



Mississippi Valley Division,
Regional Planning and
Environment Division South

Pearl River Basin, Mississippi Federal Flood Risk Management Project



Draft Appendix E – Hydrologic and Hydraulic Model July 2025

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Section 1 Introduction

This Appendix includes the limited hydrologic, hydraulic, and statistical analysis conducted by the U.S. Army Corps of Engineers (USACE) Hydraulic Project Delivery Team (PDT) members to support an update to modeling and risk.

1.1 PROJECT AREA

The Pearl River Watershed is in the south-central portion of Mississippi and in southeastern Louisiana. The river drains an area of 8,760 square miles (sq. mi.) consisting of all, or parts, of 23 counties in Mississippi and parts of three Louisiana parishes. The primary study area comprises the Pearl River watershed between river mile (RM) 270.0, located south of Richland, MS, and RM 301.77, just downstream of the Ross Barnett Reservoir dam.

Municipalities within the study area include Flowood, Jackson, Pearl, and Richland. The study area includes parts of Hinds and Rankin counties. Major tributaries of the Pearl River within the study area include Caney, Eubanks, Hanging Moss, Hog, Lynch, Prairie Branch, Purple, Richland, and Town Creeks. Per the NFI report, the study area denotes the area that will be potentially impacted by implementation of the project, which is different from the project area, the actual site the project will occupy.

1.2 PREVIOUS EVENTS

Numerous flood events have affected the study area, most notably the Easter flood of 1979, the May flood of 1983, and the February 2020 flood event. The 1979 event flooded transportation routes, homes, and businesses, causing damages that, at that time, totaled approximately \$223 million. If the same event occurred in the present day, damages would surpass \$1.2 billion. More recently, the Pearl River crested at 36.67 feet in Jackson on February 17, 2020, the third highest crest ever recorded. The communities sustaining the most devastation from this flood event were in minority and low-income areas of Jackson.

1.3 PROJECT ALTERNATIVES

The project descriptions for the updated alternatives evaluated include the Modified Nonstructural plan, Alternative A1, and two structural USACE Combination Thereof (CTO) alternatives, Alternative D1 and E1. The CTO Alternatives may be comprised of a Nonstructural components and flood damage risk reduction structural features.

1.4 NFI 211 REPORT REVIEW

USACE reviewed the final array of alternatives and associated reporting as provided by the NFI for technical accuracy and consistency, specifically in regard to hydraulic, hydrologic, and statistical analyses. This was in support of relevant items in the Assistant Secretary of the Army for Civil Works (ASA-CW) comment list. USACE worked through these items in support and in addition to the overall PDT direction of developing the updated nonstructural Alternative, NED, and LPP. Items with economics, cost, or plan form objectives are not included in this list.

1.5 MODEL UPDATES

To resolve the ASA review comments, USACE recommended the following model updates. Further details and results of this model update are provided in the following sections of this report.

- Hydrology Model Creation and Calibration
- Updates to Hydraulic Model and Calibration
- Update to Statistical Modeling
- Routing of Existing Conditions and Proposed Alternatives
- Simplified Climate Change Analysis
- Simplified Risk Assessments
- Model and Report Review

Section 2

Historical Project and Flood Analysis

2.1 HISTORY OF REGION/RIVER

The Pearl River drains nearly 78,000 square miles in Mississippi and 900 in Louisiana, running from Edinburg, Mississippi to near the Rigolets at the Gulf of America. Spanish Explorers discovered the river in 1519. In 1699 Jean-Baptiste Le Moyne, Sieur de Bienville named the stream La Riviere des Perles- a translation of the Acolapissa Indian name. In July and August 1732, Lt. Sieur Louis Joseph Guillaume de Regis du Roullet explored the Pearl River from source to mouth. He reported a land empty of humans, likely due to the spread of recently introduced European diseases and the recent Choctaw-Chickasaw wars and noted a draft of driftwood choking the lower river. This report was repeated by Andrew Ellicott in 1798. After the war of 1812, the United States began to settle the areas near the mouth of the Pearl River. (Mississippi Encyclopedia 2018) The river was cleared of driftwood to the 31st parallel, but Natchez residents blocked further development of the river. (National Geographic 2023)

Mississippi became a state in 1817; and Andrew Jackson and General Thomas Hinds negotiated the Treaty of Doak's Stand with the Choctaw Indian Nation in 1820, where 5 million acres in central and western Mississippi were opened to settlement. (Britannica 2023) Three commissioners were ordered to place and survey a new capital city in the center of the state. The exact center of the state was a swamp, so the commissioners located the city just down the Pearl River to the southeast, at the site of LaFleur's Bluff, a small village founded by French-Canadian trader Louis LeFleur. (The City of Jackson Mississippi 2023)

The Choctaw was the first steamboat to make it to Jackson in 1835, and by 1840 there was regular traffic along the river, only traveling as far north as Jackson during higher river stages. (Sea Coast Echo 2022) By 1856, the Pearl, which had maintained channel stability and water clarity, became threatened environmentally. Planters and rivermen cut off river bends to increase the water's flow rate and to shorten distances along the river, but this loss of pool increased flooding. In addition, timber clearance on the banks increased silting and erosion. Nevertheless, the Pearl remained a key transportation highway until the Civil War. (Mississippi Encyclopedia 2018)

The city of Jackson was occupied multiple times and destroyed by Union Troops during the Civil War, and the city moved toward recovery in the following decades. The arrival of new railroads in the 1880s and discovery of natural gas fields in the 1930s helped to improve recovery and economic growth. (Britannica 2023)

2.2 EARLIEST RECORDED EVENTS- 1874 TO 1902

The earliest recorded events are a series of floods occurring between 1874 and 1902. Peak stage/flow measurements are available from 1874, and stage data is available at the Jackson gage from 1901 to the present. USACE added the floods of April 25, 1874, December 5, 1880, and April 21, 1900, to the gage record from data provided by residents and newspaper records. Periodic weather observations are also available from 1849-1871 and 1873-1876 prior to the gage development to help inform the historical

flood record. The 1902 event was the historical flood of record with a recorded discharge of 85,000 cubic feet per second (cfs). (Grice 2006, USGS 2023)

2.3 J.H. FEWELL WATER TREATMENT PLANT (WTP) AND WEIR-1915

In 1915, to ensure a reliable source of water supply, the city of Jackson constructed the J. H. Fewell WTP located at river mile (RM) 290.7. A weir was later constructed. Jackson's current water supply still draws on this weir, along with the O.B. Curtis WTP, which withdraws water from the Ross Barnett Reservoir.

2.4 ROSS BARNETT-1965

The Ross Barnett Reservoir is a 33,000-acre impoundment just upstream of Jackson, Mississippi. The lake provides water supply for the city of Jackson and various recreational opportunities. Construction began in 1960, and the lake reached full pool by 1965. The Pearl River Valley Water Supply District maintains the reservoir between 296 to 297.5 feet.

Although the reservoir does not have a flood reduction mission, in recent years the reservoir has been operating under large inflow events in conjunction with the Lower Mississippi River Forecast Center and USACE's Vicksburg District to implement future informed releases within the lake limits to delay or decrease peak releases for events with a forecasted peak discharge above 35,000 cfs. The principal spillway consists of ten (10) 40-foot (width) by 21- foot (height) gates with a discharge capacity of 180,000 cfs. The emergency spillway is a fuse plug type with a discharge capacity of 70,000 cfs. (State of Mississippi 2023; FTN Associates 2011)

2.5 BRIDGES IN THE AREA-1960S

There are many road crossings though the project reach, many of which were constructed in the 1960s. Table E1-1 lists each crossing from upstream to downstream and Figure E1-1 provides a profile plot of the peak of the 2020 flood event showing approximated water surface increases occurring due to the constrictions at each crossing.

Table E1-1. Listing of Local Bridges with Date of Construction (Road Crossings: Clarion Leger 2023)

Bridge Location	Date of Construction/ Major Reconstruction
Highway 25 (West)	1965/2001
Highway 25 (East)	1965/2001
Highway 25 Relief (West)	1965/2001
Highway 25 Relief (East)	1965/2001
Abandoned Railroad (GM&O)	1927 (Historical Marker Database)
I-55 over Pearl (North)	1967/1998
I-55 over Pearl (South)	1967/1997
Silas Brown/Woodrow Wilson (Old Brandon Road)	1925/2003
KCS Railroad	1838/1868 (Newspapers.com 2023)
Highway 80	1938
I20 (West)	1965
I20 (East)	1965/1998
CN Railroad	Unknown

******Many of the older bridges have been modified/rebuilt since dates listed.

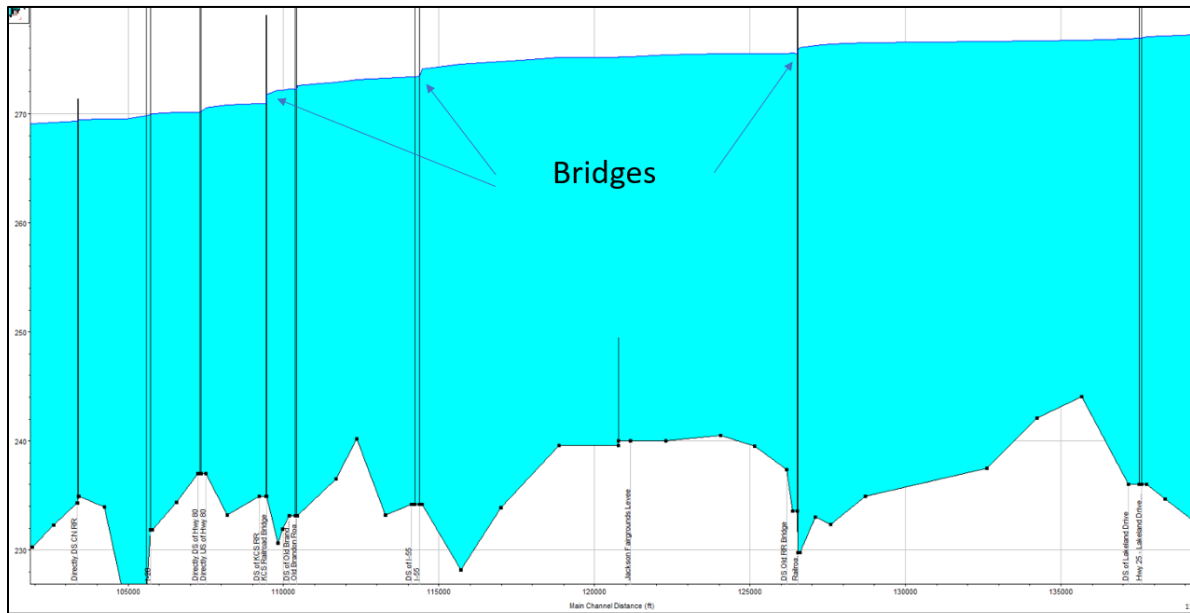


Figure E1-1. Water Profile Showing Backwater at Bridge

2.6 FEDERAL LEVEES AND CHANNEL STRAIGHTENING-1960's

The Jackson Fairgrounds and East Jackson Levees were authorized in the 1960 Flood Control Act, with construction completed in 1968. This work included two earthen embankments, 5.34 miles of river channel work (a new wider channel was created with overbank areas between the levees), four gated outlets, and two pumping plants. (Rankin Hinds 2021; figure E1-2).



Figure E1-2. Levees and Channel Straightening

Source: (Rankin Hinds 2021)

2.7 APRIL 1979

The winter of 1978-1979 was exceptionally wet: December and January received at least 150% above normal rainfall, and February – April 9th also received well above average precipitation. On April 11, a squall line associated with a slow-moving cold front began to move over the area. Four to five inches of rainfall fell over the Jackson Metropolitan Area and induced flash flooding. The National Weather Service office in the Jackson area measured 4.5 inches of rainfall accumulation in just over an hour. (NWS 2023a, b)

The cold front continued to western Mississippi on April 12th and became stationary. Eight to ten inches of rain fell over the headwaters of the Pearl, Noxubee, and Tombigbee Rivers in one day. Total rainfall for the basin for the event is shown in the graphic below. (NWS 2023a, b), see Figure E 1-3.

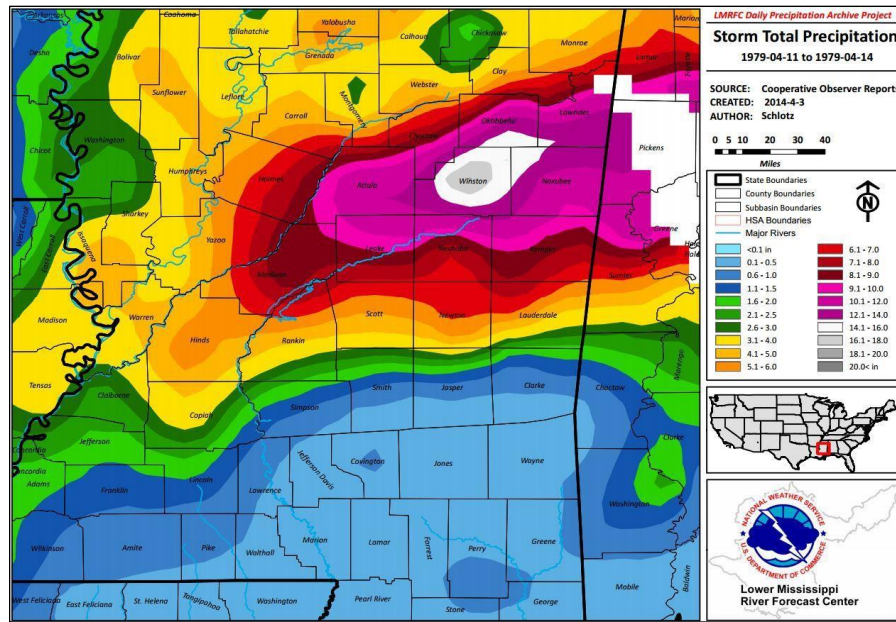


Figure E 1-3. Total Rainfall 1979 Event

Source: (NWS 2023a)

At 6 a.m. Friday morning, April 13, the river was at 33.5 feet and rising rapidly. The water due to the river flooding began impacting some homes and businesses at about 34 feet. Later in the day the reservoir officials [after coordination with USACE and the National Weather Service (NWS)] decided to try and lower the reservoir pool to provide storage for large inflows forecasted in the next few days. By April 14th the historic flood of record (1902- 37.5 feet) was exceeded, and the stage continued to rise rapidly. I-55 South was closed at approximately 5 p.m. on April 14th when water began to encroach in multiple places. (NWS 2023a, b) (Hederman, 1979) (Figure E 1-4)

On Easter Sunday, April 15th, wide streams of water began to overtop the fairground levee. Workers attempted to plug the gaps but were unable to stop the floodwater from flanking the levee at Fortification Street. By late Monday the Ross Barnett Dam, which now held a record pool, began showing signs of stress, and emergency workers reinforced weak spots. Peak flows into the reservoir were estimated at 160,000 cfs. (NWS 2023a, b) (Hederman, 1979)

On the Rankin County side of the river, hundreds, perhaps thousands, of volunteers worked feverishly night and day to keep the levees intact. By the time they were through, they had added about 3 feet to their levee. (NWS 2023a, b) (Hederman, 1979).

The river crested at 43.28 feet around 3 p.m. on Tuesday, April 17th. Many homes in the northeast section of the city were under water for a week. Many businesses in the downtown area were flooded by backwater from a creek that runs through town. Other businesses were impacted when the river flanked around the levee. (NWS 2023a, b) (Hederman, 1979) (Figure E 1-5).

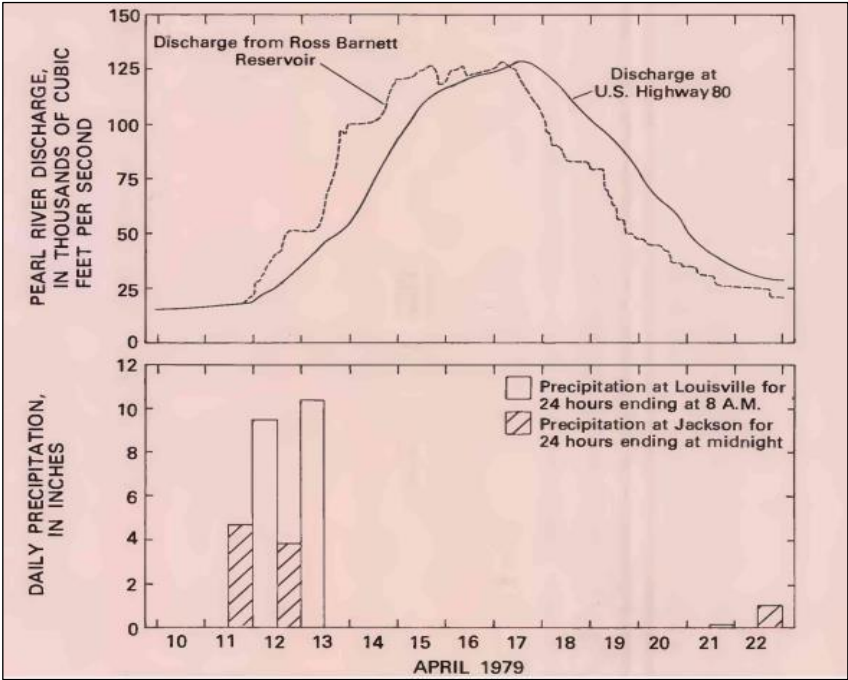


Figure E1-4. 1979 Routing-USGS Publication

(Source: USGS 2023d)

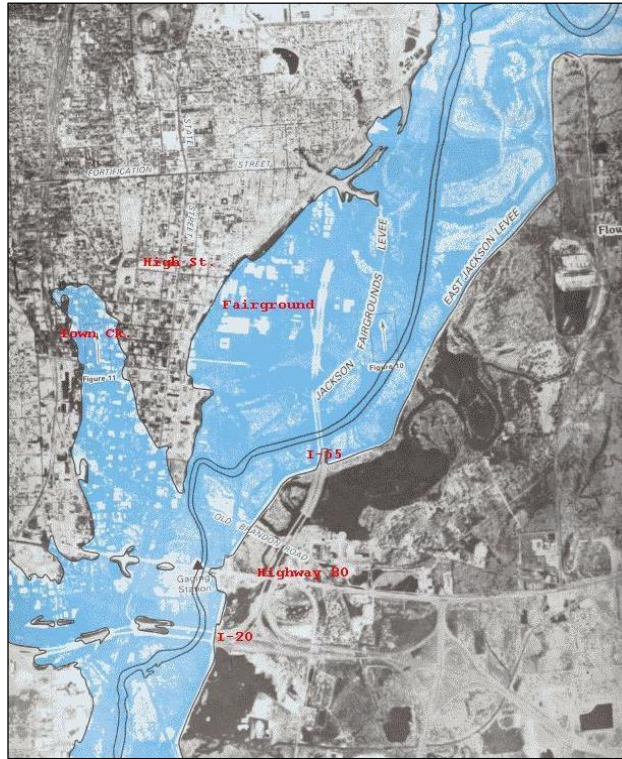


Figure E1-5. Inundation Extent 1979 Flood

(Source: USGS 2023a)

2.8 APRIL 1983

In May 1983 another severe rainfall in the upper Pearl River Basin generated a peak inflow into the Ross Barnett Reservoir of 117,000 cfs. Downstream of the dam, the peak at the Jackson gage was 78,000 cfs. The resulting peak stage at the Jackson Gage was 39.6 feet, the second highest recorded peak stage. (Rankin Hinds 2021)

2.9 LEVEE EXTENSION – 1984

The Fortification Street Levee Extension to the Jackson Fairgrounds levee was authorized and funded in the 1984 Jobs Bill and completed in 1984. This extension involved building up Fortification at the I-55 Northbound Access Ramp, adding a side fill levee on the river side of the ramp, and providing dikes across the Interstate 55 median and the ditch on the west side of the southbound lane of the interstate. (USACE 1985) (Figure E 1-6).



Figure E 1-6. 1984 Levee Extension to Prevent Flanking

(Source: Left: Final Rankin Hinds EIS, 2022; right: National Levee Database)

2.10 CLEARING-1983 TO 1985

In 1983, channel modification was conducted at the Highway 25 bridge, which consisted of removing material from the west bank of the Pearl River approximately 600 feet upstream and downstream of the bridge to increase the conveyance of the stream at that location. The Pearl River Basin Development District (PRBDD) completed this work in 1983.

A 3.3-Mile-Long overbank clearing, and channel enlargement work was also authorized in the supplemental Appropriations Bill of Fiscal Year 1983 and completed in 1985. This project consisted of 237 acres of complete clearing, 20 acres of selective clearing, 89 acres of partial clearing, and the placement of riprap around some bridges. The Pearl River Basin Development District was also the sponsor of this activity.

2.11 ADDITIONAL PUMP CAPACITY (1993)

The Jackson East Levee Pumping Station consists of four 67,000 gallon per minute or 150 cfs pumps. Three of these pumps are contained in the same building and were constructed in 1968. In 1993, the local sponsor, Rankin-Hinds Pearl River Flood and Drainage Control District constructed an additional pump adjacent to the existing pumping station. The pump platform was placed in the approach channel to the existing gravity structure (USACE 2012a)

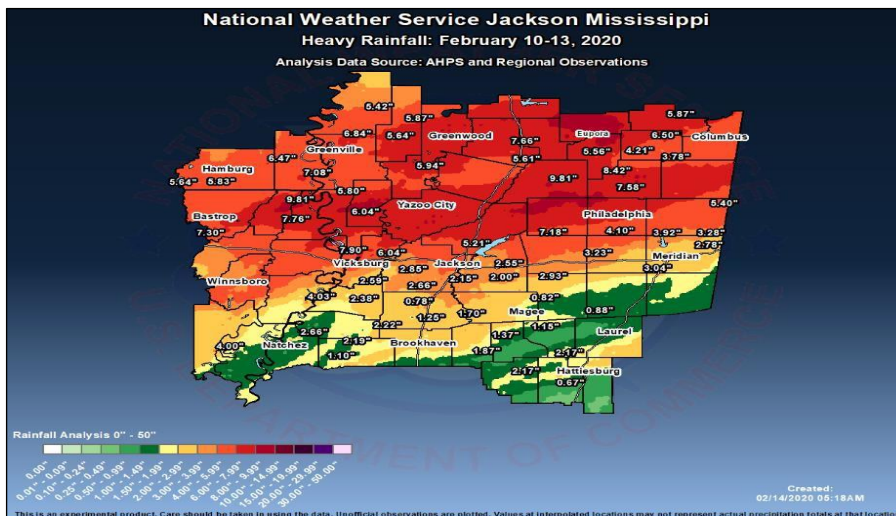
Three identical pumps are installed in the Fairgrounds Pumping Station. The station was constructed in 1966 as part of the Jackson Flood Control Project. The station capacity was increased in 1996 by the addition of a new 42 inches vertical shaft pump rated at 20,000 gallons per minute (GPM) at 15 feet. The station has a total pumping capacity of 40,100 GPM when pumping against a static head of 19.0 feet. (USACE 2012b)

2.12 MOWING/SPRAYING- 2013/2014

PRPRBDD removed excess vegetation from the locations and resumed regular O&M (herbicide treatment on a 3-to-5-year interval) in the 2013/2014 time period.

The Pearl River Basin Development District (PRBDD) areas of O&M responsibility were transferred to the Rankin-Hinds Pearl River Flood and Drainage Control District when the PRBDD closed in 2018. The district no longer had adequate funding due to decreased participation and lack of grants and federal funding. (Thompson 2017) Rankin-Hinds has continued to mow and maintain vegetation in these areas since this time February 2020.

A very wet January and February led to a saturated river system. Then between February 10 and 13, a swath of 5 to 10 inches of rain fell over the Pearl, Big Black, and Tombigbee Rivers. (NWS 2023c). Reference figure E 1-7 for rainfall totals.



The river crested at 36.7 feet at the Jackson Gage on February 17th and was the 3rd highest crest of the gage’s period of record. Roughly 120 homes and businesses were damaged from the flood, and many more businesses and homes were temporarily inaccessible due to roadway overtopping. No levees were overtopped during this event. (NWS 2023c). Figure E 1-8 depicts the extent of inundation in 2020.

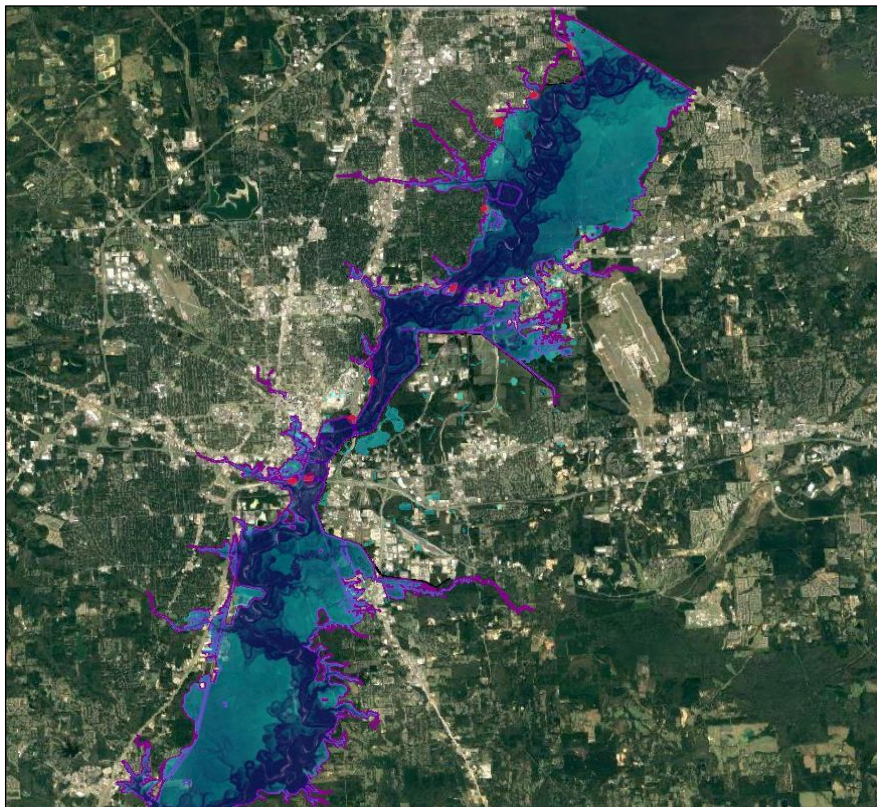


Figure E1-8. 2020 Inundation Extent

2.13 LOADING DIFFERENCES

When looking back at the flows from the 1983 event, the river was now pushing MORE water though the gauge at LOWER stages -- NWS Story map. The 2020 Flood Event was devastating but could have been much worse.

When evaluating why the stages were lower for higher flows, “, it is hard to precisely know the reason, but there are several theories. One insists that the riverbed has changed drastically due to some of the higher discharges from the Reservoir causing sand and silt to be picked up and carried downstream. Another theory: after the 1983 flood, the land between the levee in Jackson was clear cut of all the trees and in the recent years the levee board has been keeping the grass mowed. This would cut down on the friction between the river and the ground and allow the water to move though unimpeded.” (NWS 2023c)

“Another interesting factor in this flood had to do with the Ross Barnett Reservoir and the spillway operations. Originally the Reservoir was built as a recreational and water supply lake and NOT for the purpose of flood control. In 2019 though, the Reservoir officials made the decision to keep the winter lake levels lower than normal because an aquatic plant pest called Giant Salvinia ... Well, due to these lower lake levels, the Reservoir was able to act (in part) like a flood control reservoir and hold back some of the flood waters which would normally have to pass through the spillway.” It is difficult to measure how much storing 3.5 feet of water across the lake was able to shave the peak flow, but it is estimated that the stage at Jackson could have been at least 1-1.5 ft higher.” (NWS 2023c)

Other significant differences include the levee extension in 1984, and the increased pump capacity that was installed in the 1990s, which reduces flash flooding due interior drainage.

During the 2020 event, further discrepancies were noted between what was happening and previous events. The neighborhoods north of Lakeland Drive were experiencing flooding more than expected with a 38 feet river stage at the Jackson gauge while the areas south of Lakeland Drive, particularly in downtown Jackson, were experiencing flood patterns more typical of previous events. (NWS 2023c) (figure E1-9, E1-10). Table E1-2 presents the 1983 and 2020 stage and flow data.

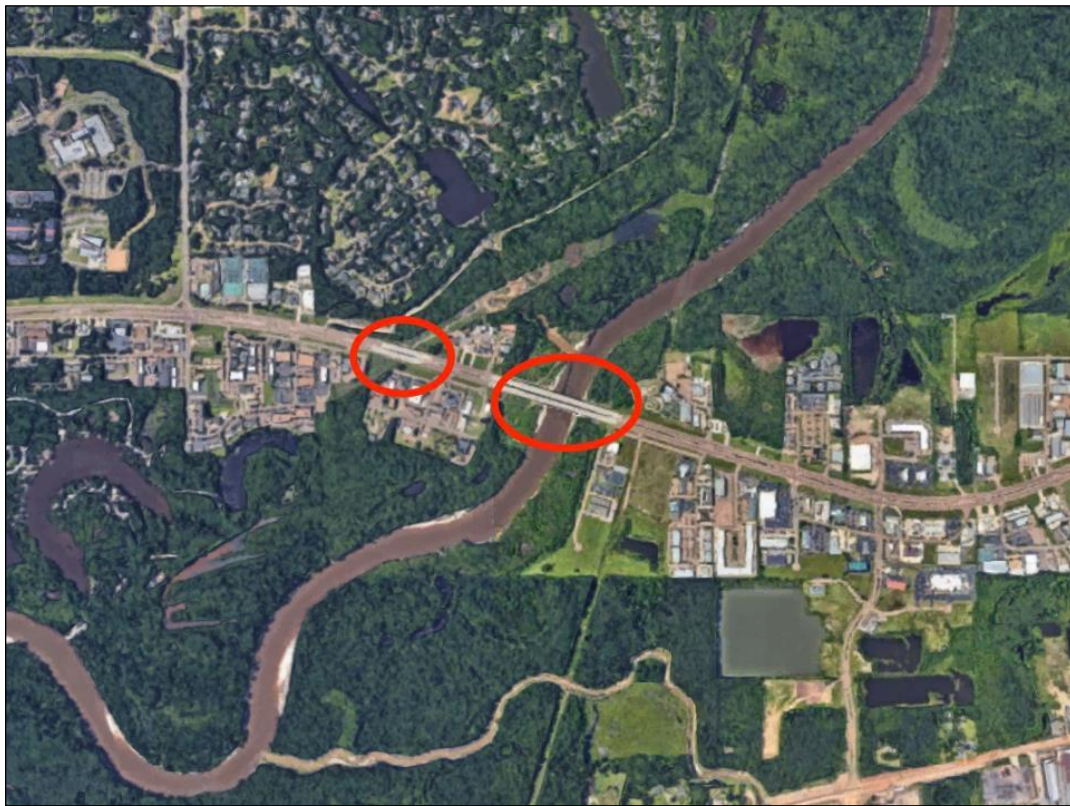


Figure E 1-9. Lakeland Drive/HWY 25 Bridge and Overflow Bridge

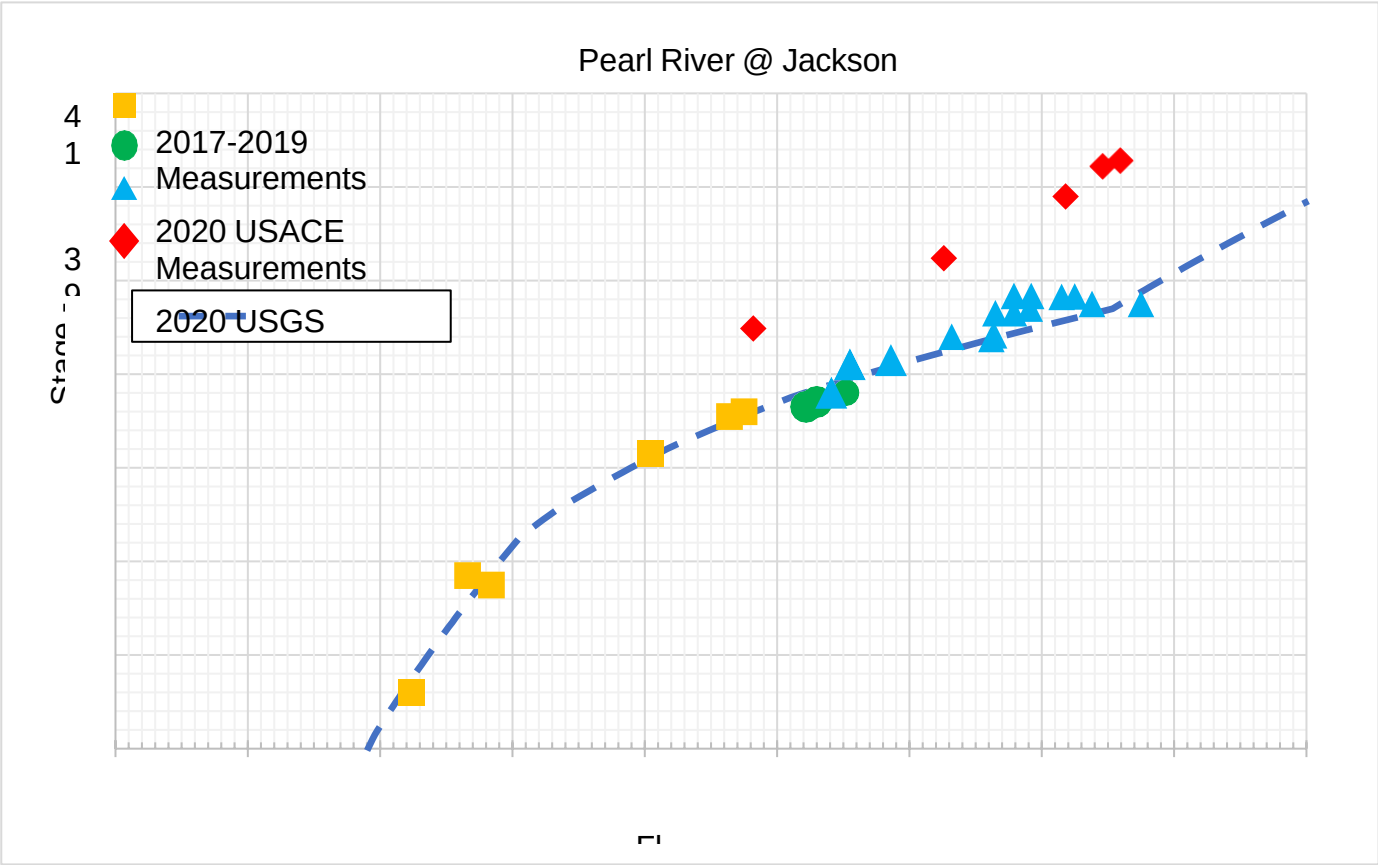


Figure E1-10. Updated Rating Curve with Discharge Measurements

Table E1-2. 1983 and 2020 Stage and Flow Data

Flood Event Year	Ross Barnett Release (CFS)	Flow at Hwy 80 Gage (CFS)	Elevation at Hwy 80 Gage (Feet, NAVD 88)
1983	85,000 (prev. 78,000)	79,500	272.9
2020	78,361	77,300	270.0

2.14 ROSS BARNETT RELEASE DISCREPANCY

Along with the channel efficiency adjustments, the Ross Barnett Reservoir releases were underestimated prior to 1999. It is noted in the 1999 Downstream Impact and Reservoir Regulation Flood Control and Development Plan for the Jackson Metropolitan Area (source, 1999) that “part of the problem may be in the way the reservoir calculated discharge at its gate... Also our study of the gate construction plans indicates that the cables which elevate the gates, produce lift in excess of the amount calculated. If we are correct, the reservoir is understating discharges during major floods (such as the 1979 flood) by about 10%. Tables included in this document indicate that at the maximum pool of 300 feet mean sea level (MSL) (1979 was at elevation 299.9) flows could have been miscalculated by as much as 15,000 cfs.)

This revises the original 1979 Ross Barnett Discharge from 124,500 CFS to 137,000 CFS, and the 1983 peak discharge from 78,000 to 85,000. The Ross Barnett Reservoir operators updated their reporting method in at some point between the 1983 flood event and the 1999 report described in the section and therefore all recent peaks are considered valid (Table E1-3 and Figures E1-11 thru 14).

Table E1-3. Rating Adjustments at the Ross Barnett Reservoir

Water @ 300' MSL			
Gate Elevation	Calculated Flow Rate	Reported Flow Rate	Discrepancy
288	125500	112000	13,500
289	135000	121000	14,000
290	144000	131400	12,600
291	154000	139000	15,000
292	163500	149000	14,500

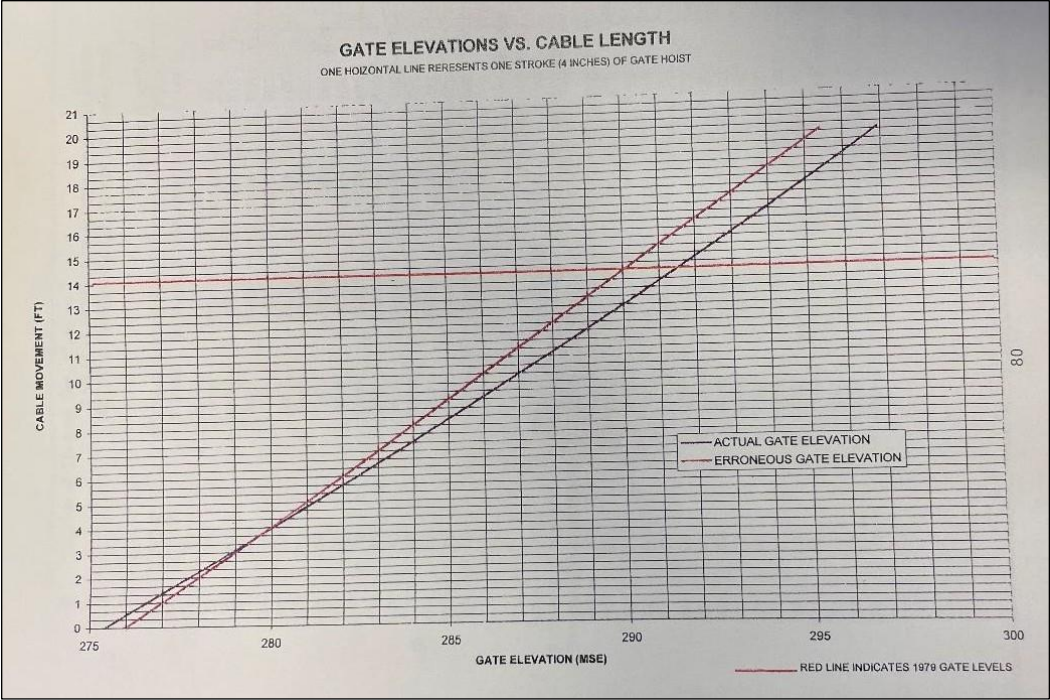


Figure E1-11. Gate Elevation vs Cable Length Discrepancy

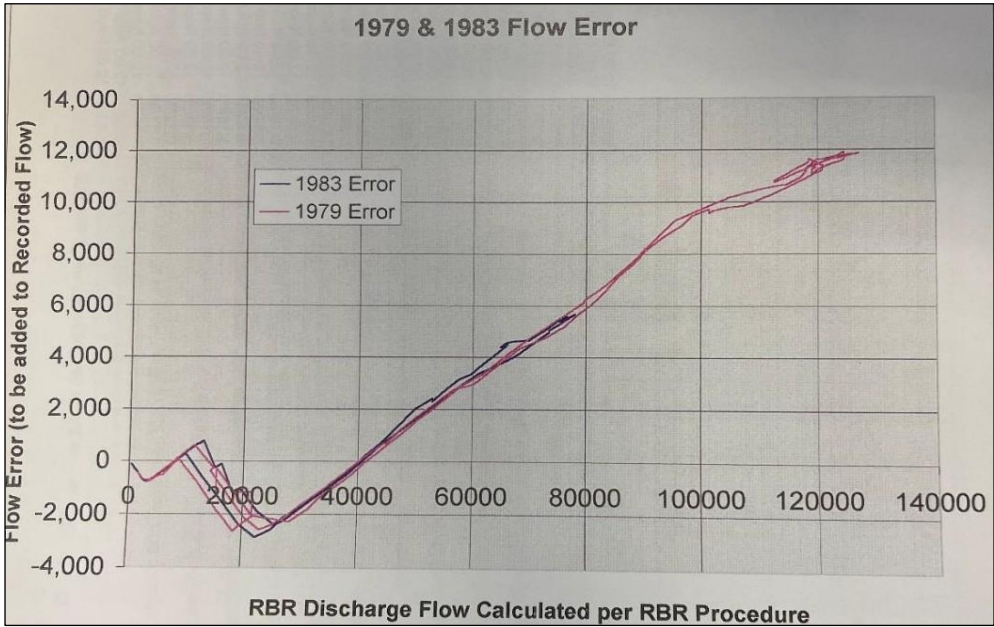


Figure E1-12. 1979 and 1983 Flow Error

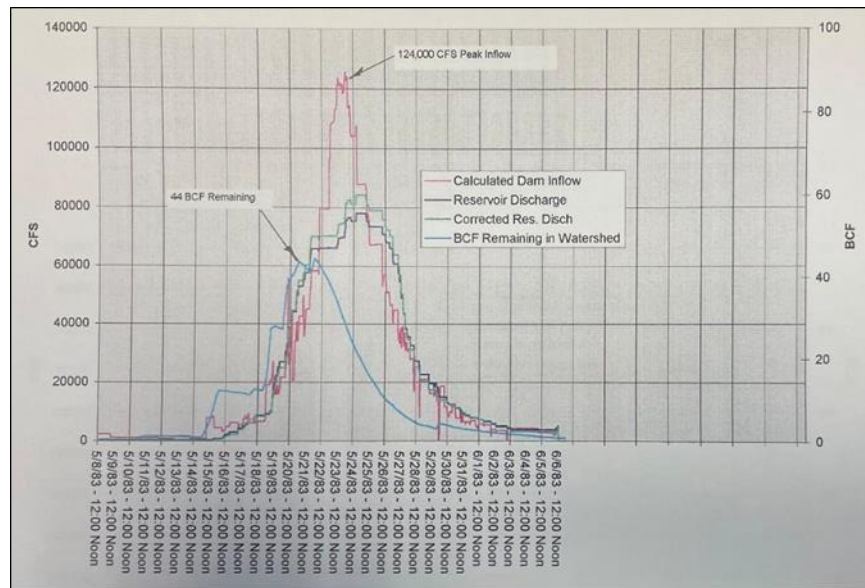


Figure E2-13. 1983 Corrected Routing

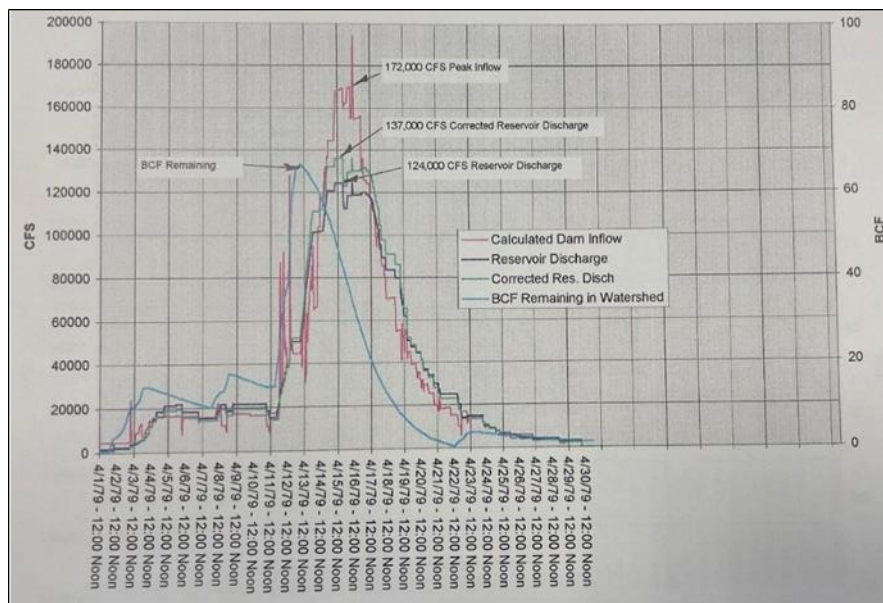


Figure E1-14. 1979 Corrected Routing

2.15 VARIOUS PEARL RIVER STUDIES-1970-PRESENT

Various studies have been completed in the Jackson MSA in recent history. Table E1-4 summarizes these studies.

Table E1-4. Various Pearl River Studies Occurring Since 1970

Reconnaissance FRM and Bank Stabilization Study Report for Caney Creek, MS	November 1990: Report Released.	No economically justifiable plan was identified, and further studies were not recommended.
Draft Feasibility Flood Risk Reduction Report for Jackson Metropolitan Area, MS	1996: DRAFT Report released with recommendation of the comprehensive levee plan.	July 1998: was found to be not implementable due to lack of local support.
DRAFT Flood Control, Pearl River Basin, Mississippi, Jackson Metropolitan Area, Mississippi, Feasibility and EIS	2007: DRAFT Report released. No plan recommended but Comprehensive Levee Plan was economically justified and the Lefleur Lakes (LL) Plan was found not justified due to not meeting environmental policy objectives.	
ATR Summary Report for the Pearl River Watershed Integrated Feasibility Report and Environmental Impact Statement	June 2020: ATR of the draft and final report products from June 2017 to April 2020. ATR was closed with significant concerns that were identified during review of the final report documents.	
Letter Report for Water and Wastewater Infrastructure, Jackson, MS Savanna Street WWTP Improvements	December 2022: Mississippi Division approved the Letter Report for increment of work for the Savanna Street WWTP Improvements	

Section 3

Project Description and Design

The NFI Section 211 Report final array of alternatives included a “nonstructural plan” (Alternative A), a “levee plan” (Alternative B) and a “channel clearing/weir/levee plan” (Alternative C).

USACE developed new plans to include the Modified Nonstructural plan, A1, and two structural USACE Combination Thereof (CTO) alternatives, Alternative D1 and E1. The CTO Alternatives (Section 3104 Authority) may be comprised of a Nonstructural components and flood damage risk reduction structural features.

USACE modeling considered a variety of upgrades to the Rankin Hinds modeling effort. These included calibration to the recent 2020 flood event, which had not occurred at the time of NFI modeling, incorporating more recent flow record data (1980s to 2022), updating all runs to unsteady state routing, inclusion of tributary coincident flow, and the inclusion of lateral structures to represent the levees. Updated calibration has shown that the system response has changed since the 1979 event to be more efficient. as illustrated by the comparable events from 1983 and 2020. The two events had similar flows at Pearl River gage in Jackson, but the stage was reduced by approximately 2.9 ft for the 2020 event.

Levee Setbacks were removed from this plan as it was determined that these features would provide limited flood risk reduction benefits. Demolition of the existing weir was removed from this plan as the existing weir is submerged and does not impede water flow. The existing weir would also be necessary to maintain adequate water supply should a new weir not be constructed.

3.1 NFI Alternative Description- “C”

The Nonfederal Interest, the Rankin Hinds Flood Control District produced a Draft EIS in June 2018 and a final EIS in June 2022 for the Pearl River at Jackson Metropolitan Statistical Area (MSA). The locally preferred plan.” Additional coordination occurred between USACE and the NFI to provide the clarified project description for this alternative. Alternative C realized flood risk management through removing areas that constrict the floodplain along with widening and deepening of the channel and floodplain within the project footprint, thereby improving downstream conveyance of water through the project area and lowering the water surface elevation of the river in some places within the project area by as much as 8 feet (2.4 m). Alternative C consists of the construction of channel improvements, demolition of the existing weir near the J. H. Fewell WTP site and construction of a new weir with a low- flow gate structure further downstream for water supply to be continued while simultaneously creating an area of surface water for recreational opportunities, Federal levee improvements (excavated material plan), and upgrading an existing non-Federal ring levee with slurry wall around the Savannah Street WWTP.

Construction of the project will require relocations and/or improvements to various public and private utilities and infrastructure, mitigating potential Hazardous, Toxic, and Radioactive Waste (HTRW) and other hazardous waste sites within the floodplain, avoidance and minimization features required under the Environmental Site Assessment, and the creation of new habitat mitigation areas to offset losses within the project’s construction footprint areas.

3.2 Channel Improvements

Channel improvements consist of excavating areas along the Pearl River, to improve conveyance from RM 284 to 294. Excavation depths will vary between 5-20 feet to meet the proposed bottom elevation of 248.0 Feet National Geodetic Vertical Datum of 1929 (NGVD 29). The preliminary project layout also includes islands within the channel improvement excavation area that will be maintained and/or expanded upon from RM 289.5 to RM 292.0. The existing river channel would not be widened, instead excavation of the overbank areas would occur. The footprint of the channel overbank improvements overlay and extend downstream of the previous channel realignment/creation work.

3.3 Hardpoints at Base of Tributary

Multiple tributary inflow points exist within this reach and Alternative C will add a hardpoint, via a riprap chute to prevent backward erosion at each tributary inflow where the excavation of overbanks decreased the tributary channel bottom elevation at or near the confluence of those tributaries with the Pearl River.

3.4 Maintenance and Reinforcement of Bridge Abutments

Stabilization or armoring, such as riprap, slope paving, slide repairs, etc., would be required due to changed river conditions and will be carried out prior to clearing and any major channel work. When additional information becomes available during later phases of study, adjustments to the design can and will be made to reduce potential impacts. Any proposed countermeasure design and implementation will be conducted with MDOT's concurrence, review, and approval.

Rough estimations of the level of effort required to mitigate for bridge impacts include improvements for approximately 36 bents, 12 piers, abutment scour, as well as funding to conduct monitoring surveys. A pile is a concrete post that is driven into the ground to act as a leg or support for a bridge. A bent is a combination of the cap and the pile. There are a total of 2 active railroad bridges within the project area. All efforts would be made to avoid, monitor, and protect these structures. Additional modeling is required to validate these assumptions during later phases of study. If avoidance is not possible, then coordination with the operating entity to determine specific requirements of each bridge will be conducted during later phases of study. All alterations of railroad bridges would be in accordance with Section 3 of the 1946 Flood Control Act (22 USC 701p).

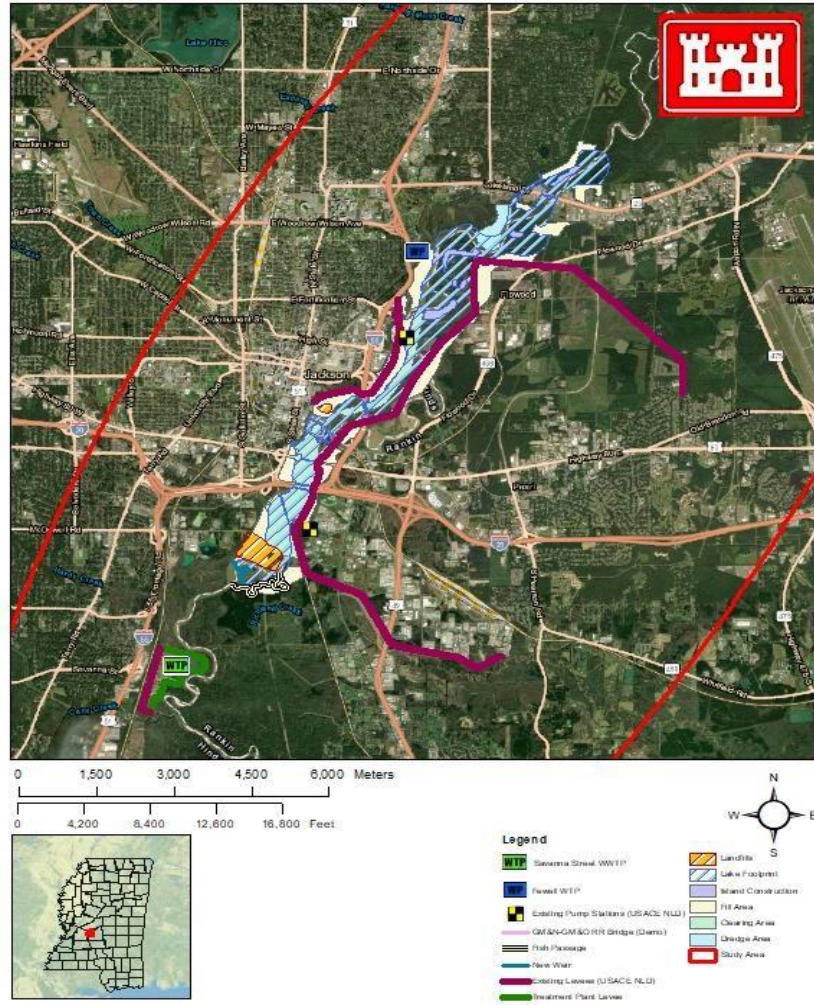


Figure E2-1. Alternative C Features



Figure E2-2. Plan View of Proposed Channel Improvements, Excavated Material Plan, & Weir

3.5 Excavated Material Plan

Federal levees exist within much of this reach and Alternative C would use the existing levees, upgraded with excess excavation placed behind them. Excavated fill would be placed in designated disposal areas on the protected side of existing levees. These areas would be graded to be at the same elevation or lower than existing levees, compacted for suitably for future land development, and grassed to establish long-term erosion control. Additional riprap or other armoring would be placed as required during the final grading operations.

The excavated material disposal fill areas placed on the protected side of levees would impact approximately 465.6 acres (188.4 ha). The new land mass created behind the levees would range from 200 to over 1,000 feet (121.9-304.8 m) in width. If any structures are to be built on top of any portion of the maintenance berm designed or used a seepage control, the berms would be overbuilt and utilities or any other structure or penetrations would be limited to within the overbuilt section. Penetrations through the berm could become seepage exit points, and this is specified to limit fracture through the main berm. Where water would be permanently ponded against the riverside slope, these areas would require a 40-foot-wide semi-compacted impervious riverside maintenance berm to limit seepage through the levee.

3.6 Structure Demolition

In the area surrounding the J. H. Fewell WTP, Plan C calls for the demolition of the J.H. Fewell Weir located at RM 291, which is currently set to approximate elevation 250 feet. Dredging would be conducted to elevation 248 feet. It is undetermined if the water intake structures and access points of

the J. H. Fewell WTP would need further modification. Additionally, demolition may also be required for all or part of the abandoned GM&N/GM&O Railroad Bridge. The length of area (including the island) directly along the railroad bridge is approximately 3,600 feet.

3.7 Construction of New Weir with Fish Passage

The demolished weir would be replaced with a new weir constructed downstream near RM 284.3 at the south end of the channel improvements area. The purpose of the new weir would be to maintain the baseline low-water level for water supply at the J. H. Fewell WTP within the channel improvements area. The new weir would provide for a significantly larger body of water within the Pearl River channel to the north of the weir. Downstream low-water hydrologic flows (extreme drought condition minimum flows) within the Pearl River channel would be maintained by means of a 12 x 12-foot low-flow gate. The gate is also required for any future maintenance which requires drawdown of the lake. Portions of weir would be submerged thereby allowing excess water to pass downstream. As opposed to the existing weir, the replacement weir would be constructed to a higher elevation of 258 NGVD vs. the current of 250 NGVD, and a larger width of 1,500 feet along an approximately 1 mile (1.6 km) stretch on the southern end of the proposed channel improvements area. This weir would impound an area of approximately 2600 acres. Baffle blocks to help prevent floating solids from flowing over the weir are part of the conceptual designs. Further, additional excavation for the fish ladder would occur along the left descending bank of the relocated weir in the project area. The fish ladder has been conceptually designed to be approximately 7,300 feet (2,225.0 m) in length. The fish passage design will be coordinated with The Service and state agencies during later phases of study.

The proposed weir meets USACE and State criteria to be defined as a dam based on the height of the structure and water storage. Additional costs were added to the NFI project cost to account for a redesign and constructing the weir to higher USACE and State criteria for a dam. Rough cost estimates were derived using some unit costs from the NFI. A more refined cost estimate would be done once the dam is redesigned to meet USACE and State criteria.

3.8 Savannah Street WWTP Levee

An existing non-Federal levee protects the Savanna Street WWTP near RM 282. As part of Alternative C, the levee would undergo maintenance and additional upgrades, so the levee meets the freeboard needed for certification for a 1 percent AEP flood event in advance of the main construction phases (Figure E2-2). The levee section proposed for the new Federalized levee around the WWTP consists of a 10-foot crown width with 1V on 3H landside and riverside slopes. If needed, a slurry wall for seepage mitigation would be added.

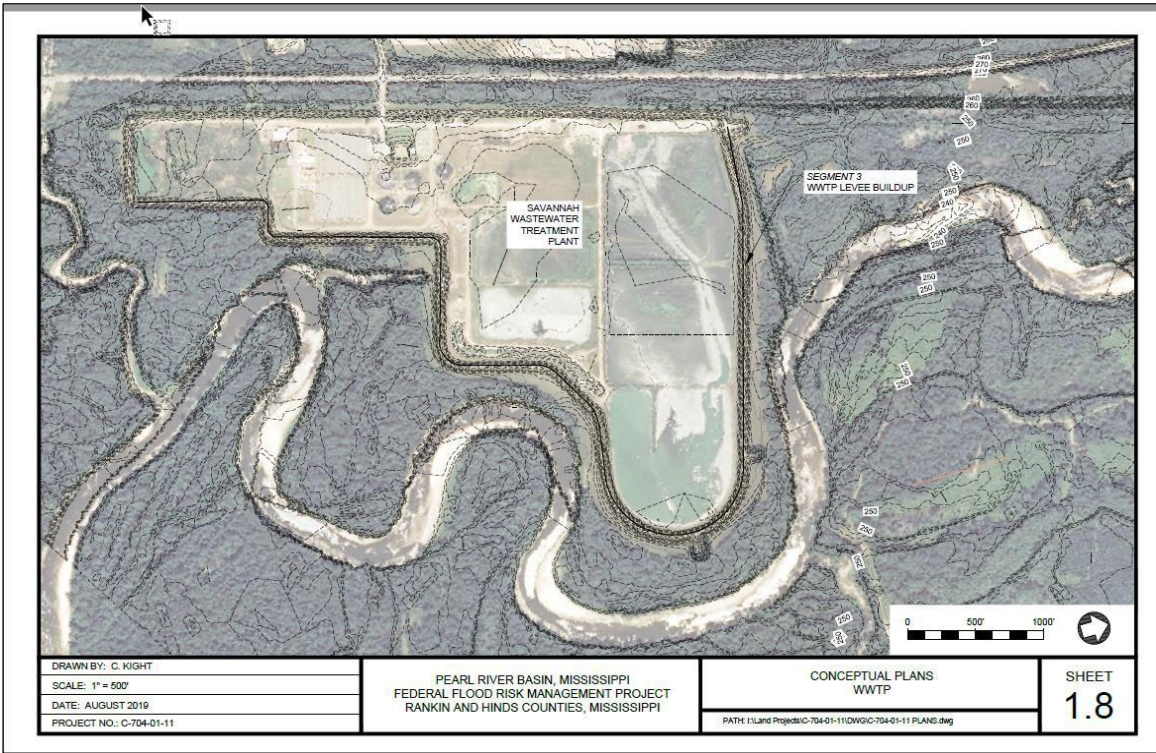


Figure E2-3. Proposed Federalized Levee at WWTP

3.9 Interior Drainage Evacuation for Existing Levee

The existing levees contain drainage structures that allow water to drain from the interior of the leveed area when the Pearl River is low. When the Pearl River water level is high, the drainage structure is closed, and pump stations are used to pump water out of the leveed area. The original design of these features called for the drainage structure to handle a 0.01% AEP interior drainage flow, and the pumps were originally designed for a smaller event.

