of flow withdrawals and variations throughout the day.

Pool elevations seen during the simulation are lower than those listed in the main report and Engineering Appendix for the recommended plan. However, pool elevations for the recommended plan as reported in the main report assume that the flashboards at Steven Creek are in place to reregulate Thurmond discharges for hydropower generation (see Object 1 discussion above). After the simulation the hydraulic model was used to simulate releases from Thurmond without reregulation from Stevens Creek. The model was able to reproduce some of the effects seen during the simulation, such as the exposed training wall, mudflats, and shoreline retreat during periods when Thurmond was not generating hydropower and flows in the river dropped to near zero. This validated the model's performance from normal and extremely low flows, and given the uncertainty discussed above no modifications to the model were deemed necessary.

The model has undergone extensive review by experts within and outside of USACE. Despite the shortcomings discussed above, the model represents our best understanding of the river system given the data we have available and is suitable for the purposes of alternative evaluation that led us to the recommended plan.

Objective 4 – Observe Pool Elevations at the Training Wall

The depth of water over the training wall varied throughout the simulation, due to the fluctuations in flow and resulting pool level as discussed above. This made measuring depths difficult as there wasn't a steady pool level against which to measure depths. However, it was clear from the simulation that parts of the training wall were exposed during the simulation and other portions were visible just below the water's surface. The photo below shows the cribbing and rock fill used to construct the training wall, near 5th Street Bridge.

The low flow levels discussed in Objective 1 above exposed more of the training wall than would be expected during normal conditions for the recommended plan, and the impacts discussed in the main report are still valid. The training wall is a feature of the Savannah River Below Augusta navigation project constructed c. 1910 and is a known navigational hazard for recreational boating. The training wall will be marked with buoys as part of the fish passage construction. The Savannah District has requested approval to study removal of the training wall separate from the fish passage analysis.

Objective 5 – Acquire Aerial Imagery

An unmanned aerial vehicle was used to acquire aerial imagery of the shoreline and any exposed features during the simulation. Areas of interest for which imagery was acquired are shown in the figure below:


North Augusta
Riverview Park
Woodlawn Ave W
West Ave
Georgia Ave
121
Old Edgefield Rd
Wemath Rd
Powerhouse Rd
Cherokee Dr
Old Aiken Rd
Storm Branch
E Buena Vista Ave
River Watch Pkwy
Goodrich St
River Golf Club
278
Augusta
Reynolds St
Halocarbon Products Corp
Revco Rd
North Augusta Industrial Park
Horse Creek
Greene St
Augusta University Health Science
Paine College
11th St
7th St
6th St
5th St
Telfair St
May Park
2nd St
Broad St
Sand Bar Ferry Rd
GEORGIA
Laney Walker Blvd
12th St
15th St
Martin Luther King Jr Blvd
Old Savannah Rd
New Savannah Rd
Laney Walker Blvd Ext
520
Brickyard Pond Rd
Columbia Nitrogen Dr
Lowers Ln
Augusta Levee Rd
Bobby Jones Expy
Phinizy Swamp
SOUTH CAROLINA
Marvin Griffin Rd
Butler Creek
Phinizy Swamp Nature Park
Dixon Airline Rd
250 ft
314 ft
Lock & Dam Rd
Gordon Barnard Pkwy
Augusta Regional at Bush Field
New Savannah Bluff Lock & Dam Park
Gum Swamp

The imagery was collected over the course of several days during the simulation, during which time flow and pool levels fluctuated on an hourly basis. This made mapping the impacts on flow levels to shoreline retreat and exposed mudflats difficult. If the aerial vehicle was not flying over an exposed area during low flows, we were unable to get imagery of that feature during the extreme low flows we saw during the simulation.

Goodale Landing

On February 15th a homeowner in the Goodale Landing community contacted USACE with concrens regarding a retaining wall that was experiencing sloughing. USACE dispatched a team of engineers varying in specialties to evaluate the situation noted several areas where the wall was deformed and sloughing in the backfilled area landside of the wall. The team noted a lack of drainage system in the wall, and the ground behind the wall appeared to be very saturated and not draining well. The pool was lowered incrementally over a number of days to avoid impacts like this, but the lack of a proper drainage system for the retaining wall likely contributed to the sloughing and deformation.

As a result of this evaluation USACE made the decision to cancel the remainder of the simulation to alleviate some of the pressure on the retaining wall. Operators at Thurmond Dam immediately began bringing the pool back up to normal operations.