The proposed new weir would maintain a minimum pool at elevation 258.0 ft. As a result, the drainage structures would have always at least 9 ft of water on the structures and would no longer be able to operate in order to prevent the new reservoir from flooding the interior leveed areas. Additional pumping capacity would be needed to mitigate for the loss of capacity of the drainage structures. In addition, some of the proposed fill areas in the NFI plan would fill in part of the sump that is used to store water for pumping. The NFI did not perform an interior flooding analysis to determine mitigation features for the loss of the use of the drainage structures.

3.10 Alternative A1

Non-Structural Component

The nonstructural analysis was based on an inventory of residential and non-residential structures that USACE developed in 2023 using the National Structural Inventory version 2.0. An assessment of structures located in the 10 percent, 4 percent, 2 percent, and 1 percent AEP floodplains was performed for the portions of the study area that are subject to flooding from the main stem of the Pearl River and backwater flooding on the tributaries. Elevation and floodproofing were considered to determine the effectiveness of a nonstructural alternative. For the analysis, residential structures were to be elevated to the 1% AEP/BFE plus one foot, up to 13 feet above the ground, and nonresidential structures were to be floodproofed up to 3 feet above the ground.

Based on an incremental floodplain analysis, the 10 percent and 4 percent incremental AEP floodplains were both economically justified. Approximately 143 structures, 81 residential and 62 nonresidential, are included in this cumulative 4 percent AEP floodplain.

These structures have been identified to be preliminarily eligible for the nonstructural alternative. Due to feedback from public meetings in May and June 2023 requesting the option to have properties acquired, the option of nonstructural property acquisition (buyout) on a voluntary basis (if a wavier is received for this action, if not mandatory acquisition would occur) is included in the nonstructural implementation plan (Appendix N).

Table 2-1. Nonstructural Plan A1 Structure Type Eligibility

Structure Type	Public	Private-Non-Profit	Residential- Non-Historic	Residential-Historic	Nonresidential
Property Acquisition & Structure Demolition	x	x	x	x	x
Property Acquisition Structure Relocation	x	x	x	x	x
Structure Elevation			x	x	x
Structure Dry floodproofing				x	x
Structure Wet floodproofing			x	x	x
Retrofitting of Existing Buildings			x	x	x

Levee Addition to Alternative A1- Canton Club Levee

A levee segment of approximately 1.4 miles is proposed on the west bank of the Pearl River in northeast Jackson. This levee would provide additional flood risk reduction for approximately 100 acres of high density developed neighborhoods. This area is bounded on the north by the North Canton Club Circle and Beechcrest Drive on the south. It is estimated this would reduce flood risk for over 250 homes. The levee will range from natural high ground, to up to 9 feet high. Exact elevation will be set as the with-project 100-year flood event with 90 percent assurance levels in PED.

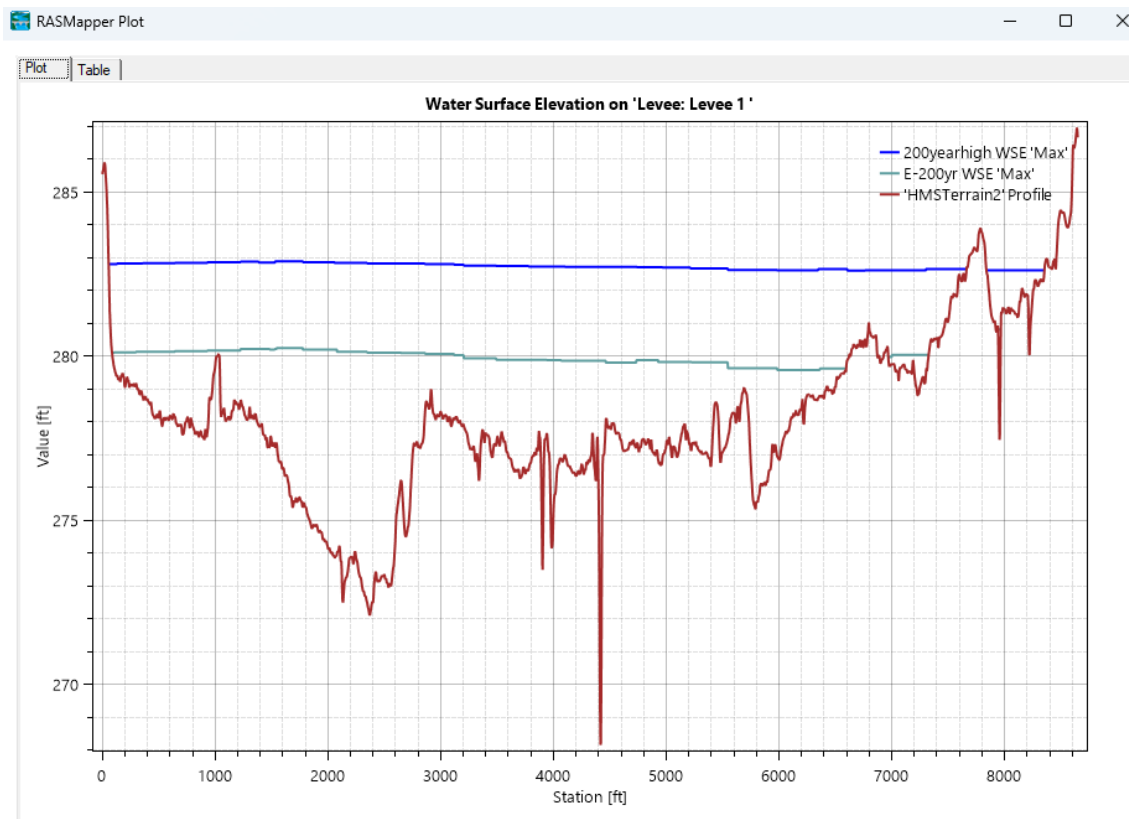


Figure 2-4. Canton Club Levee Location, Existing Terrain, as compared to the 200-year Flood Elevations, with and without channel improvements

Typically, during a flood event on the Pearl River or its tributaries, rainfall also falls behind the levee. The rainfall runoff needs a way to leave the leveed area. There are three possible locations that will require interior gravity drainage structures along the Canton Club Levee. For the purposes of this study, these structures will be 100' long, 36" reinforced concrete pipes with a flap gate closure. The structures will utilize existing ditches, and they will require minor earthwork.

Principal features of the work include mobilizing and demobilizing, clearing and grubbing, removing and stockpiling any existing crushed stone surface, semi compacted levee embankment, traverses, adding new crushed stone surfacing, mowing, turfing, erosion control matting, preventing storm water pollution,

and providing environmental protection. Constructing the project will require relocations and/or improvements to various public and private utilities and infrastructure.

Contractor furnished borrow areas will not be permitted. All borrow areas will be acquired by the NFI as part of its Lands, easements, Right of Ways, Relocations, and Disposals (LERRDs) requirement and furnished by the Government to the contractor. Some small areas could be more appropriate for the construction of a short floodwall, typically an I or T wall for some small areas due to space constraints, though further analysis would be required.

Construction of the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar), and the creation of new habitat mitigation areas to offset losses within the project area.



Figure 2-5. Proposed Canton Club Levee (orange line)

3.11 Borrow Plan (Canton Club Levee)

A borrow plan has not been developed at this stage of the analysis. It is conceivable that there is enough borrow material from the material excavated but it is unknown at this time if the material is suitable for constructing levees. Should the excavated material be determined to be unsuitable, borrow material would need to be identified for construction of any levees. There is potential borrow sources

within close proximity of the project area (10-mile radius). Borrow opportunities would be further investigated during PED and a supplemental NEPA document would be prepared if necessary.

3.12 Alternative Combination Thereof Plans (D1 and E1)

USACE modeling of Alternative D1 and E1 considered a variety of upgrades to the NFI routing. These included calibration to the recent 2020 flood event, which had not occurred at the time of NFI modeling, incorporating more recent flow record data (1980s to 2022), updating all runs to unsteady state routing, inclusion of tributary coincident flow, and the inclusion of lateral structures to represent the levees. Updated calibration has shown that the system response has changed since the 1979 event to be more efficient. as illustrated by the comparable events from 1983 and 2020. The two events had similar flows at Pearl River gage in Jackson, but the stage was reduced by approximately 2.9 feet for the 2020 event. By combining features, Alternatives D1 and E1 provide additional benefits as compared to the previous Alternative C, while reducing environmental impacts, avoiding HTRW sites and lowering specific costs.

3.13 Alternatives D1 and E1 Feature Summary

Table 2-2 Provides a listing of the project features of the CTO alternatives with and without a weir (Alternatives D1 and E1 respectively) for comparative purposes. This weir would be in a different location from the new weir previously identified in Alternative C.

Table 2-2. Alternatives D1 and E1 (Comparison with and Without Weir)

Feature	ALT D1	ALT E1	Units
	Quantity	Quantity	
Channel Overbank Improvements			
Clearing and Grubbing	954	954	acres
Excavation Area	954	954	acres
Excavation Volume	9.38	9.38	MCY
Inducements	11	11	Structures - 100-year flood or more frequent Acres - 100-year flood or more frequent
	81	81	
Excavated Material Plan			
Clearing and Grubbing	523	523	acres
Fill Area	523	523	acres

Features Created due to Excavation			
Hard Point in tributary channels to prevent tributary incision	525	525	Feet (crossing river)
Stabilization or armoring for bridge abutments	7	7	bridges
Stabilization or armoring for RR bridge abutments	1	1	bridges
Slurry Wall Savanna Street WWTP	6,000	6,000	feet
Savanna Street WWTP Levee Raise	N/A	N/A	Levee was verified by to have sufficient height
J W Fewell and Mays Lake Armoring	98,000	98,000	Tons-rock
Weir and Associated Features			
Weir and new gate	1	0	each
Water Surface Area	1556 total	0 added	acres
Seepage Jackson East	1	0	each
Seepage Jackson Fairgrounds	1	0	each
Pump Station	360	0	cfs
Other interior drainage features – Existing 1 Levee Jackson East Fairgrounds		0	each
Levee Features			
Canton Club Levee	1.4	1.4	miles
McLeod Levee	2.3	2.3	miles
Richland Levee	1.15	1.15	miles
Cany Creek Levee	0.75 to 1	0.75 to 1	miles
Recreational Features			
Utility Relocation	1	1	each

RV, Tent Camping	150	150	each
Fishing Piers	6	6	each
Boat Ramp and Parking	6	6	lane
Trails	79,000	79,000	linear feet
OPERATIONS AND MAINTENANCE			
Weir and new gate	1	0	each
Fish Passage	1	0	each
Lake (sediment/vegetation)	1	0	each
Upgraded Interior Drainage	1	0	each
Mowing of Excavated Areas	0	1	
Rock Armoring	0	1	each
New Levee Systems	4	4	each
Forested Wetlands and Uplands Habitat Monitoring	11	11	events
Lacustrine Habitat Monitoring	0	10	events
Riverine Habitat Monitoring	10	0	events
Sandbars Monitoring	6	0	events
Monitoring and adaptive management of fish passage channel	100	0	
Recreational Features	1	1	each
MITIGATION			
T&E-Fish Passage	5000-6000	0	feet
Replacement of obsolete aquatic barriers (riverine mitigation)	1	0	structure
Oxbow and Ponding (Lacustrine Mitigation)	0	105	acres

Forested Wetlands and Uplands Mitigation	5,512 – 11,612	5,512 – 11,612	acres
T&E- Sandbar surveys within construction area(s) every 2-days during construction and the nesting season (May 1 – October 3) (90/year)	90	90	events/year
T&E- Capture, tag, and relocation of listed turtles	827	0	turtles
T&E - Incubation of listed turtle eggs. Raise juveniles for at least one year, release	408	103	turtles
T&E- Riverbank preservation	10	0	River Miles
T&E- Revegetate riverbanks/ water Surface edges	42	77	acres
T&E- Sandbars (material from excavation)	31	0	acres
T&E- Species monitoring of Gulf sturgeon (GS)	3	0	events
T&E- Water velocity monitoring	10	0	events
T&E- Water quality monitoring	6	0	events
T&E- sedimentation analysis	1	1	study

3.14 Components of Alternative D and E

Alternative D1 and E1 provide similar flood risk reduction to the previous NFI Alternative C with a smaller footprint. Both alternatives consist of the construction of channel improvements, Federal levee improvements (excavated material plan), and reinforcing an existing non-Federal ring levee (the Savanna Street WWTP Levee). Alternative D1 includes a new weir with a low-flow gate structure downstream in addition to the previously mentioned features. Modifications from the previous NFI Alternative C include constructing a smaller weir in a new location (upstream of the location identified for Alternative C) and reducing excavation limits which reduces fill areas and thus reduces environmental impacts throughout the project footprint. These changes would reduce environmental impacts especially to HTRW sites within the project footprint. Additional modifications from Alternative C include the addition of 4 localized levees for additional flood reduction.

Flood risk management is realized by both Alternative D1 and E1 through lowering of the channel overbanks within the project footprint, thereby improving conveyance of water through the project area and lowering the water surface elevation of the river by over 4 feet (1.2 m) in some places within the project area. Water surface elevation reductions due to this excavation would provide reduction of flood elevations not only within the reach of excavation, but additional elevation reductions upstream for over 8 miles upstream of the excavation limits (as far as the Ross Barnett Reservoir).

Construction of the project would require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways, powerlines, or similar located within a project feature.) and any discovered hazardous waste sites within the floodplain, avoidance and minimization features required under the ESA, and the creation of habitat mitigation areas to offset losses within the project area.

3.15 Channel Improvements

Channel improvements consist of excavating areas along the Pearl River to improve conveyance from RM 285 to 294, which includes sections previously channelized during the original levee construction. The channel improvement footprint includes up to 954 acres in which excavation would occur. Excavated areas (954 acres) will be cleared and grubbed ahead excavation work. Removal of vegetation from the excavation areas shall be limited to 1,000 feet in advance of embankment placement. The excavation will be of various widths ranging from 500 to 2,600 feet (152-793 m) including the river width to be refined during the PED phase. Excavation depths will vary between 0-13 feet to meet the proposed bottom elevation of 252.0 NGVD. Approximately 9.11 million cubic yards of material will be excavated from the floodplain and channel overbanks. The existing river channel will not be widened, instead excavation of the overbank areas will occur. The preliminary project layout also includes islands within the channel improvement excavation area that will be maintained and/or expanded upon from RM 288.0 to RM 292.0. Further, sand bars could be constructed inside the floodplain and along the existing islands to compensate for the loss of sand bar habitat.

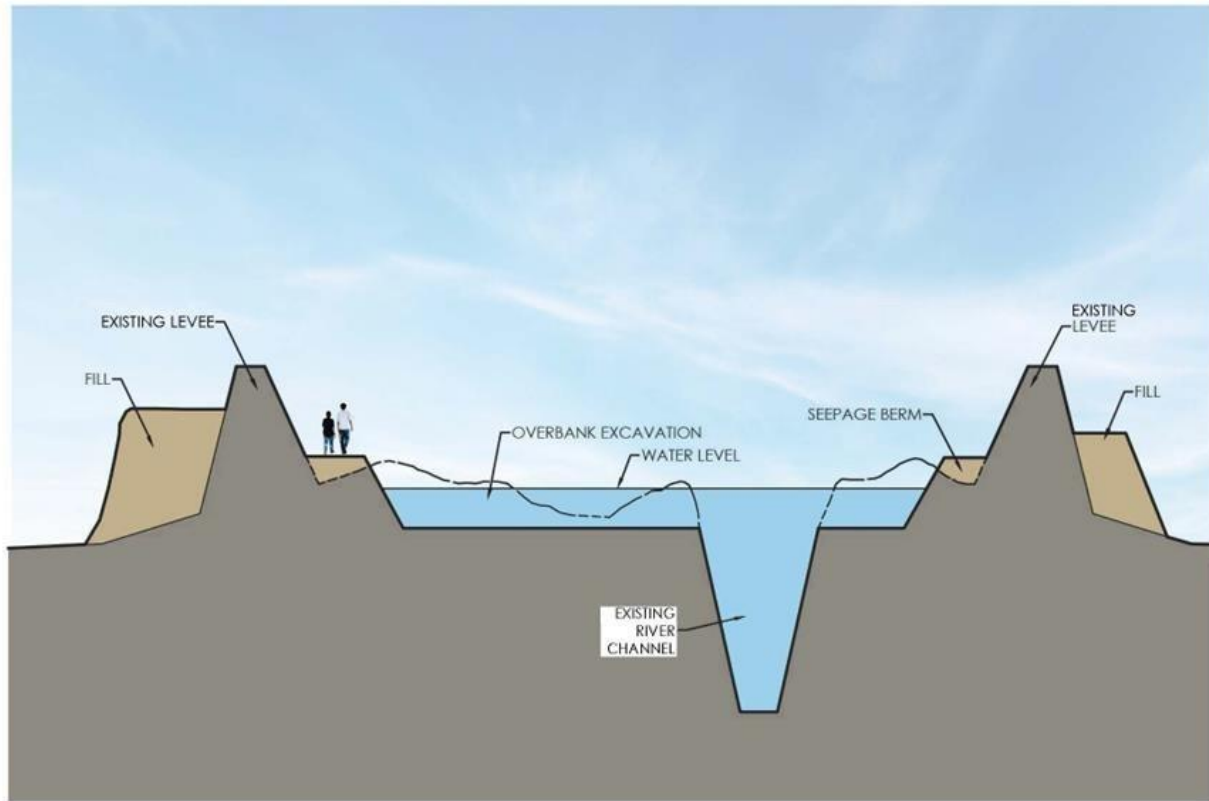


Figure 2-6. Channel Improvements with a Relocated Weir

Existing levees will remain in place and will be maintained to increase this control and to aid in haul access. Excavation limits near the existing levees will be determined during final design. The progression upstream will naturally allow for positive and continued dewatering of flooded areas ahead of moving into the next section. At locations shown where existing roadway are destroyed or degraded due to the work required under this project, the Contractor shall provide temporary roads to give access during the construction period, and repair existing roadways.

All excavation areas lacking adequate vegetation not specifically designated to receive new turf shall receive seeding, fertilizing, and mulch. Due to the likelihood of reoccurring flooding, seeding, fertilizing, and mulching will be conducted once per month in newly excavated areas during the construction season. Maintenance of established turf, and reseeding of bare areas will be completed throughout the construction period.

A percentage of excavation and fill would need to be worked around high-water events. Flow Exceedance was calculated at the Pearl River at the Highway 80 gage, which is located within the project boundary. At the gage location, it is expected that the project site would be inundated between 1 and 10 percent of the time per month throughout the construction period. The percentage of time each month that a flow would be exceeded is shown in Figure 2-7 below. This is compared to the months of year construction would be most likely to occur.

It is currently assumed that excavation areas within the floodplain will be completed over a 3-year construction period. Using this assumption and the currently proposed order of work, it is necessary to consider potential damages that may occur in the form of erosion within already excavated areas. There is no modeling to support this impact – but if it is assumed that erosion of the disturbed area during flood events will be an additional 3 percent of the volume of each excavated area for each exposed construction year the total estimated volume of material to be removed and disposed will be around 270,000 cubic yards and this should be included in the cost estimate. This is acknowledged to be a highly uncertain number, but the USACE team feels that that some volume of re-work will be necessary due to the erodible nature of the exposed sands and the expected multiple annual flooding events during the wet season of the year that will impact the project site. Existing USACE borrow pits do not have significant re-work issues; however, they are specifically designed to not expose erodible sands. Additional Mobilization and demobilization would also occur around higher water events. This assessment was completed considering a 3-year construction period. Any delays in the construction cycle expose the excavations to additional construction seasons which will further increase the cost. The construction season was assumed to be May through November using the figure below, which shows the percent of time the river overbanks would be flooded each month.

Some excavation is located near areas of historical concern for HTRW within the protected area of the Jackson East Levee, where excavation is planned near the levee toe. The sponsor will need to insure a clean site in locations of active construction. Removal of the excavation near the levee reduces project improvements just upstream of this location by approximately 0.8 feet at the 100-year event. Individual structures (homes and businesses) will be impacted, and the design of the Canton Club Levee will need to be refined.

Flow, CFS - 9800 to hit 252 at Jackson gage, 1300 to hit 256 at Jackson gage. Upstream will inundate sooner, as no slope on excavation.												
Percent time exceeded.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.1	46,210	68,267	53,502	111,545	72,591	45,854	28,106	47,990	28,963	25,911	31,103	63,455
0.2	43,687	53,970	44,200	79,362	60,381	39,899	24,045	29,420	23,680	25,100	29,534	58,015
0.5	38,361	44,672	39,990	48,772	43,112	22,709	16,433	15,118	15,700	22,801	20,674	43,200
1	33,487	40,586	37,181	45,100	30,712	16,818	12,306	11,306	11,508	16,678	15,679	32,925
2	30,674	32,624	31,948	39,518	23,836	11,600	9,622	7,734	8,168	11,256	12,858	27,000
5	23,200	26,000	24,210	27,900	17,130	7,319	6,139	3,889	3,120	4,656	7,874	16,400
10	17,100	20,920	19,000	20,700	11,900	4,329	3,788	2,312	1,540	1,880	4,718	10,700
15	12,900	17,200	16,400	16,635	8,659	2,951	2,480	1,689	1,040	1,077	2,909	8,218
20	10,500	14,900	14,200	13,800	7,050	2,248	1,870	1,360	786	728	2,080	6,460
30	7,611	10,800	10,700	9,577	4,268	1,390	1,148	897	520	440	1,100	4,200
40	6,018	7,970	8,318	6,960	2,554	923	761	627	403	333	659	2,700
50	4,550	6,140	6,615	5,055	1,650	640	542	468	328	280	424	1,880
60	3,190	4,750	5,310	3,548	1,140	468	406	365	288	242	313	1,230
70	2,250	3,444	4,030	2,383	783	361	317	307	250	211	255	793
80	1,450	2,440	2,810	1,510	508	306	273	260	218	180	205	447
90	819	1,460	1,800	765	321	250	236	219	178	122	140	262
95	530	1,000	1,130	474	261	215	205	184	151	104	110	215
99	255	331	480	283	213	137	156	136	92	81	88	146
99.9	218	258	284	224	160	57	105	103	60	65	67	96
Construction Season												

Figure 2-7. Exceedance Calculations, Showing Amount of Time Construction Site will be Flooded per Month

Station 10+00 through 140+00. Specific items included in this reach are the I-20 Interstate bridges (Sta. 95+00±) as well as the U.S. Highway 80 (Sta. 110+00), Old Brandon Road (Sta. 135+00±), and railroad bridges (Sta. 70+00±, Sta. 130+00±). Two high-pressure gas lines run through this reach and will have to be carefully monitored as excavation and grading activities progress. Multiple access points on both sides of the river would have to be maintained and monitored from a perspective of public safety and construction use.

Station 140+00 through 290+00. This reach contains excavation of the overbank areas around high points such that high points would appear as islands. As with the previous reach segment, numerous access points would require management and maintenance for use and safety. A creosote slough area (Sta. 240+00±) will be avoided during construction, to not disturb or cause any objectionable material to be exposed or mixed with other excavated material.

Station 290+00 through 400+00. As with the previous downstream reaches, there are bridges to work around (Highway 25 near Sta. 360+00), and gas lines and transmission lines that must be monitored during earthmoving operations. Depending on the final design, Mayes Lake (Sta. 310+00±) may need tie-in work to maintain its current level. A determination about the tie-in work would be made during the PED phase. An existing abandoned railroad embankment of the Gulf, Mobile & Northern/Gulf Mobile and Ohio (GM&N/GM&O) Railroad Bridge could also be affected and some of this structure would be removed. Some excavation would be required in this reach such that high points would appear as islands. The existing weir at the water works bend near Station 290+00 would require protection along bank tie-ins.

Testing of a variety of hydrograph patterns, and coincident flood types indicate that a minor amount of induced flooding will occur due to water being able to move through the Pearl River more efficiently. The largest expected inducements (raised downstream water levels) for the 100-year return interval (0.01 AEP) are 0.3 feet, but flooding still occurs at about the same length of time as before. Impacts due to this inducement have been analyzed at a higher level of detail in the 20 miles downstream of the project. This analysis determined for the 100-year frequency and all more frequent frequencies tested, only 81 acres outside of the regulatory floodway would experience water stages more than 0.25 feet higher due to the construction of the project, and that up to 11 structures would experience any amount of additional water added above ground floor elevations due to the construction of the project. The FEMA regulatory floodway was used as a proxy for the ordinary high water mark survey, which has not yet been completed for this area. The Ordinary High-Water Mark is used to show where the river typically rises to over time, this is a line along the riverbank determined visually based on landscape features that indicate frequent wetting and drying cycles. Features that are used to set the Ordinary High-Water Mark include bank shelving, changes in the soil type, destruction of terrestrial plants, and a line of debris or trash along the bank. The 0.25 feet was the mark below which no negative impact to vegetation is assumed, given the flooding occurs at generally the same amount of time. Any structure experiencing new or added water due to the project would have to be mitigated. Mitigation may be through construction of a feature, raising of a structure, acquisition of a right of way or acquisition in fee; final mitigation of inducements will be determined in the next phases of study.

3.16 Excavated Material Plan (Fill Material)

Federal levees exist within much of this reach and Alternative D1 and E1 would upgrade existing levees with excess excavation placed at the toe where possible. Excavated fill would be placed in designated disposal areas on the protected and unprotected side of existing levees as well as other locations within the flood plain. All fill is expected to be semi-compacted. Close-growing grass and other vegetation shall be removed from areas to receive semi-compacted fill to provide a completely bare earth surface immediately prior to beginning foundation preparation. Removal of vegetation from the fill areas shall be limited to 1,000 feet in advance of embankment placement. Any topsoil that is found in the excavation areas to receive semi-compacted fill shall be stockpiled for use in re-establishing sod.

Drainage of fill areas shall be accomplished by ditching, sump pumping or other approved methods. When fill areas described in this contract are inundated from high river stages, the locations with the material shall be drained and allowed to dry to a workable condition as quickly as practicable after the high river stage has passed.

The first and each successive lift of semi compacted embankment fill material shall be compacted to at least 93 percent of maximum dry density as determined by ASTM D698 (Standard Proctor Compaction Test) at a moisture content within the limits as determined from ASTM D4643 or ASTM D2216. Please note that this is less than compaction standards needed for building any future structures (i.e. recreational building).

The disposal fill areas would impact approximately 523 acres and up to 9.38 million cubic yards. Approximation of volume of material to be placed was based on a soil expansion factor. This factor represents the additional volume added as the soil is currently somewhat compacted. This factor is set to 1.2, as mostly sand, with some clay and silt in the project area. Clearing and grubbing of approximately 523 acres would occur prior to placement of the excavated fill material from the channel lowering

Table 2-3. Expansion Factor by Soil Type

Soil Type	Expansion Factor Range
Clay	1.4-1.5
Silt	1.2-1.3
Sand	1.0

These areas would be graded to be at the same elevation or lower than existing levees. However, if any structures are to be built on top of any portion of a designed seepage feature, the feature would need to be maintained as a whole and utilities, or any other structure or penetrations would be limited to within the sections built above the designed seepage feature. The excavated fill material would be used to create land areas ranging from 3 to 93 acres.

The excavated material would be used to create areas of higher elevation within the Jackson and the surrounding cities. The newly created area could allow for expanded riverfront access, natural areas, along with recreational opportunities. The project area has significant historical and cultural site presence, it is possible that final site locations will need minor modifications during PED following the identification and evaluation process defined the Pearl River Basin, Mississippi Federal Flood Risk Management Project, PRBMFRMP Section 106 NHPA Programmatic Agreement (PA) to avoid and/or minimize effects to historical and cultural resources. Any effects to historical and cultural resources that cannot be avoided and/or minimized would be mitigated in accordance with the PA.

Up to 1,660,000 cy (1,269,000 3) of fill material (estimated as 100 acres (40.5 hectares) of fill 10 feet high) would be provided to the NFI for additional usage within the project footprint. This material would be either hauled directly from the excavation site or moved to a staging area for removal by the NFI. Existing fill areas would be used as staging areas after clearing and grubbing but prior to fill activities. The final fill locations and volume of fill will be refined in PED. All fill is currently costed as if government would be placing this fill. This will also be refined in PED.

3.17 Hardpoints at Base of Tributaries

Multiple tributary inflow points exist within this reach and Alternative D1 and E1 will add a hardpoint, via a rock check to prevent backward erosion at each tributary inflow where the excavation of overbanks decreased the tributary channel bottom elevation at or near the confluence of those tributaries with the Pearl River. It is assumed that no sheet pile stabilization is needed for cuts less than 5 feet in depth. This protection is limited to areas at the edge of excavation and should not negatively impact access to water, or the flow of water at any given location.

These rock checks will utilize riprap to prevent incisions working up the affected tributaries and reduce the amount of sediment that is introduced into the project via incision and upstream sediment transportation. This prevents the excavated area from slowly filling in with sediment over time. The estimated total width of rock checks required is 525 linear feet. Initial cross sections were measured from LiDAR terrain, and cross-sectional widths were measured if the thalweg of the channel was impacted by excavation. A 1.5 safety factor was included, as there will be additional stream expected to be added to this list, when survey data is collected. This would be either due to stream bottom not being captured in the LiDAR, or the survey showing impacts to additional tributary channel overbanks. If some tributaries require a rock check over the effective height of standalone rip rap, then sheet pile will be needed in addition to riprap for the construction of the rock check.

Table 2-4. Tributary Stream Bank and Bed Protection

Creek Name	LB/RB (Descending Bank)	channel Width	Height of Cut
Belhaven	Right	N/A	0
Twin Lake B		110	0.5
Eubanks	Right	N/A	0
Twin Lake A		50	0.5
Town	Right	N/A	0
Creosote Slough		50	5
Lynch	Right	N/A	0
Prairie Branch	Left	90	1.69
Culvert Fairgrounds Levee	Right	N/A	0
Culvert East Jackson Levee	Left	50	1.5

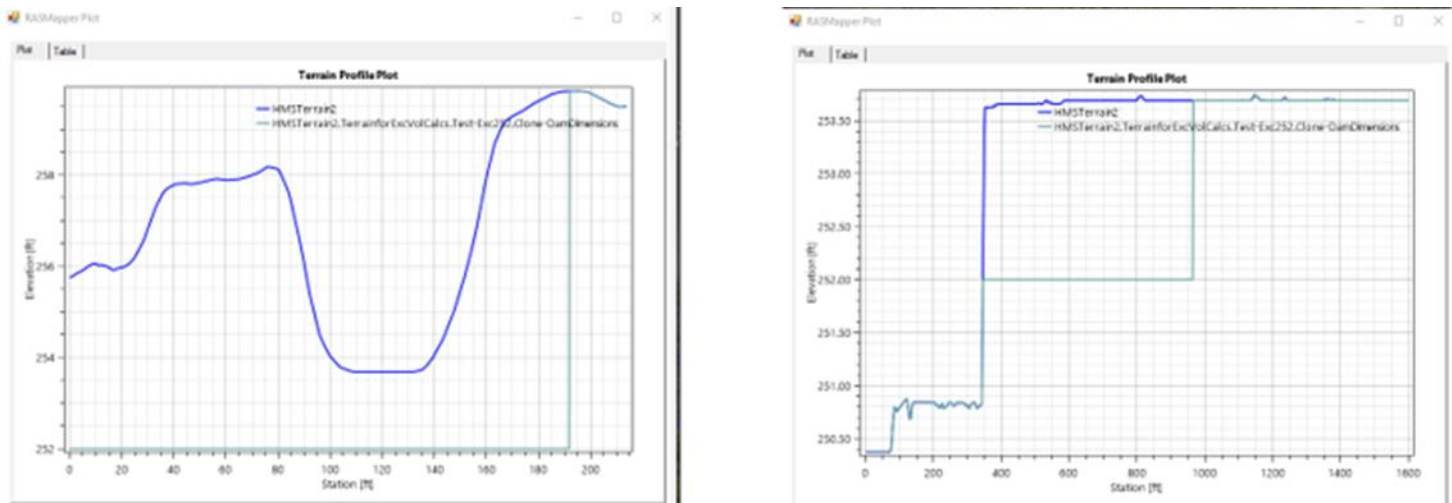


Figure 2-8. Terrain across and along the Prairie Branch Profile, with and without project

3.18 Stabilization of Bridges

If any stabilization or armoring, such as riprap, slope paving, slide repairs, etc., is required, it will be carried out prior to clearing and any major channel work. Following its own analysis, the MDOT has informed the Rankin-Hinds Flood Control District (the Flood Control District), that MDOT agrees to collaborate with the Flood Control District in “the advancement of this project and to ensure countermeasures are included, if determined necessary during the future design process.” (Letter to G. Rhoads, dated February 26, 2024) To this end, the Flood Control District developed a range of cost estimates for potential structural and hydraulic countermeasures that could be recommended if countermeasures are determined necessary. The array of countermeasure features analyzed that will mitigate potential impacts to MDOT bridges will be identified during the PED phase. The estimated cost for these features is based upon known costs for the construction of hydraulic and structural countermeasures on another MDOT project at downstream hydraulic crossings of the Pearl River. When additional information becomes available during PED, adjustments to the design can and will be made to reduce potential impacts. Any proposed countermeasure design and implementation will be conducted with MDOT’s concurrence, review, and approval.

Rough estimations of the level of effort required to mitigate for bridge impacts include improvements for approximately 36 bents, 12 piers, abutment scour, as well as funding to conduct monitoring surveys. A pier is a concrete post that is driven into the ground to act as a leg or support for a bridge. A bent is a combination of the cap and the pier. Together, with other bents, piers and abutments act as supports for the entire bridge.

3.19 Reinforcement Railway Bridges

There are a total of 2 active railroad bridges within the project area. All efforts would be made to avoid, monitor, and protect these structures. Additional modeling is required to validate these assumptions during PED. If avoidance is not possible, then coordination with the operating entity to determine specific requirements of each railway bridge will be conducted during PED. All alterations of railroad bridges

would be in accordance with Section 3 of the 1946 Flood Control Act (22 USC 701p). It is assumed that the CN railroad bridge on the downstream portion of the excavation will need some additional hydraulic protection. It is assumed that up to 18,000 tons of rock would be placed at this location.

3.20 Savanna Street WWTP Levee (Jackson-East Jackson Flood Control Project NLDID: 14050000124)

An existing non-Federal levee protects the Savanna Street WWTP near RM 282. The levee would undergo maintenance and additional upgrades, so the levee meets the items needed for certification for a 1 percent AEP flood event in advance of the channel widening construction. The levee section proposed for the new Federalized levee around the WWTP consists of a 10-foot crown width with 1V on 3H landside and riverside slopes. Spot checking of LiDAR data with survey data at boring locations show that levee crest elevations are well in excess of the 100-year flood elevations. However, if needed, maintenance to crest will be completed to ensure the 100 years with uncertainty elevations are maintained. Additionally, a slurry wall for seepage mitigation would be added at this location. At this location, additional pumps would not be needed to provide protection behind levees since the existing pumps are already in progress of being replaced as part of the Section 219 Environmental Infrastructure Program as discussed in Section 1.5.2 of this report.

To limit seepage, a cutoff wall will need to extend from Sta. 45+00 to 105+00 (approximately 6,000 linear feet). The cutoff wall will have an average depth of 40 feet (overall depths ranging from 30 to 45 feet). An 18-inch-wide wall will be constructed on the flood side toe of the levee and will require a clay cap to tie into the existing levee. Approximate clay cap volume will be 22,000 cubic yards (estimated 5 feet thick, 20 feet wide). The material would be Select Contractor furnished clay (CL) fill material compacted to the 95 percent standard proctor.

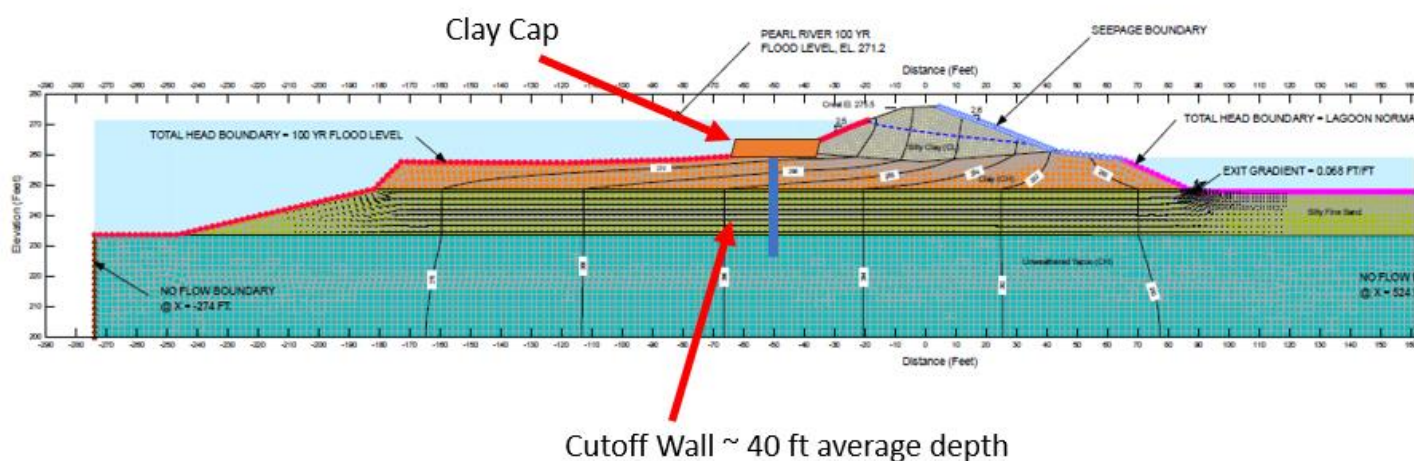


Figure 2-10. Savanna Street Riverside Cutoff Wall and Clay Cap

Principal features of the work include mobilizing and demobilizing, clearing and grubbing, removing and stockpiling any existing crushed stone surface, semi compacted levee embankment, traverses, adding new crushed stone surfacing, mowing, turfing, erosion control matting, trenching and the creation and backfill of a concrete slurry wall within the levee footprint, and preventing storm water pollution.



Figure 2-11. Proposed Federalized Levee at Savanna WWTP

3.21 Armoring of Mays Lake and the JW Fewell Weir



Figure 2-12. Mays Lake and J H Fewell Weir, as compared to the Excavation (blue) and Fill (tan)

Armoring of Mays Lake and the J W Fewell Weir will be completed to reduce the risk of losing the pools at either structure. This is critical to protect, as the J W Fewell weir maintains a pool, which is used to supply drinking water to the City of Jackson. This is applicable to Alternative D1 and E1, as these features will be needed for a long construction period, as well as for drawdowns with the downstream proposed weir, and as permanent protection for Alternative E1 (no downstream weir). The armoring is comprised of a longitudinal Peaked Stone Toe Dike, Tiebacks, and Stone Fill; Stone Bank Paving; a Check Dam Dike; and Fill.

Table 2-6. Bank Protection at J W Fewell Weir and Mayes Lake

Feature	Volume (Cubic Yard)	Notes:
Longitudinal Peaked Stone Toe Dike, Tiebacks, Stone Fill	80,000	
Stone Bank Paving	10,000	
Check Dam Dike	8,000	
Earth Fill	150,000	Fill will be refined in PED. No additional cost, as cost of handling and compacting already accounted for in Fill Feature.



Figure 2-13. Stone Placement East Bank to protect the Fewell Treatment Plant Weir



Figure 2-14. Stone Placement West Bank to protect the Fewell Treatment Plant Weir and May's Lake Tie-In

Construction of New Weir and Gate with Fish Ladder

Alternative D1 calls for a new weir to be constructed further downstream near RM 286.5 at the southern end of the channel improvements area. This would maintain the baseline low-water level to maintain water supply at the J. H. Fewell WTP within the channel improvements area. This would provide for a larger body of water within the Pearl River channel to the north of the new weir. The weir would be submerged during normal flow and flood events allowing excess water to pass downstream. As opposed to the existing weir (Fewell), the weir would be constructed to a higher elevation of approximately 256 Feet NAVD 88 with a fish ladder located on the southern end of the proposed channel improvements area. The weir will impound approximately 4 feet of water along the excavated overbanks and up to 22 feet across the main channel. This will be an area of approximately 1,556 acres.

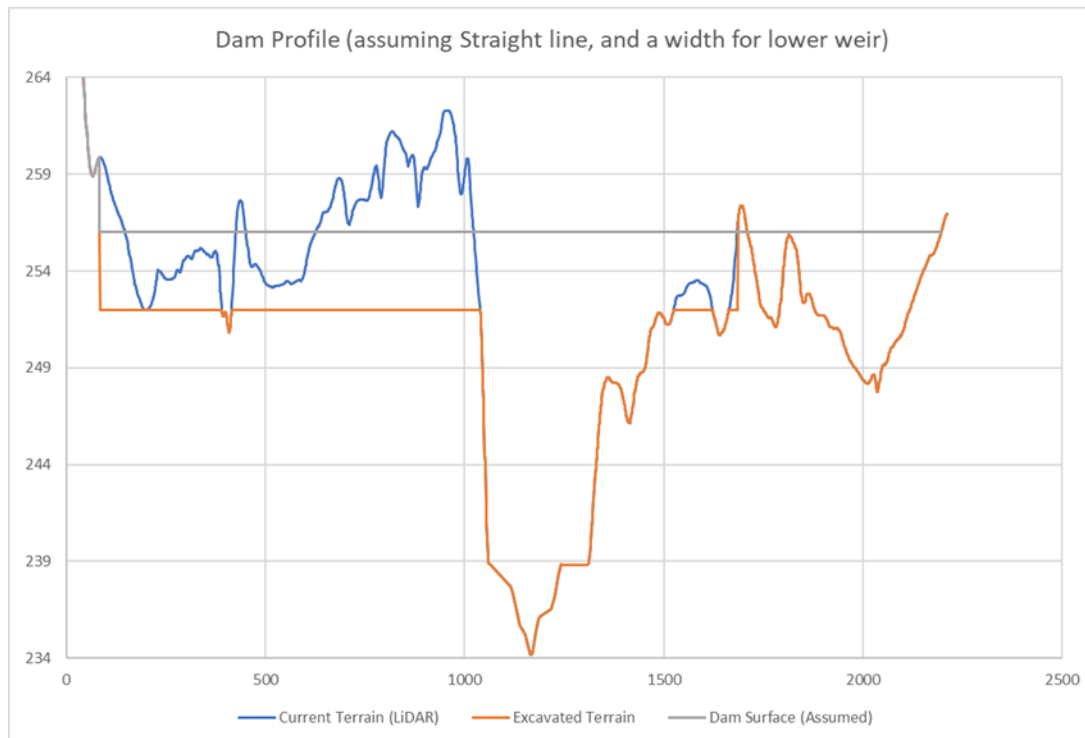


Figure 2-15. Proposed Profile, Damming Surface of Weir across Channel and Overbank

The recommended design is a concrete structure constructed the full length of the weir. The estimated length of the weir is 2,200 feet. A cross section from another USACE project (Sand Springs Dam) was used for this project and scaled down to meet the size of the project. For estimating purposes, the crest of the weir was set at a constant elevation of 256 feet for the entire project with no separate weir structure and limits the average height of the structure to about 4 feet. A unique feature of this cross section is the concrete steps on the back side of the structure that are designed to dissipate energy and prevent the “death roll” effect that results in drowning deaths downstream of low head dams. This type of feature is considered mandatory for a modern designed low head dam.

Further, a fish passage will be created around the relocated weir in the project area, which requires additional excavation. The fish passage has been conceptually designed to be between 5,000 and 6,000 feet (1524-1829 m) in length. The fish ladder will be constructed at an approximate 0.004 feet/feet slope and tie into Conway Slough. The fish passage design will be coordinated with US Fish and Wildlife and state agencies during the PED phase.

3.22 Weir Design

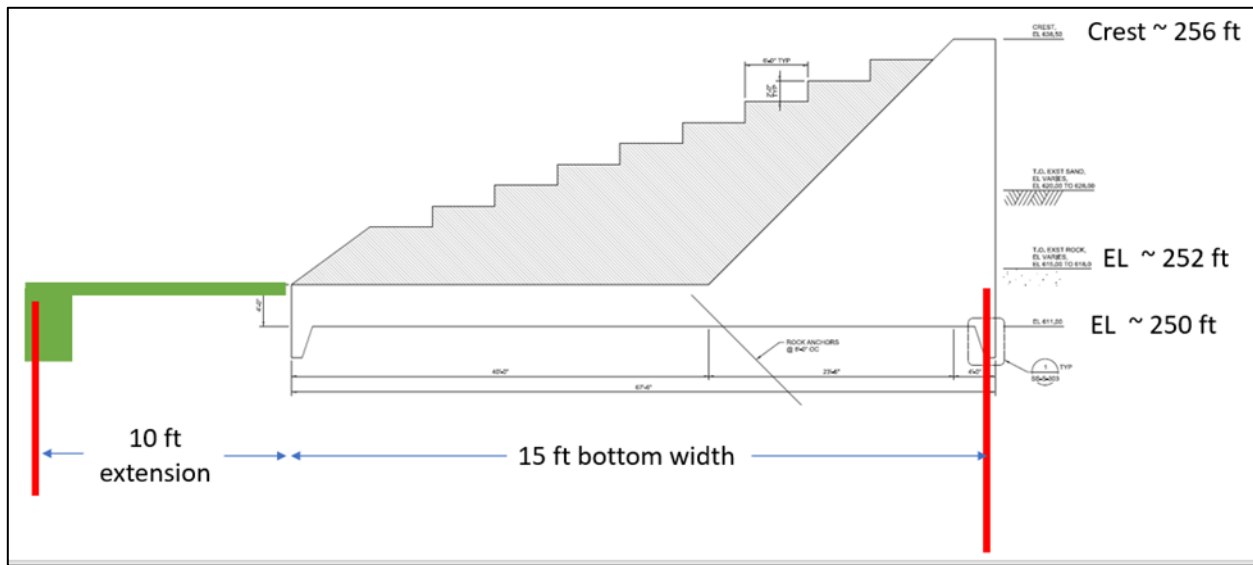


Figure 2-16. Weir Profile with Stepped Surface downstream

Low head dams often pose greater risk to life safety in combination with recreational activities. These structures trap victims in a submerged hydraulic jump with a resulting reverse roller. The submerged hydraulic jump is an energy-dissipating underwater jet that can often maintain enough kinetic energy to cause it to travel downstream and then rise to the surface, with a portion of the water of the jet flowing back toward the weir. This represents the reverse roller. These rollers can be mitigated with various energy dissipation schemes, such as concrete steps, proposed as part of the weir design.

The proposed weir in Alternative D1 meets USACE and State criteria to be defined as a dam based on the height of the structure and water storage. As a result, the dam will need to be designed and constructed to meet higher USACE and State criteria for a dam. A more refined cost estimate will be completed in PED once the dam is redesigned to meet USACE and State criteria.

The concrete weir structure is assumed to be able to be ground supported due to the limited height (except for the portion over the river plug). However, a sheetpile will be required on the upstream face of the structure to mitigate excessive seepage and maintain stability of the structure. The sheetpile will extend completely through the alluvium into the underlying over-consolidated clay foundations. A PZ-27 sheetpile is assumed that will have an average depth of 20 feet.

A 10 feet concrete extension and a short 10-feet long PZ-27 sheetpile turn down on the backside of the structure is also required to further reduce potential erosion during overtopping events. This is necessary since the structure will sit directly on exposed alluvial sands that are highly erodible. Until more detailed H&H modeling is completed – this is the expected design.

3.23 Low Flow Channel and Structure

The location of the low flow structure has been conceptually moved towards the right abutment.

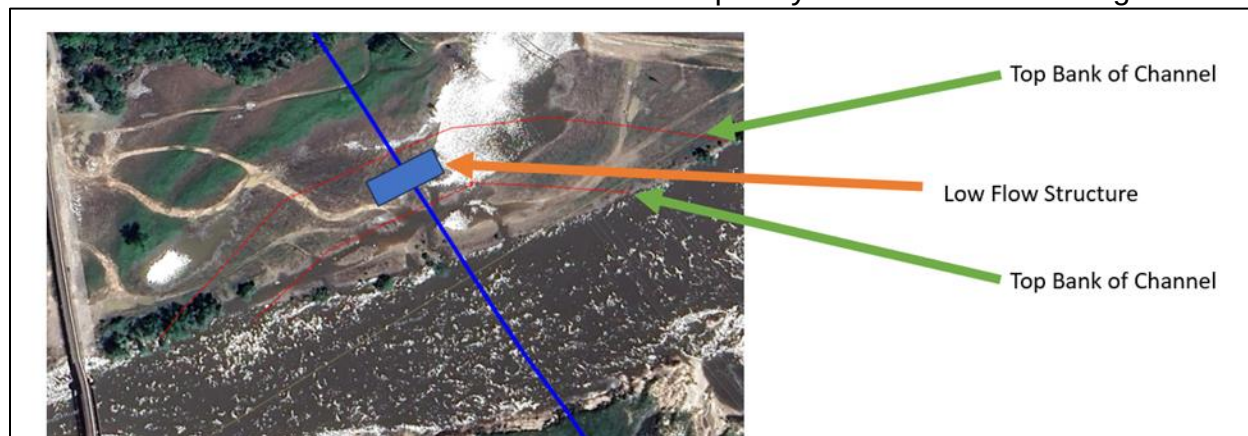


Figure 2-18. Low Flow Channel and Structure

The invert of the low flow structure is set at EL 234 feet, which is the estimated elevation of the bottom of the existing river channel. The structure and channel need to match the elevation of the existing river channel bottom to maintain flow. It is assumed that this existing area will have already been excavated to EL 252 feet prior to construction of the low flow structure.

The average depth of the low flow channel is estimated to be 18 feet. A 15-foot wide channel bottom is assumed to match the current design width. Maximum steepness of the side slopes will be 3H:1V. At that inclination the top bank of the channel will be about 123 feet wide. However, it is likely that flatter slopes will be required due to the geotechnical conditions at this site. The bottom of the low flow channel will expose high plasticity, over-consolidated clays that are subject to stress relief and shrink/swell movements that will reduce the effective shear strength at the base of the excavation and expose the low flow channel to both short term and long-term slope stability failures. The side slope may need to be flattened to as shallow as 6H:1V to prevent the potential for stability failure. These types of shallow slopes are consistent with local practice in this geology and should be considered in the cost estimate. This will effectively increase the amount of required excavation and top width of the low flow channel.

The exposed side slopes will be erodible and alluvial soils. The low flow channel will need to be lined with riprap in the bottom and along the entire side slopes.

Completing the excavation to EL 252 feet in the entire area, excavating the low flow channel, constructing the low flow structure, and placing riprap in the low flow channel may be difficult to achieve in one low-flow construction period. It may take 2 years to construct it all in this area – which provides additional exposure to damage from annual flooding – which will increase the cost of this feature. Cost increase due to some flood damage could be in the range of 10 percent to 50 percent of total cost for this feature – depending on the magnitude of the flooding and stage of construction complete.

The low flow drainage structure consists of a single 12 feet by 12 feet reinforced concrete precast box culvert. This structure will incorporate wingwalls and an inlet and outlet apron. The low flow structure will allow for passage of flow downstream when the weir is not being overtopped. The flow through the structure will be regulated by a sluice gate. This will require operating machinery to be mounted above the gate, which will require a platform. The machinery platform will be built at an elevation that will not be submerged frequently. There will be a pedestrian bridge that will allow access to the structure from the top of the adjacent highway embankment. This bridge will consist of a concrete superstructure and concrete piers due to the consistent fluctuation of water levels. The low flow structure will also require a second form of closure which will be 1 foot by 1 foot series of wooden stoplogs that will be set in a slot on the upstream end of the box culvert. These will be set and removed using a chain hoist attached to the underside of the machinery platform. The box culvert invert elevation will be located at 234 feet NAVD 88, which requires 22 feet of cut. The box culvert is estimated to be 60 feet long. The walkway platform will be located at 262 Feet NAVD 88. The columns for the walkway platform will span from between elevations 261 to 246 NAVD 88 (15 feet) and will be 18-inch x 18-inch reinforced columns. The concrete piers will be 18-inch x 18-inch reinforced concrete piles that go from Elevation 261 to 230 feet NAVD 88 (31 feet). A schematic is included in the below figure.

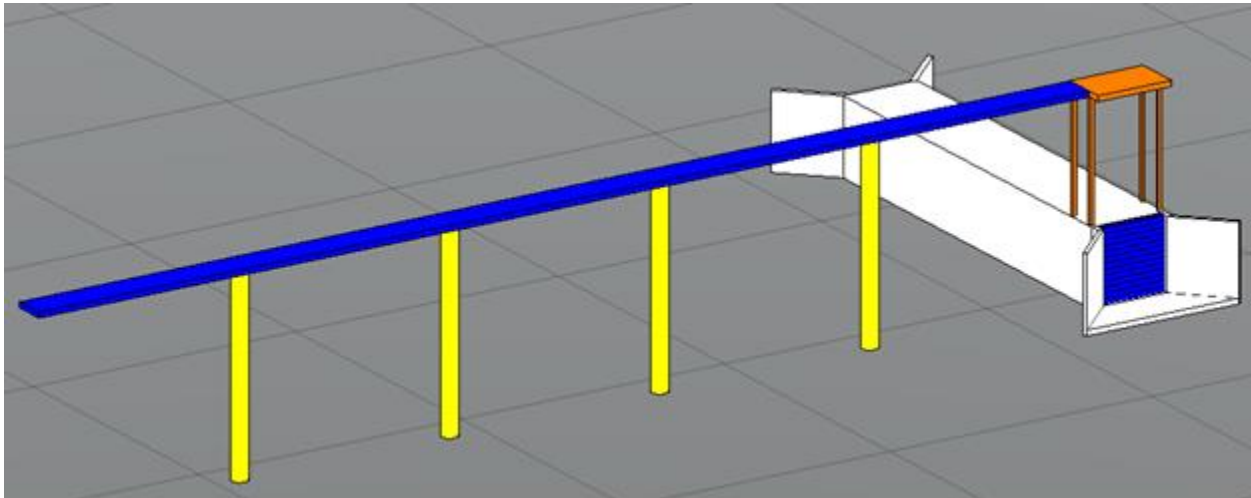


Figure 2-19. Low Flow Gate

3.24 River Plug

The river will need to be plugged during construction for any weir option selected. The plug is a reinforced part of the foundation of the dam located at the original river channel, as this is the tallest point of the dam, with expected sandy soils. Key design features include the need for a temporary cofferdam at the upstream end of the clay plug. This will need to consist of either an earthen cutoff dike and/or sheetpile cutoff to be installed approximately 150 feet upstream of the weir centerline. This will allow for the fill placed within the river channel to be constructed in a “relatively” dry condition. Assume this work is started during late summer and continues through early fall to make a more active dewatering system unlikely.

Excavation will be required to remove all alluvial soils above the Tertiary clays within the river bottom. All fill materials placed within the river plug will need to be select fill materials consisting of silty clays (CL) or sandy clays (CL). Lifts will need to be fully compacted in 9-12-inch-thick loose lifts to a minimum of 95 percent maximum dry density from a Standard Proctor. Excavated soils within the river channel will not be suitable. The current estimate is that the river plug excavation will need to extend to the current river bottom to about EL 334 feet.

Channel width is approximately 275 feet wide, with an assumed top width of excavation to about 325 feet wide to allow for benching of fill into the adjacent overbank. An assumed 50-foot wide section along the weir centerline is constructed to approximate EL 352 feet. This central section will then slope down into the upstream and downstream channel for 180 feet on either side until reach the channel bottom at approximate EL 334 feet (Approximate 10H:1V slope).

The clay plug fill will need to be capped with riprap to prevent erosion. It is likely that the crest will be raised 1 foot to 2 feet higher along the clay plug to reduce erosion potential until tailwater builds up during overtopping events.

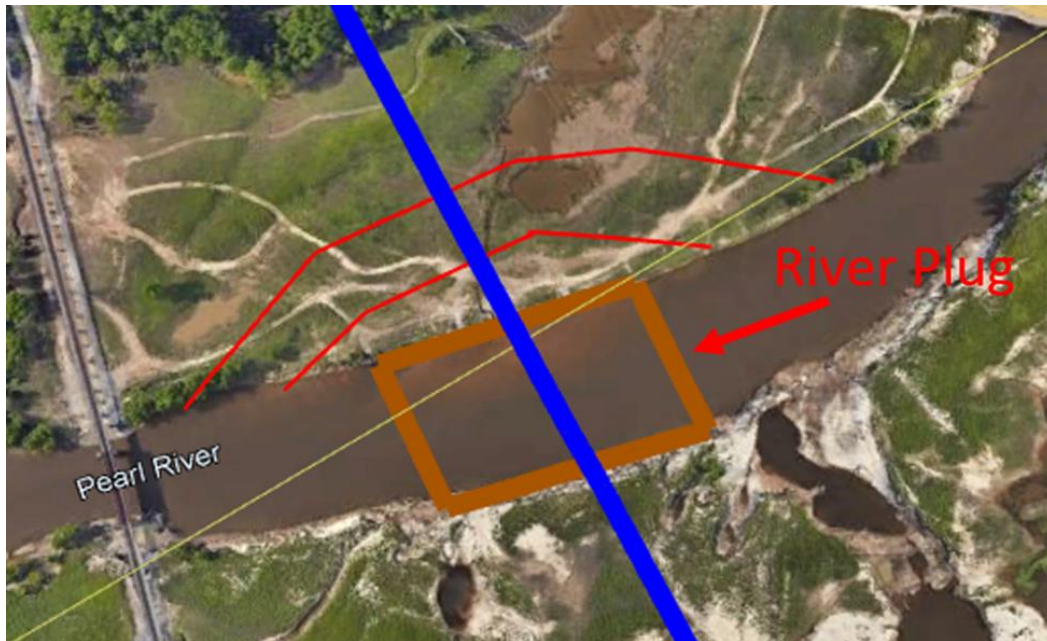


Figure 2-20. River Plug at Weir Site

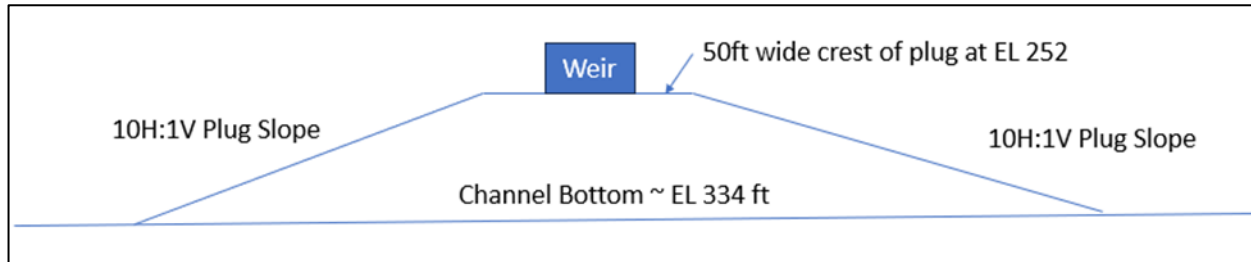


Figure 2-21. Profile of River Plug at Weir Site

3.25 Fish Passage

Costs of the fish passage were compared to ongoing design of a similar fish passage being pursued by USACE in the state of Alabama which also targets gulf sturgeon. Design requirements were also compared to the Lower Yellowstone River Intake Dam Fish Passage and Screening Preliminary Design Report (Corps 2006). Preliminary costs for the Alabama Gulf Sturgeon project were compared with the original NFI estimate for Alternative C. Costs were adjusted based on length and width of the proposed fish passage and it was found that the costs were a similar order of magnitude as that of the NFI cost estimate.

A fish ladder would be excavated around the relocated weir within the project area. The fish ladder is conceptually designed to be between 5,000 - 6,000 feet (1524-1829 m) in length. The fish ladder would be constructed at an approximate 0.004 feet/feet slope and tie into the Conway Slough which connects to the Pearl River 0.8 miles downstream of the CN Railroad Bridge. The fish ladder design would be coordinated with US Fish and Wildlife, state agencies and Tribes during the PED phase.

There are some known limitations to the design of the fish passage. A narrow segment will need to pinch in underneath the existing railroad bridge at Conway Slough. Further the existing weir location has minimal space available to create needed length especially, given the 40 to 50 feet of width needed. Additionally, it is estimated that between 1100 and 2000 cfs will be needed to maintain 5 feet of depth in a fish passage. Even if diverting the entire Pearl River through the fish passage, there will not be enough water available to support a fish passage throughout the calendar year. All of these limitations will be considered and coordinated with the resource agencies during design. An image below demonstrates the percent of time a given flow is exceeded based on existing data.

Flow, CFS - 1100 to 2000 cfs needed to maintain 5 ft channel												
Percent time exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.1	46,210	68,267	53,502	111,545	72,591	45,854	28,106	47,990	28,963	25,911	31,103	63,455
0.2	43,687	53,970	44,200	79,362	60,381	39,899	24,045	29,420	23,680	25,100	29,534	58,015
0.5	38,361	44,672	39,990	48,772	43,112	22,709	16,433	15,118	15,700	22,801	20,674	43,200
1	33,487	40,586	37,181	45,100	30,712	16,818	12,306	11,306	11,508	16,678	15,679	32,925
2	30,674	32,624	31,948	39,518	23,836	11,600	9,622	7,734	8,168	11,256	12,858	27,000
5	23,200	26,000	24,210	27,900	17,130	7,319	6,139	3,889	3,120	4,656	7,874	16,400
10	17,100	20,920	19,000	20,700	11,900	4,329	3,788	2,312	1,540	1,880	4,718	10,700
15	12,900	17,200	16,400	16,635	8,659	2,951	2,480	1,689	1,040	1,077	2,909	8,218
20	10,500	14,900	14,200	13,800	7,050	2,248	1,870	1,360	786	728	2,080	6,460
30	7,611	10,800	10,700	9,577	4,268	1,390	1,148	897	520	440	1,100	4,200
40	6,018	7,970	8,318	6,960	2,554	923	761	627	403	333	659	2,700
50	4,550	6,140	6,615	5,055	1,650	640	542	468	328	280	424	1,880
60	3,190	4,750	5,310	3,548	1,140	468	406	365	288	242	313	1,230
70	2,250	3,444	4,030	2,383	783	361	317	307	250	211	255	793
80	1,450	2,440	2,810	1,510	508	306	273	260	218	180	205	447
90	819	1,460	1,800	765	321	250	236	219	178	122	140	262
95	530	1,000	1,130	474	261	215	205	184	151	104	110	215
99	255	331	480	283	213	137	156	136	92	81	88	146
99.9	218	258	284	224	160	57	105	103	60	65	67	96
Travel Up						Travel Down						

Figure 2-22. Exceedance Calculations, Showing Amount of Time Proposed Fish Passage would have sufficient flow to achieve Purpose

3.26 Additional Weir Descriptions

Construction of the weir necessitates additional pumping needs at existing levees as well as seepage protection in the form of berms and slurry walls on existing levee features upstream of the weir. The proposed weir would result in an expanded, year-round water body capable of supporting recreational facilities. Potential recreation sites would be limited to areas disturbed by construction and design of these facilities would be coordinated during PED (Figure 3-14). The incidental recreational features could include boat ramps, camping areas, fishing piers, trails, or wildlife viewing areas.

Implementation of this alternative would be subject to the non-Federal sponsor agreeing to comply with the applicable federal laws and policies prescribed in the model Partnership Agreement for Authorized Structural Flood Risk Management Projects.

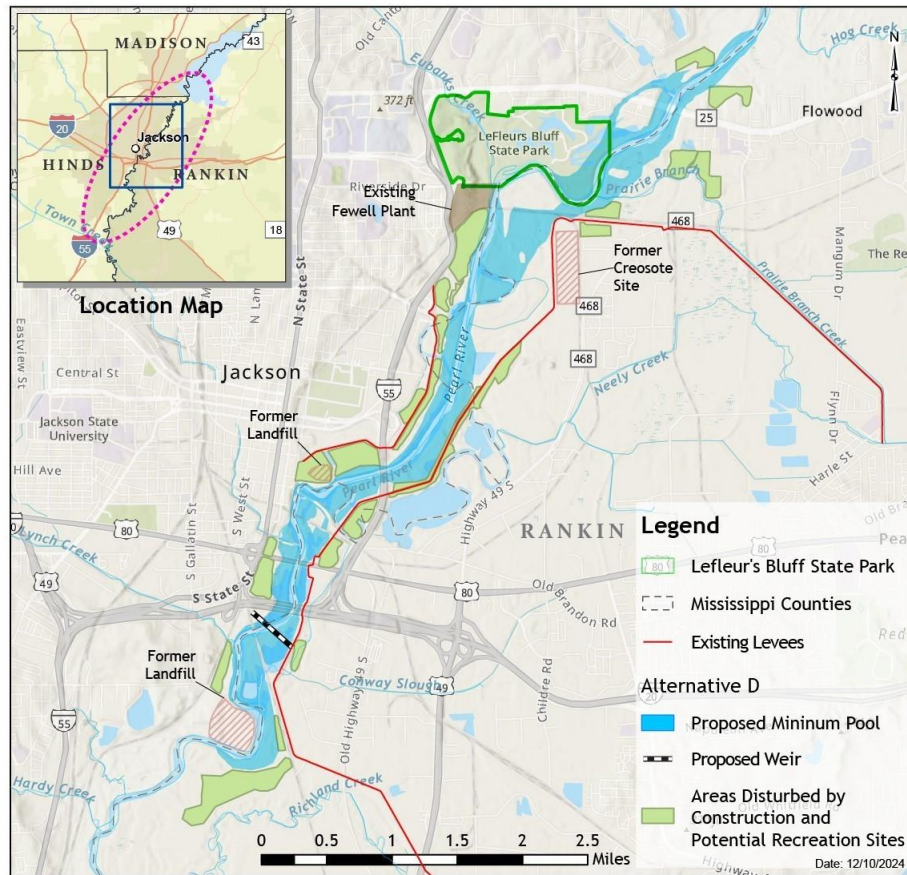


Figure 2-23. Potential Sites for Incidental Recreational Features

Seepage Mitigation (Permanent Ponding) for Existing Federal Features

Seepage mitigation features will be constructed where levee features do not meet appropriate factors of safety due to permanently ponded water against the riverside slope. No removal of the riverside blanket (existing seepage features) near the existing levees is anticipated.

Fill areas will be cleared and grubbed ahead of receiving excavated material from the channel widening. However, if any structures are to be built on top of any portion of a designed seepage feature, the feature would need to be maintained as a whole and utilities, or any other structure or penetrations would be limited to within the section built above the seepage feature. Penetrations through the berm could become seepage exit points, and this is specified to limit fracture through the main berm. In locations where berm length is not sufficient, additional seepage mitigation features will be included.

3.27 Jackson East Seepage

Additional features beyond existing fill are listed in the table below. Please note that the Jackson East Levee has existing seepage issues on the far upstream end of this levee that are not impacted by the

project and therefore are not corrected. The areas not impacted by this project that will continue to have seepage concerns are near Sta. 60 to 70, Sta. 100 to 125, and Sta. 170 to 180.

All cutoff walls are expected to have an average depth of 40 feet (overall depths ranging from 30 feet to 45 feet). They will be constructed on the riverside toe of the levee and will require a clay cap to tie into the existing levee. (Estimated 5 feet thick clay cap approximately 20 feet wide). Select – Contractor furnished clay (CL) fill material will be compacted to a 95 percent standard proctor.

Table 2-7. Additional Seepage Mitigation- Jackson East Levee

Stationing		Solution Description	Length	Depth/ Thickness, feet	Width, feet	LS Blanket	
Start	End					Thickness, feet	Length, feet
210+00	240+00	North of Creosote site. Remedial measurement needed based on past performance seepage and sand boils.	1300	45	2	5	20
302+00	304+50	Cutoff wall due to limited space on riverside (RS)	250	45	2	5	20
312+50	319+50	Cutoff wall due to limited space on RS and Past Performance	700	45	2	5	20
323+00	328+50	Cutoff wall due to limited space on RS and Past Performance	550	45	2	5	20
356+50	363+50	Cutoff Wall- could be designed at a higher level with Fill/Dikes in PED for a reduced cost. Cost of Cutoff Wall vs Bank Paving compared, and least cost (Cutoff Wall) reported.	900	45	2	5	20
378+50	379+50	Cutoff wall due to limited space on RS and Past Performance	100	45	2	5	20
389+00	397+00	Cutoff wall due to limited space on RS and Past Performance	800	45	2	5	20
402+50	408+00	Cutoff wall due to exposed sands on RS	550	45	2	5	20
		Cutoff Wall at exiting Pump-excavation nearby	500	45	2	5	20



Figure 2-24. Work near Areas of HTRW Concern, Channel Overbank Excavation in Blue, near the Jackson East Levee, with Site of Previous Creosote Plant on the interior of the Levee

Some fill and cutoff wall work is located near areas of historical concern for HTRW. This fill is placed to reduce seepage through and under the Jackson East Levee where excavation is located near the levee toe. The sponsor will need to guarantee a clean site in locations of active construction. Removal of the excavation near the levee reduces project improvements just upstream of this location by approximately 0.8 feet at the 100-year event. The level of protection at individual homes and businesses will be impacted, and the design of the Canton Club Levee will need to be refined.

3.28 Jackson Fairgrounds Seepage

Additional features beyond existing fill are listed in the table below. All cutoff walls are expected to have an average depth of 40 feet (overall depths ranging from 30 feet to 45 feet). They will be constructed on the riverside toe of the levee and will require a clay cap to tie into the existing levee. (Estimated 5 feet thick clay cap approximately 20 feet wide). Select Contractor furnished clay (CL) fill material will be compacted to a 95 percent standard proctor.

Table 2-8. Additional Seepage Mitigation- Jackson Fairgrounds Levee

Station		Solution Description	Length	Depth/ Thickness, feet	Width, feet	LS Blanket	
Start	End					Thickness, feet	Length, feet
25+00	30+00	Cutoff on Landside. Fill on LS not possible due to limited space. Recommended due to past performance during high water level event.	500	45	2	5	20
91+00	100+00	Fill on Landside, near Pump Sump. This is a new berm requested; existing fill location/ acreage will be switched with this location in PED.	900	5	75	N/A	N/A

3.29 Interior Drainage of Existing Levees

The existing levees contain drainage structures that allow water to drain from the interior of the leveed area when the Pearl River is low. When the Pearl River water level is high, the drainage structures are closed, and pump stations are used to pump water out of the leveed area. The original design of these features called for the drainage structure to handle a 1 percent AEP interior drainage flow, and the pumps were originally designed for a smaller event.

Alternative D1 calls for the construction of a new weir with a minimum pool at elevation 256.0 feet. As a result, the drainage for the Jackson Fairgrounds Levee would always impound water on the structure and would no longer be able to operate under gravity flow to prevent the new lake from flooding the interior leveed areas. Additionally, the Operation and Maintenance of the additional pumping will need to be updated prior to construction.

3.30 Pump Station (Jackson Fairgrounds Levee)



Figure 2-25. Typical Pump Configuration

A new pump station will be provided to pump these flows. The pump station flowrate required is up to 360 (cubic feet per second) CFS at 19 feet static head. The pump station will be a typical up-and-over the levee type with vertical axial/mixed flow pumps. The pumps also have a maximum head requirement of 31.4 feet, which determines the motor horsepower. Electric motors (300 HP) operating at the required pump speed will be used as the power source. The entire drainage area for the levee and pump station is a mix of commercial and residential properties. The pump station is designed with four 90 CFS pumps and a 5th 90 CFS pump as an installed redundancy. The pump station is provided with back-up power supplied by two 600 KW generators.



Figure 2-26. Typical Pump House Configuration

The relocated weir for Alternative D1 was placed upstream of the East Jackson Levee drainage structure, so the pool should not impact the operation of the drainage structure.

3.31 Other Interior Drainage (Jackson Fairgrounds Levee)

There are existing sluice gates to evacuate interior drainage for the Jackson East and Jackson Fairgrounds Levees. The Jackson East Sluice were reviewed, and no impacts are expected. Verification of operations with the sponsor, showed that the gates remain open at base pool for Alternative D1. The Jackson Fairgrounds contains 2 sluice gates which will be permanently impounded. These structures will be grouted in or removed to reduce risk to levee. Currently a removal cost is specified, but this will be refined as level of engineering design increases in PED.

3.32 Property Relocations

Alternate D1 and E1 also includes removing the abandoned GM&N/GM&O Railroad Bridge and part of its embankment, relocating or reconstructing property of others, bridge counter measures, utilities and lands or interests purchased for such relocations and conveyed to others.

HTRW sites within the project area will be avoided if possible pursuant to ongoing consultation with the Mississippi Department of Environmental Quality (MDEQ). For those sites that may have impacts, additional investigations will occur during PED. If sites will require involvement, remedial designs would be coordinated with appropriate Federal and State agencies (MDEQ), to determine necessary actions.

3.33 Utility Relocation

There are numerous utilities within the project area. All efforts will be made to avoid, monitor, maintain clearance requirements, and protect these structures. If avoidance is not possible, then utility relocation or raising of lines/protection of structures would be necessary. It is assumed that a subset of these lines will require additional utility relocation costs. Coordination with the operating entity to determine specific requirements of each utility will be conducted during PED. Rough costs for relocation power transmission and distribution lines, communication lines, water supply lines, sewage collection lines, and an oil/gas pipeline have been included in the cost estimates.

3.34 Replacement Of Obsolete Aquatic Barrier (Weir Removal; Riverine Mitigation)

Riverine habitat restoration may be included in the project by replacement of obsolete aquatic barrier(s) downstream of FRM project with a rock chute. Although not the proposed measure, this was used for planning purposes as existing data is available and the resource agencies suggest that it could potentially fully satisfy the riverine mitigation needs. Further analysis is needed to confirm this assumption and would be conducted in subsequent phase(s). Replacement of a sill(s) by means of excavation and placement of fill on site, along with the construction of a rock chute(s) is considered to mitigate for riverine impacts due to implementation of Alternative D1. The rock chute(s) will utilize riprap to prevent incisions working up the affected stream, reduce the amount of sediment that is introduced into the project via incision and upstream sediment transportation, as well as maintain a portion of the upstream water levels currently maintained by the sill. If height of sediment behind structure requires a rock check over the effective height of standalone rip rap, then sheet pile will be needed in addition to riprap for the construction of the rock chute(s). Estimated width of sill removal is about 415 linear feet across the river. Estimations were taken from the rural Green River Kentucky dam removal efforts, where the Green River Lock 6 and Barren River Lock 1 have been recently removed. Green River Lock 5 is currently being removed. Estimations for the rock chute was taken from the recent Hickahala rock check design.

Table 4.a: Pertinent Data for the Green and Barren Rivers Locks and Dams							
L&D No.	year built	lock				pool	
		mi above mouth	width	length	lift	upper	lower
Green 1	1956	9.1	84.0	600.0	11.8	349.1	337.3
Green 2	1956	63.1	84.0	600.0	14.0	363.1	349.1
Green 3	1836	108.5	35.8	137.5	17.3	380.4	363.1
Green 4	1839	149.0	35.8	138.0	16.4	396.8	380.4
Green 5	1934	168.1	56.0	360.0	15.2	412.0	396.8
Green 6	1906	181.7	36.0	145.0	9.2	421.2	4112.0
Barren 1	1934	15.0	56.0	360.0	15.2	412.0	396.8
Rough 1	1897	7.0	27.0	123.0	9.9	373.3	363.4

Figure 2-27. Green River System Dam Removal Study (2004)

3.35 Creation of Oxbows and Ponds (Mitigation)

The creation of oxbow lakes and/or ponds would mitigate for lacustrine impacts due to the implementation of Alternative E1. These lakes will be excavated 5 feet below the floodplain lowering depth (El. 247) with 1 vertical to 3 horizontal sloped borders. No clay layer will be added to pond bottoms. Modeling tests indicate that this feature impacts Water Surface Elevations by less than 0.1 foot.

Table 2-10. Oxbow and Fishponds for Lacustrine Habitat

Pond/Oxbow	Area Acres	Additional Depth, (Beyond Excavation to El. 252)	Additional Volume Ac-Ft	Length of Armoring(feet)
NE Oxbow (1)	12	5	60	1350
LeFleur's (2)	17.5	5	87.5	2600
Pond 1 (3)	8.9	5	44.5	600
Pond 2 (4)	8.2	5	41	0
Southeast Oxbow (5)	41.8	5	209	1335
South Oxbow (6)	16.9	5	84.5	2450



Figure 2-28. Oxbow/Ponding Features 1 and 2



Figure 2-29. Oxbow/Ponding Features 3 and 4



Figure 2-30. Oxbow/Ponding Features 5 and 6

Additional restoration of habitat may be included in the project by means of protection, enhancement, or creation of instream habitat (shoals, gravel bars, woody debris, sand bars), and reforestation of the riparian buffer along the Pearl River within the Project area. USFWS recommended these potential restoration measures (not mitigation) for Alternative E1 justified under ESA section 7(a)(1).

3.36 McLeod Levee

A levee segment of approximately 2.3 miles is proposed on the west bank of the Pearl River in northeast Jackson. This levee would provide additional flood risk reduction for approximately 170 acres of high density developed neighborhoods. However, 2 homes constructed at the riverbank will have to be acquired for construction of this feature. This area ties into Old Canton Road on either end. The levee begins at the Old Canton Club at Purple Creek and extends downstream and back up a tributary to end at the intersection of Old Canton Club at White Oak Creek. Portions of this levee alignment may require floodwalls or additional acquisitions due to space constraints along White Oak Creek. It is estimated this would reduce flood risk for 415 homes. The levee will range from natural high ground, to up to 10 feet high. Exact elevations will be set as the with project 100-year flood event with 90 percent assurance levels in PED.

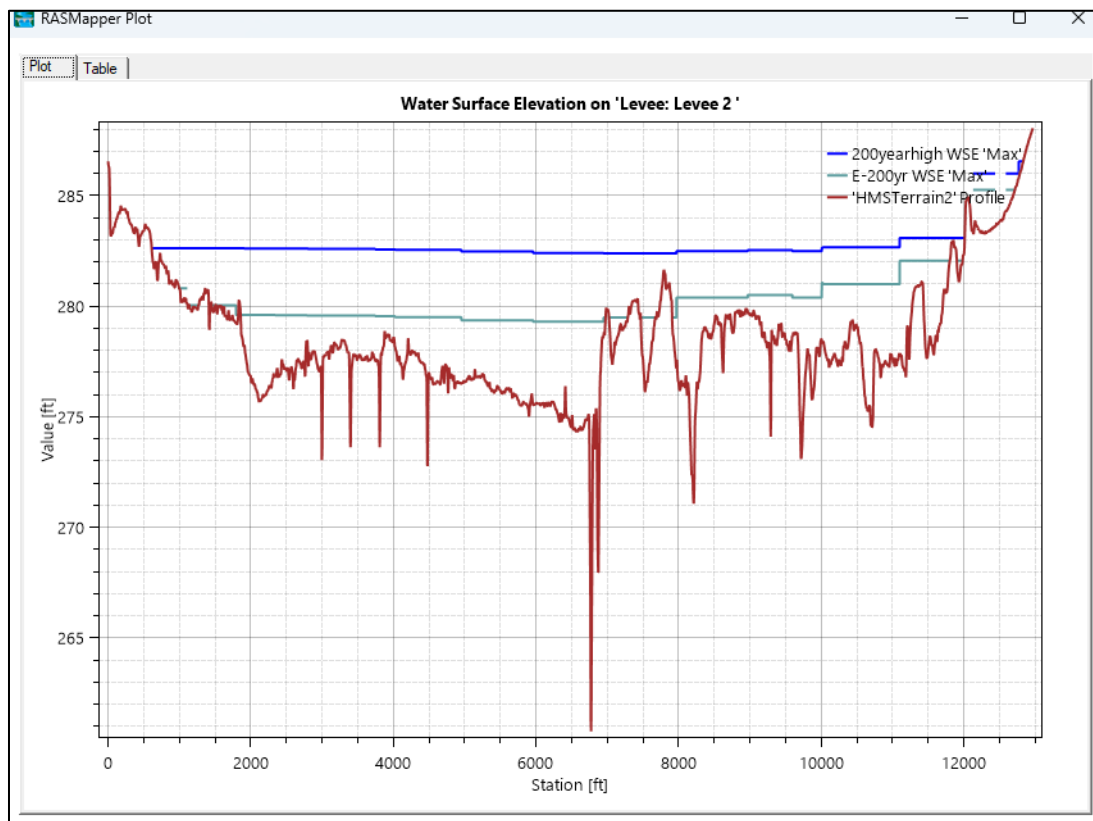


Figure 2-31. McLeod Club Levee Location, Existing Terrain, as compared to the 200-year Flood Elevations, with and without channel improvements

Typically, during a flood event on the Pearl River or its tributaries, rainfall also falls behind the levee. The rainfall runoff needs a way to leave the leveed area. The drainage area for local rainfall is less than 300 acres, and therefore it is assumed that much of the water can evacuate the system prior to peak stages on the Pearl River and its tributaries. There are five possible locations that will require interior gravity drainage structures along the McLeod Club Levee. For the purposes of this study, these structures will be 50 feet long, reinforced concrete pipes with a flap gate closure. The structures will utilize existing ditches, and they will require minor earthwork.

Principal features of the work include mobilizing and demobilizing, clearing and grubbing, removing and stockpiling any existing crushed stone surface, semi compacted levee embankment, traverses, adding new crushed stone surfacing, mowing, turfing, erosion control matting, and preventing storm water pollution. Constructing the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar).

Contractor furnished borrow areas will not be permitted. All borrow areas will be acquired by the NFI as part of its LERRD requirement and furnished by the Government to the contractor. Some small areas could be more appropriate for the construction of a short floodwall, typically an I or T wall, due to space constraints, though further analysis would be required.

Construction of the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar), and the creation of new habitat mitigation areas to offset losses within the project area.

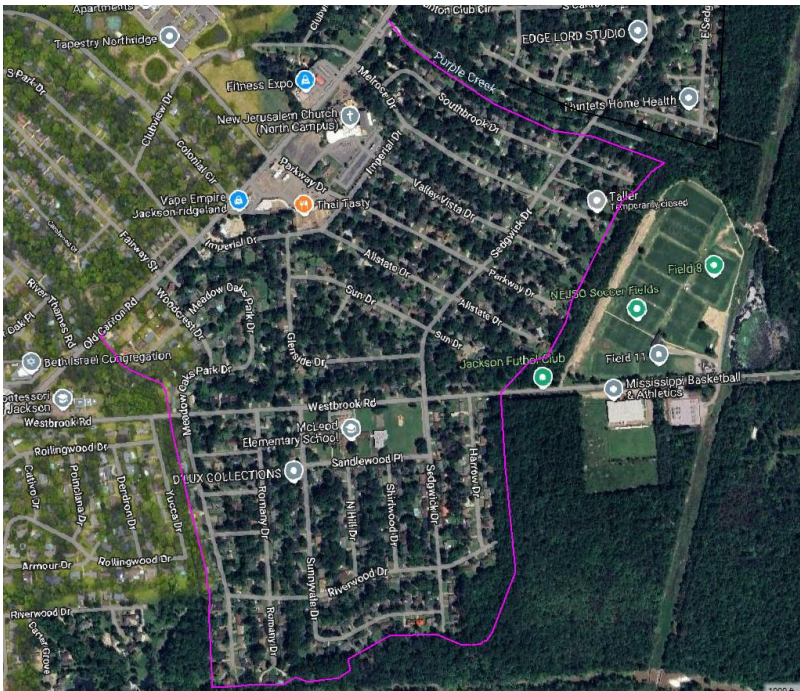


Figure 2-32. Proposed McLeod Club Levee (purple line)

3.37 Canton Club Levee

A levee segment of approximately 1.4 miles is proposed on the west bank of the Pearl River in northeast Jackson. This levee would provide additional flood risk reduction for approximately 100 acres of high density developed neighborhoods. This area is bounded on the north by the North Canton Club Circle and Beechcrest Drive on the South. It is estimated this would reduce flood risk for over 250 homes. The levee will range from natural high ground, to up to 9 feet high. Exact elevation will be set as the with-project 100-year flood event with 90 percent assurance levels in PED.

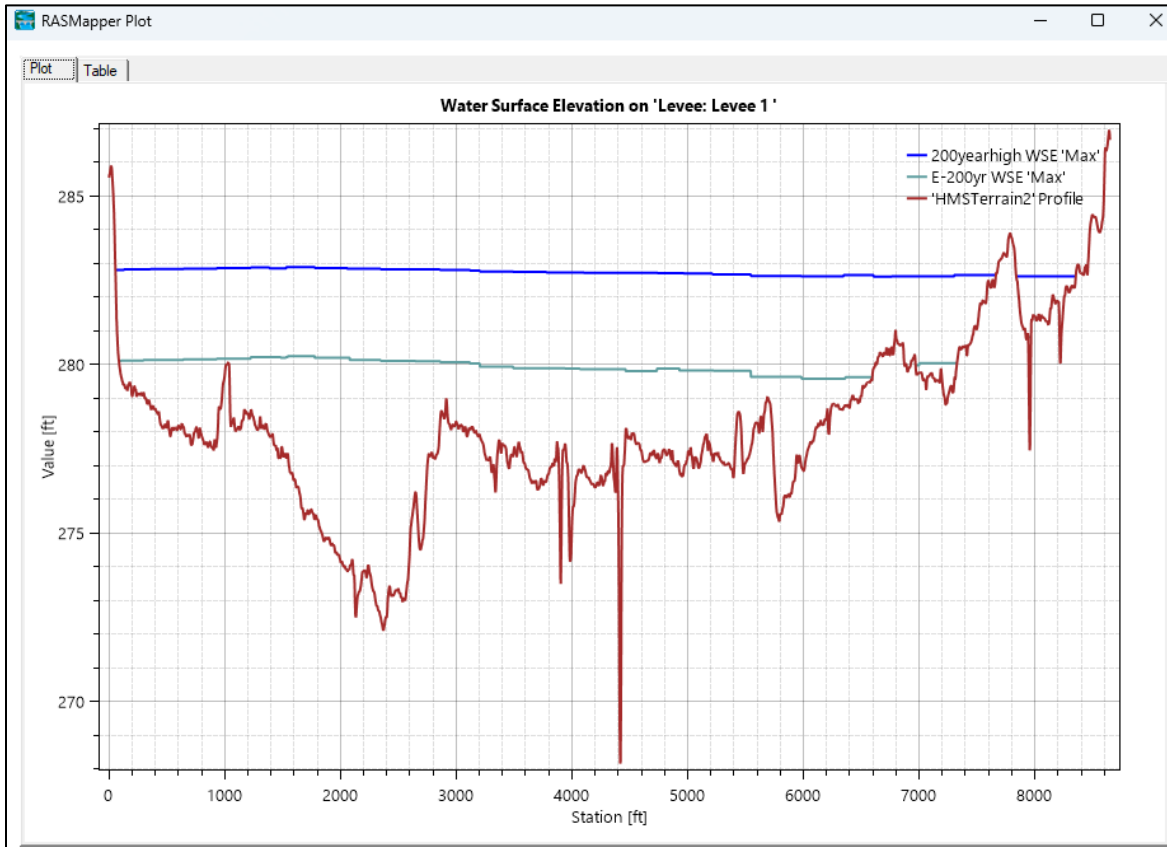


Figure 2-33. Canton Club Levee Location, Existing Terrain, as compared to the 200-year Flood Elevations, with and without channel improvements

Typically, during a flood event on the Pearl River or its tributaries, rainfall also falls behind the levee. The rainfall runoff needs a way to leave the leveed area. The drainage area for local rainfall is less than 200 acres, and therefore it is assumed that much of the water can evacuate the system prior to peak stages on the Pearl River and its tributaries. There are three possible locations that will require interior gravity drainage structures along the Canton Club Levee. For the purposes of this study, these structures will be 100' long, 36" reinforced concrete pipes with a flap gate closure. The structures will utilize existing ditches and will require minor earthwork.

Principal features of the work include mobilizing and demobilizing, clearing and grubbing, removing and stockpiling any existing crushed stone surface, semi compacted levee embankment, traverses, adding new crushed stone surfacing, mowing, turfing, erosion control matting, and preventing storm water pollution. Constructing the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar).

Contractor furnished borrow areas will not be permitted. All borrow areas will be acquired by the NFI as part of its LERRD requirement and furnished by the Government to the contractor. Some small areas could be more appropriate for the construction of a short floodwall, typically an I or T wall, due to space constraints, though further analysis would be required.

Construction of the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar), and the creation of new habitat mitigation areas to offset losses within the project area.



Figure 2-34. Proposed Canton Club Levee (orange line)

3.38 Richland Levee

A levee segment of approximately 1.15 miles is proposed on the east bank of the Pearl River in Richland. This levee would provide additional flood risk reduction for approximately 122 acres of industrial area. This area is bounded on the north by the Old Highway 49 just north of Walker Circle and Old Highway 49 near Wynn Street on the South. It is estimated this would reduce flood risk for 40 structures, mostly industrial. The levee will range from natural high ground, to up to 9 feet high. Exact elevations will be set as the with-project 100-year flood event with 90 percent assurance levels in PED.

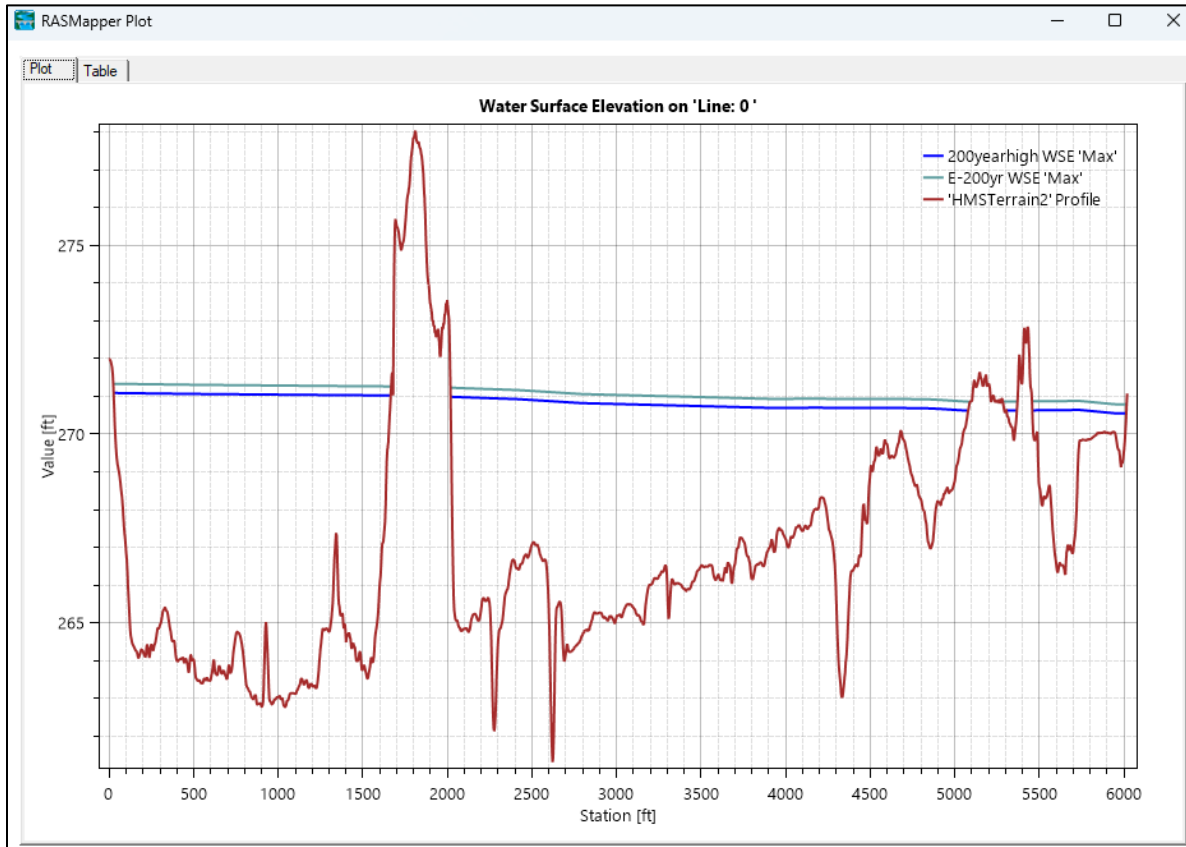


Figure 2-35. Richland Levee Location, Existing Terrain, as compared to the 200-year Flood Elevations, with and without channel improvements

Typically, during a flood event on the Pearl River or its tributaries, rainfall also falls behind the levee. The rainfall runoff needs a way to leave the leveed area. The drainage area for local rainfall is less than 175 acres, and therefore it is assumed that much of the water can evacuate the system prior to peak stages on the Pearl River and its tributaries. There are six possible locations that will require interior gravity drainage structures along the Richland Levee. For the purposes of this study, these structures will be 50 foot long, reinforced concrete pipes with a flap gate closure. The structures will utilize existing ditches and will require minor earthwork.

Principal features of the work include mobilizing and demobilizing, clearing and grubbing, removing and stockpiling any existing crushed stone surface, semi compacted levee embankment, traverses, adding new crushed stone surfacing, mowing, turfing, erosion control matting, and preventing storm water pollution. Constructing the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar).

Contractor furnished borrow areas will not be permitted. All borrow areas will be acquired by the NFI as part of its LERRD requirement and furnished by the Government to the contractor. Some small areas could be more appropriate for the construction of a short floodwall, typically an I or T wall, due to space constraints, though further analysis would be required.

Construction of the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar), and the creation of new habitat mitigation areas to offset losses within the project area.



Figure 2-36. Proposed Richland Levee (Purple line)

3.39 Cany Creek Levee

A levee segment of up to 1.0 miles is proposed on the west bank of the Pearl River in south Jackson. It is likely that 1250 feet of this extent is limited in flow capacity due to the existence of Interstate 55, and therefore the levee would only be approximately 0.75 miles long. This levee would provide additional flood risk reduction for approximately 137 acres of residential area. This area is bounded on the upstream end of Cany Creek near Terry Road and extends downstream to Interstate 55. It is estimated this would reduce flood risk for 40 homes. The levee will range from natural high ground, to up to 9 feet high. Exact elevations will be set as the with-project 100-year flood event with 90 percent assurance levels in PED.



Figure 2-37. Caney Creek Levee Location, Existing Terrain, as compared to the 200-year Flood Elevations, with and without channel improvements

Typically, during a flood event on the Pearl River or its tributaries, rainfall also falls behind the levee. The rainfall runoff needs a way to leave the leveed area. The drainage area for local rainfall is less than 500 acres, and therefore it is assumed that much of the water can evacuate the system prior to peak stages on the Pearl River and its tributaries. There are five possible locations that will require interior gravity drainage structures along the Caney Creek Levee. For the purposes of this study, these structures will be 50 long, reinforced concrete pipes with a flap gate closure. The structures will utilize existing ditches, and they will require minor earthwork.

Principal features of the work include mobilizing and demobilizing, clearing and grubbing, removing and stockpiling any existing crushed stone surface, semi compacted levee embankment, traverses, adding new crushed stone surfacing, mowing, turfing, erosion control matting, and preventing storm water pollution. Constructing the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar).

Contractor furnished borrow areas will not be permitted. All borrow areas will be acquired by the NFI as part of its LERRD requirement and furnished by the Government to the contractor. Some small areas could be more appropriate for the construction of a short floodwall, typically an I or T wall, due to space constraints, though further analysis would be required.

Construction of the project will require relocations and/or improvements to various utilities and infrastructure (e.g. existing roadways or similar), and the creation of new habitat mitigation areas to offset losses within the project area.

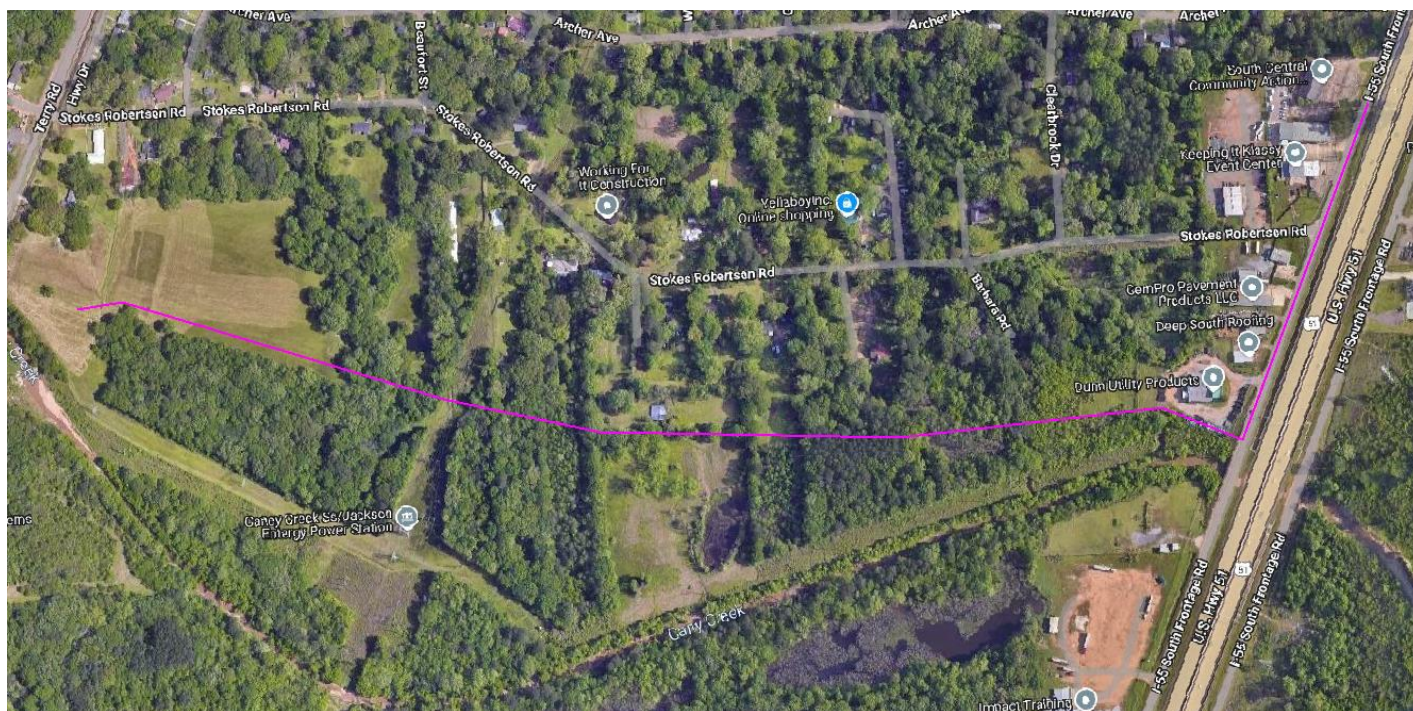


Figure 2-38. Proposed Caney Creek Levee (Purple line)

3.40 Borrow Plan (All Levees)

A borrow plan has not been developed at this stage of the analysis. It is conceivable that there is enough borrow material from the material excavated but it is unknown at this time if the material is suitable for constructing levees. Should the excavated material be determined to be unsuitable, borrow material would need to be identified for construction of any levees. There is potential borrow sources within proximity of the project area (10-mile radius). Borrow opportunities would be further investigated during PED and a supplemental NEPA document would be prepared at that time.

Section 4

Statistical Analyses

4.1 STATISTICAL MODELING

USACE used the Hydrologic Engineering Center Statistical Software Package (HEC-SSP) version 2.3 to update the flow frequencies to Bulletin 17C at key gaged locations within the Basin. HEC-SSP includes tools to perform annual peak flow frequency analyses, volume frequency analyses, duration analyses as well as produce balanced hydrographs.

The USACE developed peak flow frequencies and scaled discharge hydrographs discussed in this section are used as input to the hydraulic modeling at the Ross Barnett Outflow into the Pearl River. The hydrologic model discussed was used to develop incremental local flows within the project area and are also included within the project area.

4.2 PEARL RIVER GAGE

The Pearl River at Jackson is the longest dataset within the project area, with data available on the USGS gage site from 1874 to 2022. 1874 to 1900 are peak measurements, and 1901 to present are gage recordings. The peak annual flow data is shown below (Figure E3-1).

USACE selected a perception threshold of 60,000 cfs as the likely level of event below which a measurement would have not been recorded.

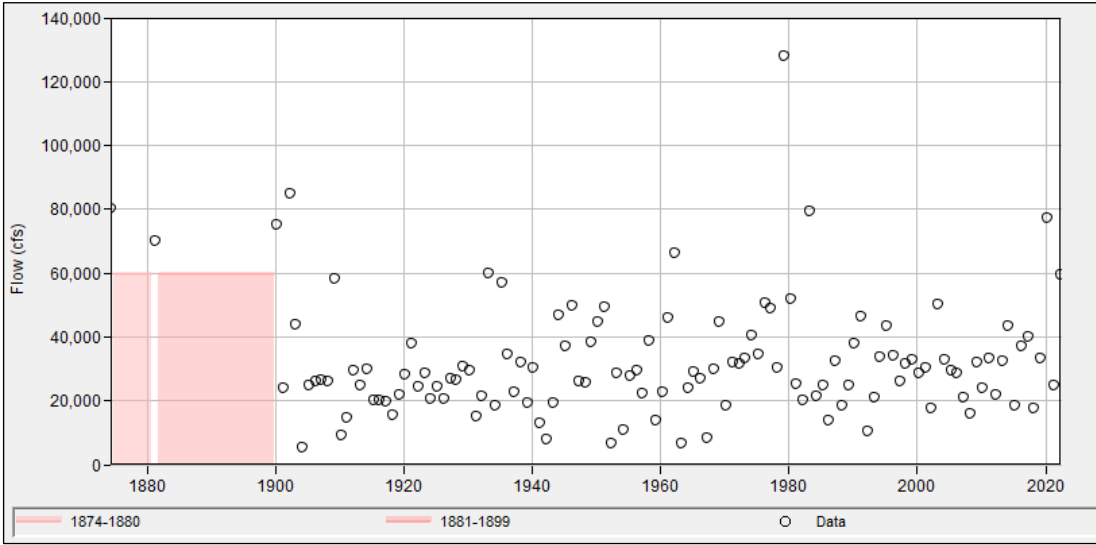


Figure E3-1. Annual Peak Flows at the Pearl River at Jackson Gage

4.3 Flow Frequency

A Bulletin 17C flow frequency was completed on full period of record observed data using HEC-SSP (1874-2022). This modeling effort does not account for regulation at the Ross Barnett reservoir. Discussion with the project NFI, the local National Weather Service (NWS), and USGS officials confirmed continued historical operations at the Ross Barnett Reservoir. This assumption is consistent with the NFI study. Table E3-1 lists the peak annual flow frequency results for the Pearl River at Jackson Gage. Figure E3-2 shows the peak flow relationship at the Jackson Gage.

Table E3-1. Peak Annual Flow Frequency Results for the Pearl River at Jackson Gage

Percent Chance Exceedance	Computed Flow in CFS	Variance Log (EMA)	0.1 Confidence Limit (CFS)	0.9 Confidence Limit (CFS)
0.1	147000	0.0089	215000	118000
0.2	129000	0.0067	179000	106000
0.5	108000	0.0044	140000	91900
1.0	93500	0.0030	115000	81500
2.0	80100	0.0020	94300	71400
4.0	67700	0.0013	76600	61600
10.0	52700	0.0007	57300	48900
20.0	42000	0.0005	45000	39400
50.0	28000	0.0004	29700	26400
80.0	19200	0.0004	20300	18000
90.0	16000	0.0007	17100	14500
95.0	13800	0.0012	15000	12100

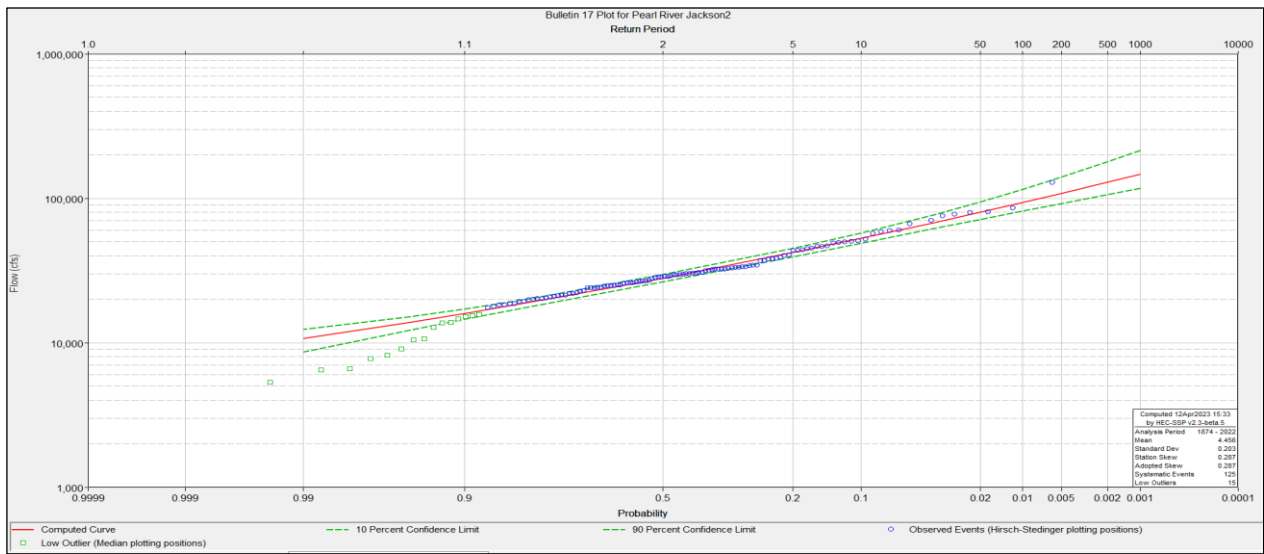


Figure E3-2. Peak Flow-Frequency Relationship at the Pearl River at Jackson Gage

4.4 ROSS BARNETT RELEASES

HEC-SSP analysis were developed with period of record data (1874 to 1978-local, and 1979 to 2022-at site) to update the flow frequency values. The 1979 and 1983 discharge values were corrected within the period of record data.

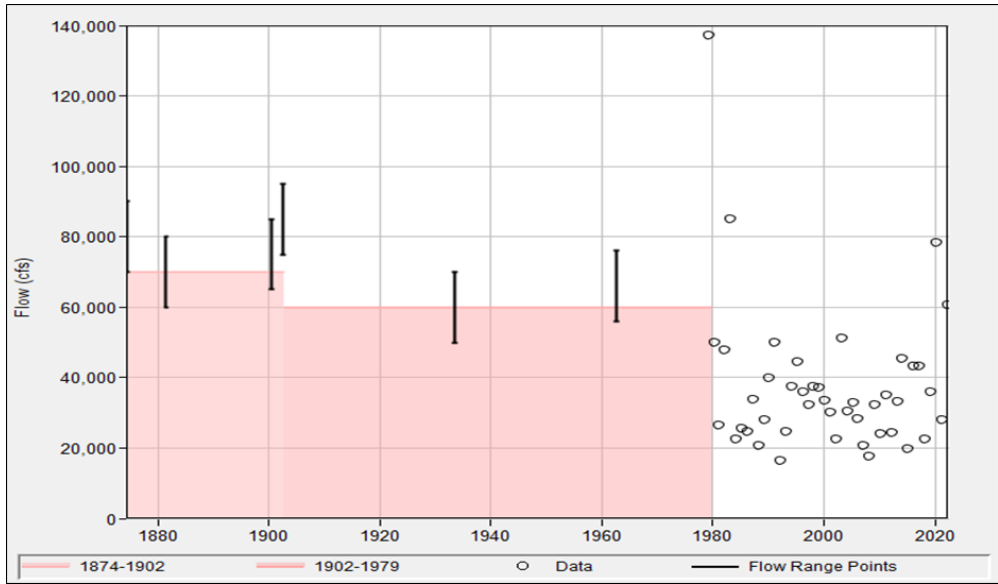


Figure E3-3. Annual Peak Flows at the Pearl River at Ross Barnett Reservoir

4.5 Flow Frequency

USACE completed Bulletin 17C flow frequency on full period of record existing data using HEC-SSP. The period of record was supplemented with data from the downstream Jackson gage, using the same assumptions on perception thresholds. USACE added a 10,000 cfs. range for the major historical flood events, as the impact of attenuation and local tributary inflows vary due to the shape of each individual storm pattern. This modeling effort does not account for any regulation that the Ross Barnett reservoir and simply utilizes the reservoir output datasets. The Ross Barnett reservoir generally acts as run-of-river but does somewhat limit peak flows. Discussion with the project NFI, the local National Weather Service (NWS), and USGS officials confirmed continued historical Ross Barnett Reservoir Operation. This assumption is consistent with the NFI study. An additional sensitivity for flow releases is discussed in the section 3.3.2. Reference Table E3-2 for a list of the Pearl River at Ross Barnett Reservoir gage flow frequency relationship and Figure E3-4.

Table E3-2. Pearl River at Ross Barnett Reservoir Gage Flow Frequency Relationship

Percent Chance Exceedance	Computed Flow in CFS	Variance Log (EMA)	0.1 Confidence Limit (CFS)	0.9 Confidence Limit (CFS)
0.1	155000	0.0115	353000	117000
0.2	135000	0.0084	264000	106000
0.5	111000	0.0052	181000	91200
1.0	95700	0.0034	138000	80900
2.0	81800	0.0021	106000	71000
4.0	69300	0.0013	82300	61400
10.0	54500	0.0008	60800	49000
20.0	44400	0.0007	48700	39700
50.0	31500	0.0006	34400	28300
80.0	23800	0.0005	25900	21800
90.0	21000	0.0006	22800	18800
95.0	19100	0.0009	21300	16800

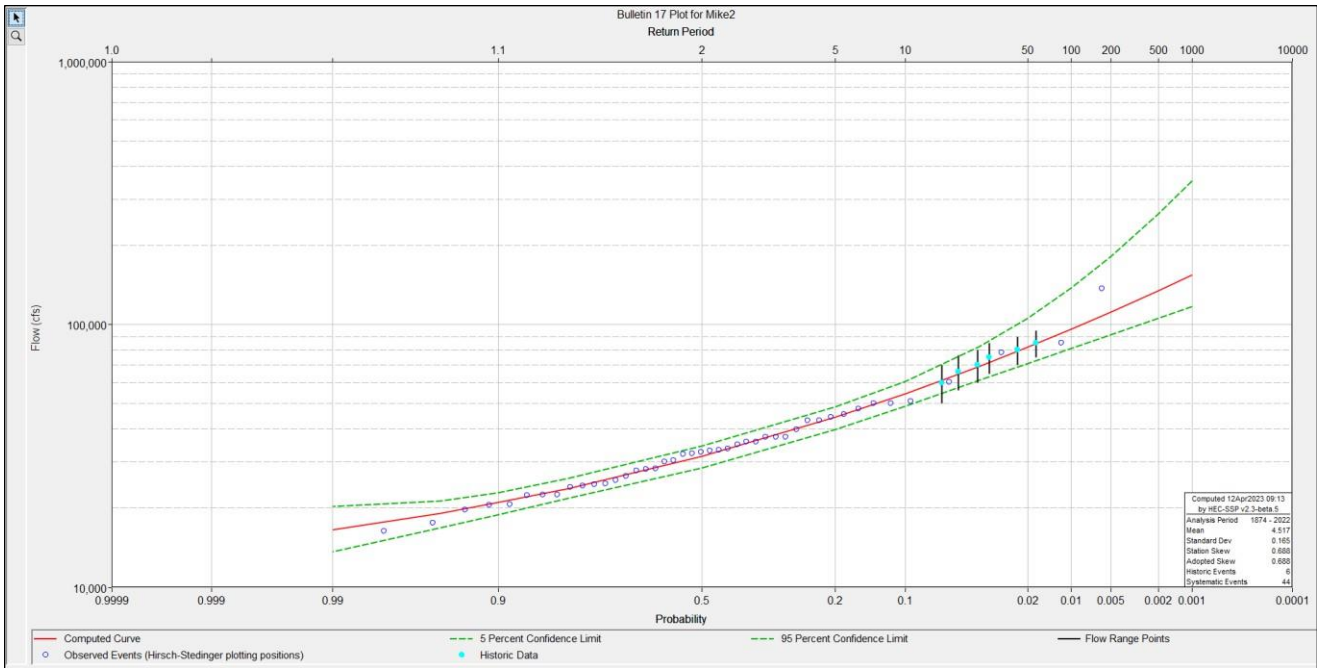


Figure E3-4. Peak Flow-Frequency Relationship at the Pearl River at the Ross Barnett Reservoir

4.6 Ross Barnett Releases Sensitivity/Updates

USACE completed a Bulletin 17C flow frequency sensitivity on the full period of record of observed data using HEC-SSP. This sensitivity uses the data in section 3.3.1 but assumes that the Ross Barnett at some point in the future may not be able to operate as it currently does for inflows over 75,000 CFS (Table E3-3). Therefore, the 1979, 1983, and 2020 events are set as historical events with flow-interval ranges ranging up to the reported inflow value. The SSP model would select the geometric mean of these two bounding parameters, for an estimate that is removing roughly half of the regulating capacity.

**Table E3-3. Pearl River at Jackson, MS Gage Flow Frequency
Relationship with Adjustment over 75,000 cfs**

Percent Chance Exceedance	Computed Flow in CFS	Variance Log (EMA)	0.1 Confidence Limit (CFS)	0.9 Confidence Limit (CFS)
0.1	163000	0.0129	394000	122000
0.2	141000	0.0094	294000	109000
0.5	115000	0.0058	196000	93600
1.0	98400	0.0038	146000	82600
2.0	83500	0.0023	110000	72100
4.0	70300	0.0014	84200	62100
10.0	54800	0.0008	61400	49100
20.0	44400	0.0007	48800	39500
50.0	31300	0.00066	34300	28100
80.0	23600	0.00048	25800	21700
90.0	20900	0.00058	22700	18800
95.0	19200	0.00096	21400	16900

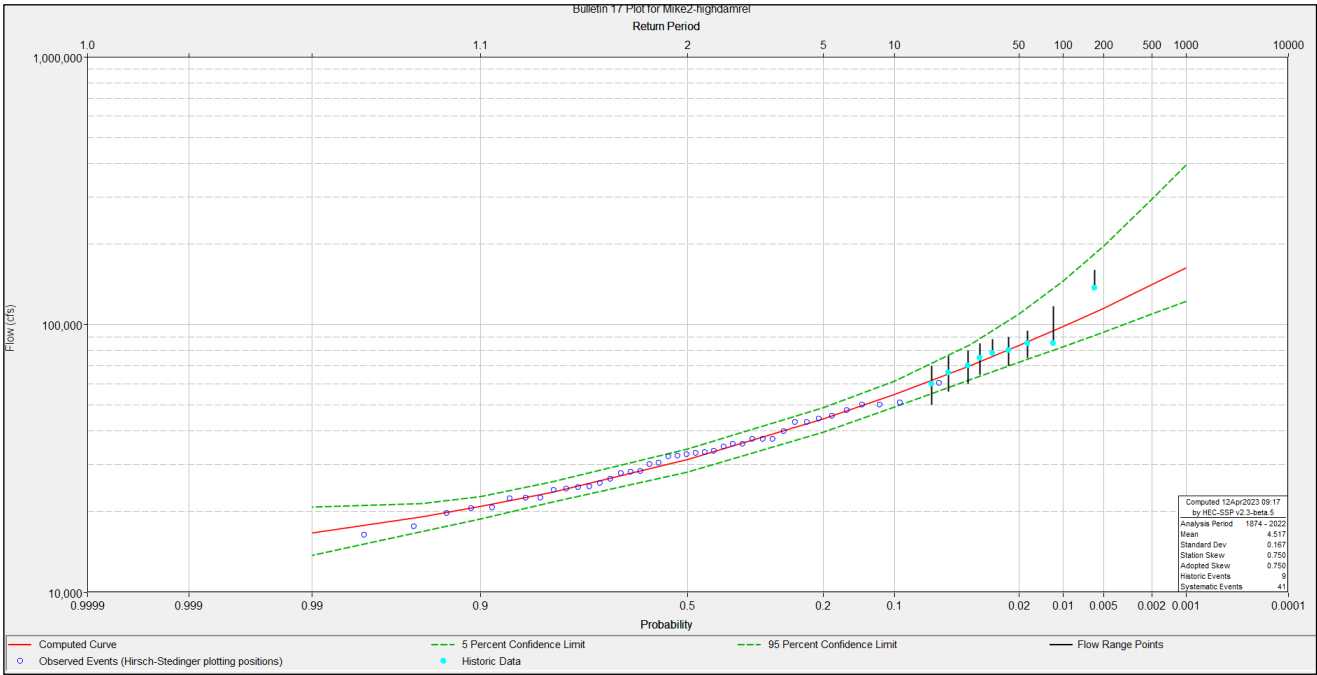


Figure E3-5. Peak Flow-Frequency Relationship at the Pearl River at the Ross Barnett Reservoir with Adjustments to the Ross Barnett High Flow Release

4.7 COMPARISON TO PREVIOUS NFI FREQUENCY DATASET

Table E3-4 presents the differences in NFI and current Flow datasets. NFI data incorporated a single flow value throughout the study reach, which is compared to the input at the upstream of the project boundary.

Table E3-4. Comparison of Updated Values to NFI Dataset

Frequency- Return Interval	NFI Reported Flow- CFS, Data Though 1988	Updated Flow- Ross Barnett Operation as Current	Updated Flow-Ross Barnett Operation Reduced by Half Current
100-Year	106,000	93,800	97,200
200-Year	125,000	108,400	113,300
500-Year	148,000	130,000	137,600
1,000-Year	N/A	148,400	158,600

4.8 HYDROGRAPH PATTERNS FOR ROSS BARNETT INFLOWS

Due to the limited time available to complete the existing condition scenarios and the nature of the data available for the Ross Barnett inflows, balanced hydrographs at this location from a previous study were not completed for use within the Hydrologic Engineering Center's River Analysis Software (HEC-RAS) modeling effort. Instead, USACE considered a series of three observed hydrograph shapes to represent the Ross Barnett Dam inflows. Hydrograph patterns were from the 1979, 2020, and the 2022 flood events and a balanced flood hydrographs completed in a pervious study downstream of the Pearl River at Jackson gage were considered for template patterns.

The 1979 event was initially considered as a pattern but later dismissed because, although it was the highest event, it likely does not represent current condition reservoir release operations occurring with more modern forecasting technology and current water conditions and channel geometry. USACE removed the 2022 event hydrograph from the study as well because it is the lowest of the events considered. Both the past study balanced hydrographs at the Jackson gage and the 2020 flood event was considered reasonable. However, USACE adopted the 2020 hydrograph pattern to represent inflows because the balanced flood hydrograph from the previous study already accounted for the flood attenuation occurring between the dam and the Highway 80 gage. The peak of the 2020 event hydrograph was scaled to match the peaks for the frequency events determined from the statistical flow frequency analysis. These scaled 2020 pattern frequency hydrographs were used as input into the hydraulic model.

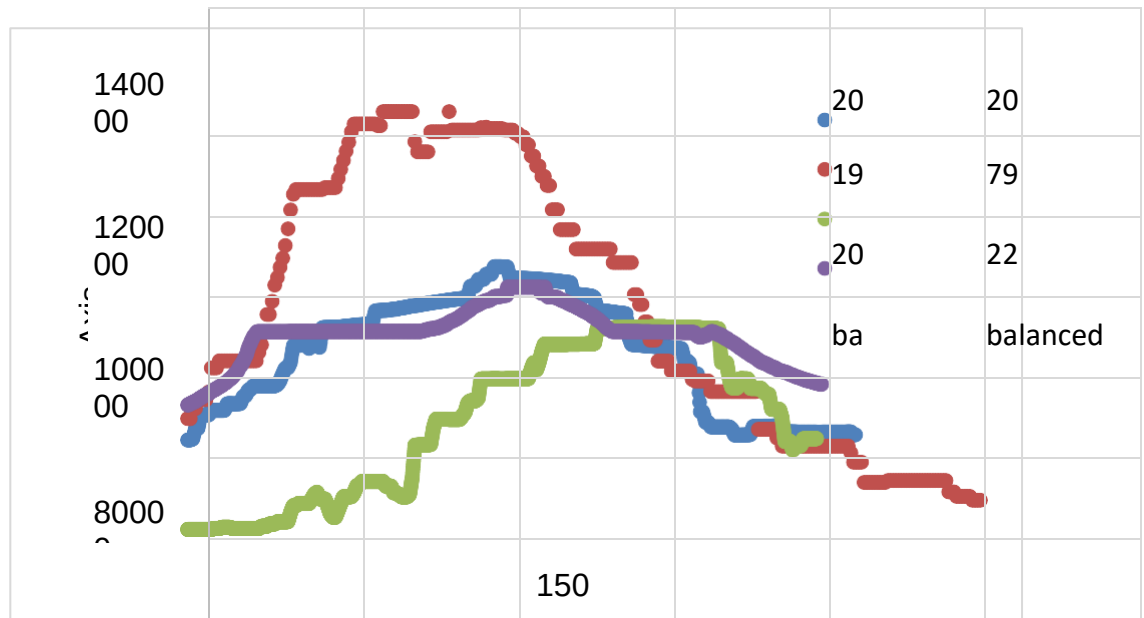


Figure E3-6. Sample Hydrographs at the Ross Barnett (flow vs time (hrs))

4.9 LOCAL TRIBUTARIES

Table E3-5 lists the mainstem and tributary gages within the Pearl River project area. The initial intent was to use both stage and flow hydrographs where available, in addition to supplemental flow/stage annual peaks. However, it was determined through the calibration process that the local drainage gages of concern are all backwater influenced at high Pearl River stages.

Figure E3-7 shows an example plot illustrating this backwater influence for the Hanging Moss, Lynch Creek, and Pearl River at Jackson Gages. The Lynch Creek enters the Pearl River just downstream of the Pearl River at Jackson Gage, and the Hanging Moss enters the Pearl River well upstream of the Pearl River at Jackson Gage. Figure E3-7 shows that even without accounting for slope, the Pearl River backwater leaves a signature on upstream tributary gages. This backwater signature is seen in six of the observed hydrographs at the Hanging Moss Creek gage and two times at the Lynch Creek gage between October 2019 and May 2020. USGS verified that the ratings used to calculate flow have known issues when stages on the Pearl River are high. Therefore, flow was not considered in the calibration of the tributaries but completed in the hydraulic model with reference to observed stages. This was an iterative process that involved changing parameters in the hydrologic model to adjust flow and then adding the adjusted flows to the hydraulic model to see the impact on stages.

Table E3-5. Gage Data Available in Local Tributaries

Gage Stream	Identifier	Drainage Area	Used?
Belhaven Creek	Laurel Street	Unknown	No
Belhaven creek	River Side Drive	Unknown	No
Cany Creek	Jackson, MS	8.38	Yes
Eubanks Creek	Eagle Avenue	4.11	No
Eubanks Creek	Jackson, MS	5.2	Yes
Hanging Moss Creek	Jackson, MS	16.8	Yes
Lynch Creek	Jackson, MS	12.1	Yes
Pearl River	HWY 25 at Jackson, MS	3,130	Yes
Pearl River	Jackson, MS (HWY 80)	3,171	Yes
Purple Creek	Jackson, MS	6.12	Yes
Ross Barnett Reservoir	Jackson, MS	3,050	No
Town Creek	Jackson, MS	11.4	Yes
White Oak	Westbrook Road at Jackson, MS	8.21	Yes

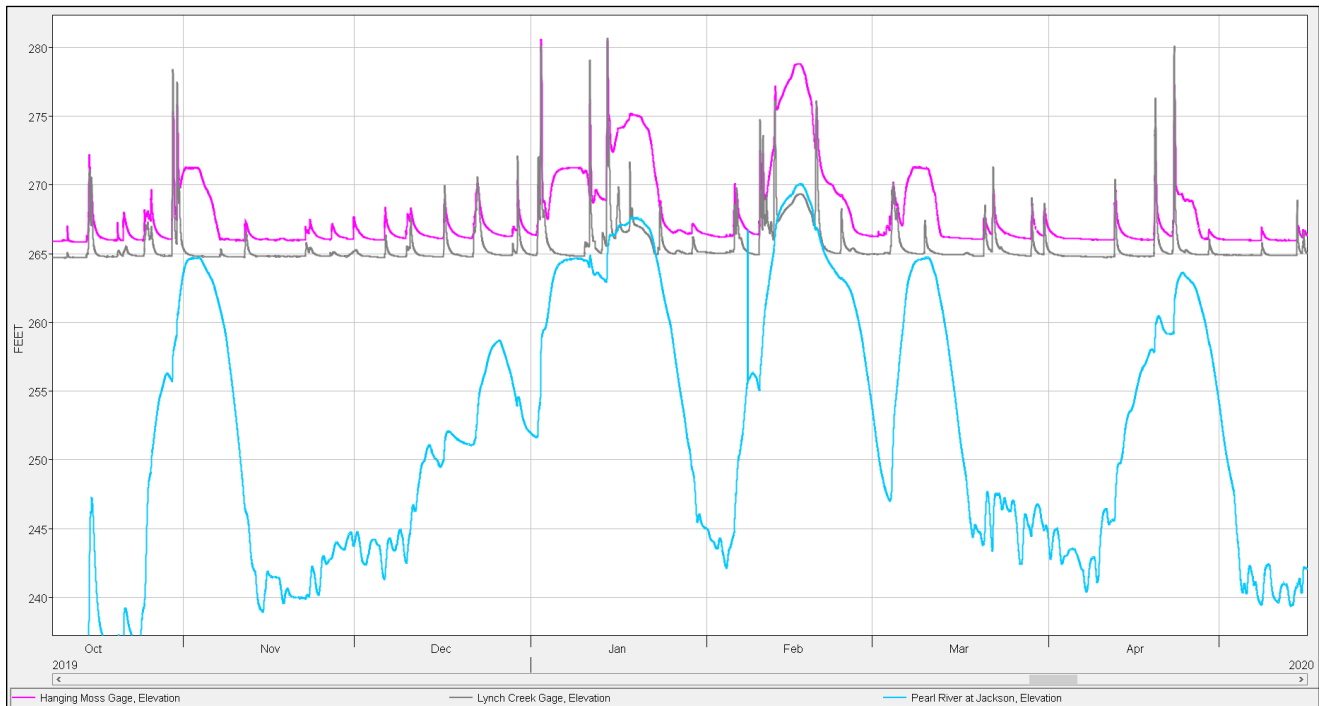


Figure E3-7 Local Rainfall vs Peak River Stage

4.10 Status of Selected Local Tributaries

As of the writing of this report, many of the local tributaries experience frequent flash flooding, and the hydraulic and hydrologic modeling discussed later in this report show significant damages in these areas.

USACE completed a quick analysis of this discrepancy to validate the results. This analysis focused on Town and Lynch creeks. While the study values are higher than the published Federal Emergency Management Agency (FEMA) frequency datasets, the FEMA datasets are dated (some dating back to the 1970's), there has been increased urbanization allowing for faster runoff. The Hydraulic and Hydrologic models are also calibrated low for stage to observed events, though to lower flows within the tributaries, and without consideration to observed data. Both streams have experienced a lack of maintenance as shown in the image below. Further there are multiple news articles referenced that note frequent flooding at more common events than were historically experienced.

The City of Jackson, as well as Hinds, Madison, and Rankin Counties have planned activities to enact various flood risk management/ channel cleanout activities. Most of this work is in planning or design phase and will need to be incorporated into this study modeling efforts, after construction of these projects.

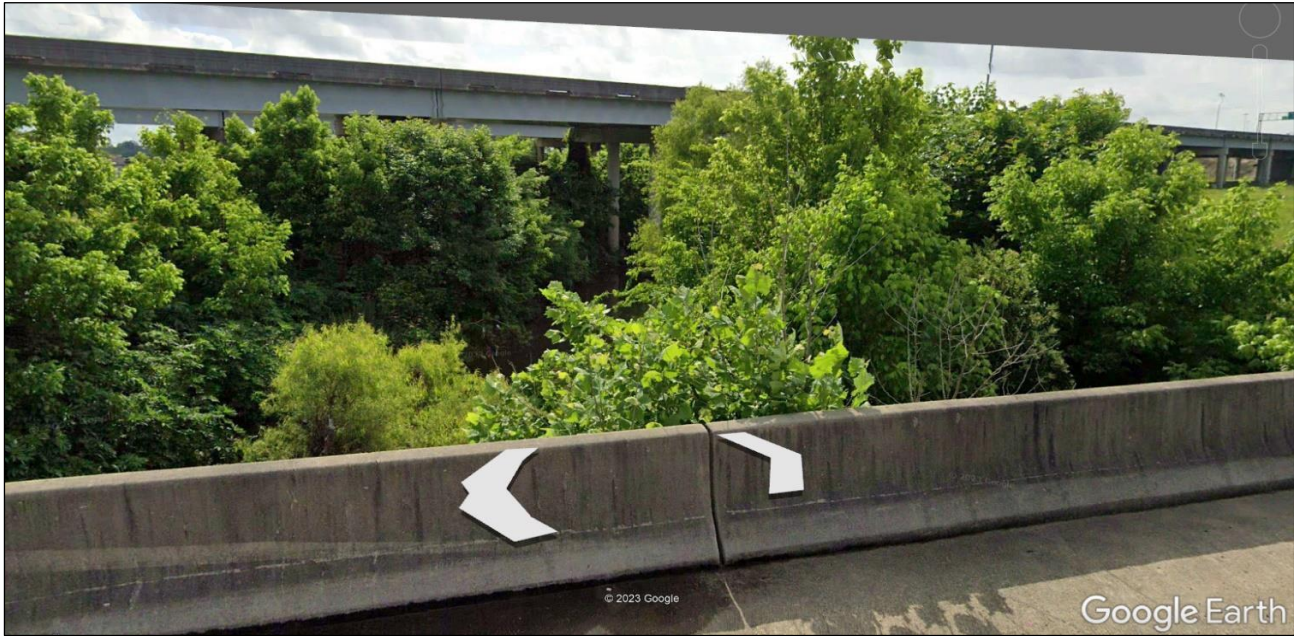


Figure E3-8 Lynch Creek Looking Toward 1-20 from Valley Street



Figure E3-9 Town Creek at an Abandoned Road/Bridge Just Upstream of State Street, Looking Downstream at State Street

Table E3-6. News Articles Describing Local Tributary Flooding

https://www.jacksonfreepress.com/news/2013/sep/18/revisited-town-creek/
https://www.wlbt.com/story/31870644/homeowners-fed-up-with-town-creek-flooding/
https://mississippitoday.org/wp-content/uploads/2022/09/Capital-Infrastructure-Plan.pdf
https://www.wapt.com/article/flash-flooding-alerts-in-place-as-heavy-rain-continues/40978596
https://www.wlbt.com/2020/01/29/coolers-tires-flooding-leaves-behind-piles-trash-along-local-waterways/
https://www.wapt.com/article/residents-cope-with-flooding-on-westbrook-road/30589660
https://www.northsidesun.com/hanging-moss-creek-floods-near-jackson-academy
https://www.wjtv.com/news/local-news/flooding-along-old-canton-road-appears-maintenance-related/
https://www.wlbt.com/story/35061739/several-richland-businesses-along-highway-49-dealing-with-flood- water/
https://www.clarionledger.com/story/news/local/2017/04/06/jackson-woman-my-house-flooded-due-citys- poor-maintenance/99995150/
https://www.wjtv.com/news/richland-avenue-flooding-in-pearl/

4.11 COINCIDENT FREQUENCY MODELING

Due to the time limitations of this effort and with consultation with USACE leads, it was determined to be conservative to assume full coincidence with a three-day lag. This coincidence and timing pattern were observed in the case of the catastrophic 1979 flood event.

To adequately size interior drainage structures through selected alternatives if alternatives are available to continue this effort, it is recommended that a Watershed Analysis Tool (WAT) model be developed to combine meteorological inputs, Hydrologic Modeling System (HMS) rainfall-runoff calculations, and Reservoir Simulation Software (HEC-ResSim) reservoir operations and routing later in the project. It is recommended this modeling of interior drainage be developed in later phases of design.

A coincident frequency analysis considering the timing of peak flows between the tributaries and the Pearl River mainstem was started but not completed due to time constraints. Full coincidence was assumed in later modeling. To validate this a correlation analysis was completed for local precipitation (flow/stage in tributaries could not be used due to the backwater issues noted above), the analysis was completed by event and by time. Both analyses reported results below the limit used by USACE standards to indicate coincidence.

4.12 SELECTED DATA TO BE INCORPORATED IN THE HEC-RAS MODELING EFFORT

Two scenarios are available for the HEC-RAS modeling effort. For the first, full coincidence was assumed as a conservative estimate for this modeling effort, with the HMS model incorporating the full frequency rainfall for tributary flows matching the frequency peak outflow for the Ross Barnett Reservoir, as determined by the SSP model. The peak flow was routed through the system using a scaled February 2022 event hydrograph shape. The frequency scenario with the reduced flood protection from the Ross Barnett was used as final. This was considered a conservative option, as although the Ross Barnett does participate in flood reduction, it is not required to operate to any specific standard.

Additionally, a more likely tributary flow scenario was chosen. This scenario routes flow from the Ross Barnett Reservoir in the same manner as the first scenario. The tributary flows from the 2020 event used as pattern inflows for the tributaries in addition to the Ross Barnett Reservoir outflows. These were then ratioed by the same factor as the factor used to ratio the flows out of the Ross Barnett Reservoir, to capture relative differences, without a direct probability assignment to the tributaries.

Section 5

Hydrologic Analyses

5.1 HEC-HMS MODEL CONSTRUCTION

A HEC-HMS version 4.10 (HEC, July 2022) model was developed to model the incremental local flows downstream of the Ross Barnett dam. HEC-HMS stimulates the rainfall-runoff process in a watershed, and includes many traditional hydrologic analysis processes, such as infiltration, baseflow contribution, and hydrologic routing. Advanced capabilities are also provided for gridded runoff simulation using the ModClark methodology.

The HEC-HMS model was calibrated to four events. Selected calibration events included the April 2017, January 2020, February 2020, and August 2022 events.

The study HMS model was built for this study. An existing model was available for the area but was too coarse spatially to be of use (one subbasin per study area of interest). Steps included to develop the initial HEC-HMS model included:

- Determining that the HEC-HMS model extents to be the Hydrologic Unit Code (HUC) for Pearl River at Jackson and the two downstream HUCS. The HEC-HMS model was extended further downstream to allow for better downstream consequence analysis if needed, at a later phase of this study.
- Using tools within the HEC-HMS model to create an initial basin layout.
- Importing key gage locations and features in alternatives B and C as subbasin breaks.
- Making corrections via Geographic Information Software (GIS) where terrain issues routed water incorrectly (bridges/culverts/outlet structures/etc. that were not represented within the terrain)
- Simplified the original basin delineation by combining as many basins/reaches as was reasonable for the purpose of the project.
- Initial routing, loss, and baseflow estimation.

The following sections describe the estimation of initial and calibrated basin parameters. All initial and final model parameters are submitted with this report in an Excel document labeled Appendix E.2.

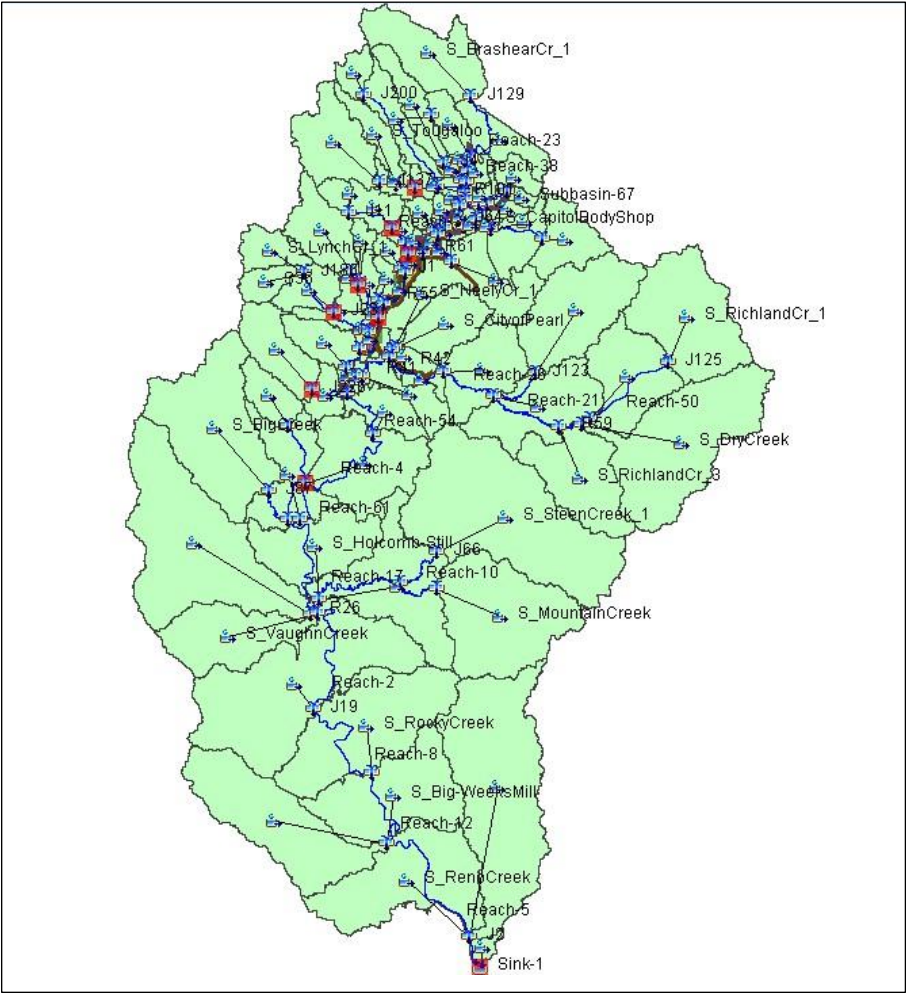


Figure E 4-1. HEC-HMS Basin Layout

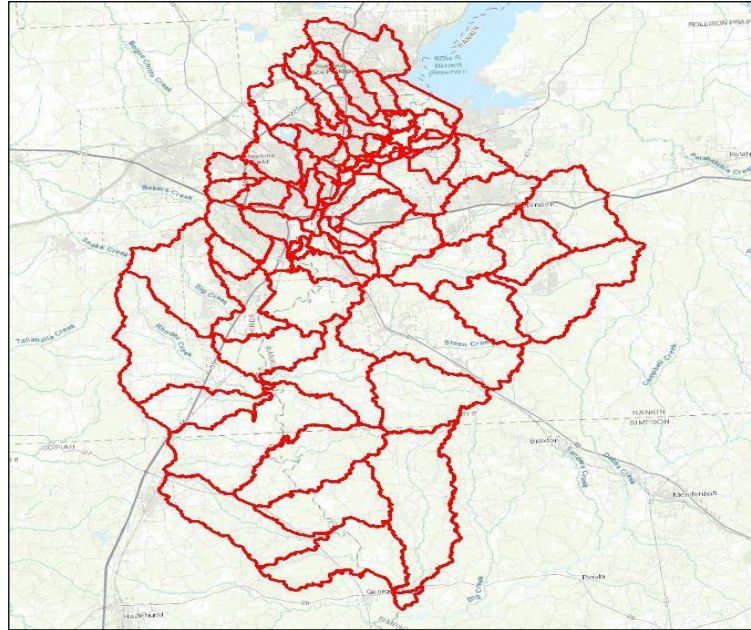


Figure E4-2. HEC-HMS Basin Layout with Background Map

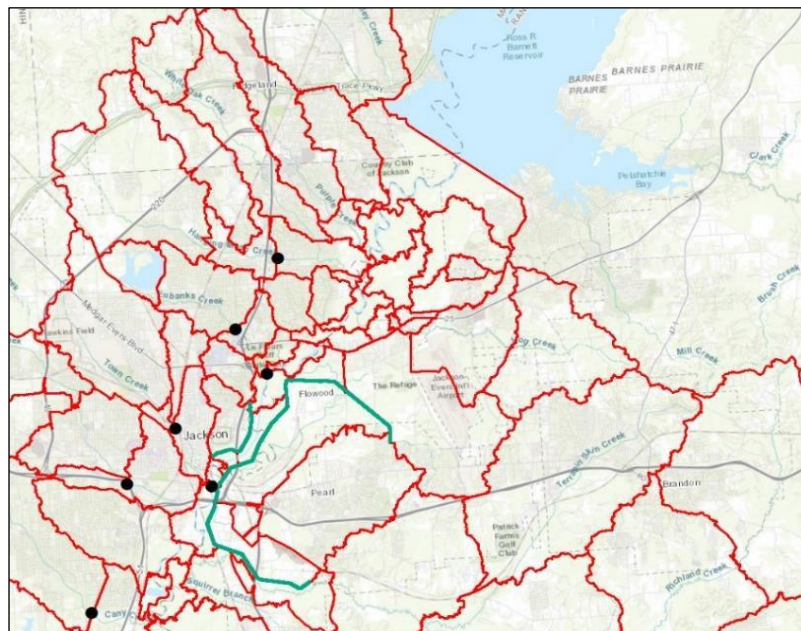


Figure E4-3. HEC-HMS Basin Layout with Background Map at Study Area

Table E4-1. Listing of HMS Subbasins with Drainage Areas

Subbasin Name	Area (MI2)	Subbasin Name	Area (MI2)
Subbasin-1	1.3139	S_Pearl_HogCreek	0.99059
S_BigCreek	26.85	S_Pearl_Hwy25	0.7645
S_Big-WeeksMill	21.083	S_Pearl_HWY80	0.23581
S_BrashearCr_1	12.994	S_Pearl_I55	0.96278
S_BrushyCreek	23.908	S_Pearl_PrairieBranch	0.58603
S_CaneyCreek_2	3.033	S_Pearl_Purple	1.6932
S_CanyCreek_1	8.5408	S_PrairieBranch_1	9.4389
S_CapitolBodyShop	0.23585	S_PrairieBranch_2	0.7813
S_ChristwayChurch	2.859	S_PurpleCreek_1	6.1148
S_CityofPearl	8.4798	S_PurpleCreek_2	0.7878
S_DryCreek	29.601	S_RenoCreek	23.437
S_EubanksCr_1	1.7129	S_RhodesCreek	37.116
S_EubanksCr_2	3.8206	S_RichlandCr_1	20.975
S_EubanksCr_3	1.2694	S_RichlandCr_2	13.713
S_EubanksCr_4	0.64261	S_RichlandCr_3	14.736
S_Fairgrounds	1.5873	S_RichlandCr_4	14.932
S_FlowoodYMCA	1.5456	S_RichlandCr_5	11.384
S_GallatinStDump	1.2697	S_RichlandCr_6	2.0173
S_Haley-Chestnut-Bear	37.595	S_RichlandCr_7	4.0709
S_HangingMossSouth	0.16996	S_RiverRoadN	0.1444
S_HangingMoss_1	11.24	S_RockyCreek	26.633
S_HangingMoss_2	1.8912	S_RossBarnett	6.1657

S_HangingMoss_3	2.2186	S_SavannaStWWTP	0.4843
S_HardyCreek	5.6221	S_SPearOrchardRd	3.4262
S_HogCreek_1	7.3102	S_SteenCreek_1	42.204
S_HogCreek_3	0.29562	S_SteenCreek_2	20.671
S_HogCreek_4	0.41722	S_TerrapinSkinCr	18.005
S_HogCreek2	4.9705	S_TheVault	1.5586
S_Holcomb-Still	14.046	S_Tougaloo	4.1197
S_Howard-Steamboat-Hawkins	16.799	S_TownCr_1	8.3137
S_JacksonHewitt	0.4858	S_TownCr_2	0.33194
S_LimestoneCreek	37.909	S_TownCr_3	2.0979
S_LynchCr_1	4.5075	S_TrahonCreek	4.7718
S_LynchCr_2	4.5603	S_Trahon-Big	12.19
S_LynchCr_3	3.6818	S_TwinLakeA	1.1689
S_MountainCreek	25.39	S_TwinLakeB	1.4737
S_NeelyCr_1	5.8296	S_UMMC	1.3031
S_NeelyCr_2	2.3688	S_VaughnCreek	14.36
S_Pearl-CanyCr	5.9005	S_WestsidePark	3.1609
S_Pearl-RichlandCr	0.88588	S_WhiteOakCr_1	2.6847
S_Pearl_EubanksCr	0.72277	S_WhiteOakCr_2	5.6652
S_Pearl_HangingMoss	1.5052		

5.2Initial Values for Subbasins

Key basin parameters were calculated via the HMS GIS parameter toolbox including size, centroid, grid cells, flow paths, and slopes.

5.3Initial Values for Loss Rates (Deficit and Constant Method)

Initial loss values were generic assumptions based off HEC-HMS tutorial suggestions. Impervious grids were downloaded from National Land Cover Database (NLCD)-2019 edition and processed to estimate the percent imperviousness of the subbasins.

Gridded Soil Survey Geographic (gSSURGO) data were downloaded and joined by soil type. These were indexed against the soil type table (Table E4-2) documented in the HMS training tool (<https://www.hec.usace.army.mil/confluence/hmsdocs/hmsguides/applying-loss-methods-within-hec-hms/applying-the-initial-and-constant-loss-method>). The resulting raster dataset was processed to produce basin-average loss vales for the subbasins. H&H and a GIS team member created the raster data set which provided the subbasin averaged values for the constant loss rate. (USDA 2020)

Table E4-2. Soil Texture and Conductivity (USDA 2020)

Soil Texture	Saturated Hydraulic Conductivity (in/hr.)
Sand	4.6
Loamy Sand	1.2
Sandy Loam	0.4
Loam	0.1
Silt Loam	0.3
Sandy Clay Loam	0.06
Clay Loam	0.04
Silty Clay Loam	0.04
Sandy Clay	0.02
Silty Clay	0.02
Clay	0.01

5.4 Initial Values for Transform Parameters (Mod Clark)

Initial values for the Mod Clark Transform method parameters Time of Concentration (T_c) and Storage Coefficient (R) were calculated from formulas in the HEC-Training Manual based on physical parameters of the subbasins, which were calculated within the HEC-HMS Subbasin Characteristics Tool. Where: T_c is the time of concentration in hours, L is the longest flow path in miles, L_C is the centroidal flow path in miles, $Slope_{10-85}$ is the slope of flow path represented by 10 to 85 percent of the longest flow path in feet per mile and R is the storage coefficient in hours.

$$5.5 \quad T_c = 2.2 * \left(\frac{L * L_C}{\sqrt{Slope_{10-85}}} \right)^{0.3}$$

$$R = \frac{T_c}{5.6} = 0.65$$

5.7 Initial Values for Baseflow

Initial baseflow values were generic assumptions based off HEC-HMS tutorial suggestions. Baseflow parameters for the initial and constant loss method were estimated from the Calibrated Pearl River Corps Water Management System (CWMS) model. The CWMS model had one basin covering the study area, and these values are shown in Table E4-3. Estimated baseflow parameters then underwent further calibration for the purposes of this project.

Table E4-3. CWMS Model Baseflow Parameters

Value	Parameter
100	Initial Discharge (cfs/mi ²)
0.61	Recession Constant
0.1	Ratio to Peak

5.8 Initial Values for Reaches

Reach parameters were set to Muskingum-Cunge computation method. Parameters are physically based, other than the Manning's N value, and therefore were calculated within the HEC-HMS module, unless otherwise described here. The Manning's N values were assumed to be 0.05 prior to calibration. Stream Bottom Width was estimated from Google Earth Imagery. Side slope was estimated as 2 feet/feet for all small streams and 7.5 feet/feet for the Pearl River, from a selection of cross-sections taken from the LiDAR terrain. Index celerity was set to 5 and adjusted based on initial run error messaging.

5.9 MODEL CALIBRATION

As discussed in section 3.5, recorded flows at location gages were determined to be reporting incorrect flow values at high Pearl River stages. Therefore, the hydrologic model was not calibrated to observed flows. Instead, parameters in the hydrologic model (HMS) were adjusted to calibrate to the stage hydrographs in the hydraulic model (RAS).

A zone configuration was set to help facilitate adjustments. These groupings, which are by the closest gage location, are shown in Table E4-4.

Table E4-4. Calibration Regions

Zone	Subbasins:
Cany Creek Gage	S_RichlandCr_1, S_RichlandCr_3, S_TerrapinSkinCr, S_DryCreek, S_RichlandCr_2, S_GallatinStDump, S_SavannaStWWTP, S_CaneyCreek_2, S_Pearl- RichlandCr, S_RichlandCr_7, S_RichlandCr_4, S_Pearl_EubanksCr, S_CanyCreek_1, S_Pearl-CanyCr, S_RichlandCr_6, S_HardyCreek, S_RichlandCr_5
Eubanks Creek Gage	S_EubanksCr_1, S_EubanksCr_2, S_EubanksCr_3, S_PrairieBranch_1, S_PrairieBranch_2, S_EubanksCr_4, S_Pearl_PrairieBranch, S_UMMC, S_Tougaloo,
Lynch Creek Gage	S_LynchCr_3, S_NeelyCr_2, S_LynchCr_1, S_LynchCr_2, S_WestsidePark, S_Pearl_HWY80,
Ross-Hanging Moss Gage	S_BrashearCr_1, S_WhiteOakCr_1, S_WhiteOakCr_2, S_HangingMoss_2, S_HangingMoss_1, S_PurpleCreek_1, S_PurpleCreek_2, S_HangingMoss_3, S_Pearl_Purple, S_SPearOrchardRd, S_RossBarnett, S_ChristwayChurch, S_FlowoodYMCA, S_JacksonHewitt, S_CapitolBodyShop, S_Pearl_HangingMoss, S_HangingMossSouth, S_RiverRoadN, S_HogCreek_1, S_HogCreek2, S_HogCreek_3, S_HogCreek_4, S_TwinLakeA, S_TwinLakeB, S_Pearl_HogCreek, S_Pearl_Hwy25,
South of Project-Not Calibrated	Subbasin-1, S_RenoCreek, S_LimestoneCreek, S_Big- WeeksMill, S_BrushyCreek, S_RockyCreek, S_Haley-Chestnut-Bear, S_VaughnCreek, S_Holcomb-Still, S_SteenCreek_2, S_MountainCreek, S_SteenCreek_1, S_Trahon- Big, S_TrahonCreek, S_BigCreek, S_Howard- Steamboat-Hawkins, S_RhodesCreek,
Town Creek Gage	S_NeelyCr_1, S_CityofPearl, S_TheVault, S_TownCr_1, S_TownCr_2, S_TownCr_3, S_Pearl_I55, S_Fairgrounds,

5.10 Rainfall Datasets

Precipitation Datasets were collected to incorporate into the model simulations. These included the following:

- Hourly point precipitation gage data for the 1979 event at the Pearl, MS gage from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) at https://www.ncdc.noaa.gov/cdo-web/datasets/PRECIP_HLY/stations/COOP:224472/detail. This point data was applied evenly throughout the basin in lieu of better spatial approximations.
- Gridded Next Generation Weather Radar (NEXRAD) 1-hour resolution quantitative precipitation estimates (QPE) were collected for events between 2017 and 2022 from Iowa State University's Environmental Mesonet at <https://mtarchive.geol.iastate.edu/>. This data covered the continental United States. An example link for an increment of data is https://mtarchive.geol.iastate.edu/2016/03/11/mrms/ncep/RadarOnly_QPE_01H/
- Sub-daily gridded precipitation data for 2011 covering the continental United States was requested via email to NCEI. The NEXRAD Estimates (QPE) Climate Data Record (CDR) provides radar-only and radar-gauge merged precipitation products, as well as ancillary information on precipitation type and radar quality. <https://download.avl.class.noaa.gov/download/8290586605/001> ; <https://www.ncei.noaa.gov/products/climate-data-records/precipitation-nexrad-qpe> for documentation

5.11 Calibration Methodology and Final Parameters

As discussed in section 3.5, recorded flows at location gages were determined to be reporting incorrect flow values at high Pearl River stages. Therefore, the hydrologic model was not calibrated to observed flows. Instead, parameters in the hydrologic model (HEC- HMS) were adjusted to calibrate to the stage hydrographs in the hydraulic model (HEC- RAS). All initial and final model parameters are submitted with this report in an excel document labeled Appendix E.2.

5.12 SIMULATED FREQUENCY BASED EVENTS-LOCAL DRAINAGE

Atlas 14 gridded datasets were downloaded from the NOAA site (NOAA, March 2023) at https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=ms or all frequencies and durations between 15 minutes and the three-day interval. All frequencies were annual maximum series. These grids were imported in the HEC-HMS model. The model was used to calculate individual depth duration curves for each subbasin. Depth Area Reduction factors were set to each subbasin for a conservative approach.

The Atlas 14 gridded frequency precipitation was routed within the HEC-HMS model and used as coincident local drainage inputs into the HEC-RAS model for all frequency-based events. Results of these simulations are provided in the Hydrology portion of the report. No changes were made to the inflows and routing with either HEC-SSP or HEC-HMS for existing or future conditions, for with or

without projects. All adjustments to routings for the with-project alternatives are made within the HEC-RAS modeling effort.

5.13 Adjustments for Large Events

Typically, a unit hydrograph adjustment via a peaking factor is made when calibrated events are significantly smaller than the series of events to be modeled. However, no adjustments were made to the HEC-HMS basin routing to account for the for large events, as the system model calibrated well to a recent large flood event, the 2020 event. This event is between a 50- and 100-year event and is within the range of the series of frequency events analyzed for design.

5.14 LOCAL DRAINAGE LIMITATIONS

Due to the time limitations of this effort, it was determined to be conservative to assume full coincidence with a three-day lag, as did occur most notably in the 1979 event.

To better refine any structure necessitated to pass interior drainage in the selected alternative, it is recommended that a WAT model be developed for Meteorology Inputs, HMS Routing and Res-Sim routing of the reservoir, and balanced hydrographs / with matching interior drainage be developed in later phases of study.

It should also be noted that the current model setup does not consider stormwater drainage within the interior drainage and may need to be further investigated during later phases of study.

Section 6

Hydraulic Analyses

6.1 HEC-RAS MODEL UPDATES

HEC-RAS-Version 6.4.1 unsteady state hydraulic modeling with a combination of one- and two-dimensional elements is used throughout the analysis. The software tool was developed and is maintained by IWR-HEC. Unsteady flow is necessitated in locations where complex flow networks exist, events are very dynamic with respect to time (e.g., dam or levee overtopping and/or breaching), extremely flat rivers systems where gravity may not be the significant forcing, tributary flow reversals due to backwater, and systems with a tremendous amount of storage in the overbanks. Each item listed is present within the study reach. HEC- RAS 1D is commonly used for water surface profiles over long reaches; depth averaged velocities; rainfall impact; sediment transport. HEC-RAS 2D is commonly used for 2D flow simulation over large domains such as rivers, canals, floodplains, estuaries, rainfall catchment areas, large scale simulations with long durations. HEC-RAS 2D is recommended for use when modeling behind levee systems, areas where flow is multi-directional, and wide floodplains, all of which exist within the project area. Both one dimensional (1D) and two dimensional (2D) features have been used extensively in the project area.

The existing HEC-RAS model is being developed and calibrated to four unsteady events, as well as a published rating curve and USGS mapped flood extents. These events will be selected from the April 2017, Jan 2020, Feb 2020, and August 2022 time periods. The HEC- RAS Model would then ingest the frequency data set to calculated from the expected rainfall runoff relationship for the selected study frequency events as well as Ross Barnett Reservoir outflows.

The model is being updated with 2D features within the overbanks of the system to simulate leveed areas more accurately. The model is extended slightly downstream to better verify any potential inducements or impacts. The dam feature within the With-Project geometry will be updated to current design standards.

Sensitivities on project features will be analyzed, as described in previous portions of this document, for use in updated economic and cost values for the subset of scenarios.

6.2 Initial / Base Data

Rankin-Hinds provided the Base model and Terrain to USACE. Mendrop Engineering received the model from USACE in the 2004-2007 timeframe. The project area and cross- section layout is shown in Figure E5-1. This model was an unsteady one-dimensional effort.

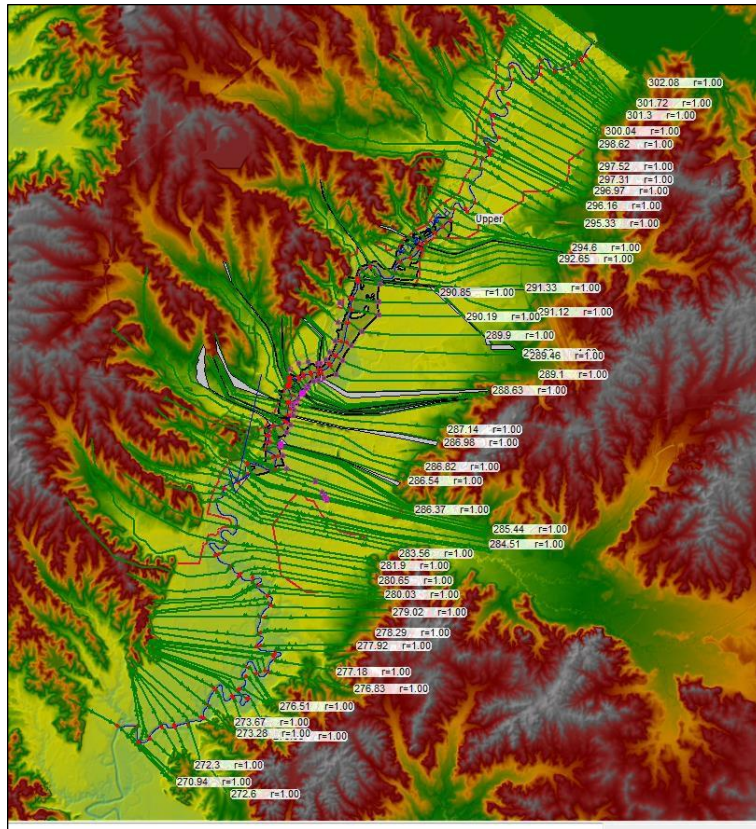


Figure E 5-1. NFI Model Geometry

6.3 Terrain and Bathymetric Data Sources

USACE used USGS 1-m LiDAR terrain in this effort to replace the Rankin-Hinds provided terrain, as the model needed to be extended. USACE collected terrain via RasMapper and merged the latest 1m data available for a given location from the USGS Natchez Trace (2016), Madison-Yazoo (2012), and MS NRCS East (2018) collects. Both terrain datasets are recent LiDAR and are similar. Though this process the model was converted to Albers equal area, and all elevations were converted to the North American Vertical Datum of 1988 (NAVD 88) if datum is known. Otherwise, proposed elevations were all assumed to be in the NAVD 88 datum.

6.4 Land Cover Datasets

USACE retrieved Land Cover from the 2019 NLCD and HEC recommended values were used for this effort within the overbanks. Modification layers were added in the two-dimensional flow areas to represent the tributary flow roughness. These modification layer N values were used as a factor for calibration to gages data, where a gage was available.

6.5 Existing Levees

Existing levees were taken when available from the Levee Database. Jackson Fairgrounds and Jackson East had elevation data available. However, Brashear's Creek Levee, Parsons Levee, and the Savanna Street Wastewater Treatment Plant levee system elevation data were cut from the 1-m LiDAR terrain. A small levee located within the Jackson East levee was also represented with a break line.

6.6 UPDATES TO EXISTING CONDITION AND ALTERNATIVE A GEOMETRY (FROM BASE GEOMETRY)

HEC-RAS Model updates to the provided NFI model include:

- The addition of one and two-dimensional storage areas to refine the movement of water at the outer extents of the floodplain.
- The addition of existing levee profile data from the National Levee Database (NLD) and Terrain when the top of levee survey was not available.
- Cross section layouts are adjusted to accommodate other routing options (e.g., storage areas)
- Initial Manning's were updated to Chow/HEC Estimates, and the National Land Cover Database (NLCD) land cover dataset was applied to the two-dimensional flow areas. Additional refinement areas were used to further define Manning's estimates for the tributaries within two-dimensional areas.
- The boundary condition was set to normal depth at the downstream extent to allow fluctuation between plans, where the previous model was held to a single downstream hydrograph.
- Ineffective areas were updated to match updated one-dimensional cross-section.
- A low flow weir at the Fewell plant (at elevation 250.0 feet) was added to the model. This elevation was provided by the NFI, the datum and original source are unknown.
- Break lines were included to better represent features that are expected to impact flow patterns within the two-dimensional geometry. These include bridge embankments, levees, and areas of high ground.
- Terrain modifications were added where appropriate to represent culverts, bridges, and tunnels. The Town Creek tunnel was approximated, with consideration to calibration results. If additional study or projects are added to this area, further fidelity is needed to this feature.

- Additional bridge calculation methods were incorporated to factor in losses more accurately though piers given the transition from steady to unsteady routing methodology.
- Converted the inflow and routings from a steady to unsteady regime. Inflow at the head of the model was moved to be based off the Ross Barnett Reservoir Releases at the head of the model, instead of the Pearl River at Jackson Gage, which is near the bottom of the study area.
- Local tributary inflows were added and routed through the project area.
- The addition of 3 additional miles of routed river to better define any downstream consequences.

The updated geometry extent with one-dimensional cross-sections, one-dimensional storage-areas, and two-dimensional flow areas is shown in the image below.

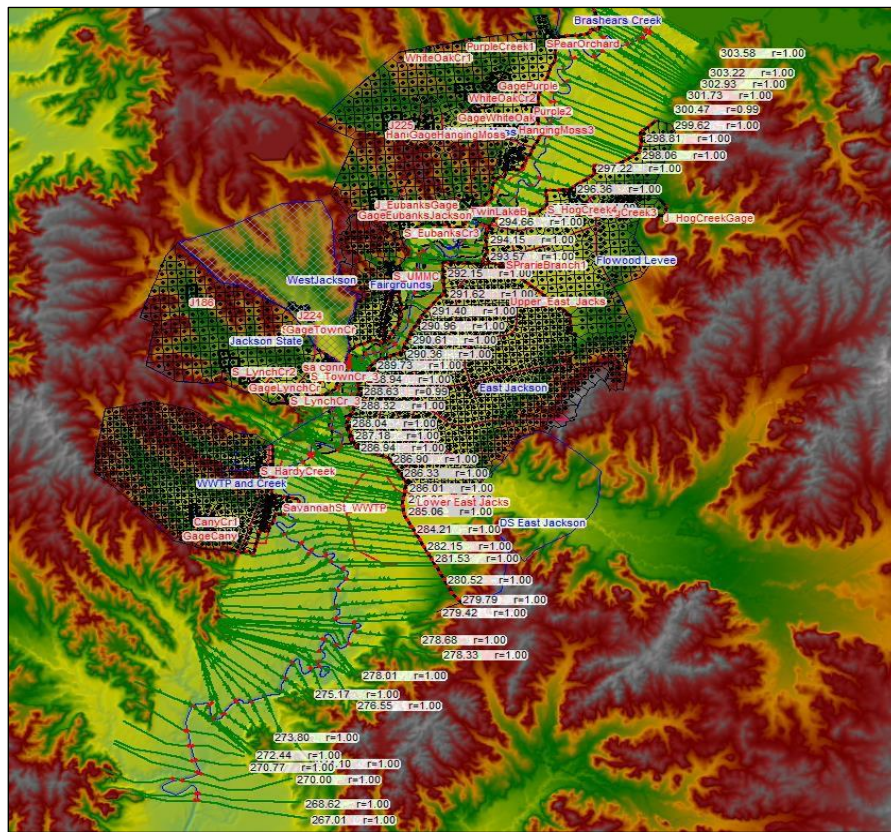


Figure E5-2. HEC-RAS Geometry Layout with Terrain at Study Area

6.7 MODEL CALIBRATION

HEC-RAS Model Calibration of existing condition included:

- Adjustments of the local inflows within the HEC-HMS model
- Adjustments to the manning's flow values in the one-dimensional areas and the addition of refinement regions within the two-dimensional areas of the model.
- Adjustments to the bridge inputs to better simulate backwater.
- Adjustments to the flow roughness factors.
- Adjustments to ineffective areas

USACE compared model results to the selected gage data, Rankin-Hinds high water marks, and a USGS February 2020 inundation event downloaded from <https://www.usgs.gov/data/flood-inundation-maps-and-water-surface-elevation-data-february-17-2020-flood-pearl-river> . Complete comparisons of gage data and the 2020 Inundation are in Appendix E.1. Priority was also given to the 2020 flood extent map created by USGS. (Outline in purple)

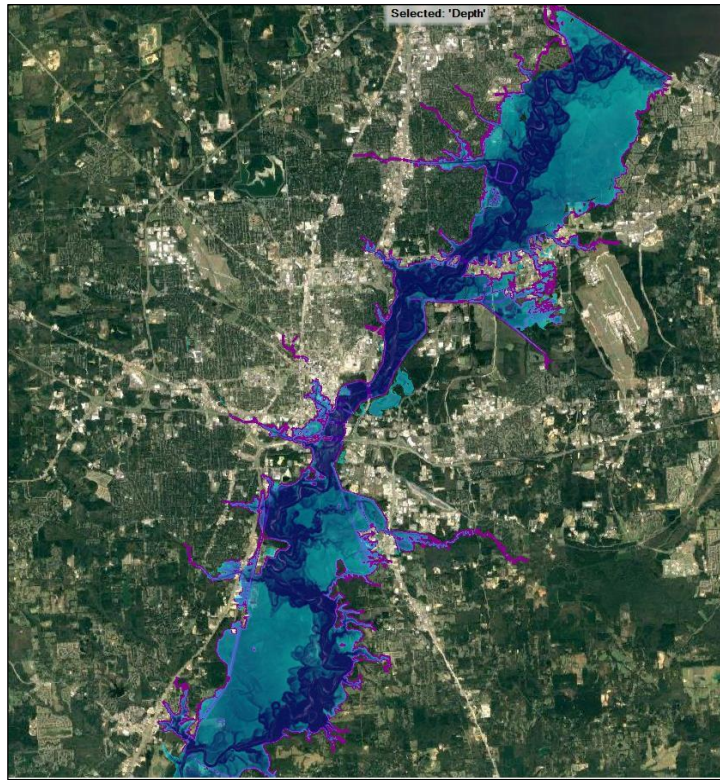


Figure E5-3. USGS Maximum Inundation for the February 2020 Event vs the HEC-RAS Simulation Results

Table E5-1. Calibration Summary

Gage	Calculated- 2017	Obs 2017	Calculated Jan 2020	Observed Jan 2020	Calculated Feb 2020	Observed Feb 2020	Calculated- Aug 2022	Obs Aug 2022
Pearl River @ Hwy 80- stage, feet	265.86	266.71	264.68	264.86	270.09	270.06	268.67	268.77
Pearl River @ Hwy 80 – flow, cfs	40753	40000	33,113	32200	72504	77300	59167	56600
Pearl River @ Hwy 25 Stage*, feet		-	-	-	276.69	277.5	274.58	274.18
Hanging Moss Creek, stage, feet	280.96	282.04	280.11	280.61	278.83	278.82	281.54	280.31
Purple Creek, Stage, feet	274	276.74			279.04	279.19		--
White Oak Creek, Stage, feet			278.97	274.99	278.83	279.15	279.39	277.01
Eubanks Creek, Stage, feet	272.56	272.63	270.91	272.26	276.85	275.34	274.74	273.21
Town Creek, Stage, feet	276.06	276.1	274.69	274.65	270.63	270.63	274.2	274.46
Lynch Creek, Stage, feet	281.76	279.25	279.27	280.11	276.25	276.13	280.11	280.39
Cany Creek, Stage, feet	266.68	267.79	265.91	264.95	264.79	265.21		

*Rating not developed until after all calibration events occurred / Flow not published till late 2022. Red is data taken from preliminary or annual peak data.

6.8 FINAL EXISTING CONDITION PARAMETERS

A Summary of Existing Condition model parameters are populated in Tables E5-2 through E5-8. Some tables are large and were included in Appendix E.2.

Table E5-2. Roughness Coefficients from Cross Section 290.96 to 267.01

Flow	Roughness Factor
1	1.05
11000	1.15
35000	1.1
50000	1.03

Table E5-3. Roughness Coefficients from Cross Section 303.58 to 290.96

Flow	Roughness Factor
1	0.95
11000	1.1
35000	1.1
50000	0.9
57000	0.9

Table E5-4. Land Cover Range within Cross Sections- Full Table in Appendix E.2

Land Type	Manning's N
Channel	0.035-0.0425
Overbanks	0.065-0.2

Table E5-5. Land Cover Range by Land Cover Type in Two-Dimensional Areas, Specified Roughness for Tributaries are included.

Name	Default Manning N
No Data	0.06
Cultivated Crops	0.035
Woody Wetlands	0.1
Developed, Open Space	0.04
Developed, Low Intensity	0.08
Mixed Forest	0.15
Deciduous Forest	0.15
Shrub-Scrub	0.11
Pasture-Hay	0.04
Grassland-Herbaceous	0.04
Open Water	0.035
Barren Land Rock-Sand-Clay	0.025
Developed, Medium Intensity	0.12
Evergreen Forest	0.12
Emergent Herbaceous Wetlands	0.07
Developed, High Intensity	0.16
CanyCreek	0.085
HardyCreek	0.06
Hog	0.06
Purple	0.095
Hanging Moss	0.12
EubanksCr	0.06

Name	Default Manning N
Town	0.03
Lynch	0.014
RichlandCreek	0.045
Eubanks	0.06
White Oak and Hanking Moss Overbank	0.16

Table E5-6. Weir Coefficients for Lateral, Inline Structures, and Storage Area Connections

Location	Overflow Weir Coefficient
Pearl River Upper 303.01	2
Pearl River Upper 301.	2
Pearl River Upper 299.45	2
Pearl River Upper 293.4	2
Pearl River Upper 292.6	2.8
Pearl River Upper 292.37	2
Pearl River Upper 291.9	2
Pearl River Upper 291.55	2
Pearl River Upper 289.58	1
Pearl River Upper 289.1	1
Pearl River Upper 286.05	2.6
Pearl River Upper 285.9	2
Pearl River Upper 285.88	2
Pearl River Upper 274.15	2
Pearl River Upper 274.09	1
Pearl River Upper 272.3	2
Pearl River Upper 272.18	2
Pearl River Upper 271.4	1
SA Conn: Lower East Jacks	2
SA Conn: Upper_East_Jacks	2

Table E5-7. Bridge Coefficients

Reach	River Sta	Drag Coef (Cd)	Peir Shape K
Lakeland	294.5	1.5	1.05
Abandoned Railroad	292.39	1.0	1.05
I-55	290.1	1.2	1.05
Old Brandon Road	289.35	1.5	1.05
KCS Railroad	289.16	2	1.25
HWY 80	288.8	2	1.25
I20	288.4	2	1.25
CN Railroad	288.035	2	1.6

Table E5-8. Pump Station Characteristics

Pump Stations	Profile	Q Pump Station(cfs)	Pump On Elevation (feet)
Jackson East Upper_East_Jacks	Max WS	600	250
Fairgrounds Pump Upper_East_Jacks	Max WS	107	250

6.9 UPDATES TO THE ALTERNATIVE D1 and E1 GEOMETRY

An analysis of the Alternatives D1 and E1 were completed. HEC-RAS Model updates include:

- The moving of proposed weir upstream of the NFI original location, maintaining the existing weir at the J W Fewell Water Treatment Plant for Alternative D1.
- Updated cross sections, storage areas, bridges, and ineffective areas to mimic proposed channelized features. This included modifying the terrain to excavate portions of the channel overbanks to 252.0 ft. The extent is reduced from the original Alternative C extent. The cross-sectional elevation data were then updated from the modified terrain file.
- Updated manning's values to adjust to proposed conditions using provided clearing shapefiles.
- Removal of an abandoned railroad bridge
- Additional Levees added in as 2D Storage Area Connections and Lateral Structures to mimic the proposed Canton Club, McLeod, Cany Creek, and Richland Levees.
- The proposed channelized and fill features are the same as Alternative D1, with the exception of additional pools/lakes that were included for mitigation. The pools were located in areas already being excavated under Alternatives D1 and E1, but the excavation was lowered to elevation 247.0 ft in areas to create pools.

The Cross Section data does include a 1:3 side slope at the extent of excavation, if this modeling effort continues or specific modeling is needed to size features, this slope should be refined, and likely extended.

Table E5-9. Land Cover Range within Cross Sections for Alternative D1 and E1. Full Table in Appendix E.2

Land Type	Manning's N
Channel	0.035-0.0425
Modified Channel Overbanks (D1-Expected Ponding)	0.45
Modified Channel Overbanks (E1-no ponding)	0.5

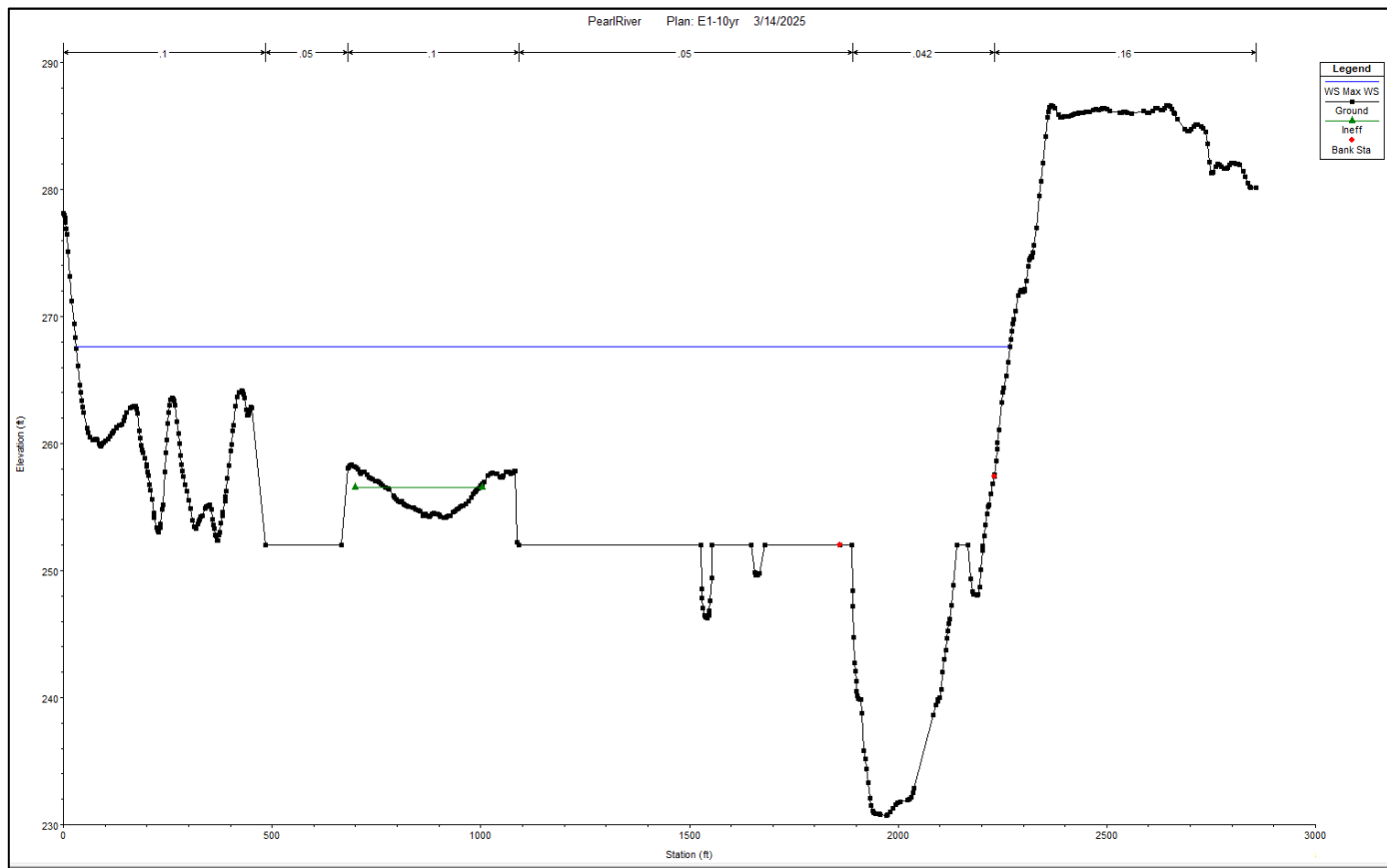


Figure E5-4. Sample Cross Section Adjustments

6.10 Alternative D1 Dam Modeling Approach

The proposed weir for Alternative D1 was modeled with an inline structure but given the limited time allowed to model Alternative D1, interpolated cross-sections were added to allow the insertion of the proposed weir. The interpolated cross-sections were clipped to terrain for overbank areas. The inline structure as shown in the figure below was modeled with a continuous weir elevation set to 256.0 ft, but at this time no separate rating curve was developed.

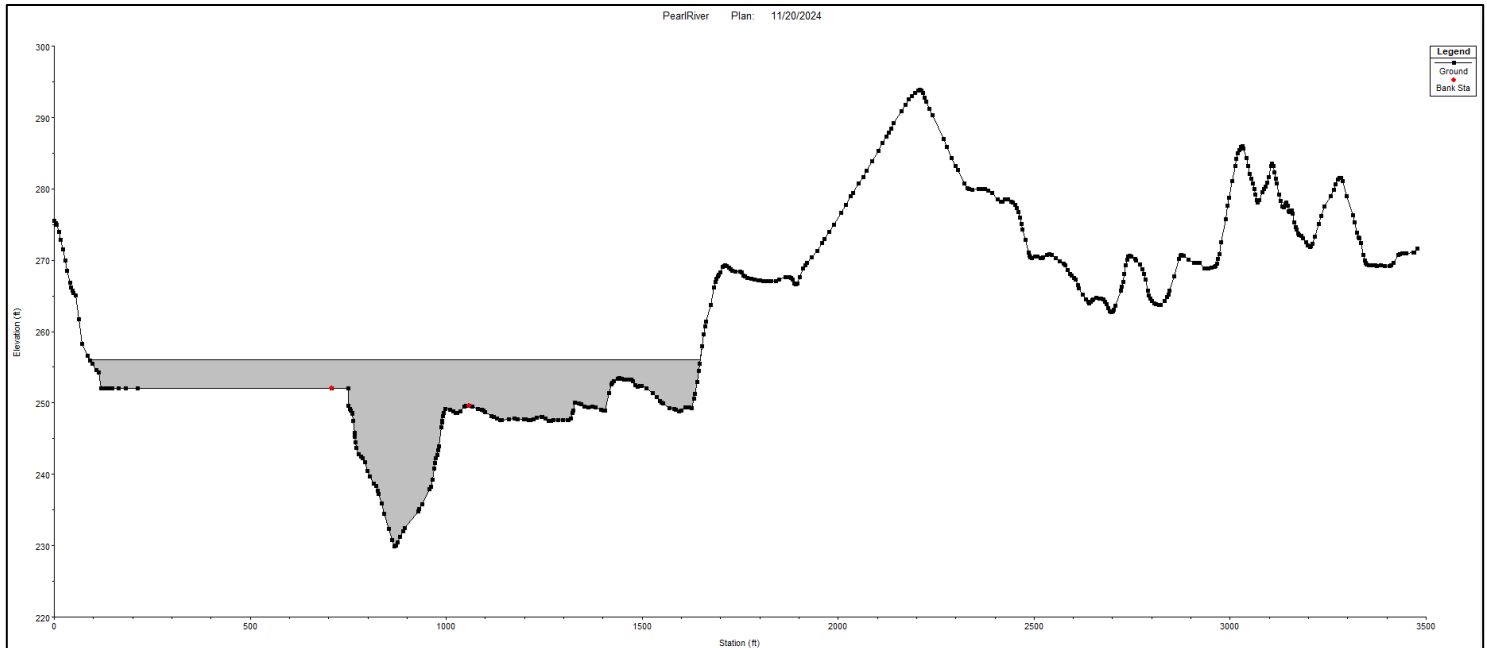


Figure E5-4. Modeled Weir Geometry

6.11 EXISTING CONDITION FREQUENCY ROUTINGS

6.12 Addition of HEC-HMS and HEC-SSP Data Sets

One scenario of frequency routings (conservative) employed the 2020 hydrograph pattern ratioed to match peak frequency flow estimates from the Ross Barnett Reservoir, this was supplemented by the assumption of a full coincidence local inflow, set 3 days prior. No changes were made to the inflows and routing with either HEC-SSP or HEC-HMS for existing or future conditions, for with or without projects.

One scenario of frequency routings (assumed likely) employed the 2020 hydrograph pattern ratioed to match peak frequency flow estimates from the Ross Barnett Reservoir, this was supplemented by the 2020 hydrograph pattern ratioed to match peak frequency for tributary inflows. No changes were made to the inflows and routing with either HEC-SSP or HEC-HMS for existing or future conditions, for with or without projects.

6.13 SENSITIVITIES ROUTING/ASSUMPTIONS FOR FUTURE CONDITION

Several sensitivities were carried forth throughout this study to reduce uncertainty in future routing.

6.14 No Tributary Inflow

A sensitivity was run to estimate the scenario of a drought on the lower end of the system, while a major flood occurred above the reservoir. This was completed for the 5- and 100-year events. This is not expected based on typical weather patterns for large events. This scenario includes flood inflows only from the Ross Barnett Reservoir releases, and baseflows below the dam.

6.15 Tributary Inflow Variation

A sensitivity was run to estimate the scenario of a drought on the upper end of the system, while a major flood occurred below the reservoir. This was completed for the 5- and 100-year events. This is not expected based on typical weather patterns for large events. This scenario includes flood inflows only from the tributaries, and minimal flows from the Ross Barnett Reservoir releases. Additionally, sensitivities were completed for the 100-year event, allowing a 5- and 7-day lag, versus the 3-day lag when using frequency flow data for the tributaries. A sensitivity of a 100-year tributary event with a 25-year Pearl River flood, and then a 25-year tributary event, with a 100-year Pearl River Flood were completed.

6.16 Manning's/Clearing

In the 2013 – 2014 timeframe Rankin-Hinds accepted O&M responsibility for several areas previously maintained by the Pearl River Basin Development District. This district lost funding over time due to decreased participation and federal funding and lack of grants.

Funding for these areas is uncertain in the future.

While it is not the USACE responsibility to maintain these areas, this sensitivity is completed to help determine impact to the project if these areas are no longer maintained.

6.17 Ross Barnett Operations

Since at least 1979 the Ross Barnett Reservoir has been working with local and federal entities to help reduce peak flows downstream of the project. However, there is a possibility that the reservoir would no longer be able to operate in this manner in the future for large inflows over 75,000 CFS. The reservoir has previously encountered stress at its highest historic peak pools.

Therefore, the 1979, 1983, and 2020 events are set as historical events with ranges from the event release ranging up to the reported inflow value. The SSP model would select the geometric mean of these two bounding parameters, for an estimate that is removing roughly half of the regulating capacity. These resulting frequency values are used to inform the HEC- RAS sensitivity scenario.

6.18 1979 EVENT COMPARISON

The historic 1979 event was devastating and is the point of comparison for many local citizens and government officials. Therefore, additional simulations of this event were completed to show the impact of the various flood reduction projects completed throughout the 1980s as well as the know system response changes.

Table E5-10. 1979 Elevation Results in Routing Comparison

Scenario	Elevation - HWY 80 Gage, Feet
1979 Event	277.0
Original Ross Barnett release records	273.7
Updated Calculation of Ross Barnett Releases	274.7

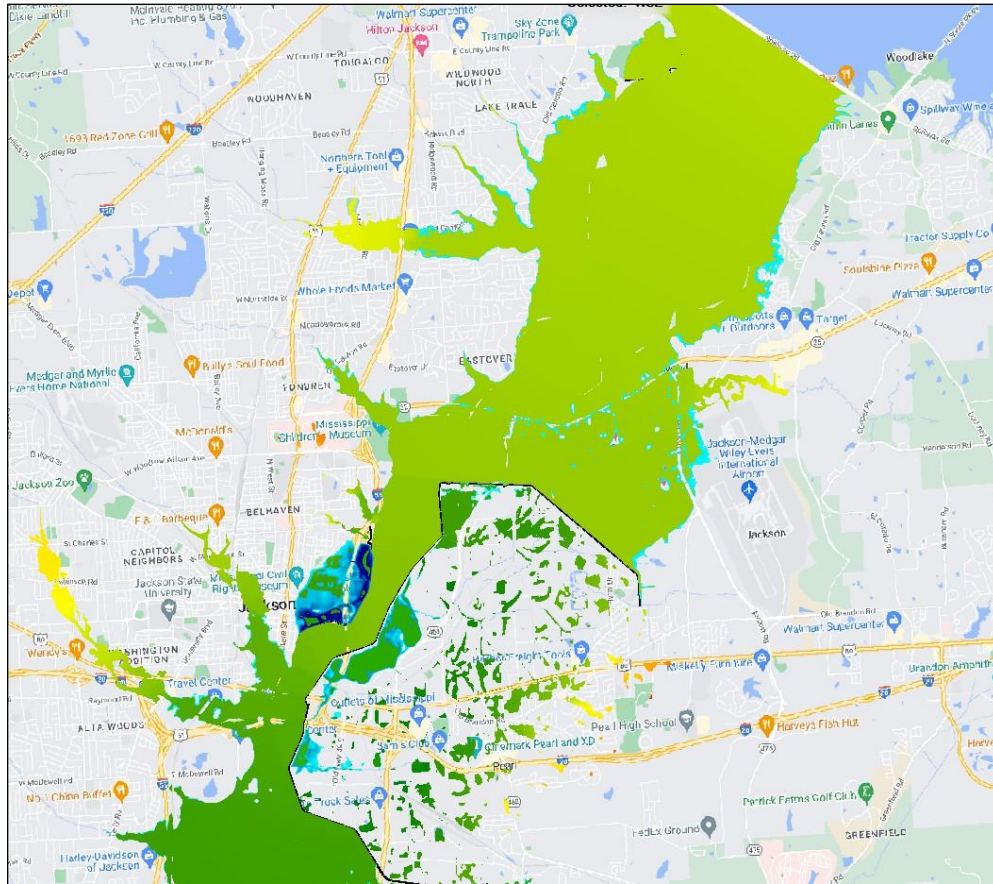


Figure E5-5. Comparison of Routing of the 1979 Flood Event Historic Flooding (Blue) to Routing with Present Day River Conditions (Green)

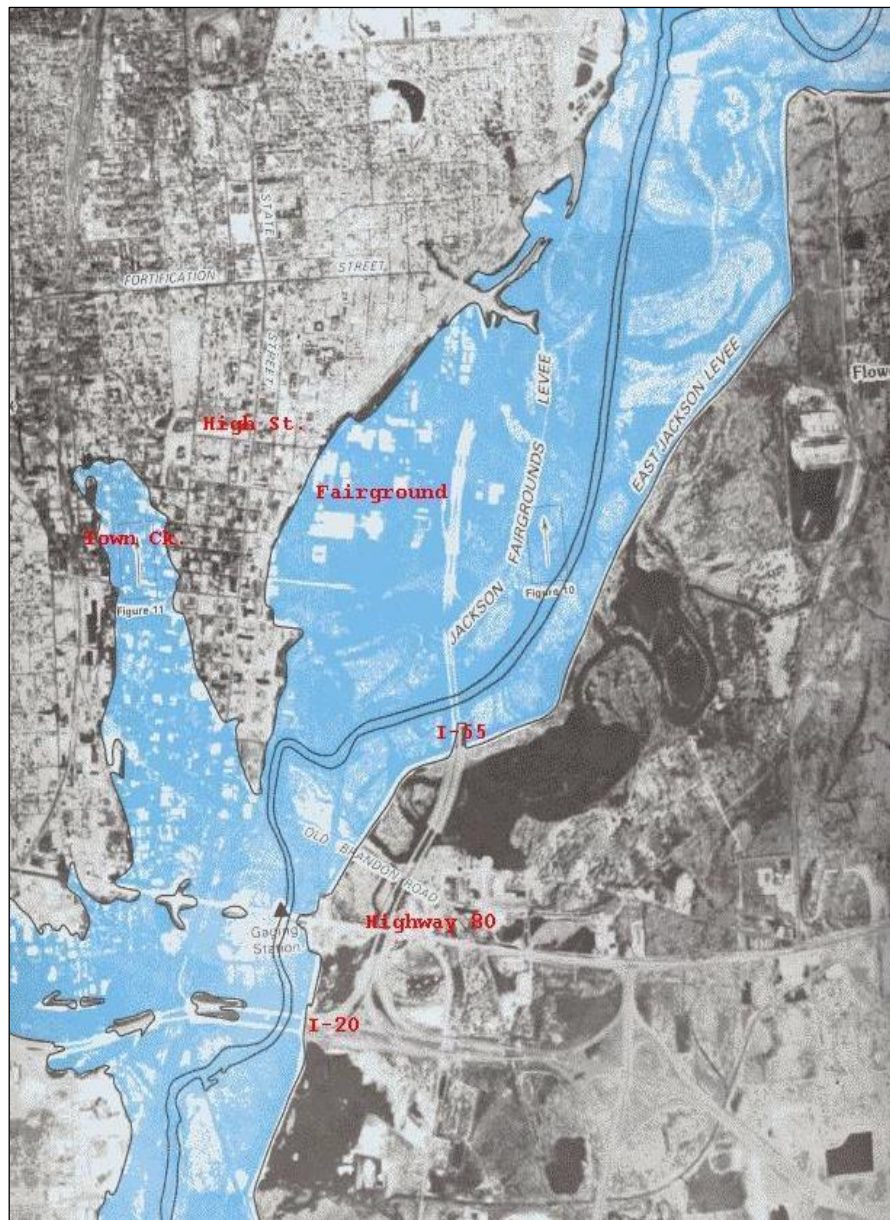


Figure E5-6. 1979 Flood Event Inundation Extent (USGS 2023a)

6.19 1979 - Losses

An additional model scenario was run reducing the calibrated loss rate by 75% help simulate a very saturated basin. This had minimal to no impact on peak stages within the Pearl River.

6.20 MODEL FREQUENCY RESULTS FOR EXISTING, ALTERNATIVE D1, AND ALTERNATIVE E1

A summary of modeled results for Routed events, and Frequency events for Existing, Alternative D1, and E1 at the Upstream, Downstream, Gage location, and at Proposed Dam (Alternative D1) are shown in Table E5-12.

Please note that an ATR (Agency Technical Review) comment resulted in changes to the modeling of bridge features, specifically the ineffective areas related to contraction and expansion of flows into the bridge opening. As a result, the hydraulic model geometry was updated, and testing of the 2020 event, 100-year return interval, and 200-year return interval for with and without project shows that these changes produce water surface elevations similar enough to the original modeling, and the original modeling provided to the economic analysis was retained. Maximum differences in the water surface elevations occurred in the area with many bridges, which is between the two federal levees currently in the project area, which limited the impact to flooded extents.

6.21 Data Provided to Other Disciplines

Final raster datasets were provided to other disciplines to complete various aspects of this effort. For Hydraulic Modeling Purposes, current and future condition were reasonably considered to be unchanged. This is as significant development is not expected throughout the basin upstream of the Ross Barnett Reservoir, and climate change is not expected to induce flooding. For Hydraulic Modeling Purposes Alternatives, A and A1 are treated the same as existing Conditions.

Table E5-11. Hydraulic Model Scenario to Alternative

	Future	Current
Alternative A1	Existing	Existing
Alternative D1	D1	D1
Alternative E1	E1	E1

Table E5-12. Elevation Results for Selected Routings

	Upstream Extent of Model (Ross Barnett Outflow)		HWY 25		HWY 80		Proposed Dam (Alt D1 Location)		Downstream Extent of Model	
Scenario Name	Flow (CFS)	W.S. (Feet)	Flow (CFS)	W.S. (Feet)	Flow (CFS)	W.S. (Feet)	Flow (CFS)	W.S. (Feet)	Flow (CFS)	W.S. (Feet)
February 2020	73932	281.1	73211	277.3	72461	270.1	72417	269.3	71771	256.1
January 2020	33226	275.3	33355	269.7	32898	263.8	33266	263.1	33688	250.7
2017	41972	276.7	41387	271.4	40929	265.2	40881	264.5	39570	252.1
2022	59881	279.2	59367	274.9	59083	268.2	59051	267.5	57415	255.3
1979 event with current routing	137075	286.7	113161	283.6	115276	275.0	116424	274.0	122191	259.6
1000year Existing (3-day lag)	162797	288.2	126227	285.1	109400	276.5	110328	275.8	155341	261.6
500year Existing (3-day lag)	140469	287.0	114603	283.9	112212	275.7	113105	274.8	138069	260.6
200year Existing (3-day lag)	114891	285.2	100835	282.2	100313	274.3	101844	273.5	117267	259.3
100year Existing (3-day lag)	93137	283.6	89068	280.5	84661	272.5	85676	271.8	98532	258.1
50year Existing (3-day lag)	83296	282.0	78963	278.3	74040	271.0	74210	270.3	83271	257.0
25year Existing (3-day lag)	70123	280.3	66914	276.3	63021	269.6	63002	269.0	69211	255.9
10Year Existing (3-day lag)	54787	278.1	51051	273.7	51533	267.8	51482	267.2	56213	254.2
5year Existing (3-day lag)	44388	276.9	42143	271.9	42922	266.1	42238	265.6	46347	252.9
500year Existing (2020 Pattern Tributary)	140370	287.0	114875	283.7	116029	275.1	117106	274.1	122678	259.7
200year Existing (2020 Pattern Tributary)	109153	285.1	100021	282.1	104117	273.8	105616	272.9	107211	258.7
100year Existing (2020	92448	283.4	88408	280.1	88878	272.0	89716	271.1	90049	257.5

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Pattern Tributary)										
50year Existing (2020 Pattern Tributary)	78805	281.7	77912	278.1	77146	270.6	77185	269.8	76960	256.5
25year Existing (2020 Pattern Tributary)	70024	280.1	65635	276.1	65106	269.2	65093	268.4	64090	255.4
10Year Existing (2020 Pattern Tributary)	54742	277.9	51701	273.3	51646	267.0	51633	266.3	50901	253.4
5year Existing (2020 Pattern Tributary)	44372	276.8	42018	271.6	41931	265.4	41921	264.7	41406	252.3
E1-500 year (2020 Pattern Tributary)	140500	285.1	129600	280.1	126700	274.7	128400	274.0	131500	260.2
E1-200 year (2020 Pattern Tributary)	115000	283.2	108600	277.5	105900	272.5	106900	272.0	107800	258.7
E1-100 year (2020 Pattern Tributary)	98300	281.9	93400	275.6	92100	271.0	92300	270.5	92500	257.7
E1-50 year (2020 Pattern Tributary)	83400	280.5	79000	273.9	78300	269.6	78300	269.2	78200	256.6
E1-25 year (2020 Pattern Tributary)	70100	279.0	66300	272.1	66200	268.1	65600	267.7	65200	255.5
E1-10 year (2020 Pattern Tributary)	54800	277.0	52300	269.5	52100	265.9	52100	265.6	51500	253.5
E1-5 year (2020 Pattern Tributary)	44400	275.9	42300	267.8	42100	264.3	42100	264.0	41700	252.3

Section 7

Hydraulic Analyses

7.1 Inducements - Alternatives C, D1, and E1

An inducement is additional water added to an area due to the construction of a flood reduction project. This is expected to some minor degree, as water moves through the system faster than before the project was constructed. USACE analyzes these areas of possible inducement to determine if the additional water causes damage. For example, an additional 2 inches of water within the river is likely not damaging, but an additional 2 inches of water in a home would be. Additional takings assessments will be needed to determine the impacts.

The initial design and construction model extended just downstream of Byram, Mississippi, and was used for all alternative analysis. Descriptions of inducements up to just downstream of Byram, Mississippi, were originally calculated for Alternative C but have now been updated for Alternatives D1 and E1. A more detailed assessment of flow and stage impacts was completed for all frequencies analyzed (5-, 10-, 25-, 50-, 100-, 200-, and 500-year events). This assessment extended for 20 miles downstream of the project extent. Alternatives D1 and E1 are very similar and are considered the same for the purposes of this analysis. An earlier assessment was completed for the previous Alternative C for the 20% AEP and 1% AEP frequencies to represent a relatively frequent event as well as a more extreme scenario to be used as an upper bound down to Byram, Mississippi. Reduced project features create less downstream inducements than with the previous alternative C. The inducements due to any event less than the 100-year event appear to resolve to less than 0.25 feet of added water less than 20 miles downstream of the project and completely resolve just prior to the Copiah Creek confluence, approximately 32 miles downstream of the project.

Table E6-1. Impacted Areas from Project Area to 20 miles Downstream

Total Acres Included by Increment of Inducement (Feet) – to 20 miles downstream of project.	1 % AEP- Acres, flooded above 0.25 feet	1% AEP - Structures
100-year frequency and more frequent	81	11
200 and 500-year frequencies	5,822	97

Table 6-1 above shows estimated acres and structures impacted due to construction of Alternative D1 or E1 for the full range of modeled events. Areas with any increase in water surface elevation were compared to the structures in the area. Structures in this assessment were taken from the national structure inventory, then structures no longer existing or habitable were removed from the list. This list of structures was compared to the depth of water at that location to determine if it was likely that water would be flooding the ground floor of a building. Structures above the water surface were removed from the list. An example would be if a house was in an area that was flooded 1 foot deep, but the house was

built 4 to 5 feet off the ground on a raised foundation. This was considered acceptable for this analysis, as impacts to land are considered separately.

Estimated Acres of land impacted was limited to the area outside of the FEMA floodway. This was used in proxy of the ordinary high-water marks, this marks areas frequently flooded by water from the river and can be indicated by things such as riverbank features, and plant types. Modeled areas with an additional 0.25 feet or more of inundation are listed in this analysis. The PDT is confident that a land area flooding 0.25 feet or less higher for approximately the same amount of time would not likely cause damage, when accounting separately for any structure use. It is likely that it would take a larger added depth of flooding than 0.25 feet to cause appreciable damage to a property (i.e. woods, parking lot, yard), but further analysis would need to be completed in PED to verify this assumption.

Additional assessment of the changes to downstream boundary was conducted for the 1% AEP event. Further analysis would be needed to validate the total impacts, specifically to verify sediment and velocity impacts of the additional water moving downstream. However, major impacts to the downstream watershed beyond the RM 200 (approximately 5 miles north of Monticello, MS) are highly unlikely. No impacts to the State of Louisiana or Gulf Coast Region are expected to occur.

7.2 Downstream Assessments Alt C

Initial Assessments were conducted to further identify downstream impact to the Alternative C construction. The calibrated and reviewed project model was extended 43.4 miles downstream just past the confluence of Copiah Creek and the Strong River at approximate River Mile 223. The model was extended downstream by creating additional cross sections and storage taken from the LiDAR terrain for both the with and without project geometries. The extended downstream boundary condition was taken from the slope of the terrain and was held constant for both geometries. An assumed channel based on upstream channel survey data was incorporated into the cross sections using the Channel Design Modifications Editor. Initial assessments for the Alternative C downstream reach inducements were evaluated at the 5- and 100- year frequencies, to represent a relatively frequent event as well as a more extreme scenario. While inflow calculations were available through a HEC-HMS model developed for the larger project effort, a simplified assumption of a frequency event was applied to the larger downstream tributaries.

Table E6-5. Coincident Frequency Assumptions

Frequency Event (within project area)	Coincident Frequency (downstream of project area)
5-year	50% AEP
100-year	10% AEP

For this reach and assessment, there was added flow and water elevations for both the 5- and 100-year frequency events. The added water surface elevation due to the 5-year event appear to resolve to 0 just prior to the Copiah Creek confluence, approximately 32 miles downstream of the project. (Alternative D1 or E1 would be expected to resolve prior to Alternative C) These were classified as either possible

inducements or unlikely inducements. Modeled areas with an additional 0.25 feet or more of inundation are considered to be a possible inducement. (Approximately 38,800 acres at the 100-year Frequency, and 2,330 acres at the 5-year frequency). Impacted areas in the 0.25 feet or less range are considered not likely to have any measurable negative impacts. These assumptions, however, will require further modeling in later phases of design.

Table E6-6. Impacted Areas from Project Area to Confluence with Copiah Creek

Increment of Inducement (Feet) – to Confluence with Copiah Creek	100-year event- Impact Acres	5 year- Acres
0 - 0.25 Feet (unlikely inducement)	Up to 16,200	Up to 33,200
0.25 - 0.5 Feet (expected inducement)	38,800	2,330

Additional assessment of the changes to downstream boundary was conducted for the 100- year frequency event by taking the flows from the project model and inserting them into the Calibrated Pearl River CWMS model. The Bogue Chitto River was the only major tributary modeled with a separate reach. Due to the distance away from the study area, it was assumed that any major rainfall would not extend to this reach and a mean annual flow of approximately 2,000 cfs was applied to this reach. The mean annual flow was pulled from the USGS Streams tats application for the Bogue Chitto River near Bush, LA. From this assessment, impacts extending to the Mississippi Gulf Coast cannot be ruled out until finalized features to construct are selected, as further analysis on the final plan set would be needed to validate current assumptions; however, impacts to the downstream watershed beyond the RM 200 are not expected. No impacts to the state of Louisiana are expected.

Table E6-7 Impacted Areas from Confluence with Copiah Creek to Coastal Boundary, 100- year Frequency.

Range of Inducements in Feet	River Mile
less than 0.2	RM 15 to 223.6

Section 8

Life Safety and Hydraulic Design Requirements

8.1 LIFE SAFETY AND LEVEL OF DESIGN EFFORTS

In order to identify any life safety risk for the proposed project, it was determined to complete three analyses. These analyses were:

- complete a dam screening and simple breach analysis for the proposed dam in the LPP to verify assumptions of life loss
- Update the Levee Safety Tool screenings for the existing levees in the system
- Complete simple Levee Safety Tool style breaching of any of levee features that remain after the hydraulic updates

Additionally, a ½ and full probable maximum flood (PMF) from the Ross Barnett will be modeled using existing data to verify the impacts on design requirement. (It is currently assumed that the proposed dam will need to be designed to survive either a ½ or full PMF; this is separate than the level of design that it is expected to offer flood benefits.)

Please note that the Alternative D1 or E1 plan is not included in this assessment, and further investigation will need to be completed after final selection of features. Alternative D1 can be assumed to have the same order of magnitude life safety concerns as Alternative C (ranging from same results to less risk to life loss). Alternative E1 will have less impacts from a Life Safety perspective.

8.2 ANALYSIS OF PROPOSED DAM- ALTERNATIVE C ONLY

8.3 Life Safety – Breach

Four pool loadings were modeled with a breach / non-breach pair using the loading and parameters listed below. All scenarios were breached at the peak of the hydrograph. A proxy ½ PMF (2022) provided by the Ross Barnett Staff was routed downstream to mimic a ½ PMF that would be calculated at the proposed dam location. Breaching data is shown in Figure E6-1.

Note that this analysis was only completed for the Alternative C geometry due to the time constraints associated with the addition of Alternative D1 modeling. It is reasonable to assume that the Alternative D1 has less impact due to a breach of a structure, given the smaller dam size, and smaller impounded water volume. It is possible but not proven that the Alternative D1 proposed weir may be considered a low hazard dam.

Table E6-1. Hydraulic Loadings for Breach Testing (Alternative C)

Pool Loading (ft)	Flow Ratio	Breach Bottom Elevation (ft)	Breach Width (ft)	Breach Formation Time (hr.)
260.1 (approximately top of dam)	0.01% AEP x 0.15	248	1900	0.1
260.3	0.01% AEP x 0.2	248	1900	0.1
260.8	0.01% AEP x 0.3	248	1900	0.1
275.2	½ PMF*	248	1900	0.1

As shown in Figure E6-1 the breach at 260.1ft showed some damages focused within the leveed area. Figure E6-2 provides a zoomed-in figure of one of the structures and the incremental difference in inundation mapping for the breach and non-breach pair. The identified structures near the inundation (structures 1 and 2) appear to be hunting cabins or temporary raised structures. The orange point further downstream in Byram, MS is the location of a local junkyard.

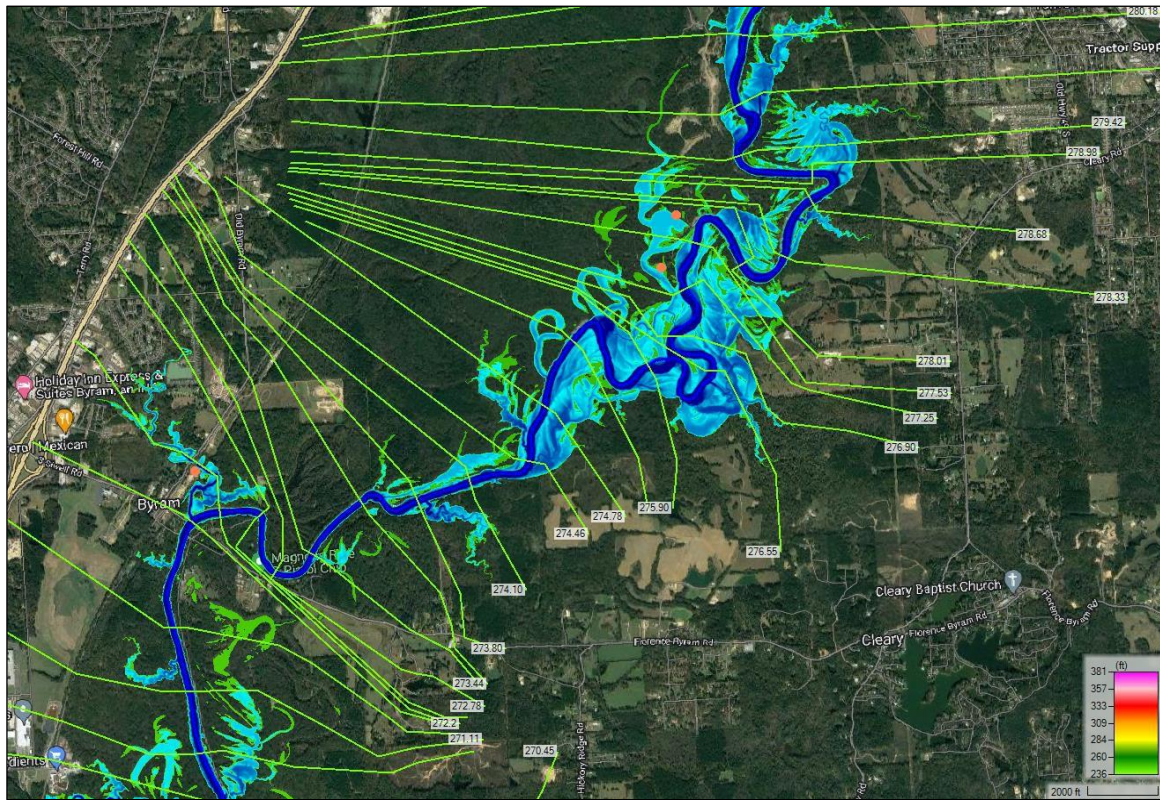


Figure E6-1. Comparison of 260.1 ft Non-Breach (blue) and Breach (green) Indicates a Difference in Inundation Mapping Between the Breach and Non-Breach Scenarios

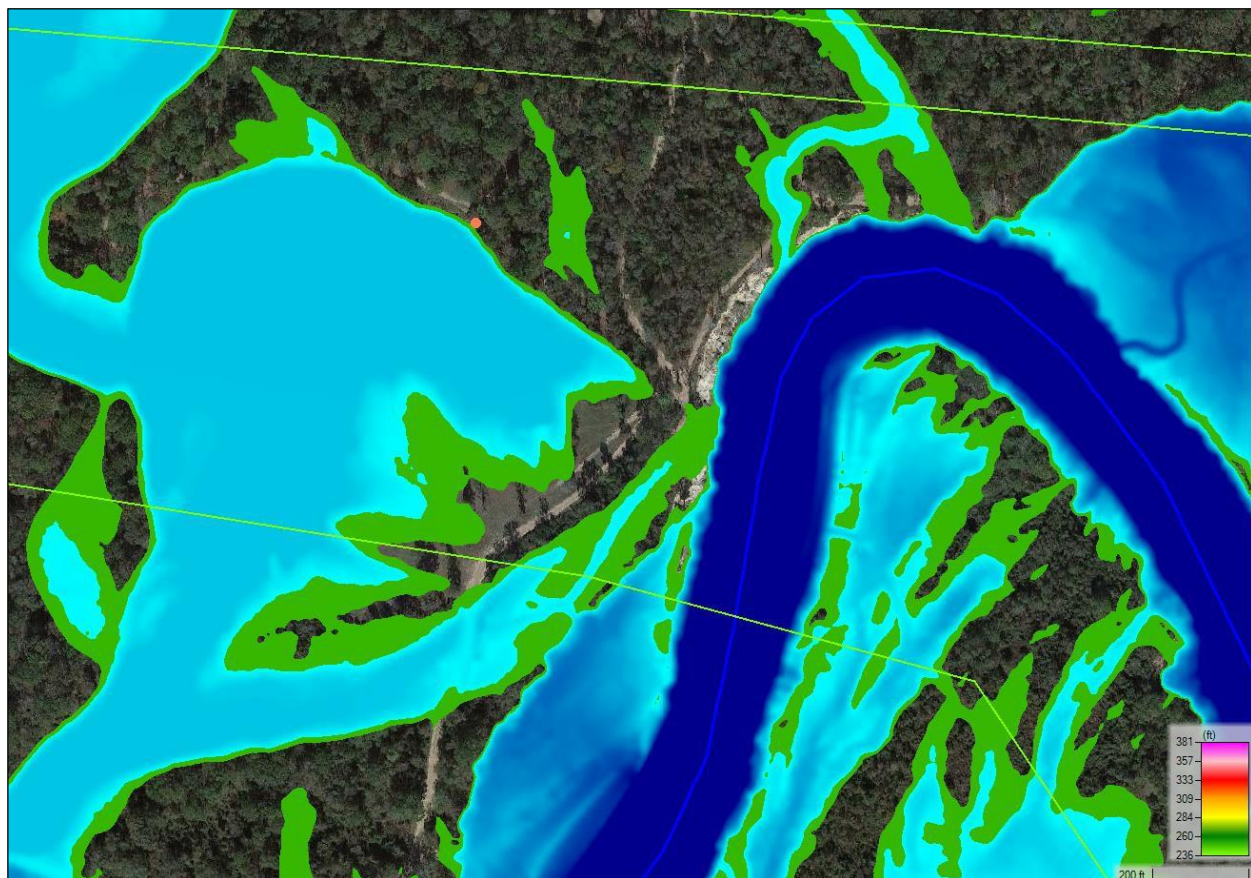


Figure E6-2. An Example of an Incremental Difference in Inundation Mapping (structure is located under orange point) for the 260.1ft pool loading (approximately top of dam) for breach and non-breach pair.

As shown in Figure E6-3, the breach at 260.3 ft indicated an incremental difference in the breach and non-breach pair. Figure E6-4 provides a zoomed-in figure of one of the structures and illustrates that the inundation is closer to the structure for the breach scenario.

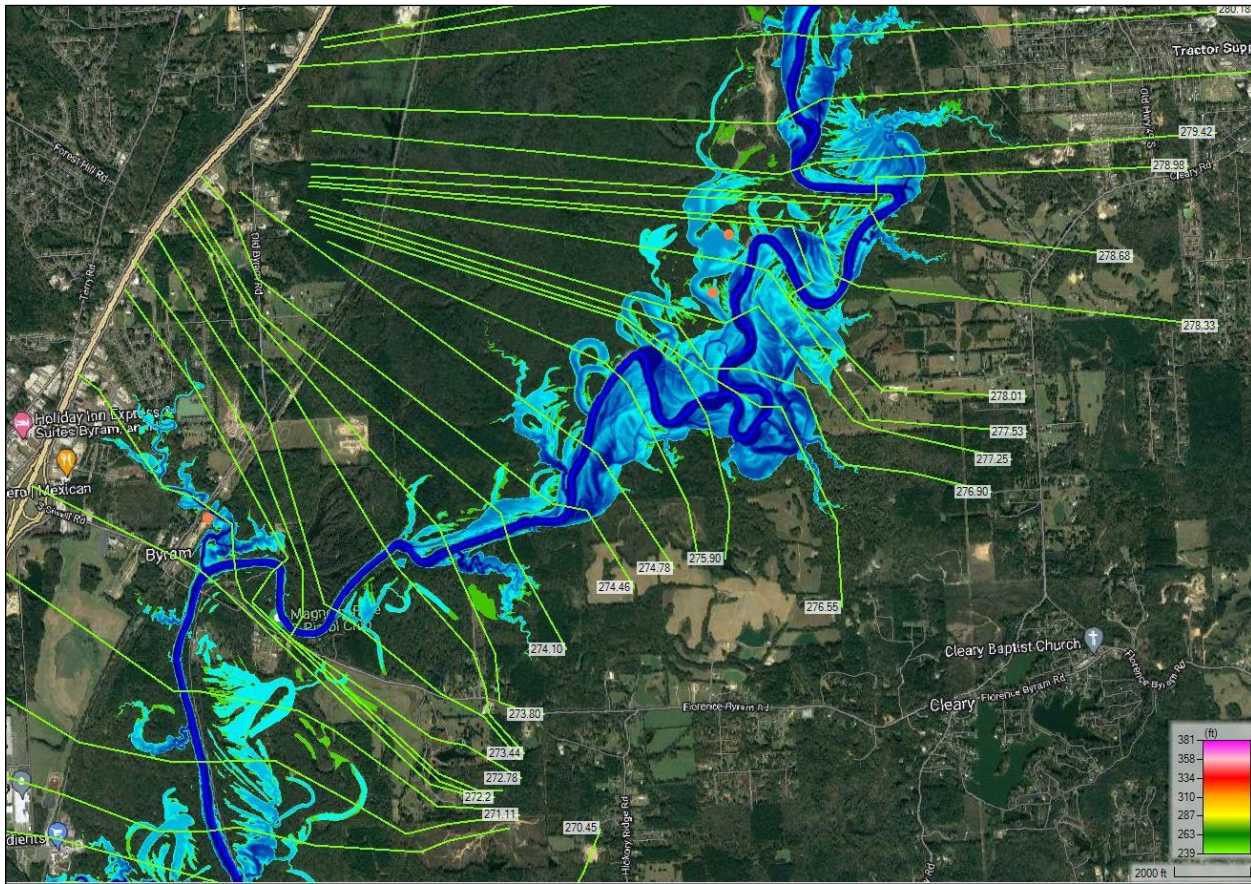


Figure E6-3. Comparison of 260.3 ft Non-Breach (blue) and Breach (green) Indicates a Difference in Inundation Mapping between the Breach and Non-Breach Scenarios

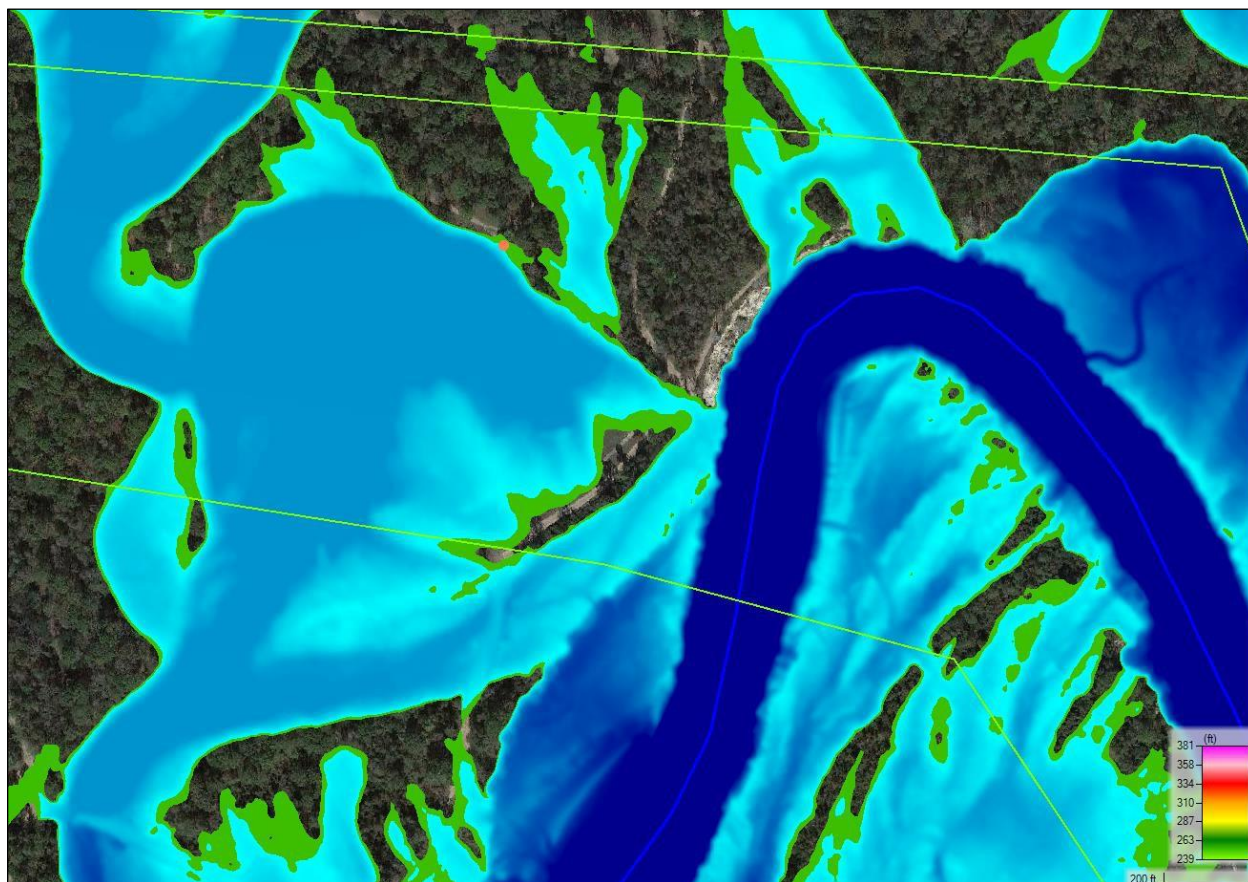


Figure E6-4. An Example of an Incremental Difference in Inundation Mapping (structure is located under orange point) for the 260.3ft pool loading (0.01% AEP x 0.2) for breach and non-breach pair.

As shown in Figure E6-5, the breach a 260.8ft (0.01% AEP x 0.3) showed a minimal incremental difference in the breach and non-breach pair. No structures appeared to be impacted by the 260.8ft breach scenario.

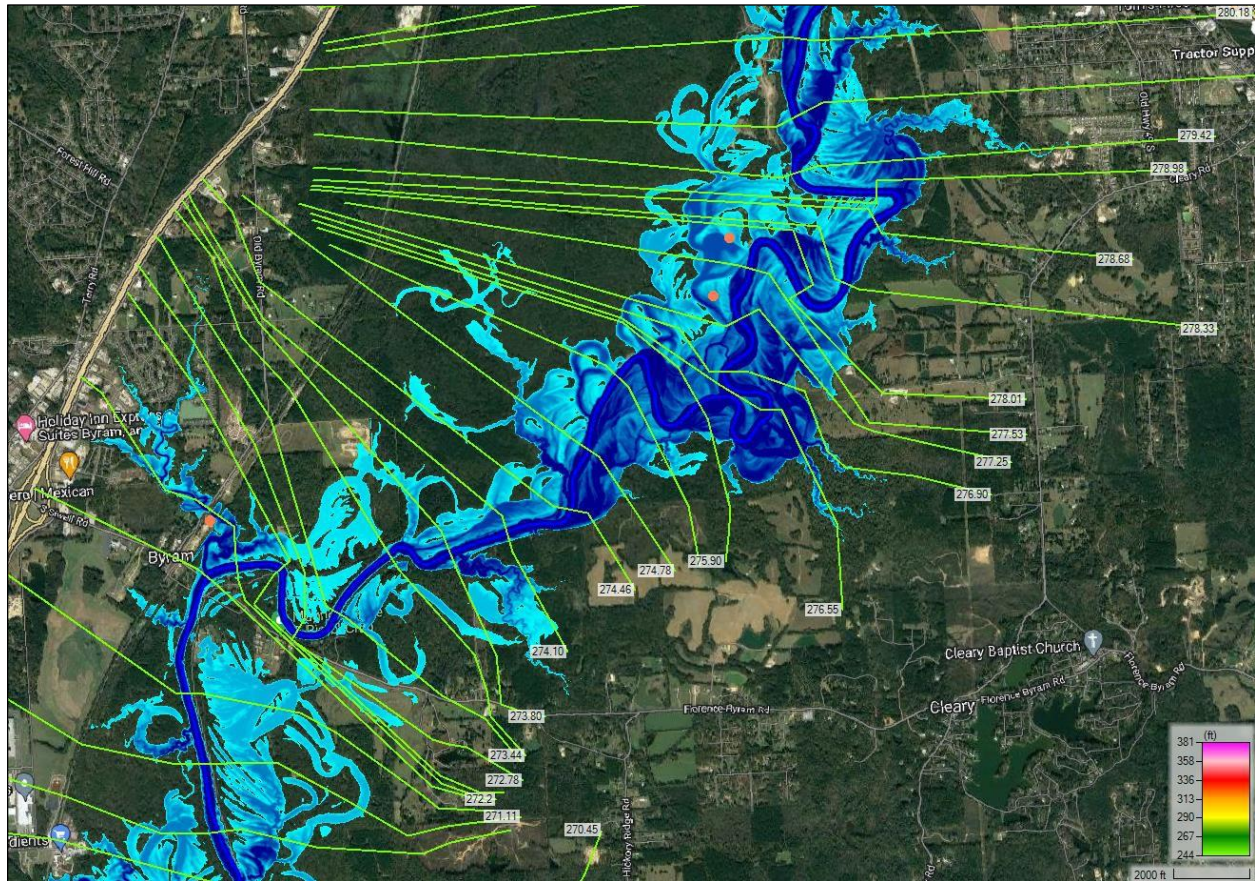


Figure E6-5. Comparison of 260.8 ft Non-Breach (blue) and Breach (green) Shows Minimal Difference between the Breach and Non-Breach Scenarios

As shown in Figure E6-6, the breach at 275.2 ft (1/2 PMF) showed no incremental difference in the breach and non-breach pair.

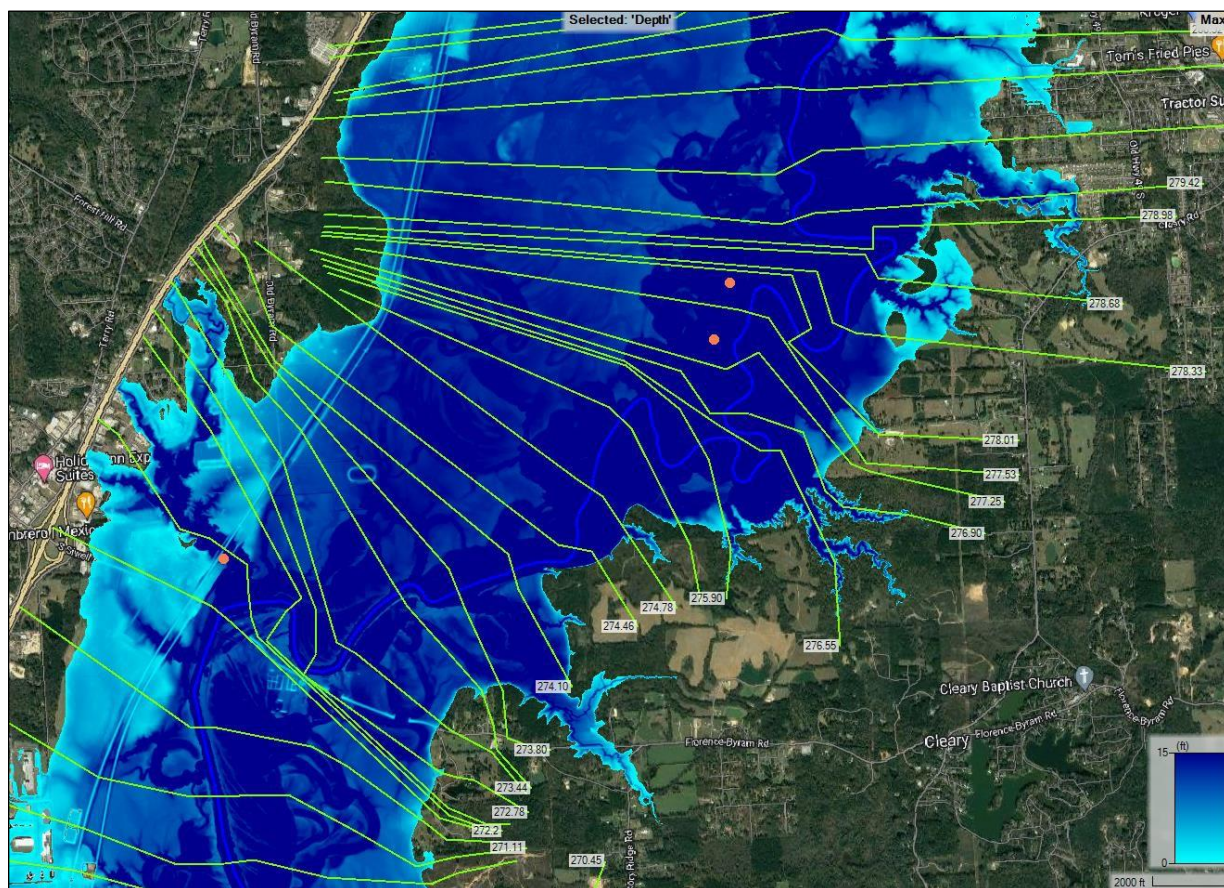


Figure E6-6. Comparison of 275.2 ft (1/2 PMF) Non-Breach (blue) and Breach (green) Shows no Difference Between the Breach and Non-Breach Scenarios

**Table E6-2. Non-Breach Modeling Results at Structure 1 (RS 278.33) and
Byram Junkyard (RS 272.2)**

Loading	Location	Flow	Stage	Location	Flow	Stage
260.1 (approximately top of dam)	RS 278.33	11,354	247.9	RS 272.2	11,336	244.7
260.3	RS 278.33	14,970	250.7	RS 272.2	14,939	247.4
260.8	RS 278.33	22,030	254.8	RS 272.2	21,962	251.1
275.2 (1/2 PMF)	RS 278.33	185,631	270.9	RS 272.2	185,440	267.1

**Table E6-3. Breach Modeling Results at Structure 1 (RS 278.33) and
Byram Junkyard (RS 272.2)**

Loading	Location	Flow	Stage	Location	Flow	Stage
260.1 (approximate top of dam)	RS 278.33	14,530	250.29	RS 272.2	14,181	246.93
260.3	RS 278.33	16,635	251.59	RS 272.2	16,429	248.4
260.8	RS 278.33	22,302	254.82	RS 272.2	22,237	251.3
275.2 (1/2 PMF)	RS 278.33	185,637	270.74	RS 272.2	185,456	267.1

8.4 Design Requirement Estimation – Simulation of Full and ½ PMF

Four breach scenarios were completed with the Alternative C model, to confirm dam safety hazard classification. Per FEMA's federal guidelines to Dam Safety Report 333, there are three hazard classifications as shown below in Figure E6-7, ranging from high to low. Per USACE guidelines 1110-8-2(FR) there are 4 classifications (Table E6-4), 1-4. Given that the proposed dam retains a large volume of water, a high hazard dam would automatically be a standard 1, a significant hazard dam would be either a Standard 1 or 2 depending on amount of property impacts, and low hazard dam would be a standard 3. (FEMA 2004)

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

Figure E6-7. Hazard Potential Classifications

Table E6-4. USACE Design Standards for Dams

Standard	Description	Inflow Design Flood
1	Risk to life and property	Probable Maximum Flood (PMF)
2	Run of river projects (e.g., Navigation)	Standard Project Flood (SPF)
3	Negligible incremental impacts due to failure	Base Safety Condition *** (Minimum ½ PMF)
4	Small dams	1% Annual Exceedance

Two structures that are not listed within the study structure inventory were incrementally damaged by this event. Therefore, there would be no life loss associated with these structures. They appear to be tractor sheds or deer camps that would not be significantly impacted by the additional water when shallow, and at higher flow/elevation breaches, there are no structures that are incrementally damaged. Therefore, for current study purposes the proposed weir for Alternative C will be considered to a significant hazard, standard 3 dam, which requires a ½ PMF design storm.

A more formal I review of terms and damages incurred will be needed during PED to confirm this determination and for any other alternative including a dam moved forward to further study.

8.5 BREACH ANALYSIS OF EXISTING LEVEES

This effort was paused after reviewing the elevation profiles along the river with the weir in place and additional risk at the existing levee features. As the flows increase in the river, risk would be attributed to a riverine flow regime, rather than a ponded body of water. The images below (E6-8) show elevations within the existing levees and show that there would be very little structure impact and very reasonably no life loss if a structure were to breach due to the low flow ponded surface.

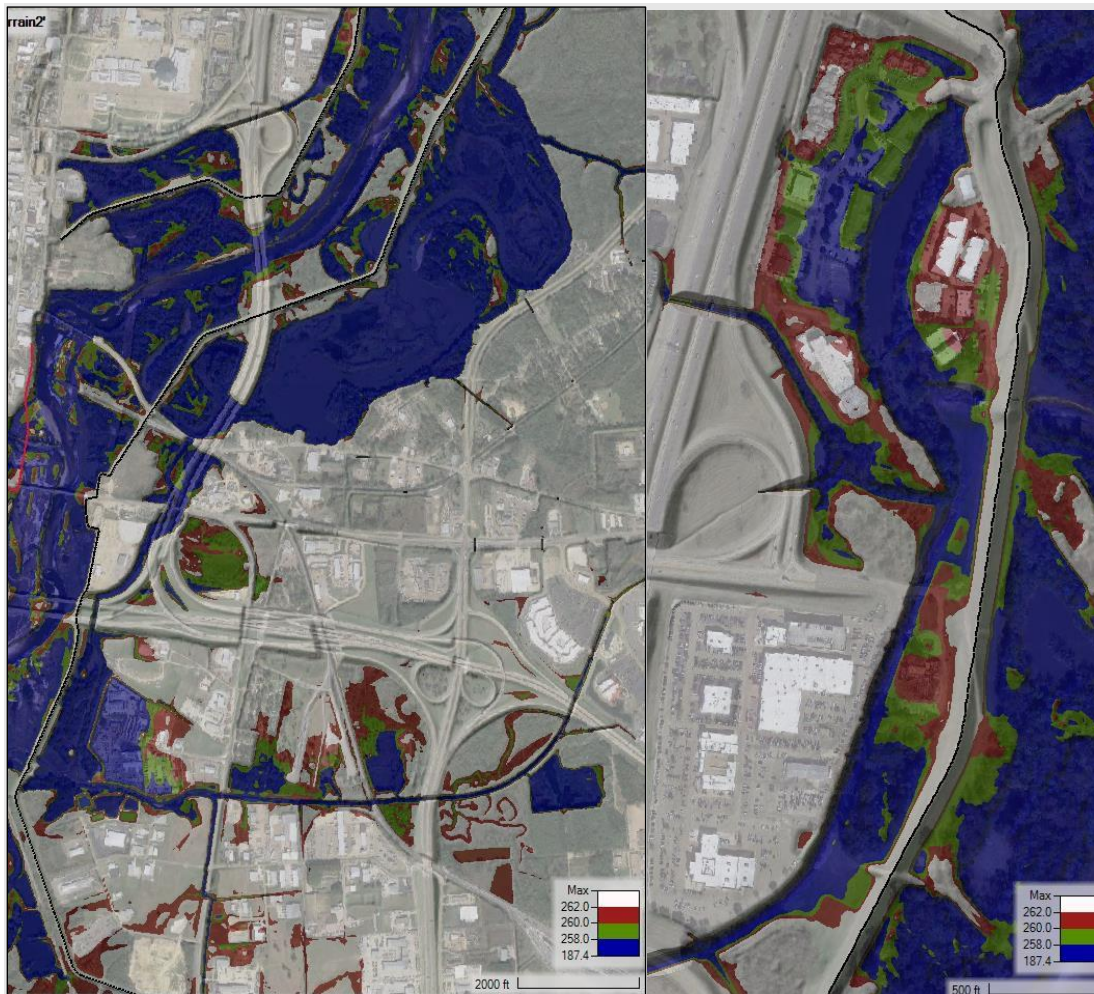


Figure E6-8. Terrain Mapping at Existing USACE Levees

8.6 Levee Safety Risk Analysis- Pearl River Project

A risk assessment was not completed or documented in any of the completed feasibility reports to understand the life safety risks for any of the proposed alternatives for this project. This includes the recent feasibility study prepared by the Non-Federal Interest (NFI) as well as past feasibility studies by USACE. USACE engineering and planning policies require that risk assessments be completed to evaluate the life safety risks during feasibility studies that include levees or dams. The scope and scale of the required risk assessment during feasibility studies may vary; however, an explicit evaluation of life safety is required for projects that include levees or dams.

As part of the USACE review of the current study report, a qualitative evaluation of the potential life safety impacts only considering available information is included. This evaluation focusses on the Alt C plan(s) in terms of levee risk. Additionally, there is insufficient information to assess the life safety risks associated with much of the Alt B plan originally proposed by USACE. A discussion of these limitations is documented. Alternative D 1 or E1 was not considered for this assessment and any dam or levee features selected not covered as part of this effort would need to be fully assessed during later phases of study.

Please note that the Alternative D1 or E1 plan is not included in this assessment, and further investigation will need to be completed after final selection of features. Alternative D1 can be assumed to have the same order of magnitude life safety concerns as Alternative C (ranging from same results to less risk to life loss). Alternative E1 will have less impacts from a Life Safety perspective.

There are three existing levee systems that are impacted as part of the Alt C and Alt B plans that are shown in the National Levee Database (NLD).

1. Jackson Fairgrounds MS (NLD System # 5905000002)
2. East Jackson MS (NLD System # 5905000015)
3. Jackson-East Jackson Flood Control Project (NLD System # 1405000124)

USACE has completed screening level risk assessments for the Jackson Fairgrounds MS and East Jackson MS levee systems evaluating the life safety risks associated with the existing levees. These risk assessments evaluated the existing levee systems only and do not provide any evaluation of alternatives included current and past feasibility studies.

USACE developed the following sections using the available data in the NLD, the data included in the feasibility report, screening level risk assessments of the existing Jackson Fairground MS and East Jackson MS levee systems completed by USACE, and evaluation of this data. A discussion of each of the existing levee systems and the current understanding of these levees and their risk is risks is included. Additionally, the uncertainties and impacts of each of these alternatives are included, along with recommendations to reduce these data gaps and comply with USACE policy as the project advances to later phases of study.

8.7 Jackson Fairgrounds MS (NLD System # 5905000002)

Description of the levee system from the NLD: “The Jackson-Fairgrounds Levee System was constructed in 1968 by USACE to provide flood risk reduction to the eastern portion of Jackson, Mississippi. It is locally maintained by the Rankin-Hinds Pearl River Flood and Drainage Control District. The levee has an average height of 21 feet and has a length of approximately 2 miles. The levee system provides benefits to approximately 1,000 people that work and live behind the levee, with more than \$173 million in land and property value. The primary flood risk concerns are based on local storm runoff, with flooding on the Pearl River being the main source. During past flooding events, seepage (water penetrating through or under the levee) has been noted in isolated areas of the levee. The Levee routinely performs well during yearly flood events, with no breaches, including during an overtopping flood event in 1979.”

The project description information included in the NLD are based on the results of a Screening Level Risk Assessment that was approved by Headquarters USACE (HQUSACE) in January 2017. The population at risk information and land/property value that are reported in the NLD have changed since 2017 and may not be reflective of current conditions and consistent with numbers presented in the feasibility report. Both values have likely increased.

8.8 Existing Overtopping Risks:

The estimated overtopping frequency in the 2017 Screening Level Risk Assessments has about a 500-year annual chance exceedance probability (AEP). The levee overtopped in 1979 near Fortification Street (~ NLD Station 15+00) and did not breach. A small raise of the levee at the overtopping location was completed after the 1979 flood. The current estimated incipient overtopping location is at NLD Station 76+00 near I-55. The levee elevation at this location is about 277 ft which correlates to a Highway 80 gauge reading of 42.02 ft.

Estimated life loss in the event of an overtopping breach is one person or less based on the results of the screening level risk assessment. Most of the levee area would be inundated during an overtopping event and flood depths would be greater than 15 feet in some areas. While inundation depths are high in some areas, the potential overtopping event would be known in advance of the flood and most of the leveed area is commercial with a smaller residential population. The levee board and local government have a plan for warning and evacuating flood prone areas.

8.9 Alternative C – Overtopping Risks:

The currently proposed Alt C being evaluated by USACE does not include any alignment or height changes to the existing Jackson Fairgrounds Levee. The proposed plan would decrease the overtopping risk to the system by reducing the frequency of overtopping. The new, less frequent, overtopping frequency of the system cannot be accurately determined based on information included in the current feasibility study. It is also unknown whether the proposed alternative will change the overtopping location on the levee system. This overtopping frequency and location would need to be calculated in later design phases.

8.10 Existing Prior to Overtopping Risks:

Levee performance and potential lost benefits documented in the NLD that were developed based on the 2017 Screening Level Risk Assessment: “The major performance risk identified with the levee is failure due to the seepage issues observed during historic flood events. The USACE and the Levee District have a plan to address seepage issues as they occur and past efforts to “flood fight” seepage issues have been successful. However, the presence of seepage issues can increase the risk of a levee failure. A levee failure due to seepage would occur suddenly, which reduces the time to warn people and evacuate the area. A reduction in warning time may increase the likelihood of property damage and human fatalities. Another risk driver is a sewer line that had significant inflow and infiltration from flood water prior to The city of Jackson West Bank Interceptor rehabilitation projects. The city’s projects have reduced the risk significantly. The leveed area lacks a flood warning system. The Levee District maintains an Emergency Action Plan that includes notification of Rankin County, Hinds County, and affected municipalities’ Emergency Operations Centers. Flooding of the leveed area would also result in significant property losses and economic damages.”

Estimated life loss in the event of a breach prior to overtopping, such as a levee failure due to seepage, is on the order of one person based on the results of the 2017 screening level risk assessment. It is expected that the estimated life loss due to a breach prior to overtopping would be higher today due to increases in population and likely in the range of 1 to 10. Most of the levee area would be inundated during an overtopping event and flood depths would get greater than 15 feet in some areas. Seepage would be the most likely cause of a failure prior to overtopping. This type of failure can occur rapidly, which can reduce the effectiveness of warning and evacuation. USACE and the local levee Sponsor actively patrol the levees at critical stages and detection and intervention would likely be successful if a seepage problem initiates during a flood event.

8.11 Alternative C – Prior to Overtopping Risks – Jackson Fairgrounds MS Levee System:

The proposed Alt C plan would reduce the frequency of loading on the levee which does **reduce** the probability of high loading levels that could trigger a failure of the levee due to seepage.

Adjacent to the Jackson Fairgrounds MS levee system, the Alt C plan includes placement of fill areas on the riverside of the levee. The Alt C plan also includes construction of a minimum 40-ft wide maintenance berm on the riverside of the levee where there is a permanent pool. It is unknown where this maintenance berm will be a requirement. The riverside fill and maintenance berm will not have a negative impact on the seepage performance of the existing levee system and may reduce the risk of the levee from a seepage failure.

The channel excavations within the Pearl River floodway provide the economic and life safety benefits for this project by reducing the frequency of loading on the existing levee system. The only potential negative impact of the channel excavations is their proximity to the existing levee system. Excavations within the channel have the potential to remove riverside fine-grained blanket soils and create an effective seepage entry point closer to the levee. These excavations have the potential to increase the probability of initiation and progression of a seepage failure mode that can lead to breach. The Alt C plan does include the construction of a 40-ft wide maintenance berm on the riverside of the levee where there is a permanent pool. It is expected that the final design will be optimized during later design phases to widen the berm towards the riverside to eliminate the potential negative impacts of the channel excavation negatively impacting the performance of the existing levee system. (Figure E6-9).

The one area on the levee system where the minimum 40-ft wide maintenance berm cannot be constructed and where permanent pool may be against the levee is at an existing pump station (see image below). At this location the presence of the permanent pool may require additional seepage control measures that presently do not exist. Those measures would potentially include cutoff walls and/or relief wells. The overall length of existing levee that may require mitigation at the existing pump station is in the range of 500 to 1000 ft. If required, these mitigation measures would reduce the probability of failure of the existing levee system to a tolerable level compared with the overall levee overtopping risks.

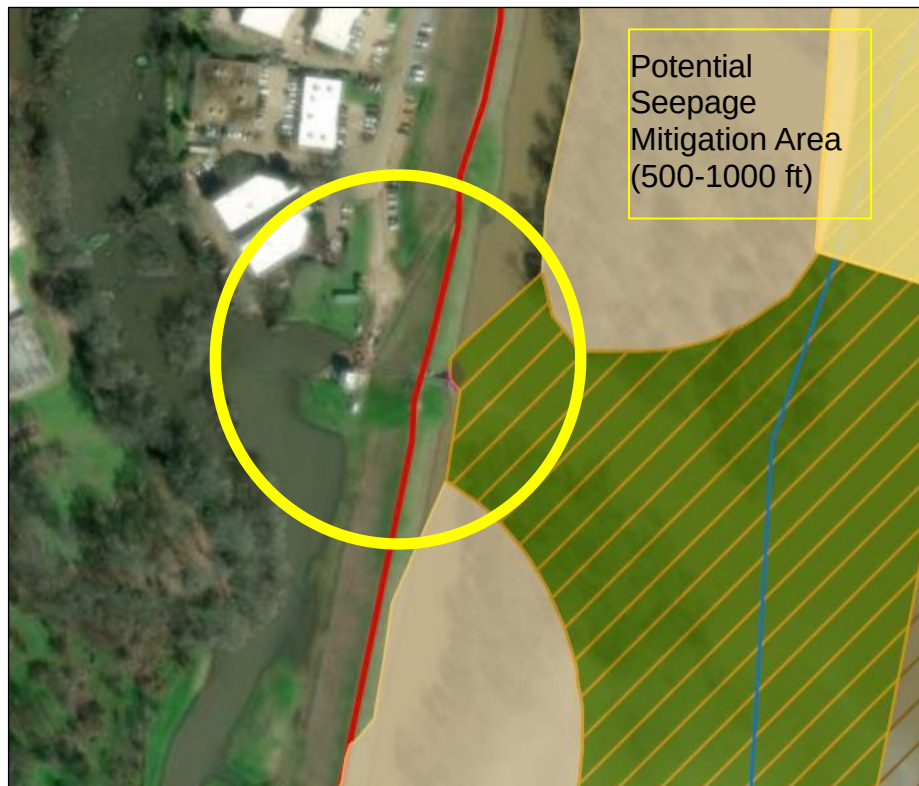


Figure E6-9. Potential Seepage Mitigation Area-Jackson Fairgrounds Levee

8.12 East Jackson MS (NLD System # 5905000015)

Description of the levee system from the NLD: “The East Jackson Levee System, located within Rankin County, Mississippi, was federally constructed in 1968 along the left descending bank of the Pearl River and provides risk reduction to the towns of Pearl, Flowood, and Richland. The levee system is approximately 13.5 feet tall and has an approximate length of 11.4 miles. The East Jackson Flood Control Project provides benefits to more than 10,000 people that work and live behind the levee, with more than \$972 million in land and property value. The primary flood risk concerns are based on local storm runoff, with flooding on the Pearl River being the main source. Minor seepage (water penetrating through or under the levee) has been noted in isolated areas of the levee in the past, but none during the most significant high-water events. The levee routinely performs well during yearly flood events with no breaches, including during the record flood of 1979.”

The project description information included in the NLD are based on the results of a Screening Level Risk Assessment that was approved by HQ USACE in May 2016. The population at risk information and land/property value that are reported in the NLD have changed since 2016 and may not be reflective of current conditions and consistent with numbers presented in the feasibility report. Both values have likely increased.

8.13 Existing Overtopping Risks:

The estimated overtopping frequency in the 2016 Screening Level Risk Assessments has about a 500-year annual chance exceedance probability (AEP). The East Jackson levee did not overtop in 1979 when the Jackson Fairgrounds system on the west side of the river overtopped. Since a small raise of the overtopping location on the Jackson Fairgrounds system did occur after 1979, it is unknown whether the East Jackson system still has superiority over the Jackson Fairgrounds system. The current estimated incipient overtopping location is at NLD Station 384+00. The levee elevation at this location is about 274.6 ft which correlates to a Highway 80 gauge reading of 41.65 ft.

Estimated life loss in the event of an overtopping breach is about one person based on the results of the screening level risk assessment in 2016. The daytime and nighttime population at risk has increased within the leveed area since completion of the 2016 risk assessment and the estimated life loss has likely increased to within the range of 1 to 10. Most of the levee area would be inundated during an overtopping event and flood depths would get greater than 15 feet in some areas. While inundation depths are high in some areas, the potential overtopping event would be known in advance of the flood and most of the leveed area is commercial with a smaller residential population. The levee board and local government have a plan for warning and evacuating flood prone areas.

8.14 Alternative C – Overtopping Risks:

The currently proposed Alt C being evaluated by USACE does not include any alignment or height changes to the existing East Jackson Levee. The proposed plan would decrease the overtopping risk for a majority of the system by reducing the frequency of overtopping.

However, inducements below the CN railroad raise the overtopping frequency by up to 0.4 feet for the 1% ACE. The new overtopping frequency of the system cannot be accurately determined based on information included in the current feasibility study. It is also unknown whether the proposed alternative will change the overtopping location on the levee system. This overtopping frequency and location would need to be calculated in later design phases.

8.15 Existing Prior to Overtopping Risks:

Levee performance and potential lost benefits documented in the NLD that were developed based on the 2016 Screening Level Risk Assessment: “The major performance risk identified with the levee is failure due to the seepage issues observed during historic flood events. The USACE and the Levee District have a plan to address seepage issues as they occur and past efforts to “flood fight” seepage issues have been successful. However, the presence of seepage issues can increase the risk of a levee failure. A levee failure due to seepage would occur suddenly, which reduces the time to warn people and evacuate the area. A reduction in warning time may increase the likelihood of property damage and human fatalities. The leveed area lacks a flood warning system. The Levee District maintains an Emergency Action Plan that includes notification of Rankin County, Hinds County, and affected municipalities’ Emergency Operations Centers. Flooding of the leveed area would also result in significant property losses and economic damages.”

Estimated life loss in the event of a breach prior to overtopping, such as a levee failure due to seepage, is on the order of 1 to 10 people based on the results of the 2016 screening level risk assessment. It is expected that the estimated life loss due to a breach prior to overtopping would be higher today due to increases in population and likely in the range of 3 to 30. Most of the levee area would be inundated during an overtopping event and flood depths would get greater than 15 feet in some areas. Seepage would be the most likely cause of a failure prior to overtopping. This type of failure can occur rapidly, which can reduce the effectiveness of warning and evacuation. USACE and the local levee Sponsor actively patrol the levees at critical stages and detection and intervention would likely be successful if a seepage problem initiates during a flood event.

8.16 Alternative C – Prior to Overtopping Risks – East Jackson MS Levee System:

The proposed Alt C plan would reduce the frequency of loading on the levee which does *reduce* the probability of high loading levels that could trigger a failure of the levee due to seepage.

Adjacent to the East Jackson MS levee system, the Alt C plan includes the construction of spoil disposal areas on the landside of the levee. These soil disposal areas will effectively function as “seepage berms” in the areas where they are constructed (Figure E6-10). Thus, the probability of breach due to seepage at a given flood stage will likely decrease in areas where spoil disposal is placed on the landside of the levee. This decrease would only occur in areas where the “seepage berms” are placed as part of spoil disposal. The feasibility study does not identify whether the proposed locations of the spoil piles are in the most critical seepage areas of the existing levee. Therefore, the overall probability of a seepage failure of the levee system during a given flood stage may not decrease but would certainly not increase because of the placement of spoil piles on the landside with the Alt C plan.

The channel excavations within the Pearl River floodway provide the economic and life safety benefits for this project by reducing the frequency of loading on the existing levee system upstream of the CN railroad Bridge. The channel excavations within the Pearl River floodway induce flooding and increase the frequency of loading on the existing levee system downstream of the CN railroad Bridge. Another potential negative impact of the channel excavations is their proximity to the existing levee system. Excavations within the channel have the potential to remove riverside fine-grained blanket soils and create an effective seepage entry point closer to the levee. These excavations have the potential to increase the probability of initiation and progression of a seepage failure mode that can lead to breach. The Alt C plan does include the construction of a 40-ft wide maintenance berm on the riverside of the levee where there is a permanent pool. It is expected that the final design will be optimized during later phases of study to widen the berm towards the riverside to eliminate the potential negative impacts of the channel excavation negatively impacting the performance of the existing levee system.

Similar to the Jackson Fairgrounds system, the one area on the East Jackson levee system where the minimum 40-ft wide maintenance berm cannot be constructed and where permanent pool may be against the levee is at an existing pump station and major sump area (see image below). The existing levee south of the pump station may also be subject to a permanent pool as well, but the most critical location will be near the pump station. The presence of the permanent pool will likely require additional seepage control measures that presently do not exist. Those measures would potentially include cutoff walls and/or relief wells. The overall length of existing levee that may require mitigation at the existing pump station and sump is in the range of 500 to 1000 ft. Although unlikely, there is the potential that isolated areas along the existing levee may require seepage mitigation south of the pump station, but that is unknown at this time and would need to be evaluated during later phases of design. If required, these mitigation measures would reduce the probability of failure of the existing levee system to a tolerable level compared with the overall levee overtopping risks.

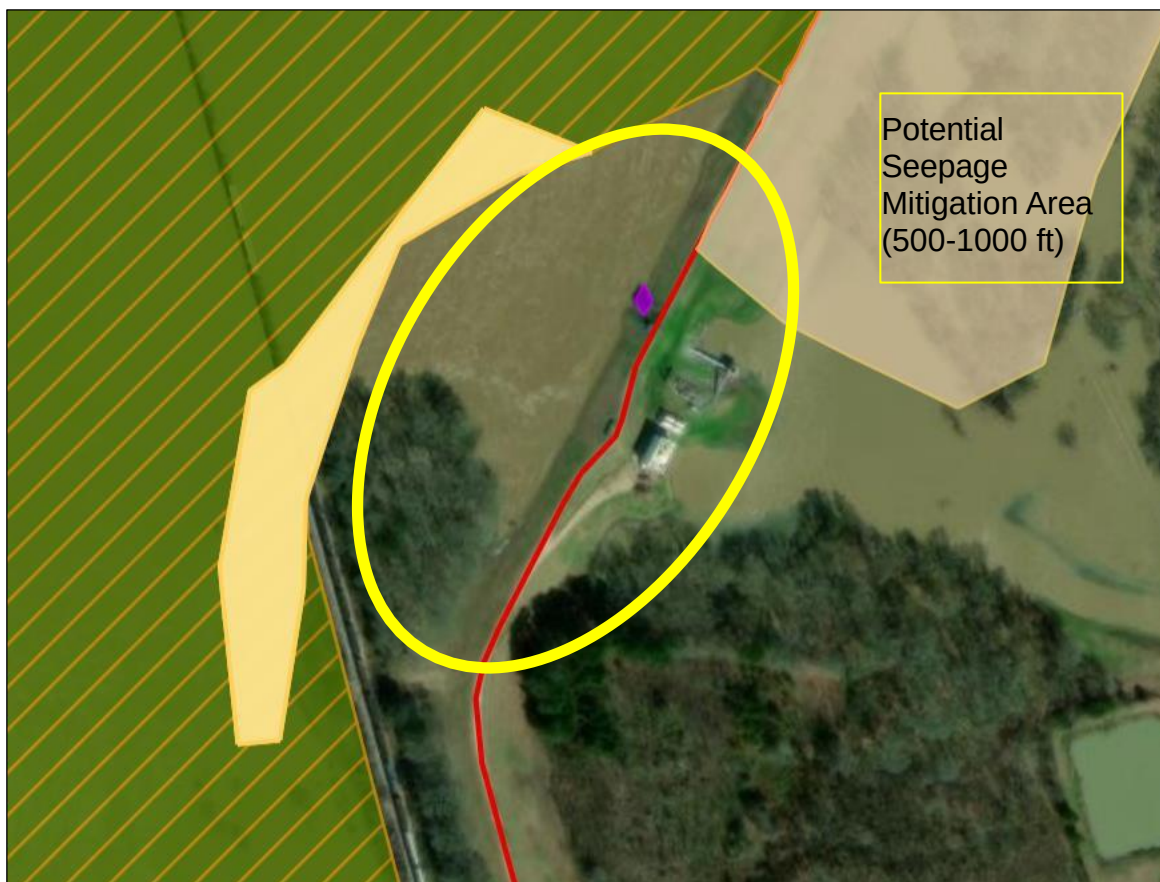


Figure E6-10. Potential Seepage Mitigation Area- Jackson East Levee

8.17 Jackson-East Jackson Flood Control Project (NLD System # 1405000124)

The NLD has limited information regarding this levee system. The Jackson-East Jackson Flood Control Project is a non-Federal levee system. The condition of the levee is unknown by USACE, and a risk assessment has not been completed for this levee. The levee is approximately 2.69 miles long and provides flood risk reduction to the wastewater treatment facility for the city of Jackson, MS. The levee system is believed to not have overtopped or breached during past flood events, in part due to flood fighting. Anecdotally, there may be potential seepage concerns for the existing levee. Upgrades to the existing levee will likely be required to bring the existing levee up to USACE standards. The extent of these potential upgrades is unknown but could be extensive. The improved upstream flow capacity for the Alt C plan will increase the probability of loading and overtopping on this system, which will necessitate a raise of the levee. The amount of the raise is unknown.

8.18 Frequency of Overtopping

A formal re-analysis of specific overtopping frequency by plan was paused for the purposes of this study.

The HEC-RAS modeling shows that the Jackson East, Jackson Fairgrounds, Pearson, the local levee behind Jackson East, and the Savanna Street WWTP Levees protect to the 100- year level of protection for Existing Conditions. The Brashear's Creek Levee does not protect to the 100-year level of protection.

Jackson East will have flood elevations both raised and lowered along the levee profile. The Jackson Fairground and Pearson Levees will not have flood elevations raised along the levee profile. However, constant loading along the Jackson East and Jackson Fairground will be raised significantly. The Savanna Street WWTP levee will require a levee raise that has not yet been designed to combat inducements for Alternative C. The Local levee behind the Jackson East Levee may have impacts, depending on the final design of Alternative C. The impact to the local levee will be further defined and mitigated to Alternative C in a later phase of study, as needed. The overtopping frequency and location would need to be calculated in later design phases as well.

8.19 Savannah St. Wastewater Treatment Facility (NLD System # 14050000124)

The current H&H modeling completed by USACE indicates that the existing Savannah Street WWTF levee will not need to be raised. However, there remains performance concerns for the existing levee. Based on review of the geotechnical Report No. 180048 completed by Burns Cooley Dennis, Inc., (BCD) dated Jun 4, 2018, portions of the existing Savannah Street WWTF levee do not meet USACE factors of safety for seepage. The recommended mitigation measure by USACE for the existing levee to meet USACE factors of safety for seepage is a cutoff wall that extends through the alluvium into the underlying Yazoo Clay (CH) deposits. Based on review of the BCD report, it is recommended that the cutoff wall extend from approximately Sta. 45+00 to 105+00 (approximately 6,000 linear feet).

The proposed cutoff wall will have an average depth of 40 feet (minimum/maximum depths ranging from 30 ft to 45 ft, respectively) for estimating purposes. It will be constructed on the flood side of the levee and will require a clay cap to tie into the existing levee. Approximate clay cap volume of 22,000 cubic yards (estimated 5 ft thick clay cap about 20 feet wide). Contractor furnished clay (CL) fill material will be required for the clay cap compacted to 95% of standard proctor maximum dry density.

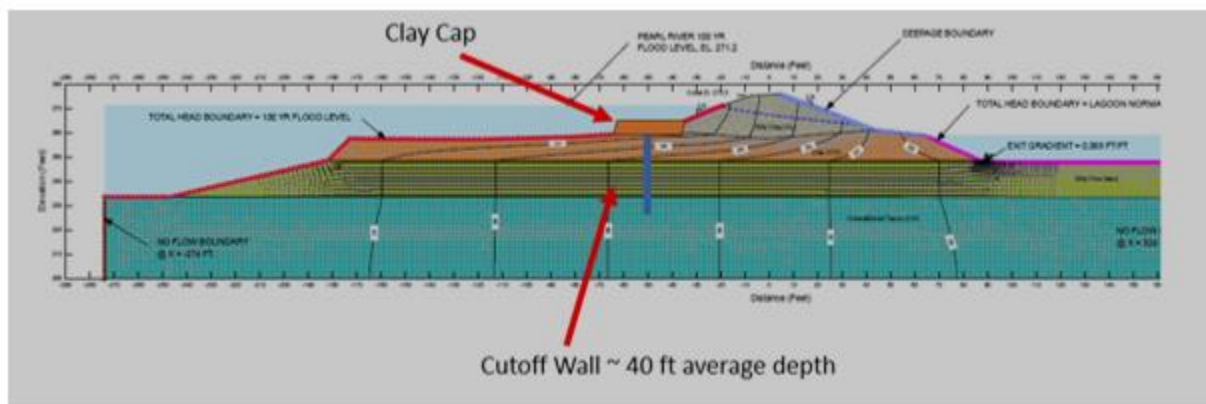


Figure E6-12. Savannah Street WWTP Levee- Clay Cap and Cutoff Wall Schematic

8.20 System Response (Probability of Failure) of Existing Savannah St. WWTP Levee

System response curves were developed for the two critical cross sections identified in the BCD report, cross sections at the location of Borings B-3 and B-5. The seepage failure mode that is driving risk for the project is Backward Erosion and Piping of the alluvial foundation. The system response curve was developed with a simplified elicitation of the nodal event tree shown below for a range of loading conditions on the existing levee. A summary of the factors influencing the elicited values for each node at the critical cross sections of Boring B-3 and B-5 are discussed in this document.

Backward Erosion Piping

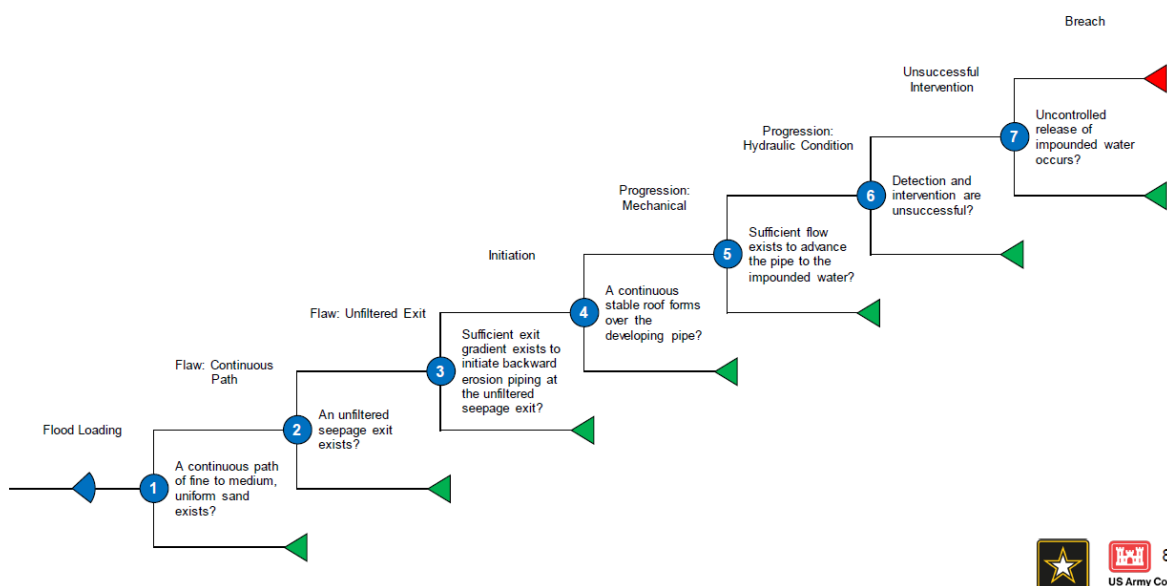


Figure E6-13. Backward Erosion and Piping Failure Analysis, Savannah Street Wastewater Treatment Plant

1. Flaw: A continuous path of fine to medium, uniform sand exists?

Most of the substratum sands consist of silty sands (SM). The borings at the most critical locations at centerline Borings 3 and 5 are the most critical in terms of having factors of safety against uplift of 0.4 and 1.05 for a river elevation of about 271 ft. Six gradation tests from those two locations range from 15.3 to 25.1 percent. The average percent fines of the SM in those two borings are 18.9% and median of 18.1%, respectively.

There are two borings in the riverside that show a 4-ft thick layer of slightly silty sands (SP-SM) soils and a clean sand (SP) below about EL 24 ft. Fines content of clean sands of 35% from one gradation test. No landside or levee centerline borings show the SP and SP-SM soils.

Elicitation Rationale: A continuous path of fine to medium uniform sands (SP or SP-SM) soils is not present at the two critical boring locations (Borings 3 and 5). However, there are two riverside borings that do show some SP and SP-SM soils. For these reasons a value of 0.5 (50% chance) was conservatively elicited as the likelihood of a continuous path of SP or SP-SM soils at the site.

2. Flaw: An Unfiltered Exit Exists.

There is no designed landside filter on this project so the likelihood of an unfiltered exit at both critical locations was 1.0 (100%).

3. Initiation: Sufficient Vertical Gradient Over Continuous Path with Unfiltered Exit

This node in the event tree is typically linked with the vertical gradient required to heave the landside blanket above the underlying aquifer. The results of the analyses completed by BCD shows factors of safety of 0.4 and 1.05 for a river elevation of about 271 feet at the cross sections at the locations of Borings B-3 and B-5. The factor of safety well below unity at Boring B-3 is easily explained by the absence of a natural blanket within the wastewater lagoon based on the assumed stratification at this cross section. While there is no natural blanket, sediments tend to accumulate on the bottom of the wastewater lagoon and it is reasonable to assume that there is typically a layer of fines that is present such that effectively functions as a blanket of unknown thickness. The natural blanket at the location of Boring B-5 within the landside wastewater lagoon is about 9.5 ft thick.

Elicitation Rationale: Elicitation was conducted for the cross sections at Boring B-3 and B-5.

Boring B-3. The likelihood of initiation was likely (0.9) to virtually certain (0.999) for flood loadings ranging from about EL 268 ft to the top of levee (EL 275.5 ft). It was unlikely (0.1) at a lower-level flood event at EL 263 ft since the levee is typically loaded to this level multiple times annually and there have been no reports or documented observations of distress during low-level, routine annual floods. This is likely due to the impact of sedimentation in the sewage lagoon.

Boring B-5. The likelihood of initiation was estimated to range from less than neutral (0.4) to virtually certain (0.999) for flood loadings ranging from about EL 258 ft to the top of the levee (EL 275.5 ft). It was very unlikely (0.01) to initiate at a lower-level flood at EL 263 ft since the factor of safety against heave of the blanket is above 1.0 at the lower-level floods and the levee is typically loaded to this level multiple times annually and there have been no reports or documented observations of distress during low-level, routine annual floods.

4. Stable Roof to Advance a Seepage Pipe

The existing levee and/or fine-grained blanket are both made of clay (CL/CH) materials and will support a roof; therefore, it was considered virtually certain (0.999) that a stable roof would form for both cross sections evaluated.

5. Sufficient Horizontal Gradient/Flow to Advance a Seepage Pipe to the River

In order to evaluate this node, the USACE RMC Backward Erosion Piping (Progression) Toolbox was utilized to estimate the potential for a backwards erosion pipe to have sufficient energy to progress from a landside exit to the river. The Schmertmann method in this toolbox is considered the most representative of the materials present at this site and was used for this evaluation. Some of the key assumptions used in the toolbox are summarized below. These assumptions were developed based on interpretation of data presented in the BCD report.

- Most likely coefficient of uniformity of 4.0 used based on grain size data
- Direct seepage length at Boring B-3 ~ 270 ft
- Direct seepage length at Boring B-5 ~ 290 ft
- No higher permeability underlayers
- No correction factor was applied to the field critical gradient.

Elicitation Rationale: The resulting probabilities from the erosion toolbox were used directly as the nodal estimate. The estimates for this node at the location of Boring B-3 and B-5 were similar and ranged from virtually impossible (0.001) at events at or below EL 263 ft to as high as less than likely (0.08) at the top of levee (EL 275.5 ft). The relatively long seepage path for the range of differential heads and relatively high coefficient of uniformity are what drive the low to very low likelihood of a full seepage piping developing. These conclusions are given further credence by the following statement in the BCD geotechnical report “Although the factors of safety are low, the estimated flow rates are relatively low, which would reduce the potential for piping.” The erosion toolbox estimates are indicative of a scenario that would have low flow rates.

6. Duration and Size of Seepage Pipe Sufficient to Cause Breach

This node in the event tree for both boring locations was likely (0.9) for flood events greater than about EL 268 ft. Development of full breach was neutral (0.5) for flood events at about EL 263 ft because the levee would have about 12 feet of freeboard if a breach started to form at that type of event.

7. Detection and Intervention is Unsuccessful

This node was assumed to be 1.0 for all scenarios due to the difficulty of detecting distress within the wastewater seepage lagoon in sufficient time to be able to successfully intervene during a flood.

8.21 Conclusion and Results:

The resulting system response curves for prior to overtopping of the levee at the two cross sections evaluated are presented below. When combined with the flood frequency for the various river stages, the overall annual probability of failure of the Savannah Street Wastewater Treatment Plant Levee is approximately $1\text{E-}4$. The system response curves presented below can be used in the economic analysis for this feature of work for evaluating failure prior to overtopping of the levees. During PED for this project, it may be possible to eliminate or reduce the current recommended seepage cutoff depending on the results of more refined geotechnical or risk analyses.

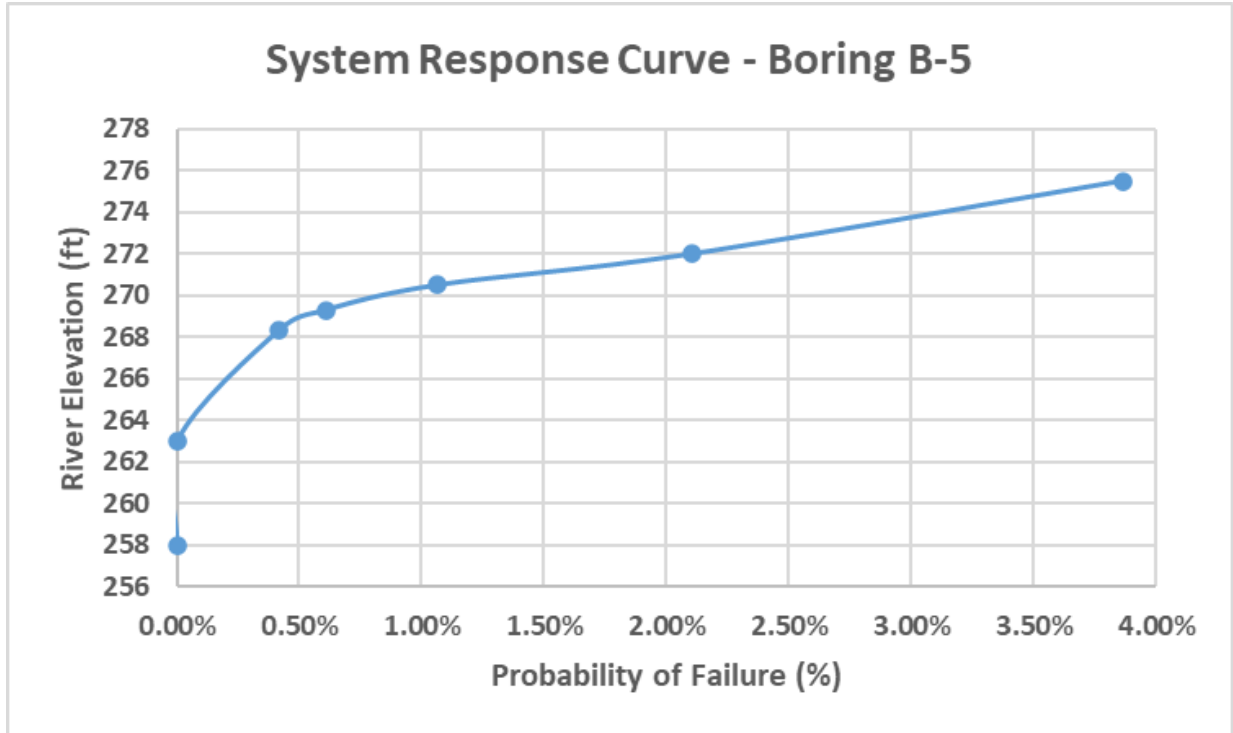


Figure E6-14. System Response Curve – Boring B-5

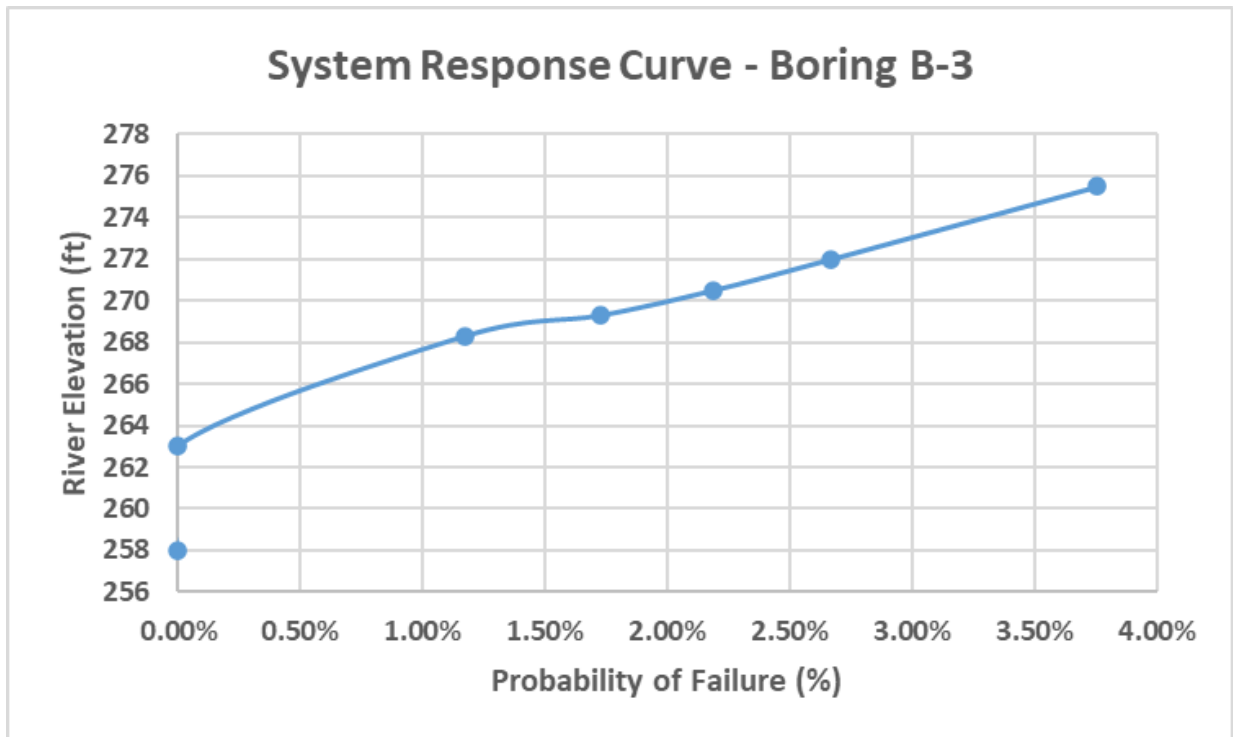


Figure E6-15. System Response Curve Boring B-3

8.22 Proposed Levee Systems

An analysis of existing conditions was completed to demonstrate maximum possible breach depths. Cany Creek, Canton Club, and McLeod levees would have structures flooded above 6 feet of depth at the 500-year return interval and would need higher levels of risk assessment to ensure effective risk reduction for the communities. Richland Levee does not experience flooding above 6 feet in depth at the 500-year flood event.

Section 9 Climate Change

Section has been removed.

Section 10

Items Deferred to Future Study

10.1 SEDIMENT ANALYSIS AND MANAGEMENT

Potential direct impacts to water supply and flood conveyance due to the deterioration of water quality or quantity from the existence of the proposed weir that could impact sediment load within the newly formed reservoir due to reduced velocities and entrainment potential. A sedimentation study is necessary assess the viability of project features during a future phase of this study. The impacts to water quality and conveyance to the proposed project are inconclusive due to the lack of data, and modeling efforts within the project area. No sediment samples have been provided or analyzed from the Ross Barnett Reservoir or downstream project area either on the main Pearl River channel or tributaries, for use in this study.

To determine if impacts are acceptable, additional analysis is needed. Verification would be needed to demonstrate that adding a large weir would not induce sediment loads to alter the incoming chemistry in such a way to induce failure at the existing J.H. Fewell Plant or any other proposed structure along the newly ponded area. Determination of Sediment Oxygen Demand (SOD) for Pearl River sediments that will lie under Preferred Project Lake.

Impoundment will increase the depth over the sediments potentially decreasing the dissolved oxygen (DO) in water column immediately adjacent to sediments. Deeper waters when combined with SOD could possibly result in bottom water hypoxia and anoxia.

Verification also would be needed to verify that sedimentation passed from the Ross Barnett Reservoir within a proposed ponded feature would not impact storage or conveyance of flood waters. Assessment of the tributaries for sediment load as well as the requirement of Hard Points in tributary channels to prevent incision and additional sediment into newly constructed lake would be needed.

The study described above must be completed prior to the initiation of construction phase.

10.2 WATER QUALITY

The NFI provided two distinct modeling studies, which used available data to evaluate water quality impacts the of construction of a new lake (Alternative C) on the Pearl River below Ross Barnett Reservoir. USACE Efforts were limited to review of the NFI work and recommendation for any future efforts. Modeled impacts predicted were of short duration and limited reach. A major premise of the efforts is that the waters filling the new lake are essentially those of Ross Barnett, so no significant water quality issues are expected. The studies concluded that below the proposed lake, water quality impacts in the Pearl River due to any flow alterations are muted and not substantial.

A key aspect of these studies is that the waters of the proposed lake are essentially those released from Ross Barnett and that they receive no loadings while in the proposed lake which may degrade water quality conditions. The study concluded that the three existing point sources that contribute to the project area are either not significant enough or do not directly contribute to the proposed lake waterbody, so as to not degrade the new lake water quality. However, the impact of stormwater loads upon the receiving waters of the proposed lake is poorly understood and characterized. Compounding this issue are the condition of the Jackson sewer system and the reported number of overflows and leaks. A common assumption is that sanitary sewer leaks potentially reach receiving waters via the stormwater drainage

system. The degree to which the watershed of the proposed lake is susceptible to receiving sanitary sewage overflows via the stormwater collection system is unknown.

Key Findings from a review of the provided modeling results and reports are indicated in the list below:

4. This review focused on water quality information contained in Appendix D of the NFI report. Both existing data and modeling provided in support of proposed project were reviewed. In addition, information contained within other sections of the report as well as recent news articles that have potential impacts upon water quality conditions in proposed project were considered in this review.
5. The NFI report indicates that three options were originally considered for alleviating flooding issues along Pearl River in vicinity of Jackson. Option A consisted of buyouts of flood prone properties. Option B involved raising levees along Pearl while Option C consisted of channel improvements, levee improvements and construction of a weir on the Pearl south of Interstate 20. This channel, levee, and weir plan is referred to in the documentation as the “One Lake” plan and was the preferred plan after analysis by report’s authors.
6. The documentation provided contained components of two separate water quality modeling studies. One study conducted by FTN Associates used a 1D dynamic riverine water quality model, EPD-RIV1. This model was developed from CE-QUAL- RIV1 by the Environmental Protection District of Georgia Department of Natural Resources. The focus of this study was the section of the Pearl River from below Ross Barnett Reservoir to the proposed weir of Alternative C. The second modeling study was performed by Tetra Tech and used WASP for Water Quality and EFDC for hydrodynamics. The domain of this second modeling effort was the Pearl River from below Ross Barnett Reservoir to Bogalusa, LA.
7. Existing historic water quality data available at time of model development were used to support model development and application. There is very limited data in study area and no long-term monitoring stations other than some data predating construction of the Ross Barnett reservoir (1963).
8. Mississippi Department of Environmental Quality (MDEQ) performs biannual assessments of water quality conditions. At time of report generation, current (2016) and earlier, (2008, 2010, 2012, 2014) MDEQ 305(b) reports indicated that some water bodies in study area had not attained secondary contact use conditions, were not attaining aquatic life support use, or were not addressed during frequent reporting periods.
9. There are limited existing point source dischargers within the preferred plan area. One is the O.B. Curtis water treatment plant just below Ross Barnett Reservoir. Its discharge consists of backwash waters which are permitted. This discharge is several river miles above project limits for channelization and is not expected to have detrimental impacts on overall water quality due to flow rate in river and low level of loadings. The Savannah Street Wastewater Treatment plant is the second permit and discharges into Pearl River below proposed project. Therefore, it should have no direct impact upon waters within the proposed One Lake project.
10. Report indicates city of Jackson (as of 2020) is under EPA consent decree for Sewer collection system overflows and Savannah Street WWTP overflows. This consent decree began in 2012 and was projected in report to continue until 2030. During this period Jackson is supposed to work to implement corrective action for collection system overflows and prevent Publicly Owned Treatment Work (POTW) bypasses in addition to preventing Savannah Street WWTP overflows. As of 2019 Jackson was behind the planned Consent Decree schedule. Status of this work is ongoing. In terms of direct impact to proposed project, the elimination of sewer overflows and bypasses that directly enter waters of proposed project directly or indirectly from stormwater runoff are primary concern. Overflow locations and

quantities are not presented in the report nor are locations where these flows enter the Pearl River. Depending upon the magnitude of these flows there is potential to degrade waters in proposed lake.

11. One impact of the Savannah Street Wastewater Treatment Plant upon the proposed project is that its permit requires a minimum flow in Pearl River of 227 cfs. The proposed weir has features (low flow gate) to enable this minimum flow to be provided.
12. A review of available historical water quality data indicate that it compares favorably with current water quality standards. This implies that water quality conditions in existing system in terms of traditional water quality criteria are acceptable. This information is presented as a summary table. Individual data is not presented but is believed to be contained in figures later in report. Water quality in existing river was not degraded below current standards during the periods that were historically sampled either in 1988-89 or August 2006. However, verification is needed to confirm that this status still applies.
13. Total Maximum Daily Loads (TMDLs) have been established for the Pearl River in the vicinity of Jackson for Total Nitrogen, Total Phosphorus, Toxaphene and Dichlorodiphenyltrichloroethane (DDT). Total Phosphorus TMDL was updated in 2015 to 70% recommended reduction for the river between Ross Barnett and Strong River. Status of efforts implemented to meet this goal are unknown.
14. Not covered in water quality section of report but of concern are conditions for former facilities in the footprint of the project. Specifically, the former Gulf States Creosoting Company site and the former Landfills. Though these sites are currently out of the normal flow path, legacy contamination from these sites is a concern that should be addressed prior to construction.
15. The EPD-RIV1 modeling covered the area from below Ross Barnett Reservoir to the proposed weir as the end of the proposed lake. This waterbody was divided into 24 segments similar to those used in the HEC-RAS modeling for water levels. Model water surface level predictions follow the NFI HEC-RAS reasonably well but are normally 1 ft or more above gage for 2014 data. It should be noted that this NFI model required recalibration by USACE. Temperature predictions were comparable to observations except for storm period when differences are blamed on tributary inputs not being accurate. Nutrient calibrations were based on 1-3 samples which may/may not have agreed with data. Calibration period was a summertime month, and, in most cases, there were little variability in nutrient levels that could not be associated to fluctuations in flow or temperature. Model Dissolved Oxygen (DO) exhibited diurnal pattern of the observation data period but didn't really capture peaks and valleys. Peaks are likely due to photosynthesis which is difficult to capture with this model's setup. Depth average (1D) model structure dampens DO levels due to larger portion of water column. High light extinction throughout the water column limits light penetration and model algal photosynthesis. Finally, macrophytes present in the actual system produce DO via photosynthesis which is not accounted for in the model.
16. Comparison of model conditions for existing conditions, i.e., No Action Case, and the Locally Preferred Plan, (Alternative C) indicate that diurnal temperature fluctuations decreased for preferred plan in comparison to the No Action Case. This is understandable as there are likely substantial differences in depth between the two cases. No Action would represent current flow conditions while Alternative C would have ponded water over whole of model domain. Exact depth differences are uncertain but could be substantial. These comparisons are made using July 2014 data which contain some higher flow events.
17. Dissolved Oxygen (DO) results for July 2014 existing conditions and Alternative C comparisons indicate that DO fluctuations are muted for the Preferred Plan versus the existing conditions case in lower portion of the project. This is understandable as Alternative C would

have deeper water with diminished photosynthesis over the water column. Modeled DO levels are still adequate, just not as dynamic as the No Action Case.

18. Temperature and DO results for low flow condition simulations exhibited similar behavior. Temperature results for Alternative C followed those of the existing conditions but were more muted downstream. Similar behavior was observed for DO. Modeled DO levels are adequate in Alternative C but with diminished diurnal activity and were lower than the existing conditions. Much of this behavior is likely due to comparison of physically different systems in the two cases, i.e., deeper water in Alternative C versus shallower waters in the existing conditions plan.
19. Preliminary water quality investigation assessment in the report indicates that water quality of the new lake in Alternative C will be similar to that of Ross Barnett Reservoir since it is the headwater for the new lake. This is technically correct. However, conditions in the project area are highly influenced by stormwater inflows from Jackson. Flows and loads from stormwater and associated sewerage overflows and trash are known issues. These studies do not address the hydraulic effects of a stormwater event on the project. Verification is needed to determine if stormwater flows flush the system out or only serve as nutrient, Carbonaceous biochemical oxygen demand (CBOD), and fecal coliform loads. There are varying degrees of impact on project based upon runoff quantity and duration that must be understood to ensure that project provides water quality conditions necessary to support desired uses.
20. Much of the reporting on the conclusions of the RES-1 simulations are based upon assumptions on the flows and loads that originate below the Ross Barnett Reservoir. These are in creeks and stormwater discharges. Understanding these flows and loads is critical to potential conditions in the proposed project. Much is based upon assumptions of projects ongoing at time in Jackson regarding sewer interceptor system construction and progress on Compliance Order. Though there are no combined sewers in project area, sanitary sewer overflows have potential to cross contaminate stormwater sewers thusly impacting project waters. During PED phase, would be prudent to have a current understanding of sanitary and stormwater sewer systems and their potential for direct and indirect impacts on Alternative C on the receiving waters as additional work should be accomplished up to this time.
21. The WASP/EFDC modeling package spanned from below Ross Barnett to Bogalusa, LA. The purpose of this model was to analyze downstream impacts of Alternative C on downstream waters. Three locations downstream corresponding to USGS stations were used for Existing Condition/Alternative C comparisons. Simulations were performed for period 2001-2017 with 2009-2017 being used for calibration and 2001-2008 used for validation. Results and discussion presented indicate little to negligible impact on downstream waters. In most instances, differences between existing condition and Alternative C output are indistinguishable.

Key recommendations to better understand expected water quality conditions from the review of the provided modeling results and reports are indicated in the list below:

1. Recommend USACE perform studies to better quantify of the amount of sanitary sewer leakage potentially entering waters of the project area and determination of its impact of proposed plan water quality conditions and allowable uses. This indicates the potential loading (Nutrient, CBOD, Total Suspended Solids (TSS), Fecal Coliforms) that the waters of a new lake or other construction feature may receive. Depending upon the level of loading, additional modeling may be required to quantify the effects of these loads on receiving waters and assess potential for water quality impairment.
2. Recommend USACE complete a better assessment of tributary water quality conditions and whether they have potential to degrade a proposed plan project water quality. Focus should be on the determination of impacts associated with tributaries that *directly* feed the study area, but especially into any lake feature, if selected. Due to urban/suburban environment and known issues with sanitary sewer system, a thorough investigation is warranted as even a small tributary can be disproportionate detrimental impact.
3. Recommend USACE complete a determination of Sediment Oxygen Demand (SOD) for Pearl River sediments that will lie under Preferred Project Lake. Impoundment will increase the depth over the sediments potentially decreasing DO in water column immediately adjacent to sediments. Deeper waters when combined with SOD could possibly result in bottom water hypoxia and anoxia. The likelihood of this occurrence should be assessed.
4. Recommend that USACE develop plans to prevent known HTRW sites within Potential Project footprint from having contaminants either wash into the lake or floodway, or leach from the sediments once the project is constructed. Legacy contamination from these sites and the sediments of the current Pearl River and the proposed Alternative C or other selected plan should be evaluated and, if necessary, removed or contained prior to project development.

10.3 DOWNSTREAM GAGING

Additional stream flow and stage gaging locations are needed in the project location to better understand localized impacts.

10.4 SURVEY OF EXISTING LEVEES

A survey of all existing levees is needed to better understand levee assurances and the ability to protect interior areas.

10.5 COINCIDENCE FLOWS-LOCALS AND ROSS BARNETT OPERATIONS

After consultation with USACE technical leads in HH&C and looking at historical rainfall runoff patterns, it was determined to be reasonably conservative to assume full coincidence with a three-day lag for the current effort. Additionally, a 2020 pattern was applied to the tributaries, as a more likely scenario.

To adequately size interior drainage structures through selected alternatives if alternatives are available to continue this effort, it is recommended that a Watershed Analysis Tool (WAT) model be developed to combine meteorological inputs, HEC-HMS rainfall-runoff calculations, and HEC-ResSim reservoir operations and routing later in the project.

Consideration would also be given to storm sewer or other interior drainage features.

10.6 Update Modeling to include completed work by others

If work by others is completed prior or during PED. Hydrologic and Hydraulic modeling will need to be updated for any location with significant changes.

10.7 Coordination of Cultural and Mitigation Feature

Coordination with updated cultural and mitigation design features will be needed to verify workability from a hydraulic and hydrologic perspective, and to quantify any impact to plan performance.

10.8 Update Risk Assessments on Proposed and Existing Features

Due to the time limitations of this effort and with consultation with USACE leads, it was determined to be reasonable to use simplified methods to cover items related to life safety and societal risk. To adequately meet guidance, a more thorough risk assessment of selected alternatives is needed.

An analysis of existing conditions was completed to demonstrate maximum possible breach depths. Cany Creek, Canton Club, and McLeod levees would have structures flooded above 6 feet of depth at the 500-year return interval and would need higher levels of risk assessment to ensure effective risk reduction for the communities. Richland Levee does not experience flooding above 6 feet in depth at the 500-year flood event.

Section 11

Summary Discussion

This Draft Environmental Impact Study (DEIS) presents three alternatives, a modified nonstructural plan (Alternative A1) and two structural alternatives (CTO alternatives). Alternative D1 includes a weir, and Alternative E1 does not.

The purpose of the hydrologic and hydraulic (H&H) analysis was to update the NFI's H&H analysis to current engineering standards, address unresolved comments from the incomplete ATR, correct inaccuracies, create and calibrate a hydrology model, calibrate the updated hydraulic model, and perform a simplified risk assessment on existing and proposed features. Some key updates include but were not limited to updating the statistical analysis to include the last 40 years of data, creation of a hydrology model to determine tributary inflows, inclusion of tributaries in the hydraulic model geometry, switching the hydraulic model to unsteady flow, modifying existing levees to accurately simulate overtopping flows, correcting the geometry to match the proposed plans, and calibrating the model to more flood recent events.

The USACE updated H&H analysis evaluated existing conditions and proposed alternatives. For the purposes of the H&H portions of this study, Alternative A1, which is based on buyouts and floodproofing is hydraulically the same as the existing condition, plus the Canton Club Levee. Model results may be used interchangeably. (Canton Club levee is assessed within the Economic Model.)

H&H modeled the proposed channel improvements and weir design elevations as prescribed in the NFI Alternative D1 and E1. The USACE analysis shows that all flood reductions are due to channel improvements, and that the proposed weir does not provide flood reduction benefits. In addition, the USACE analysis demonstrates inducement just upstream of the weir, along some tributaries, and downstream of the weir. The downstream inducements are due to increased conveyance from the upstream channel improvements. The calibrated model used to analyze all frequencies modeled for the first 20 miles of the project, then was extended downstream for 43.4 miles (older Alt C data only) and inducements were further assessed at the 20% and 1% Annual Chance Exceedance Events. The 1% ACE was then extended even further downstream using a USACE calibrated Pearl River CWMS model. Impacts to the downstream watershed beyond river mile 200 are highly unlikely. Impacts to the state of Louisiana are not expected.

USACE completed a simplified risk assessment on the proposed weir and existing levees. No additional risk is expected to occur to existing features under alternative A. Further Analysis and modeling are required to assess risk for alternatives D1 and E1, depending on which features are selected. Alternative D1 features a proposed weir that could meet significant hazard dam requirements and currently could require a standard 3 levels of design and construction. However, this standard would need to be continually verified during further design of the proposed weir. Alternative D1 proposed weir impounds water against existing levees, Jackson Fairgrounds MS and East Jackson MS, and seepage mitigation would be required. The Jackson Fairgrounds and East Jackson levees are not expected to have a significant reduction in overtopping frequencies, but this would need to be verified as detailed design of the proposed weir continues. The downstream Jackson-East Jackson Flood Control Project would undergo some inducement at higher flood events. Mitigation features have not been designed.

The NFI provided two distinct modeling studies, which used available data to evaluate water quality impacts the of construction of a new lake behind the proposed weir. USACE Efforts were limited to review of NFI work and recommendation for any future efforts. Modeled impacts predicted were of short duration and limited reach, and sampling efforts were hindered by a dry period. USACE has developed recommendation for further analysis to reduce risk and uncertainty, should alternative D1 with a lake be constructed.

Several analyses will need to be completed to better understand the full impact of the proposed features if Alternatives D1 or E1 are selected. These items include but are not limited to sediment analysis to determine potential sediment volume and impacts to proposed lake, water quality sampling and analysis to better understand characteristics of tributary contributions to the project area, temporary gage features to further refine calibration near key design features, analysis of overtopping assurance levels of proposed and existing features within the project area, interior drainage of existing levees to determine mitigation for loss of drainage structure operability, redesign of the proposed weir to meet USACE and State standards, further coordination and analysis of bridge impacts, updated surveys of key levee and tributary features, and determination of operation and maintenance plans for all proposed features. USACE would need to complete further analysis of the proposed weir tie in features, and seepage protection for existing levees. If tributary features are selected as part of any alternative, further refinement of the modeling along the tributary reaches would be necessary.

Section 12

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Section 13

List of Acronyms and Abbreviations

1D	One Dimensional
2D	Two Dimensional
AEP	Annual Exceedance Probability
ASA-CW	Assistant Secretary of the Army for Civil Works
ATR	Agency Technical Review
CBOD	Carbonaceous Biochemical Oxygen Demand
CDR	Climate Data Record
CFS	Cubic Feet per Second
CHAT	Climate Hydrology Assessment Tool
CTO	Combination Thereof
CWMS	Corps Water Management System
DDT	Dichlorodiphenyltrichloroethane
DEIS	Draft Environmental Impact Study
DO	Dissolved Oxygen
ECB	Engineering and Construction Bulletin
EIS	Environmental Impact Study
EM	Engineering Manual
EMA	Expected Moments Algorithm
EPA	Environmental Protection Agency
ER	Engineering Regulation

FEMA	Federal Emergency Management Agency
FRM	Flood Risk Management
GIS	Geographic Information Systems
GPM	Gallon Per Minute
HEC-HMS	Hydrologic Engineering Center- Hydrologic Modeling system
HEC-RAS	Hydraulic Engineering Center- River Analysis Software
HEC-ResSim	Hydrologic Engineering Center-Reservoir Simulation Software
HEC-SSP	Hydrologic Engineering Center Statistical Software Package
HEC-WAT	Hydrologic Engineering Center Watershed Analysis Tool
NEXRAD	Next Generation Weather Radar
HQ USACE	Headquarters United States Army Corps of Engineers
HTRW	Hazardous, Toxic, and Radioactive Waste
HUC	Hydrologic Unit Code
LPP	Locally Preferred Plan
MDEQ	Mississippi Department of Environmental Quality
MDOT	Mississippi Department of Transportation
MSL	Mean Sea Level
NAVD	North American Vertical Datum of 1988
NCEI	National Centers for Environmental Information
NED	National Economic Development
NEPA	National Environmental Policy Act
NFI	Nonfederal Interest
NFS	Nonfederal Sponsor
NGVD	National Geodetic Vertical Datum of 1929
NID	National Inventory of Dams
NLCD	National Land Cover Database
NLD	National Levee Database
NOAA	National Ocean and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NWS	National Weather Service
OSE	Other Societal Effects
O&M	Operations and Maintenance

PDT	Project Delivery Team
PED	Pre-Construction Engineering and Design
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
POTW	Publicly Owned Treatment Works
PRBDD	Pearl River Basin Development District
QPE	Quantitative Precipitation Estimation
RM	River Mile
RS	River Station
SLC	Sea Level Change
SOD	Sediment Oxygen Demand
SSURGO	Soil Survey Graphic Database
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

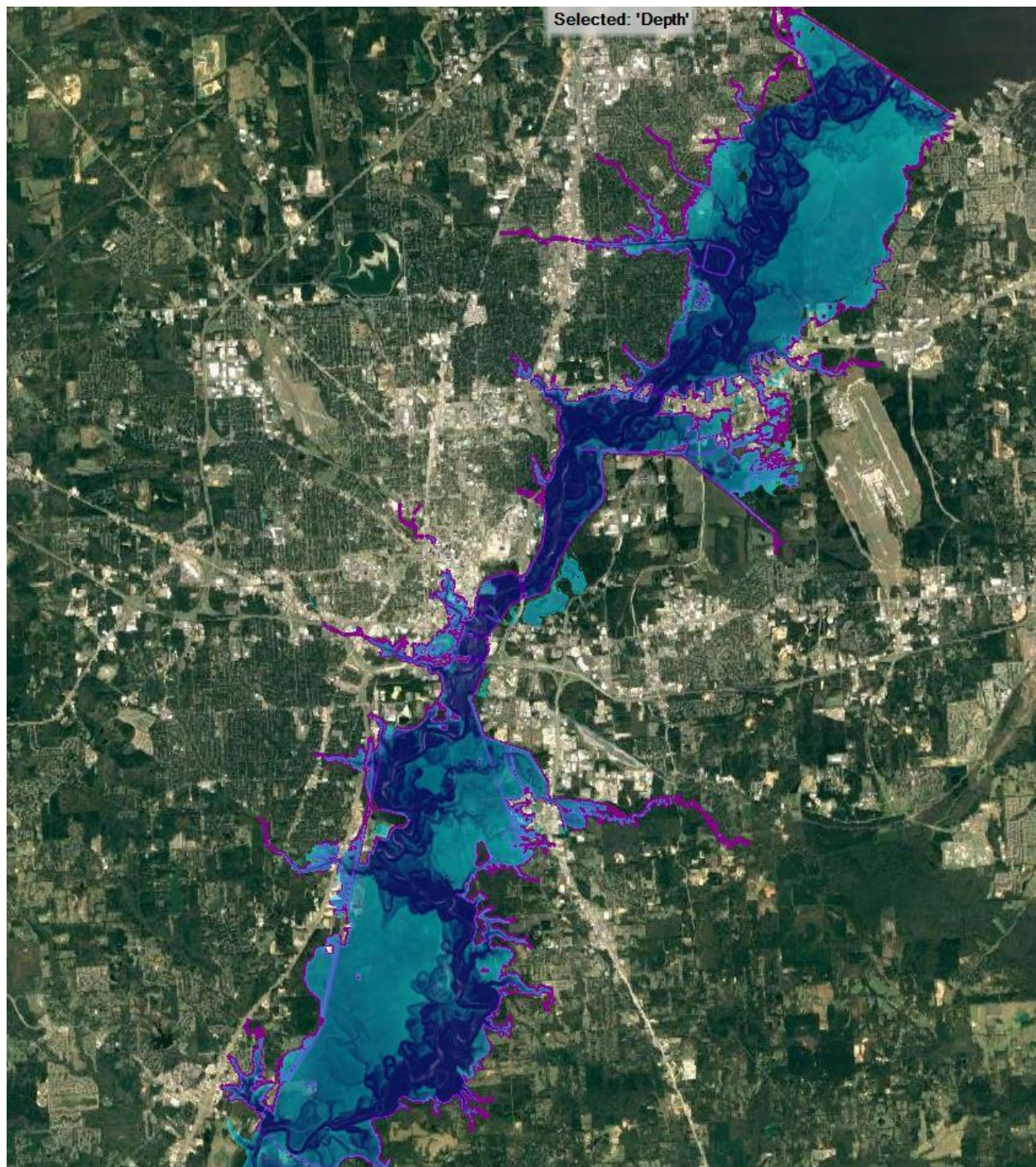


Figure 1: USGS Max inundation for Feb 2020 event vs RAS simulation

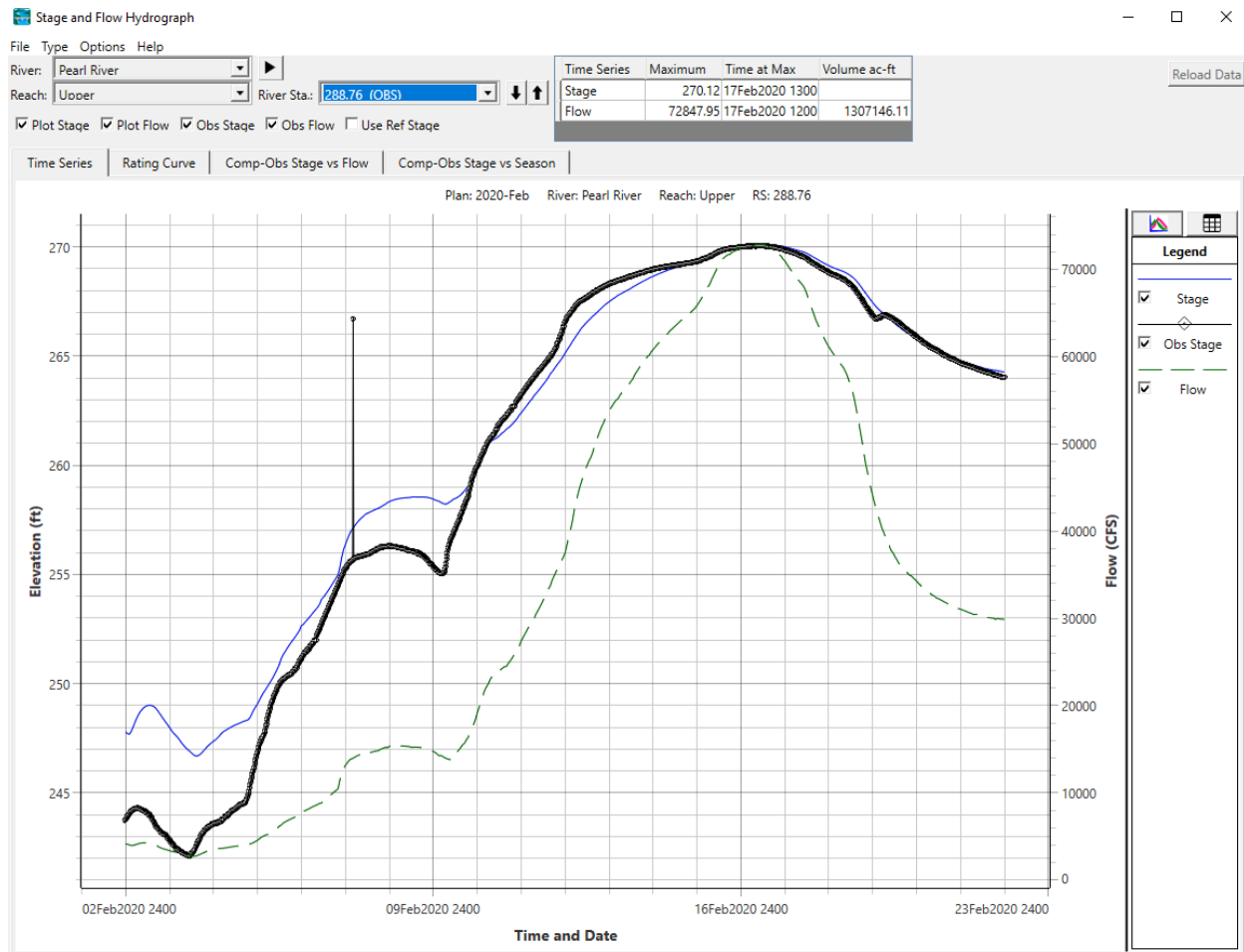


Figure 2: OBS vs Calculated Stage for Pearl River at Jackson Gage, Feb 2020, HEC-RAS model

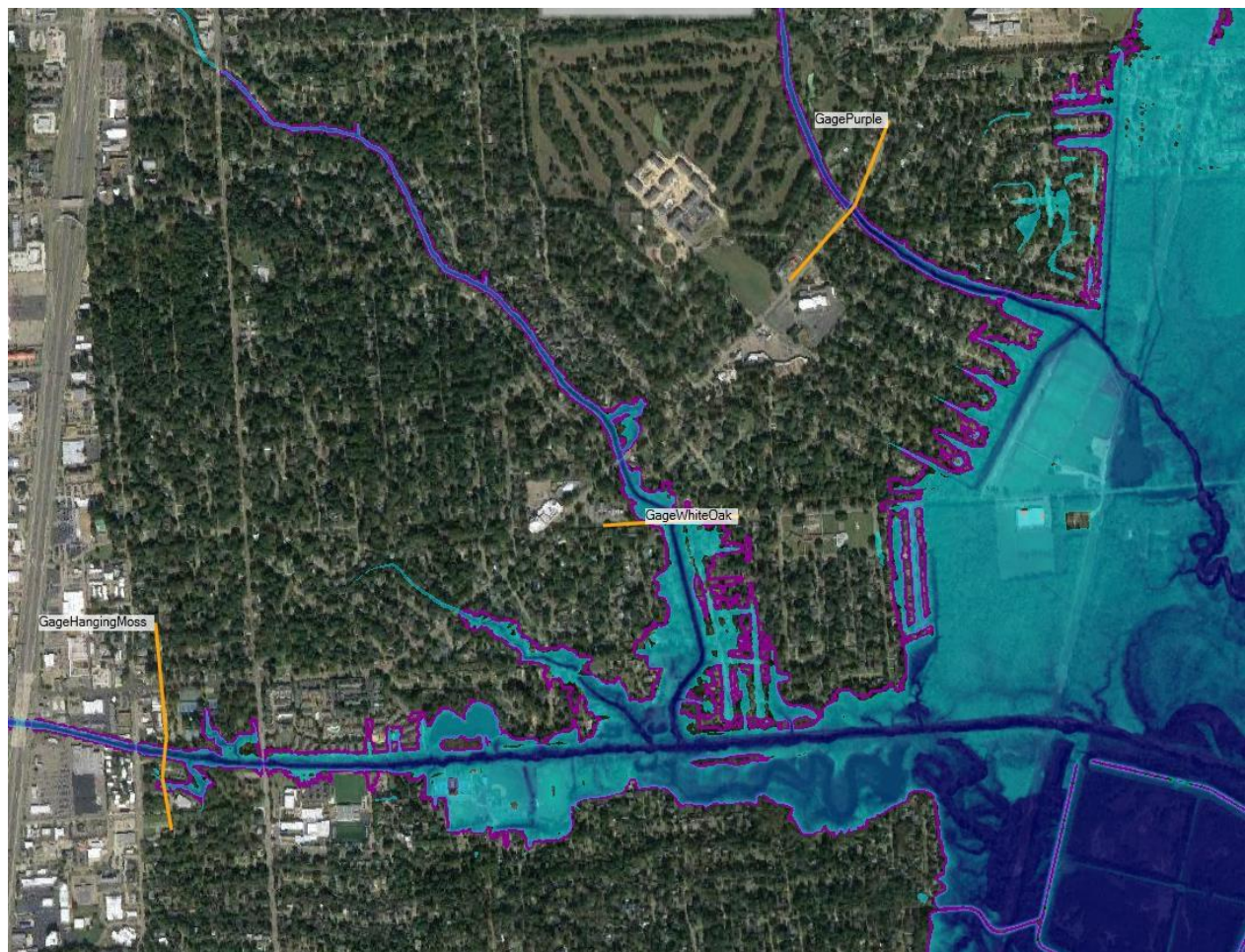


Figure 3: Flood Extent Comparison for 2020 Flood, Calculated vs USGS Flood Extent Near the Purple, White Oak, and Hanging Moss Creek Gage Locations.

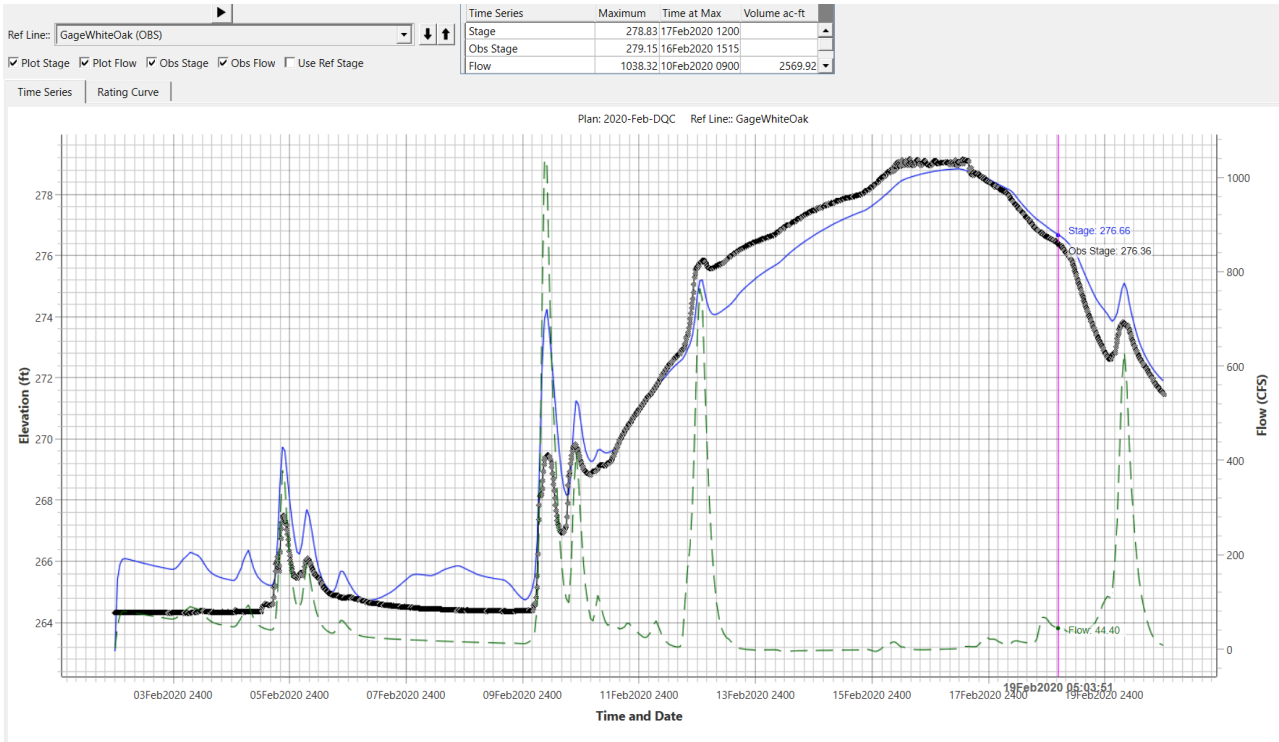


Figure 4: OBS vs Calculated Stage for White Oak Creek Gages, Feb 2020, HEC-RAS model

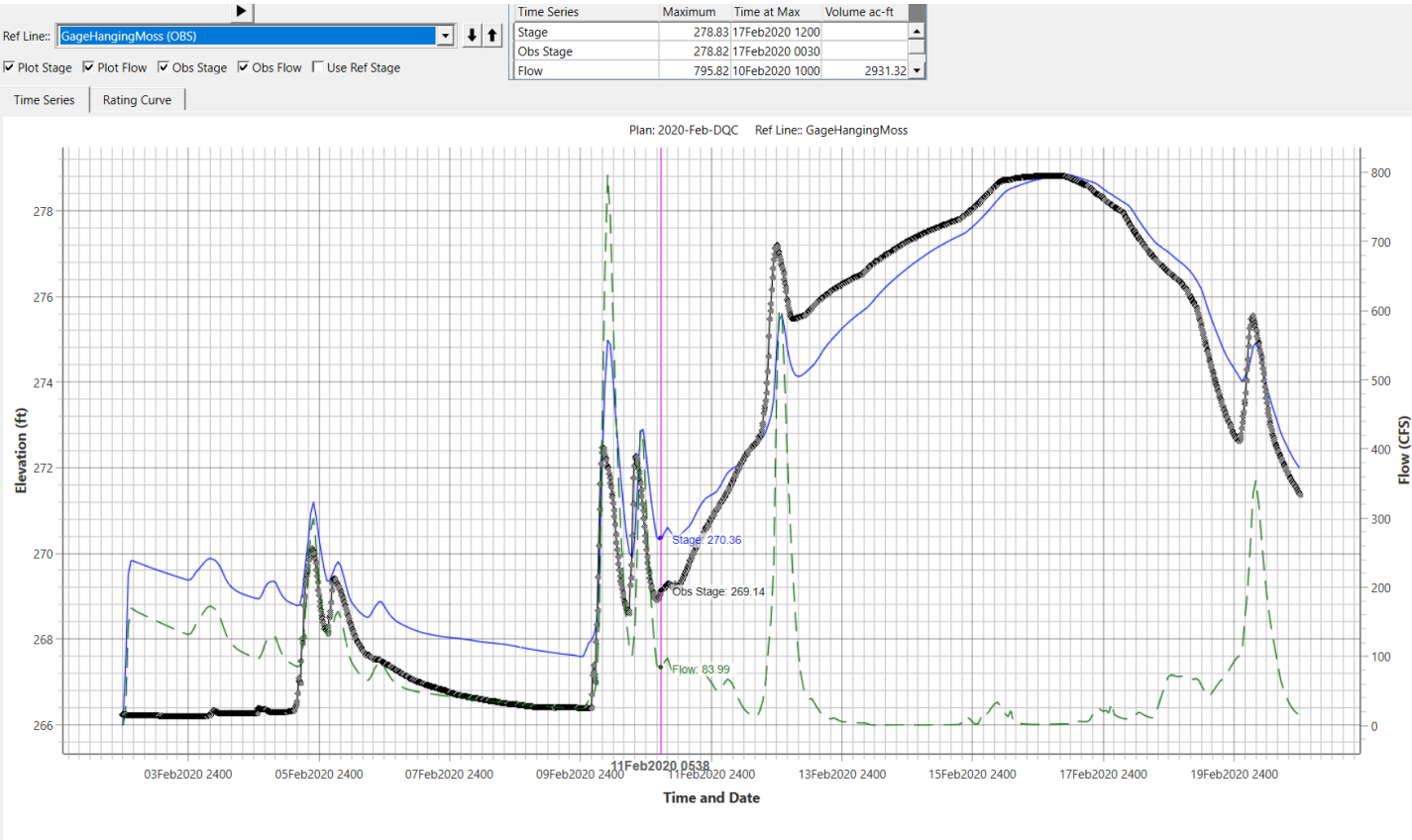


Figure 5: OBS vs Calculated Stage for Hanging Moss Creek Gage, Feb 2020, HEC-RAS model

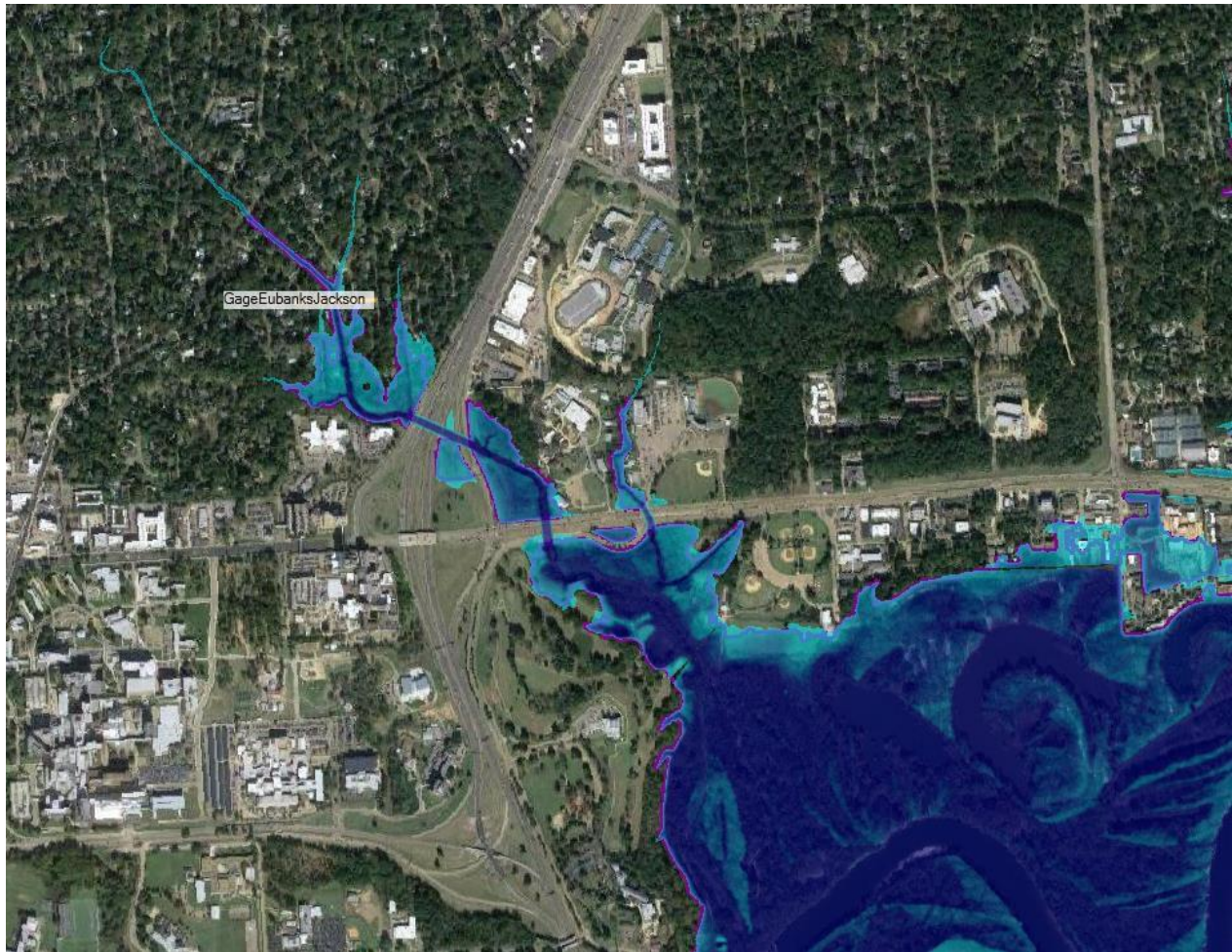


Figure 6: Flood Extent Comparison for 2020 Flood, Calculated vs USGS Flood Extent Near the Eubanks Creek at Jackson Gage Locations.

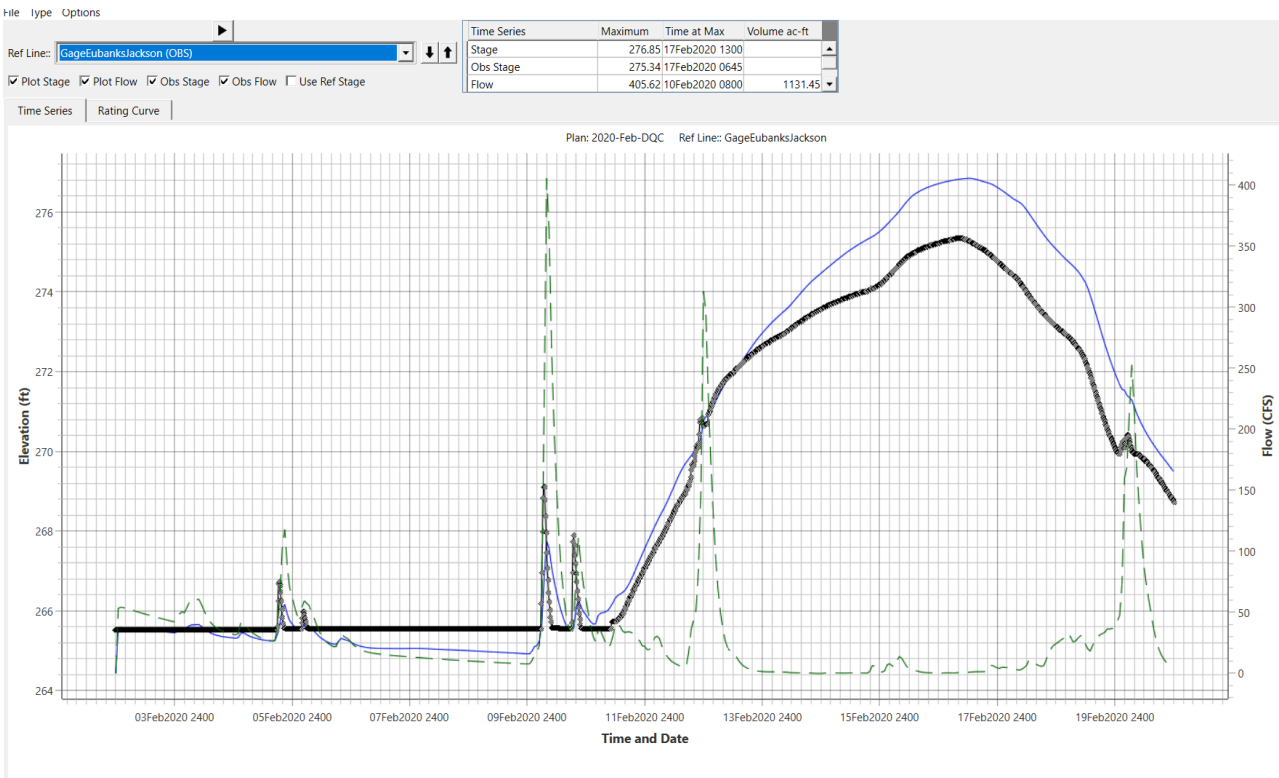


Figure 7: OBS vs Calculated Stage for Eubanks Creek at Jackson Gage, Feb 2020, HEC-RAS model

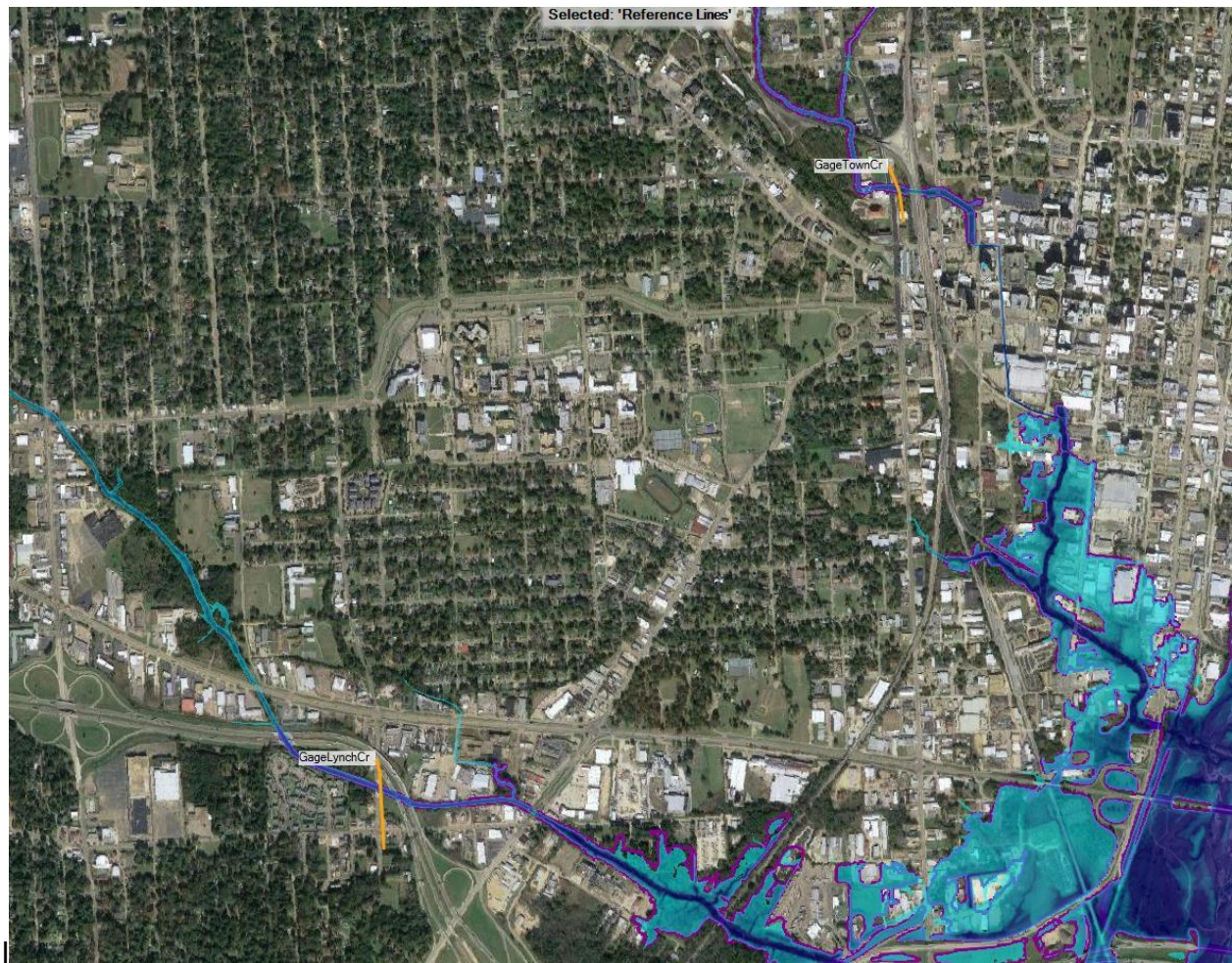


Figure 8: Flood Extent Comparison for 2020 Flood, Calculated vs USGS Flood Extent Near the Town and Lynch Creek Gage

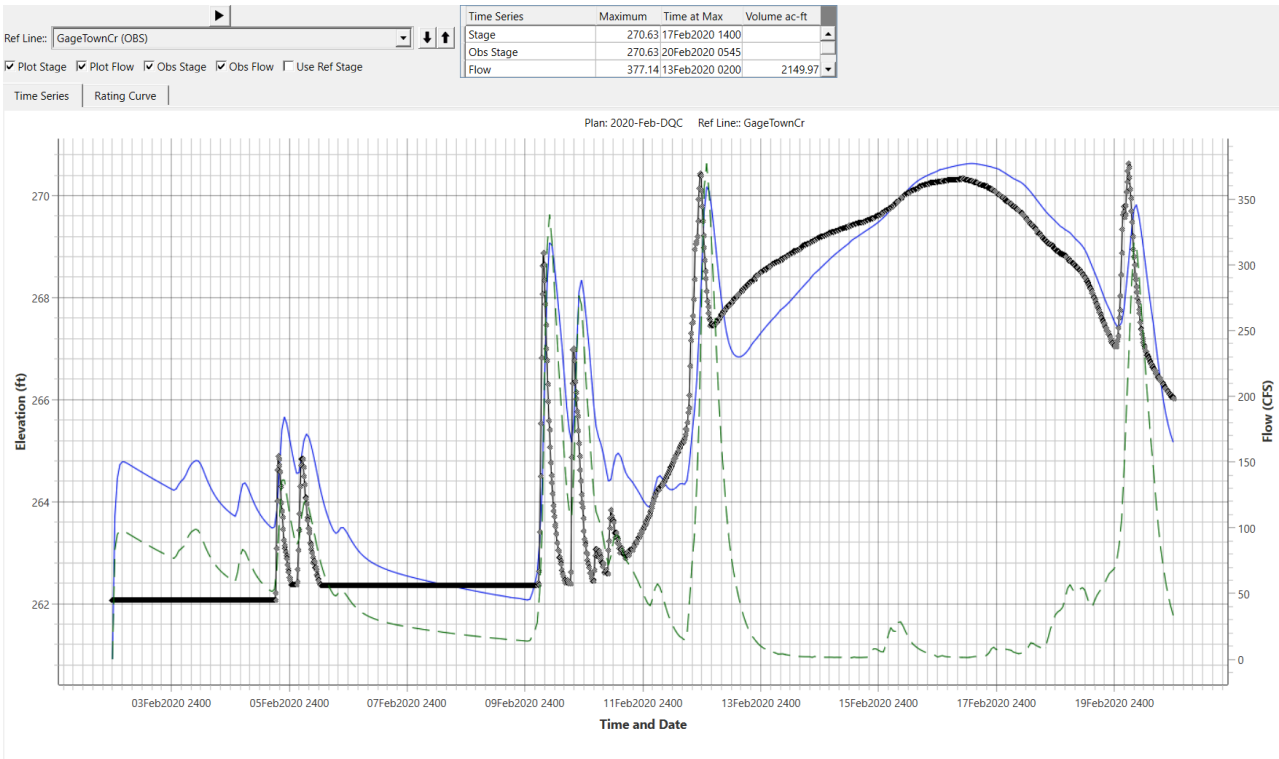


Figure 9: OBS vs Calculated Stage for Town Creek Gage, Feb 2020, HEC-RAS model

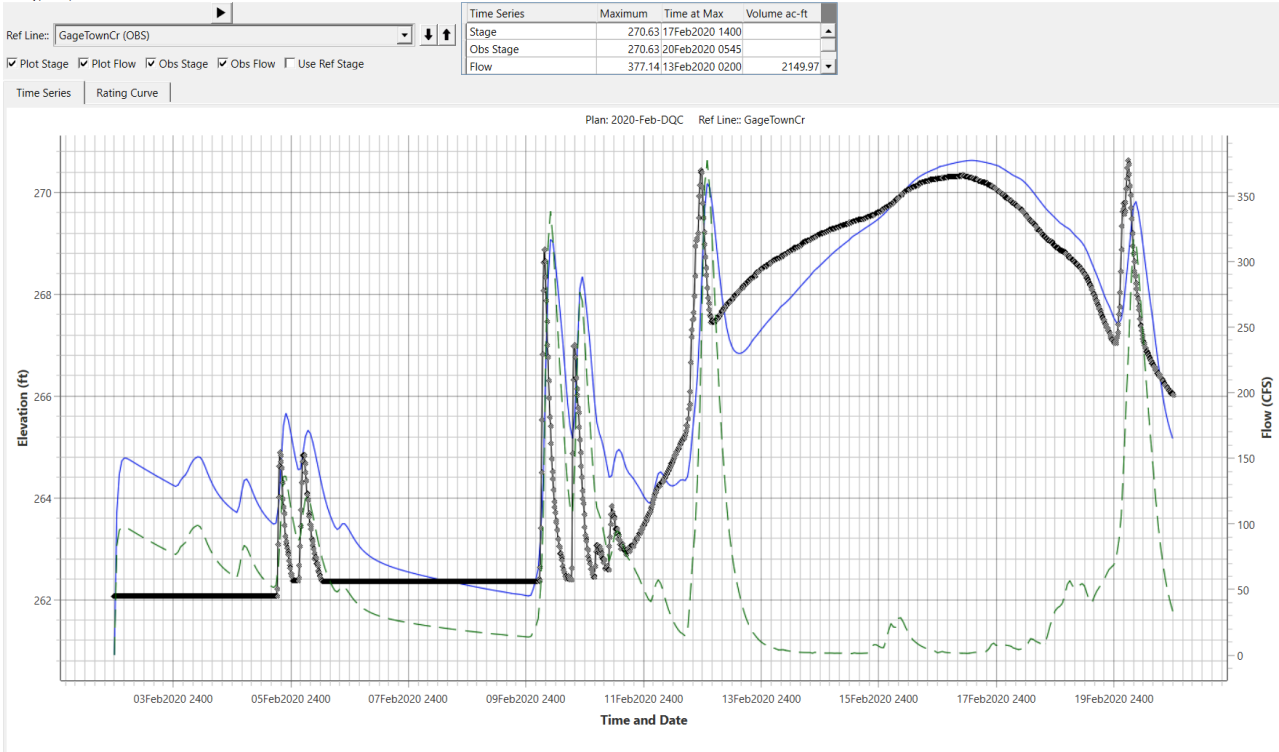


Figure 10: OBS vs Calculated Stage for Lynch Creek Gage Feb 2020, HEC-RAS model

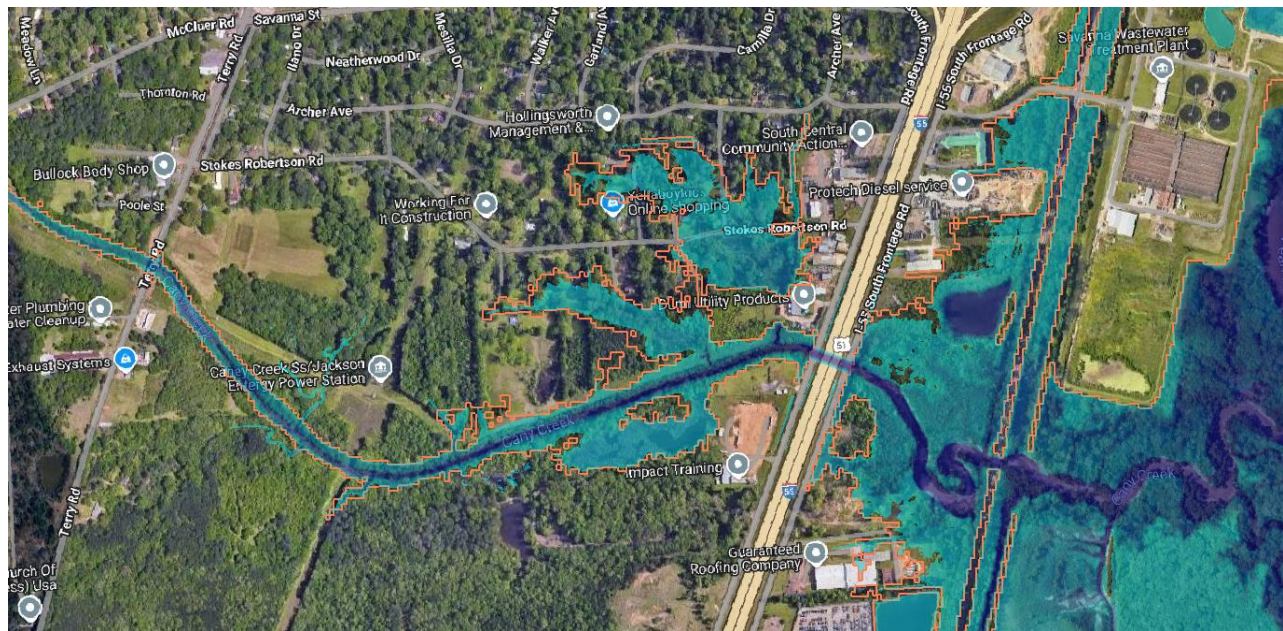


Figure 11: Flood Extent Comparison for 2020 Flood, Calculated vs USGS Flood Extent Near the Cany Creek Gage Locations.

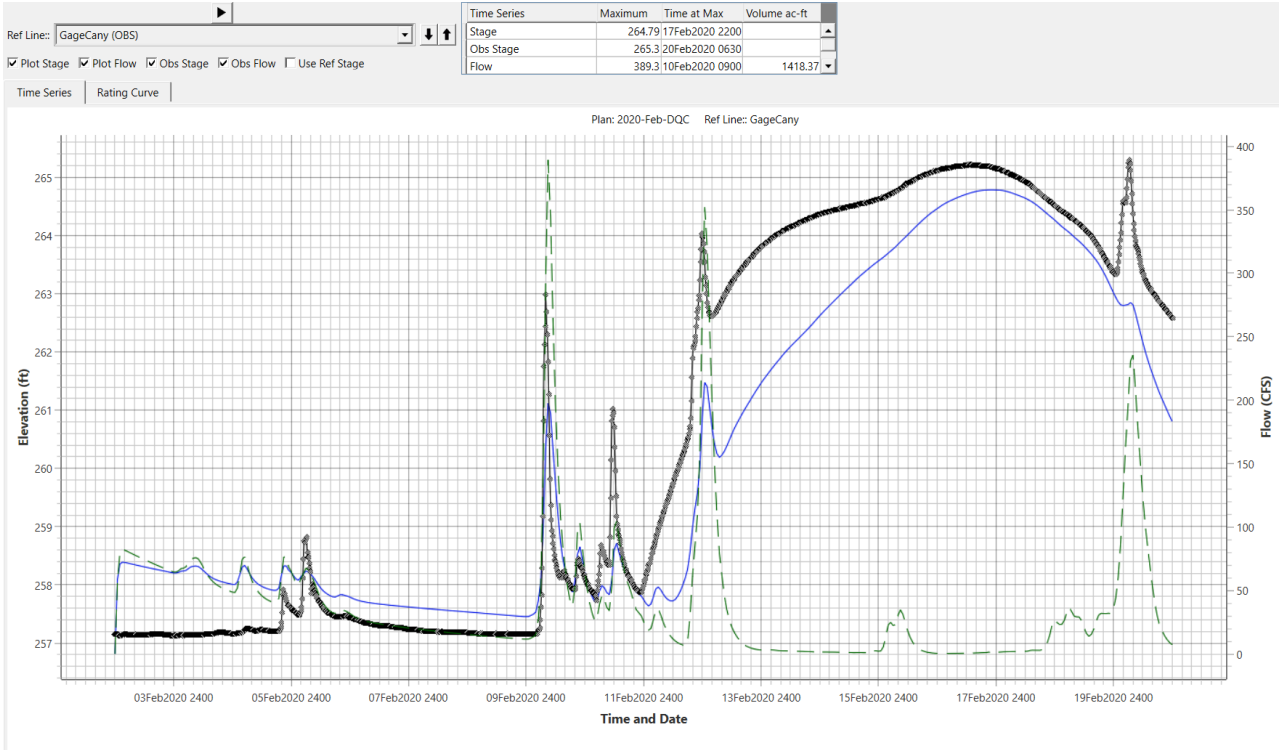


Figure 12: OBS vs Calculated Stage for Cany Creek Gage, Feb 2020, HEC-RAS model

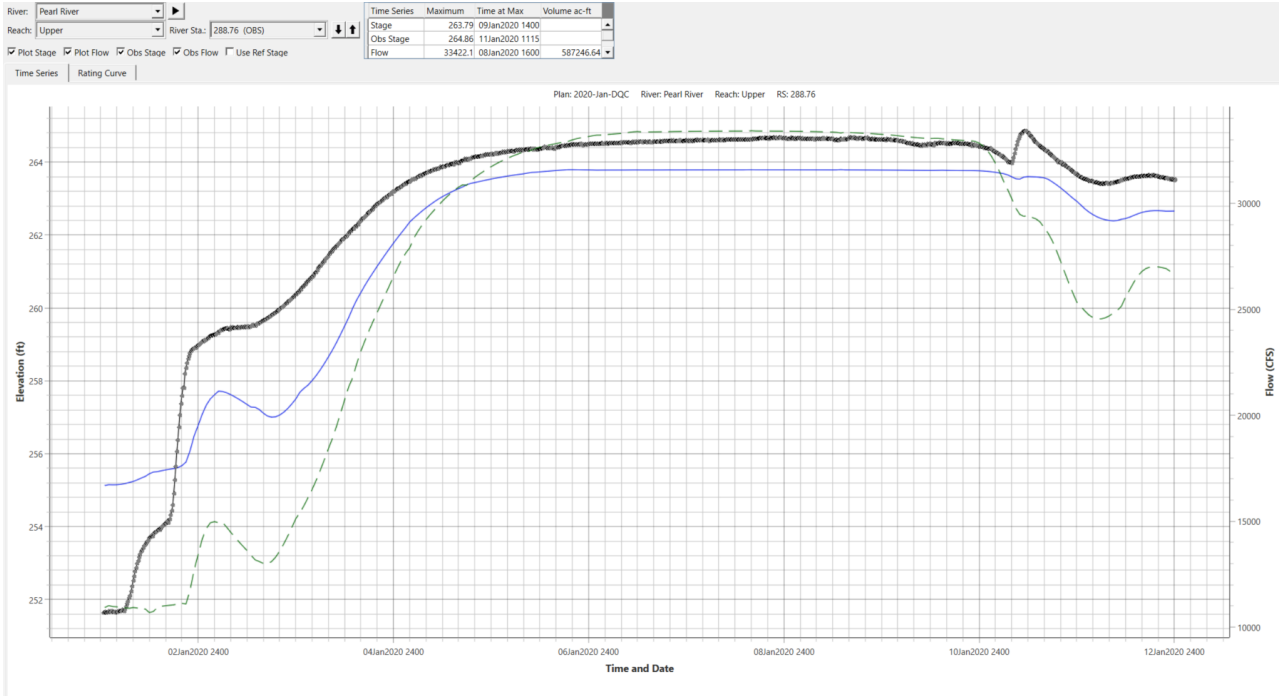


Figure 13: OBS vs Calculated Stage for Pearl River at Jackson Gage, Jan 2020, HEC-RAS model

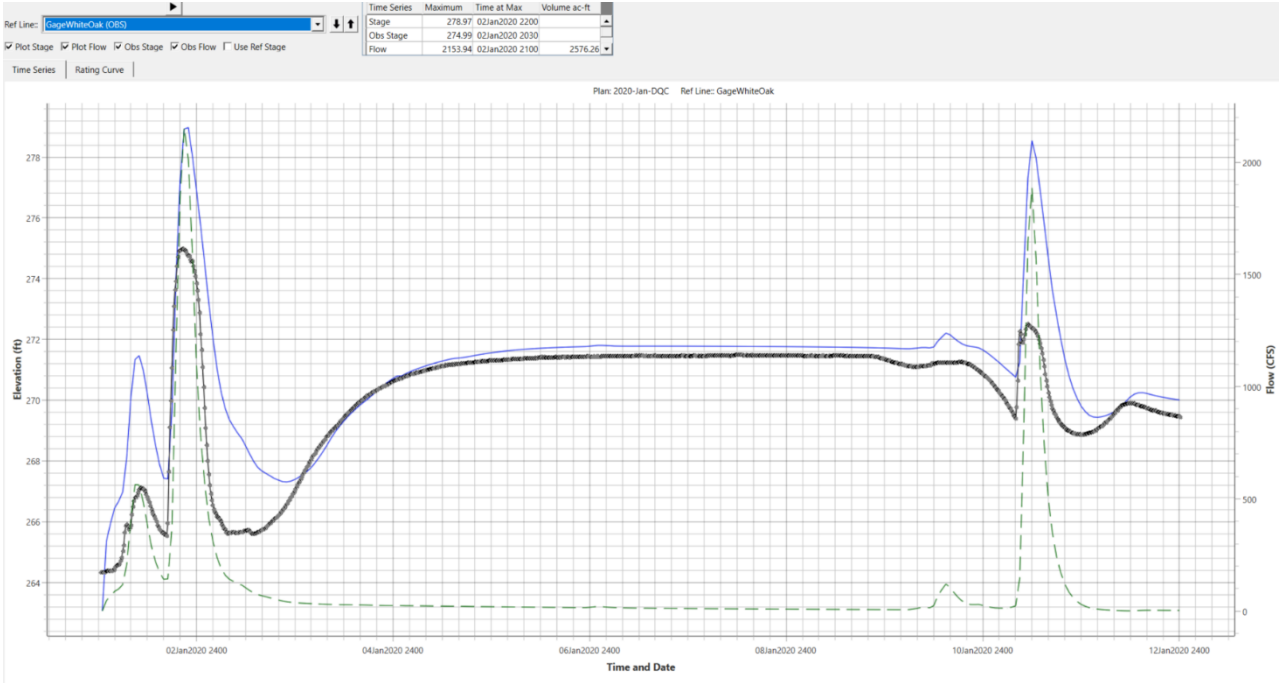


Figure 14: OBS vs Calculated Stage for White Oak Creek Gage, Jan 2020, HEC-RAS model

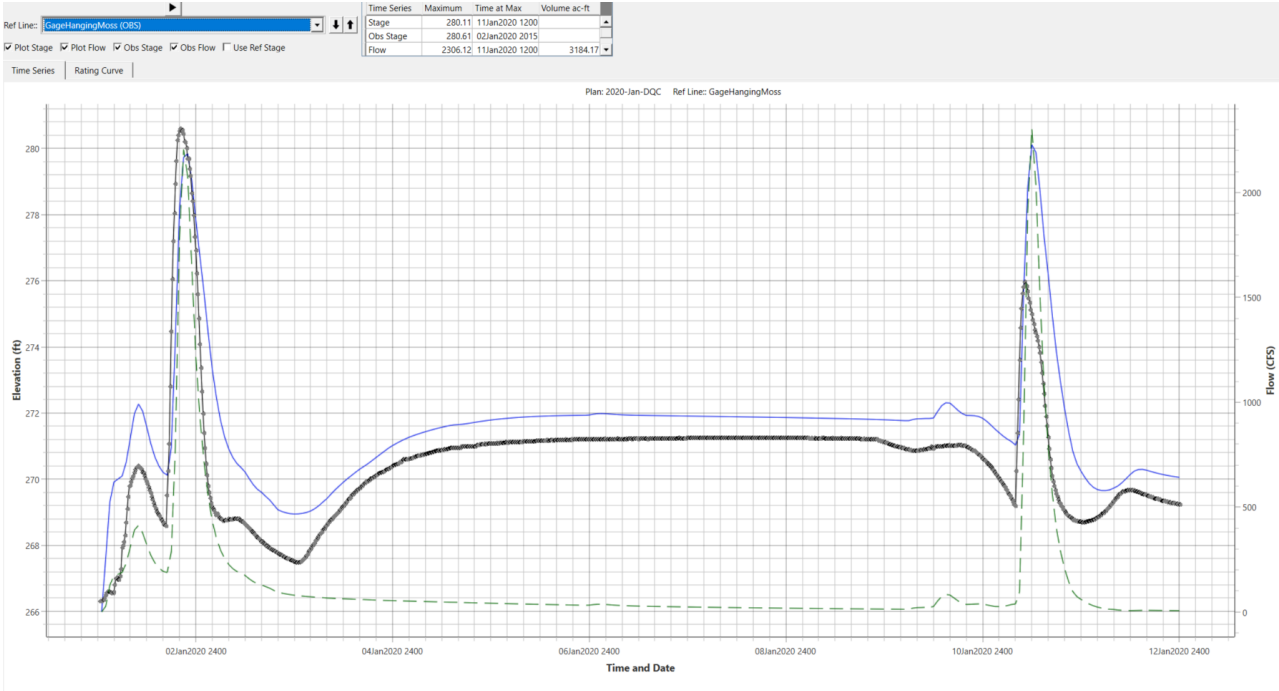


Figure 15: OBS vs Calculated Stage for Hanging Moss Gage, Jan 2020, HEC-RAS model

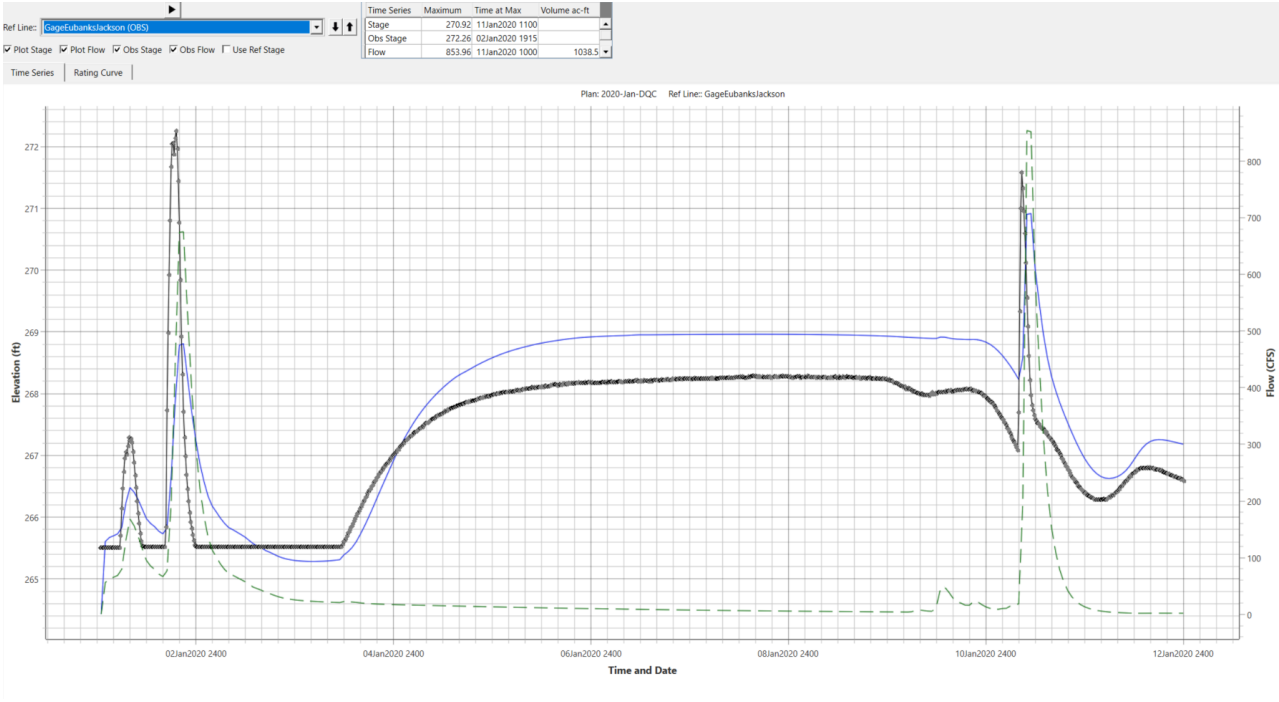


Figure 16: OBS vs Calculated Stage for Eubank Creek at Jackson Gage, Jan 2020, HEC-RAS model

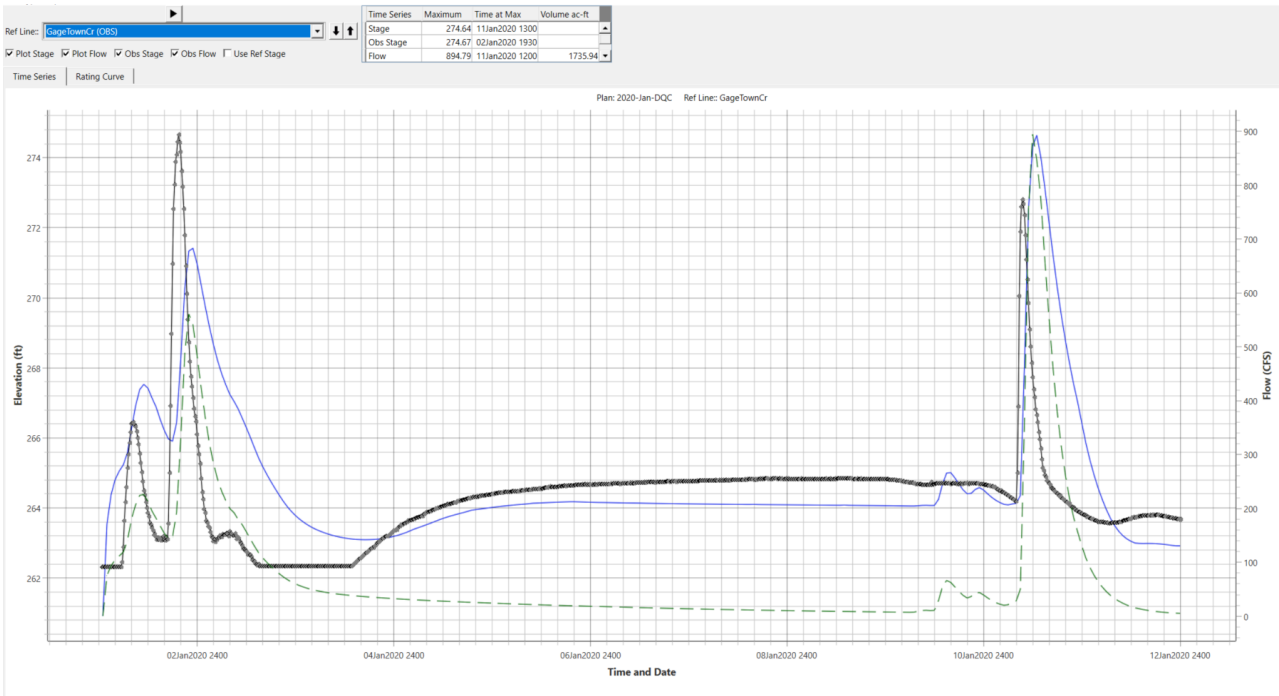


Figure 17: OBS vs Calculated Stage for Town Creek Gage, Jan 2020, HEC-RAS model

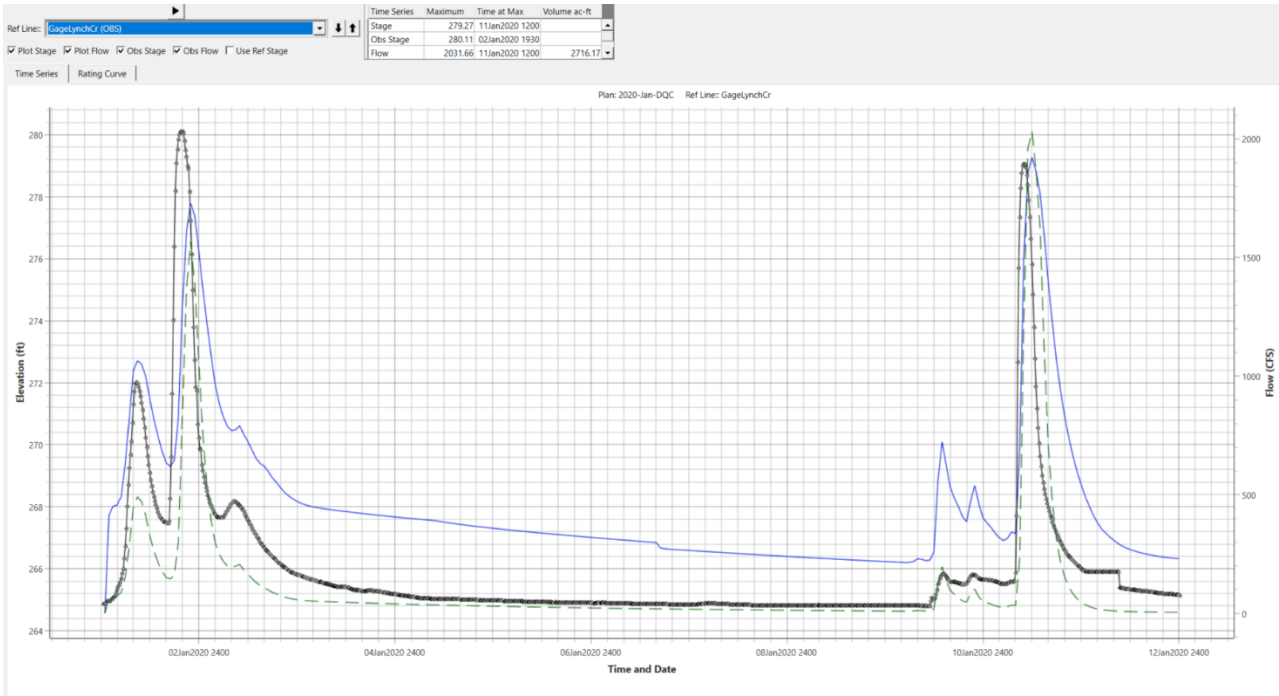


Figure 18: OBS vs Calculated Stage for Lynch Creek Gage, Jan 2020, HEC-RAS model

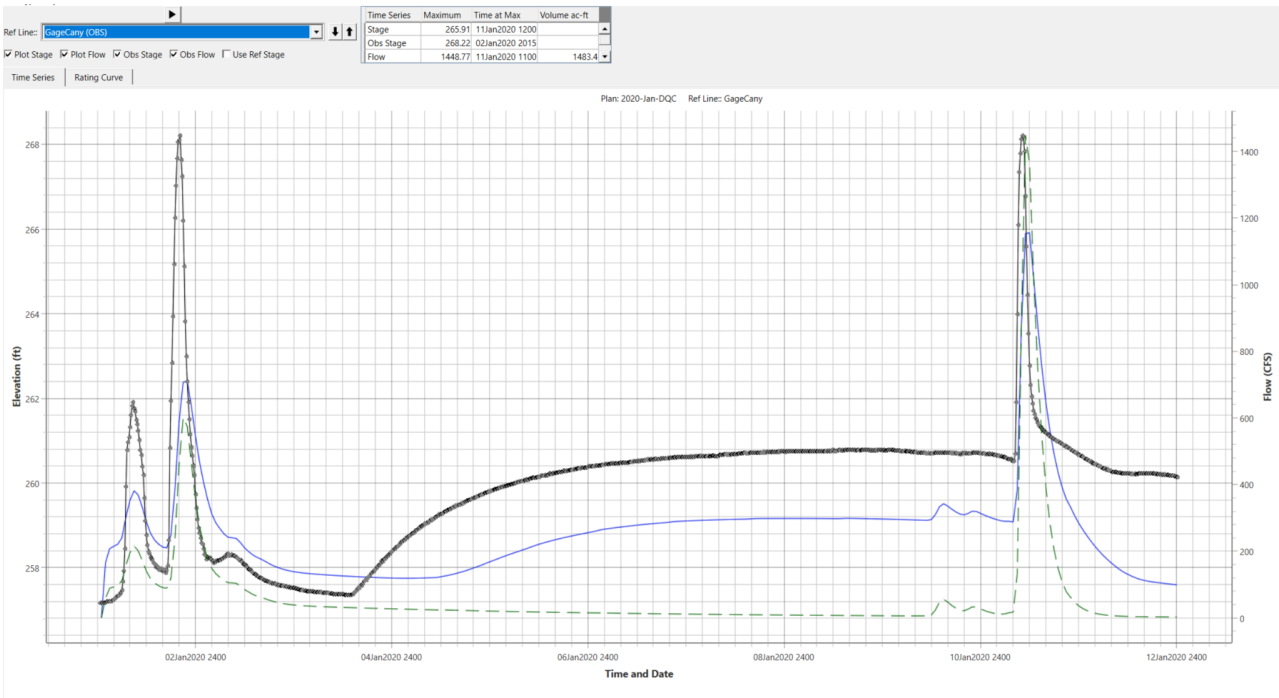


Figure 19: OBS vs Calculated Stage for Cany Creek Gage, Jan 2020, HEC-RAS model

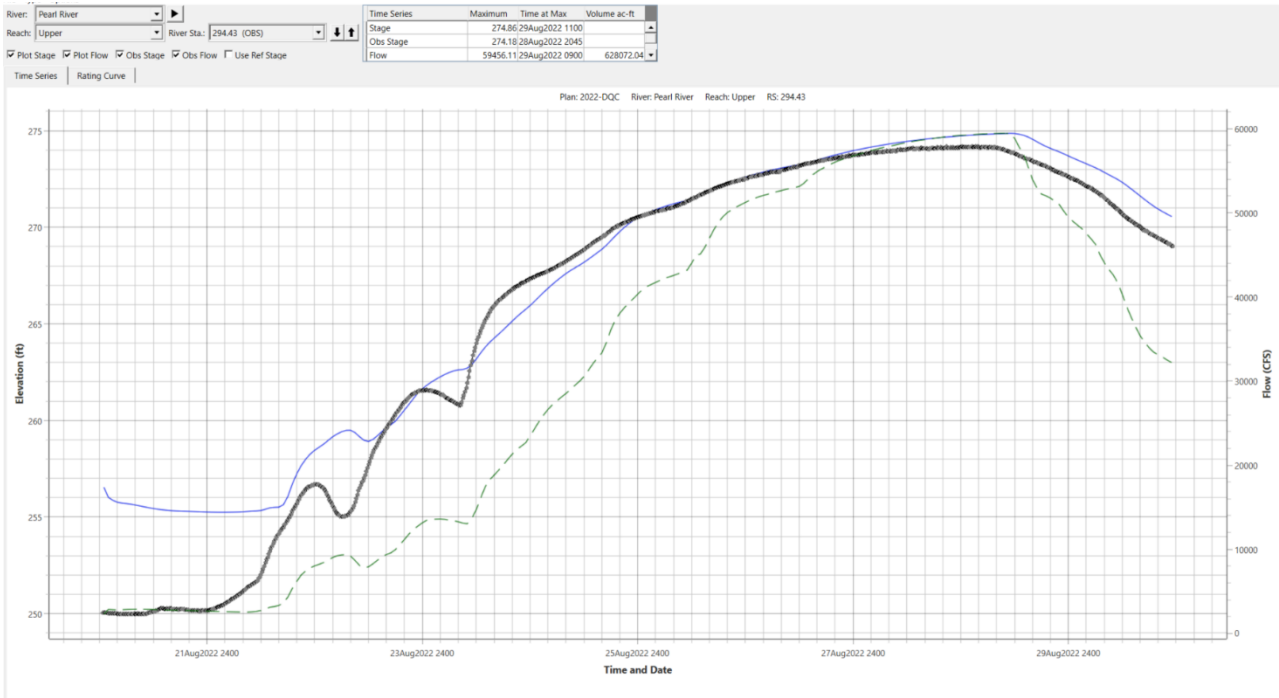


Figure 20: OBS vs Calculated Stage for Pearl River at HWY 25 Gage, Aug 2022, HEC-RAS model

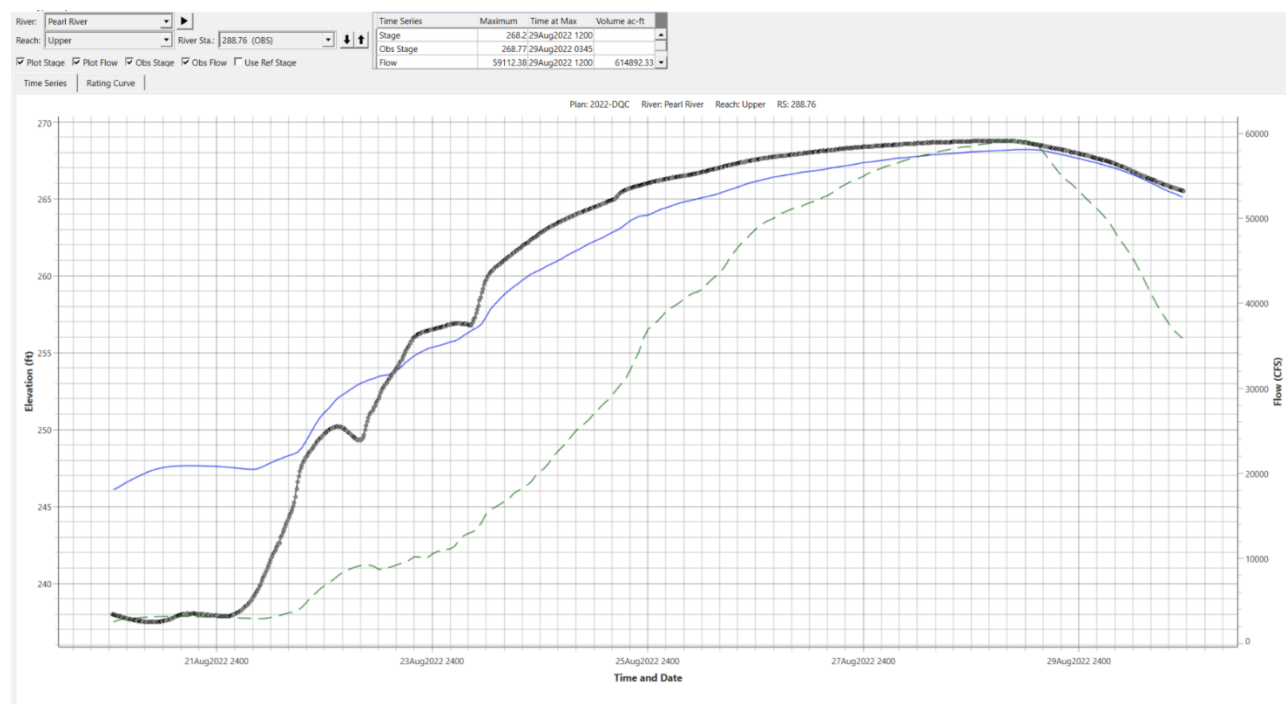


Figure 21: OBS vs Calculated Stage for Pearl River at Jackson Gage, Aug 2022, HEC-RAS model

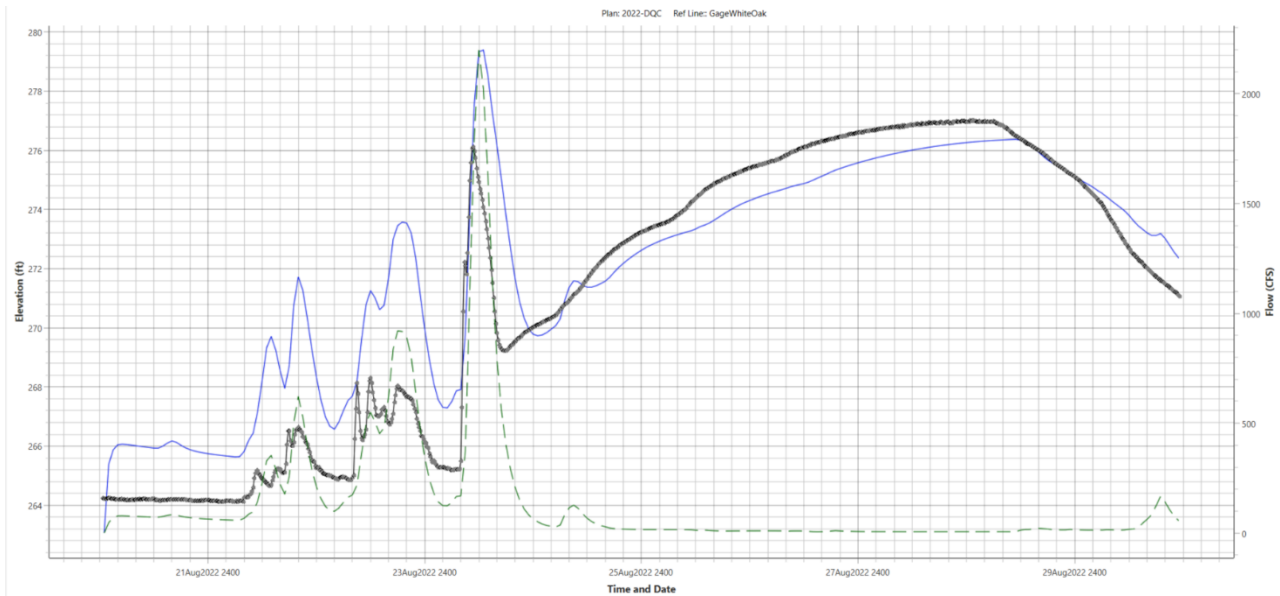


Figure 22: OBS vs Calculated Stage for White Oak Creek Gage, Aug 2022, HEC-RAS model

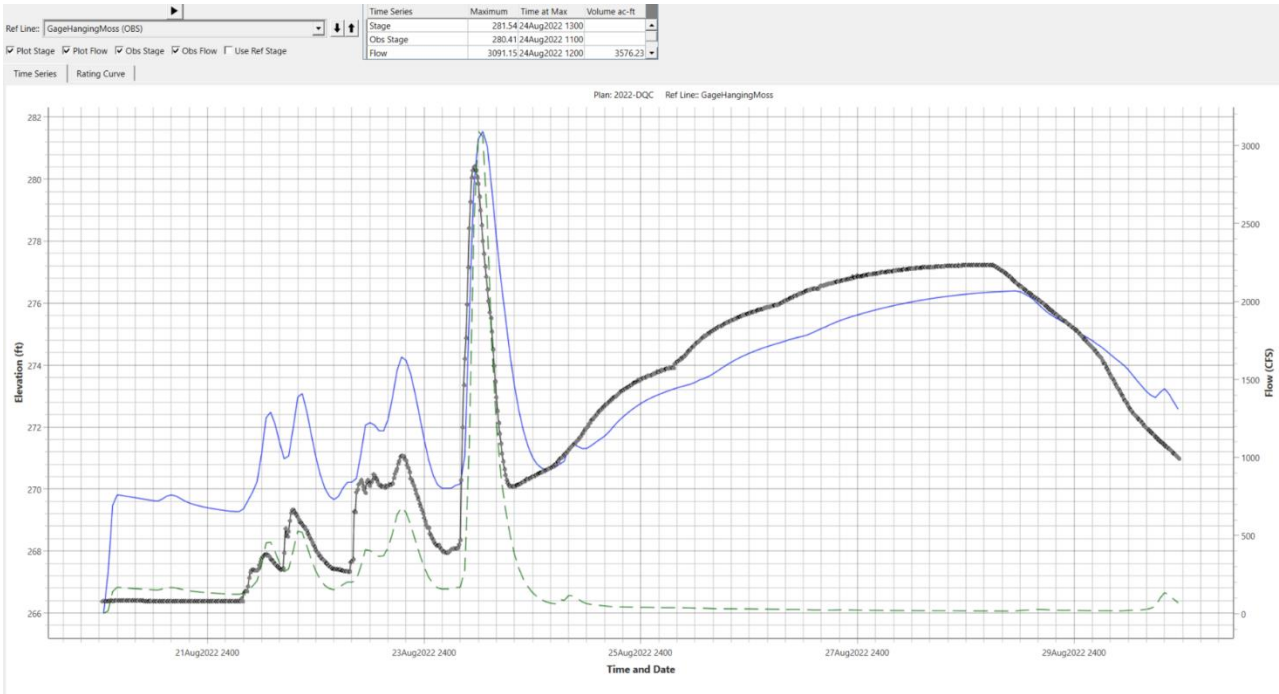


Figure 23: OBS vs Calculated Stage for Hanging Moss Gage, Aug 2022, HEC-RAS model

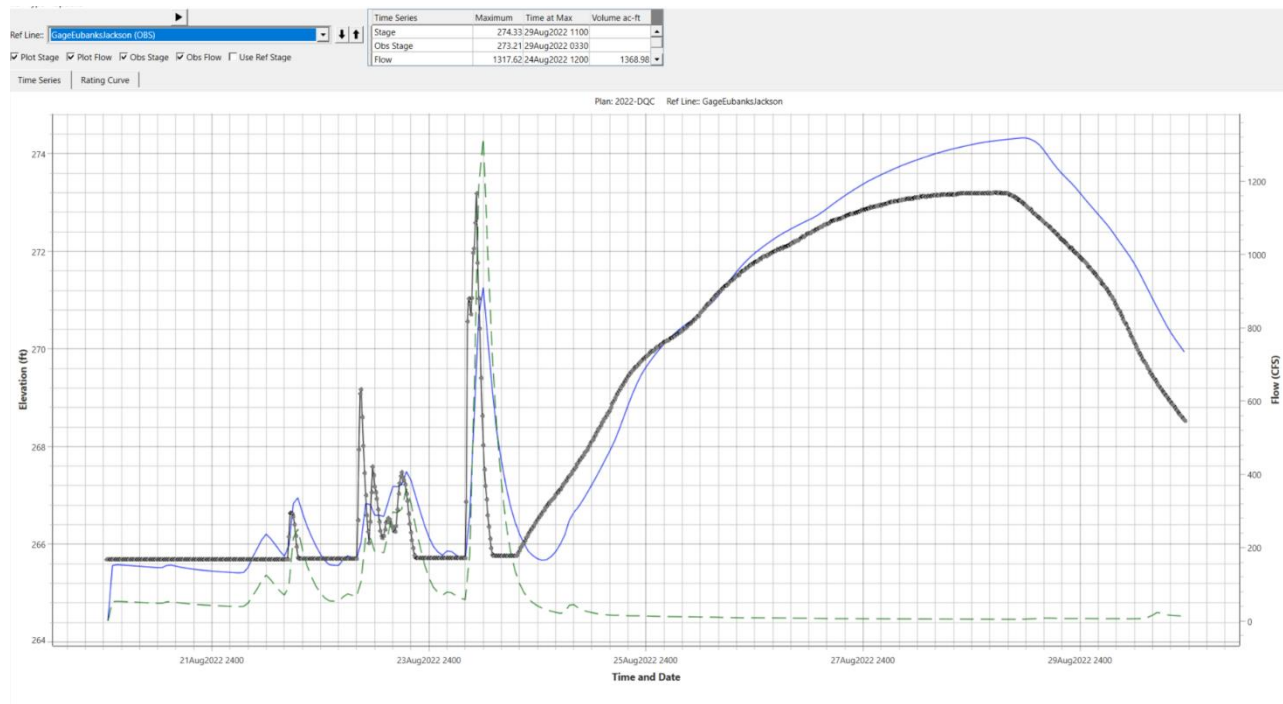


Figure 24: OBS vs Calculated Stage for Eubanks Creek at Jackson Gage, Aug 2022, HEC-RAS mode

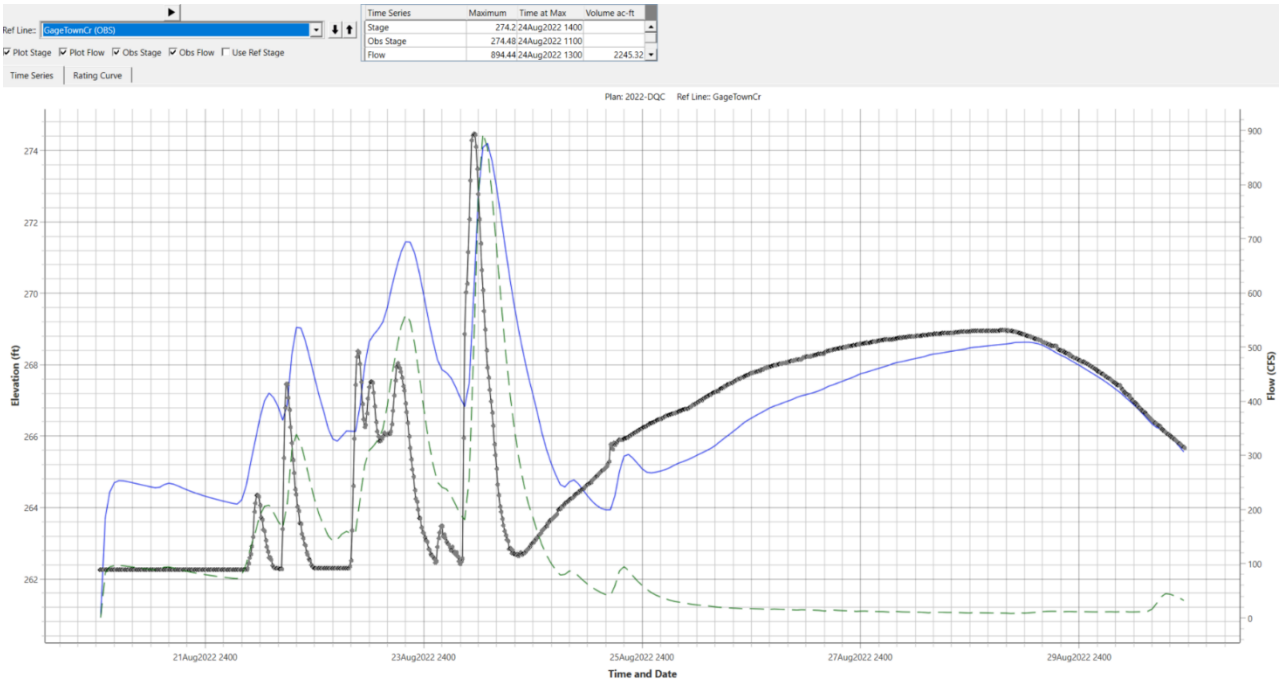


Figure 25: OBS vs Calculated Stage for Town Creek Gage, Aug 2022, HEC-RAS model

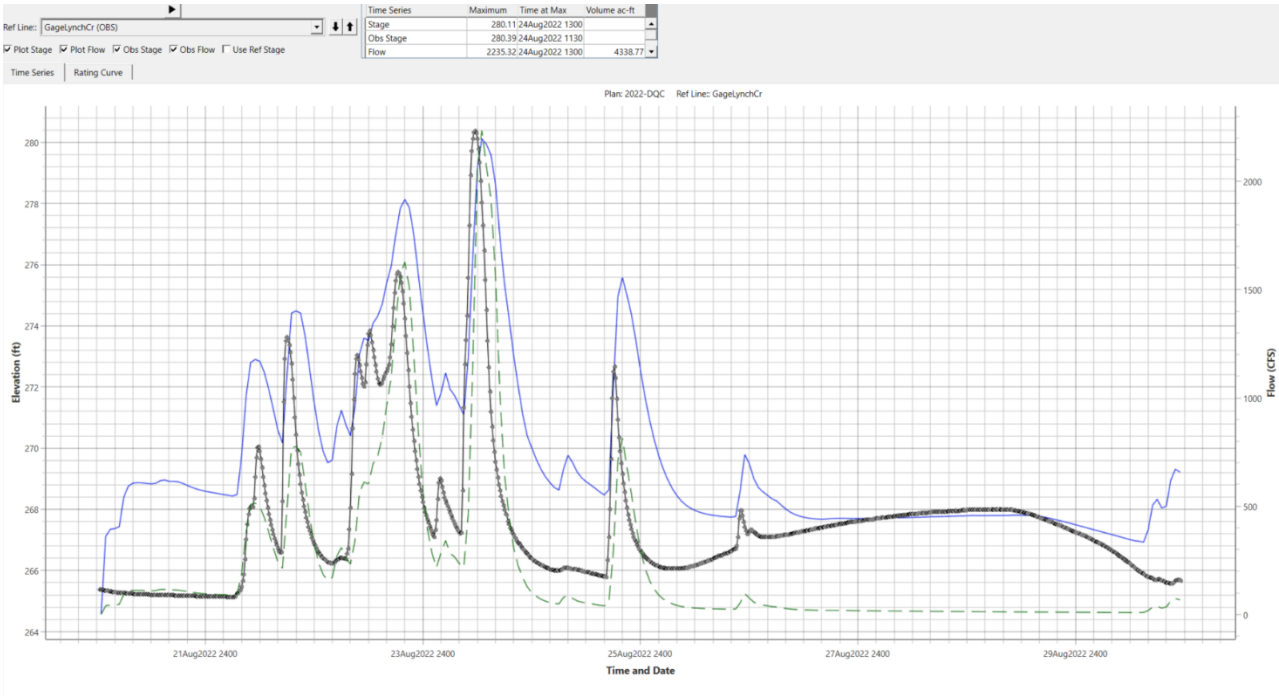


Figure 26: OBS vs Calculated Stage for Lynch Creek Gage, Aug 2022, HEC-RAS model

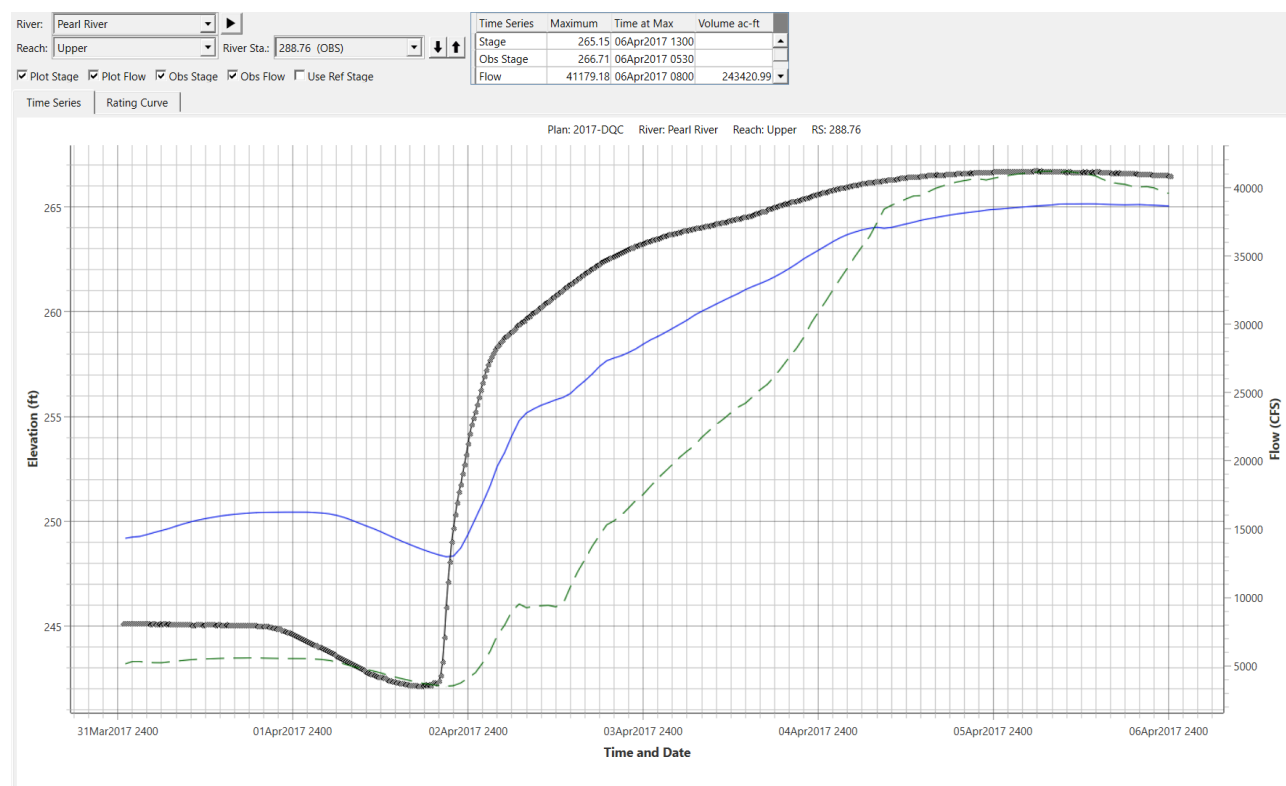


Figure 27: OBS vs Calculated Stage for Pearl River at Jackson Gage, Apr 2017, HEC-RAS model

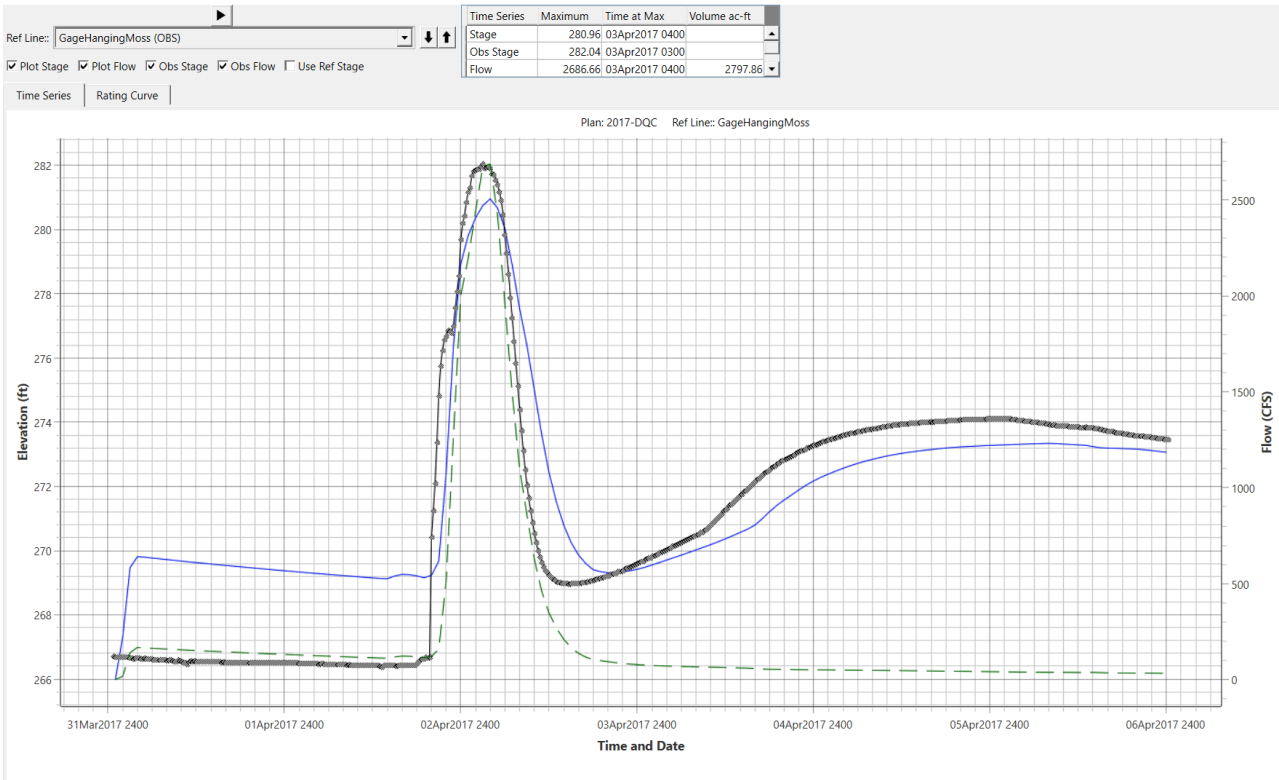


Figure 28: OBS vs Calculated Stage for Hanging Moss Creek Gage, Apr 2017, HEC-RAS model

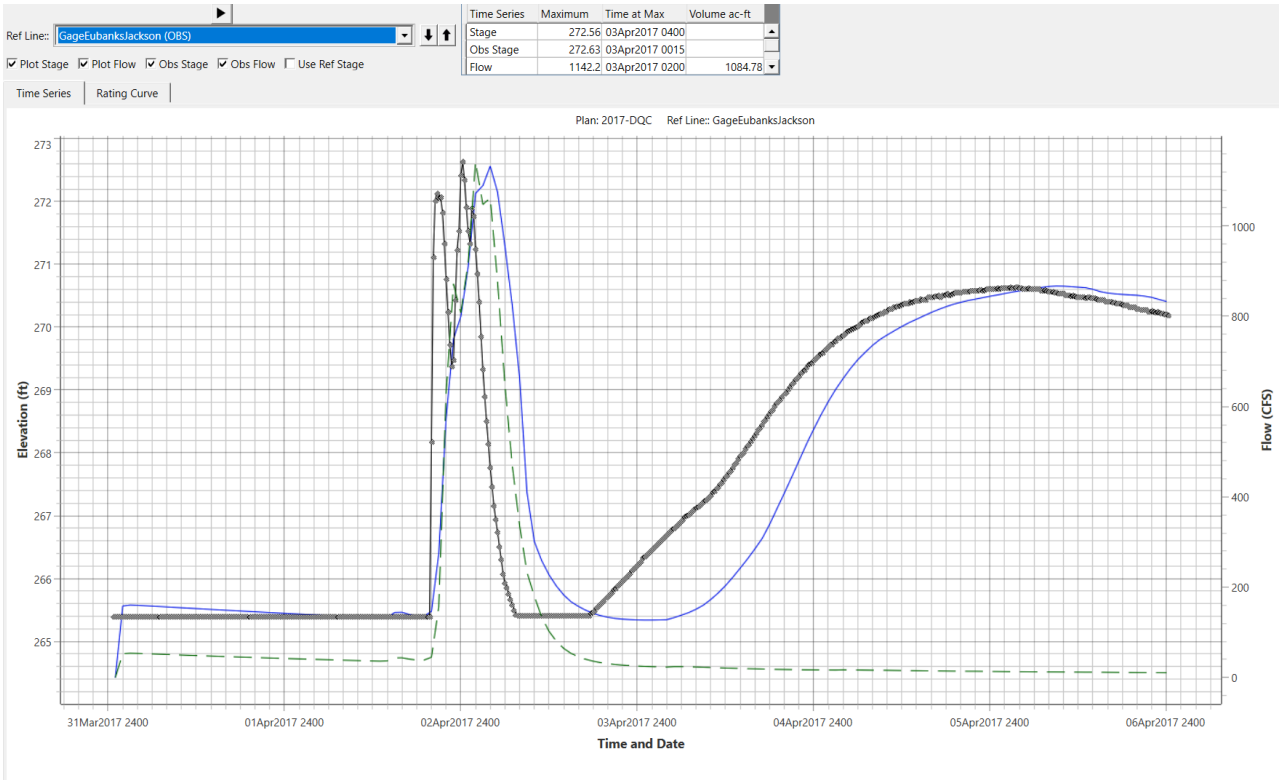


Figure 29: OBS vs Calculated Stage for Eubanks Creek Gage, Apr 2017, HEC-RAS model

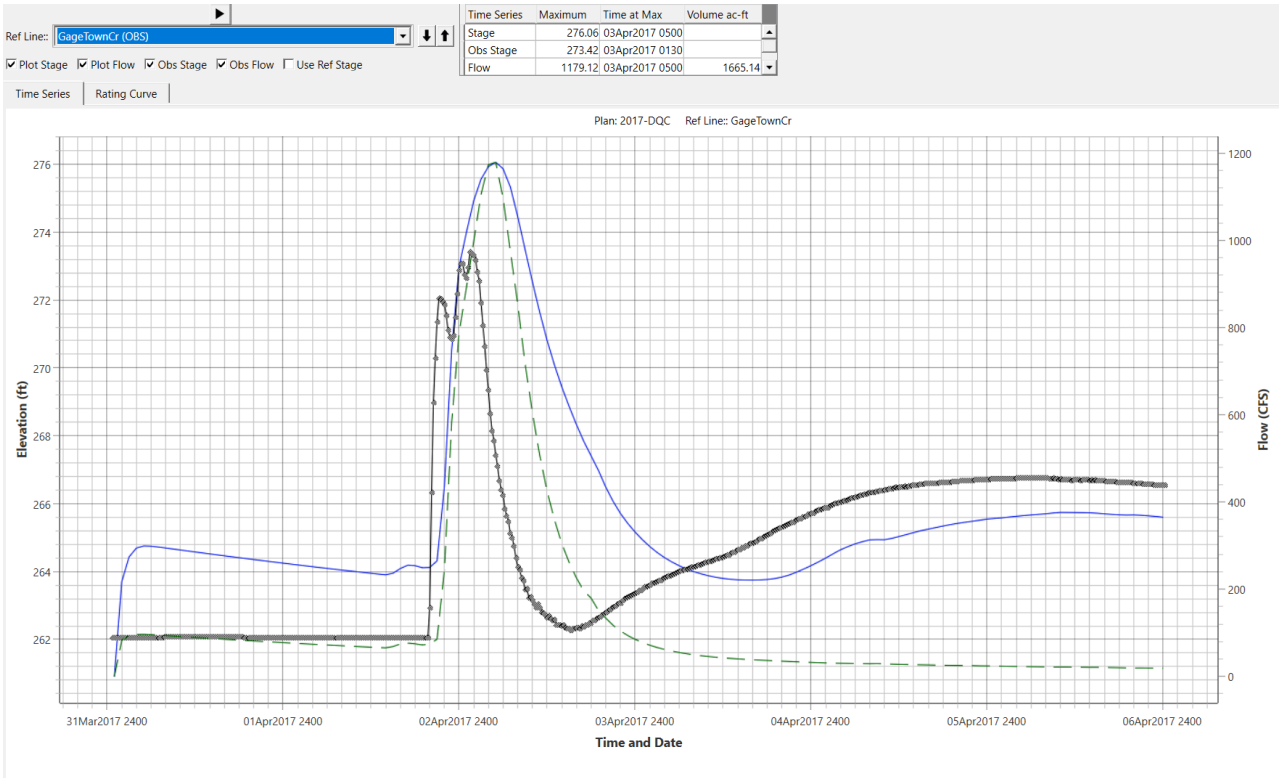


Figure 30: OBS vs Calculated Stage for Town Creek Gage, Apr 2017, HEC-RAS model

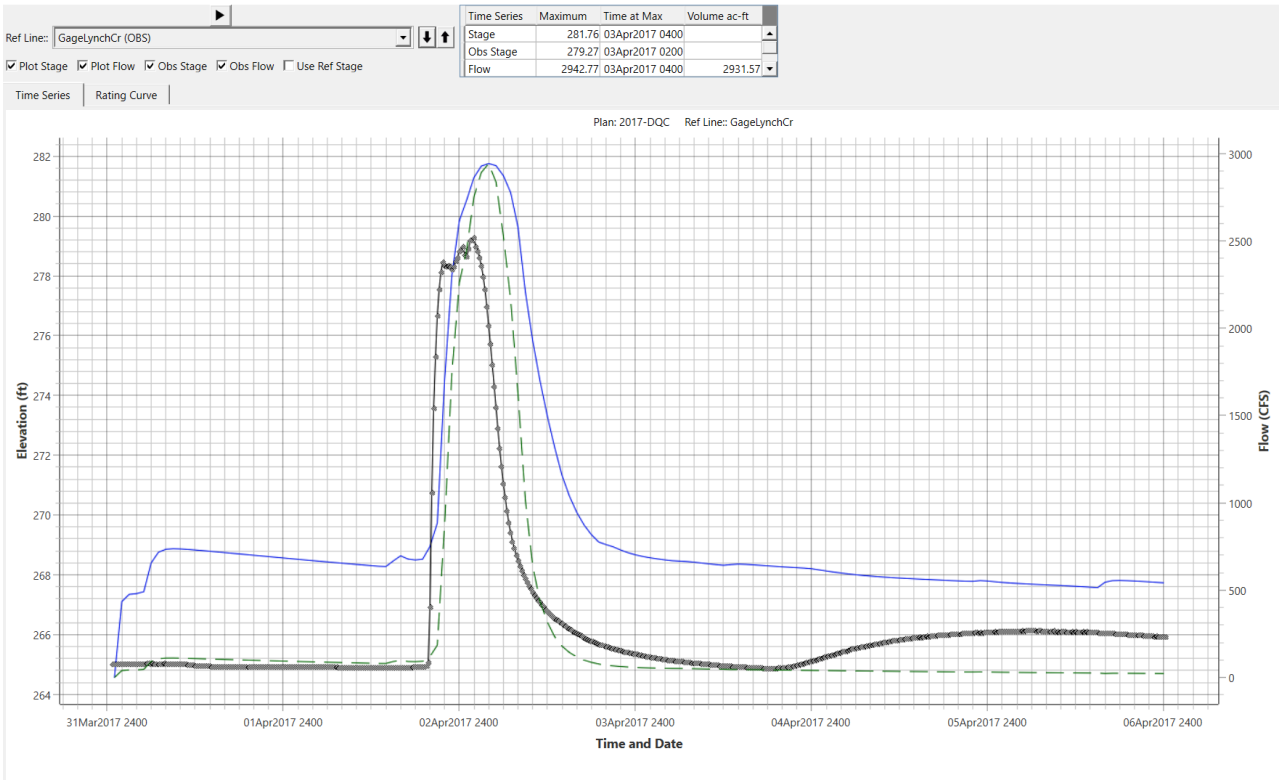


Figure 31: OBS vs Calculated Stage for Lynch Creek Gage, Apr 2017, HEC-RAS model

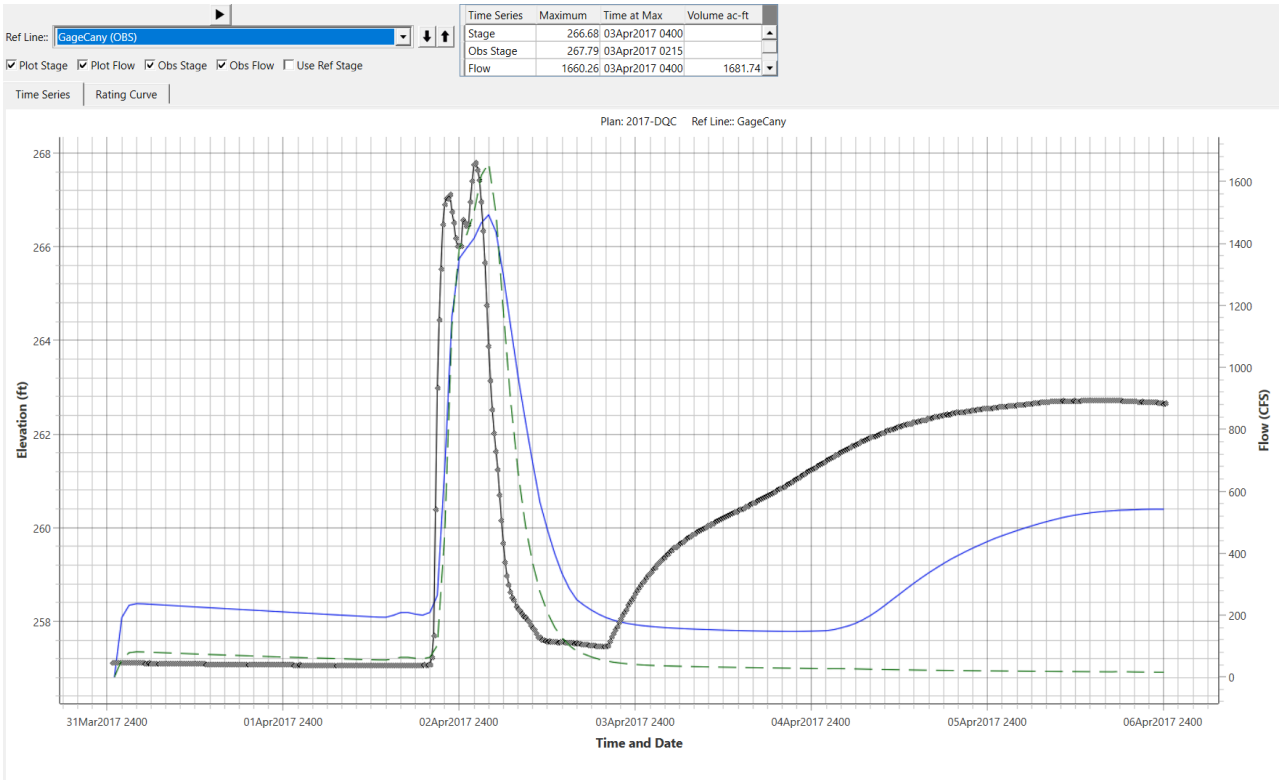


Figure 32: OBS vs Calculated Stage for Cany Creek Gage, Apr 2017, HEC-RAS model

Pearl River Basin, Mississippi Federal Flood Risk Management
Project Draft Appendix E – Hydrologic and Hydraulic Model

Initial HEC-HMS Subbasin Characteristics

Area	Longest Flowpath Length (M)	Longest Flowpath Slope (FT/FT)	Centroidal Flowpath Length	Centroidal Flowpath Slope	10-85 Flowpath Slope (M)	10-85 FlowPath Slope (Ft/FT)	Basin Slope (FT/FT)	Basin Relief (FT)	Relief Ratio	Elongation Ratio	Drainage Density (Mi/Mi2)	Subbasin Name	Area (MI2)	Subbasin Name	Area (MI2)
Subbasin-1	1.3139	3.11024	0.00366	1.20846	0.00187	2.33268	0.00362	0.04921	60.96875	0.00371	0.41586	1.54659	Subbasin-1	1.3139 S_Pearl_H	0.99059
S_BigCreek	26.85	13.0574	0.00334	5.96252	0.00142	9.79305	0.00191	0.05888	231.7813	0.00336	0.44778	0.93367	S_BigCree	26.85 S_Pearl_H	0.7645
S_Big-WeeksMill	21.083	13.19545	0.00429	5.89871	0.00022	9.89659	0.00188	0.10573	301.5	0.00433	0.39264	1.24777	S_Big-Wee	21.083 S_Pearl_H	0.23581
S_BrashearCr_1	12.994	8.4217	0.00425	3.40256	0.00209	6.31627	0.00271	0.05188	210	0.00472	0.48298	0.83984	S_Brashea	12.994 S_Pearl_IS	0.96278
S_BrushyCreek	23.908	19.01079	0.00262	9.90195	0.00164	14.25809	0.00216	0.1172	276.3125	0.00275	0.29022	1.09897	S_BrushyC	23.908 S_Pearl_Pr	0.58603
S_CaneyCreek_2	3.033	3.91179	0.0075	0.81977	0.00195	2.93384	0.00587	0.06904	158.4375	0.00767	0.50236	0.87681	S_CaneyCr	3.033 S_Pearl_P	1.6932
S_CanyCreek_1	8.5408	6.30607	0.0043	2.99007	0.00197	4.72955	0.00338	0.06164	219.5	0.00659	0.52293	0.53328	S_CanyCre	8.5408 S_PrairieBr	9.4389
S_CapitolBodyShop	0.23585	1.59396	0.00319	0.67947	0.00392	1.19547	0.00286	0.03175	36.46875	0.00433	0.34379	0	S_CapitolB	0.23585 S_PrairieBr	0.7813
S_ChristwayChurch	2.859	5.24108	0.00152	2.32777	0.00034	3.93081	0.00056	0.02733	130.5625	0.00472	0.36403	0.79005	S_Christw	2.859 S_PurpleC	6.1148
S_CityofPearl	8.4798	8.27927	0.00359	2.85194	0.00019	6.20945	0.00126	0.04469	199.1563	0.00456	0.39688	0.83494	S_CityofPe	8.4798 S_PurpleC	0.7878
S_DryCreek	29.601	21.94059	0.00173	10.50063	0.00068	16.45544	0.00097	0.06743	272.4375	0.00235	0.27981	1.34074	S_DryCree	29.601 S_RenoCre	23.437
S_EubanksCr_1	1.7129	5.47976	0.00244	3.2941	0.00249	4.10982	0.00151	0.03634	75.9375	0.00262	0.2695	1.60068	S_Eubanks	1.7129 S_Rhodes	37.116
S_EubanksCr_2	3.8206	4.27908	0.00437	1.66122	0.00299	3.20931	0.00312	0.05256	118.2188	0.00523	0.51543	0.75897	S_Eubanks	3.8206 S_Richland	20.975
S_EubanksCr_3	1.2694	2.45586	0.01033	1.1214	0.00721	1.8419	0.00838	0.07908	138.0938	0.01065	0.51766	0.90647	S_Eubanks	1.2694 S_Richland	13.713
S_EubanksCr_4	0.64261	2.09159	0.00926	1.11423	0.0027	1.56869	0.00519	0.07054	124.3438	0.01126	0.43247	0.84723	S_Eubanks	0.64261	14.736
S_Fairgrounds	1.5873	3.24616	0.00655	1.23956	0.00096	2.43462	0.0055	0.06483	112.375	0.00656	0.43794	0.39646	S_Fairgrou	1.5873 S_Richland	14.932
S_FlowoodYMCA	1.5456	3.05466	0.00413	1.61263	0.00103	2.291	0.00323	0.03239	101.5	0.00629	0.45924	0.16784	S_Flowood	1.5456 S_Richland	11.384
S_GallatinStDump	1.2697	3.14511	0.00227	1.41862	0.0001	2.35884	0.00127	0.08749	132.875	0.008	0.40427	2.2469	S_Gallatin	1.2697 S_Richland	2.0173
S_Haley-Chestnut-Bear	37.595	12.47074	0.0041	0.44023	0.00015	9.35305	0.00153	0.07881	271.6563	0.00413	0.55479	1.12621	S_Haley-C	37.595 S_Richland	0.4709
S_HangingMossSouth	0.16996	1.18926	0.01424	0.43054	0.00019	0.89194	0.01026	0.09606	89.5625	0.01426	0.39116	0	S_Hanging	0.16996 S_RiverRo	0.1444
S_HangingMoss_1	11.24	7.91787	0.00347	3.39237	0.00189	5.9384	0.00263	0.05156	202	0.00483	0.47778	0.92978	S_Hanging	11.24 S_RockyCr	26.633
S_HangingMoss_2	1.8912	3.40688	0.00369	1.04527	0.00168	2.55516	0.00329	0.04387	108.2188	0.00602	0.45548	1.01197	S_Hanging	1.8912 S_RossBar	6.1657
S_HangingMoss_3	2.2186	3.89087	0.00358	1.95854	0.00072	2.91815	0.00324	0.0585	117.7813	0.00573	0.43196	1.49927	S_Hanging	2.2186 S_Savanna	0.4843
S_HardyCreek	5.6221	5.56222	0.00514	2.14356	0.00359	4.17166	0.00423	0.06903	151.7813	0.00517	0.48101	1.16157	S_HardyCr	5.6221 S_SPearOr	3.4262
S_HogCreek_1	7.3102	5.29571	0.00488	2.24274	0.00162	3.97178	0.00302	0.06783	143.9688	0.00515	0.5761	0.81389	S_HogCree	7.3102 S_Steencr	42.204
S_HogCreek_3	0.29562	1.98885	0.00455	1.12985	0.00359	1.49164	0.00403	0.06196	47.5625	0.00453	0.30848	4.03271	S_HogCree	0.29562 S_Steencr	20.671
S_HogCreek_4	0.41722	1.82754	0.00238	0.45734	0.00397	1.37066	0.00245	0.05342	31.40625	0.00325	0.39881	2.17667	S_HogCree	0.41722	18.005
S_HogCreek2	4.9705	4.49595	0.00471	2.02783	0.00145	3.37196	0.00299	0.05327	135.9688	0.00573	0.55954	0.89971	S_HogCree	4.9705 S_TheVaul	1.5586
S_Holcomb-Still	14.046	9.4711	0.00204	5.24987	0.00068	7.10333	0.00104	0.05961	189.375	0.00379	0.44651	1.19929	S_Holcom	14.046 S_Tougalo	4.1197
S_Howard-Steamboat-	16.799	13.12264	0.00319	4.28593	0.00019	9.84198	0.00157	0.06846	220.1875	0.00318	0.35243	1.10787	S_Howard	16.799 S_TownCr	8.3137
S_JacksonHewitt	0.4858	1.40056	0.01158	0.59352	0.00216	1.05042	0.00932	0.03621	85.59375	0.01157	0.56151	0	S_Jackson	0.4858 S_TownCr	0.33194
S_LimestoneCreek	37.909	28.3259	0.00223	15.71966	0.00093	21.24443	0.00115	0.11882	333.1875	0.00223	0.24527	1.23125	S_Limesto	37.909 S_TownCr	2.0979
S_LynchCr_1	4.5075	4.96042	0.00431	2.50226	0.00258	3.72032	0.00353	0.05235	134.4375	0.00513	0.48295	0.70004	S_LynchCr	4.5075 S_TrahoC	4.7718
S_LynchCr_2	4.5603	4.00703	0.0046	1.58662	0.00146	3.00527	0.00355	0.05395	117.8438	0.00557	0.60135	0.79147	S_LynchCr	4.5603 S_Traho-	12.19
S_LynchCr_3	3.6818	5.21632	0.00526	2.14033	0.00318	3.91224	0.00282	0.05724	148.8438	0.0054	0.41507	0.8527	S_LynchCr	3.6818 S_TwinLak	1.1689
S_MountainCreek	25.39	13.70276	0.00377	6.61497	0.0011	10.27707	0.0015	0.08703	281.2813	0.00389	0.41493	1.06103	S_Mounta	25.39 S_TwinLak	1.4737
S_NeelyCr_1	5.8296	6.94462	0.00057	3.31205	0.00035	5.20846	0.00071	0.03545	47.34375	0.00129	0.39231	0.91025	S_NeelyCr	5.8296 S_UMMC	1.3031
S_NeelyCr_2	2.3688	3.84478	0.00193	1.35122	0.00232	2.88359	0.00057	0.03533	51.46875	0.00254	0.45169	0.62258	S_NeelyCr	2.3688 S_Vaughn	14.36
S_Pearl-CanyCr	5.9005	6.39929	0.00208	1.08643	0.00014	4.79947	0.00183	0.0462	173.2188	0.00513	0.42832	1.25097	S_Pearl-Ca	5.9005 S_Westsid	3.1609
S_Pearl-RichlandCr	0.88588	3.18224	0.00175	1.83012	0.00012	2.38668	0.00218	0.07049	42.09375	0.00251	0.33374	2.79823	S_Pearl-Ri	0.88588 S_WhiteO	2.6847
S_Pearl_EubanksCr	0.72277	2.11816	0.00271	0.89942	0.00155	1.58862	0.00261	0.08947	123.875	0.01108	0.45289	2.06547	S_Pearl_E	0.72277 S_WhiteO	5.6652
S_Pearl_HangingMoss	1.5052	4.25255	0.00117	2.31354	0.00165	3.18941	0.00105	0.03307	38.34375	0.00171	0.32554	1.78399	S_Pearl_H	1.5052	
S_Pearl_HogCreek	0.99059	3.69194	0.00113	1.25426	0.00002	2.76895	0.00071	0.07211	80.53125	0.00413	0.30419	3.50972			
S_Pearl_Hwy25	0.7645	2.45971	0.00243	0.42868	0.0026	1.84478	0.00214	0.06001	97	0.00747	0.40111	1.19297			
S_Pearl_HWY80	0.23581	1.07375	0.00428	0.33871	0.00016	0.80531	0.00211	0.10042	54.65625	0.00964	0.5103	4.46891			
S_Pearl_IS5	0.96278	3.12892	0.00243	1.18278	0.00017	2.34669	0.00132	0.08625	52.46875	0.00318	0.35385	3.22114			
S_Pearl_PrairieBranch	0.58603	2.48879	0.00293	1.44337	0.00095	1.86659	0	0.07533	48.5625	0.0037	0.34708	3.67823			
S_Pearl_Purple	1.6932	3.78702	0.001	2.08036	0.00004	2.84026	0.00072	0.05771	28.90625	0.00145	0.38772	1.79729			
S_PrairieBranch_1	9.4389	6.71856	0.00439	3.11689	0.00278	5.03892	0.0027	0.04807	166.375	0.00469	0.51599	0.71044			

Pearl River Basin, Mississippi Federal Flood Risk Management
Project Draft Appendix E – Hydrologic and Hydraulic Model

Initial HEC-HMS Subbasin Characteristics

Area	Longest Flowpath Length (M)	Longest Flowpath Slope (FT/FT)	Centroidal Flowpath Length	Centroidal Flowpath Slope	10-85 Flowpath Slope (M)	10-85 FlowPath Slope (Ft/FT)	Basin Slope (FT/FT)	Basin Relief (FT)	Relief Ratio	Elongation Ratio	Drainage Density (MI/MI2)	Subbasin Name	Area (MI2)	Subbasin Name	Area (MI2)
S_PrairieBranch_2	0.7813	2.22308	0.00257	0.94819	0.00091	1.66731	0.00169	0.06568	44.8125	0.00382	0.44866	2.67663			
S_PurpleCreek_1	6.1148	7.77066	0.00455	3.51973	0.00319	5.828	0.00286	0.0552	215.7188	0.00526	0.35908	0.96789			
S_PurpleCreek_2	0.7878	2.30428	0.00483	0.94469	0.00308	1.72821	0.00409	0.04668	58.78125	0.00483	0.43463	1.78706			
S_RenoCreek	23.437	13.47638	0.00371	5.69408	0.00041	10.10729	0.00215	0.09679	297.7188	0.00418	0.40536	1.2945			
S_RhodesCreek	37.116	21.77627	0.00211	11.33175	0.00112	16.3322	0.00126	0.0659	275.2188	0.00239	0.31568	1.1091			
S_RichlandCr_1	20.975	8.2903	0.00342	3.49653	0.00104	6.21772	0.00173	0.06985	237.2813	0.00542	0.62335	0.89858			
S_RichlandCr_2	13.713	7.14127	0.00482	2.9736	0.00124	5.35595	0.00193	0.06361	218.75	0.0058	0.58512	0.90112			
S_RichlandCr_3	14.736	11.6944	0.00323	4.94643	0.00094	8.7708	0.00137	0.04423	209.0313	0.00339	0.3704	1.394			
S_RichlandCr_4	14.932	12.32481	0.0021	5.15802	0.00075	9.24361	0.00083	0.05573	175.2813	0.00269	0.35378	1.54652			
S_RichlandCr_5	11.384	9.05277	0.00301	3.82277	0.00107	6.78957	0.00204	0.0602	202.4375	0.00424	0.42056	1.05148			
S_RichlandCr_6	2.0173	5.21246	0.00479	2.79397	0.00042	3.90935	0.00203	0.06975	145.4375	0.00528	0.30747	2.33556			
S_RichlandCr_7	4.0709	6.98752	0.00483	2.96257	0.00163	5.24064	0.00261	0.05243	178.5	0.00484	0.32582	1.82549			
S_RiverRoadN	0.1444	0.81071	0.00445	0.36854	0.00482	0.60803	0.00379	0.03061	23	0.00537	0.52898	0			
S_RockyCreek	26.633	17.8439	0.00286	4.3478	0.00009	13.38293	0.00131	0.09685	292.9063	0.00311	0.32634	1.27598			
S_RossBarnett	6.1657	8.23302	0.00284	2.83267	0.00007	6.17476	0.00146	0.06041	135.5625	0.00312	0.34032	1.4108			
S_SavannaStWWTP	0.4843	2.50286	0.00298	2.14286	0.00198	1.87715	0.00226	0.06647	40.78125	0.00309	0.31373	1.48455			
S_SPearOrchardRd	3.4262	5.07226	0.00464	2.60154	0.00295	3.80419	0.00411	0.05959	134.875	0.00504	0.41178	0.85593			
S_Steencreek_1	42.204	19.09873	0.00252	6.35846	0.00079	14.32405	0.00113	0.06268	287.5625	0.00285	0.38382	1.11899			
S_Steencreek_2	20.671	16.31618	0.00253	8.15741	0.00073	12.23713	0.00116	0.07656	272.8125	0.00317	0.31443	1.35522			
S_TerrapinSkinCr	18.005	8.97929	0.00482	4.06533	0.0017	6.73446	0.00232	0.06578	234.1875	0.00494	0.53322	0.84088			
S_TheVault	1.5586	3.7242	0.00449	2.22877	0.00364	2.79315	0.00377	0.04433	122	0.0062	0.37825	1.03805			
S_Tougaloo	4.1197	6.76559	0.00456	3.35056	0.00308	5.0742	0.00356	0.05175	169.7813	0.00475	0.33852	1.01834			
S_TownCr_1	8.3137	7.06275	0.00276	3.21025	0.00142	5.29706	0.0025	0.04396	119.7188	0.00321	0.46066	0.90753			
S_TownCr_2	0.33194	1.44658	0.00909	0.65297	0.00333	1.08494	0.00817	0.06373	73.625	0.00964	0.44941	2.66997			
S_TownCr_3	2.0979	4.82133	0.0053	1.81719	0.00349	3.616	0.00322	0.05493	150.3438	0.00591	0.33898	1.15211			
S_TrahonCreek	4.7718	5.25456	0.00582	2.42423	0.00236	3.94092	0.00452	0.06348	173.8438	0.00627	0.46909	0.66583			
S_Trahon-Big	12.19	9.59863	0.00311	3.29523	0.00199	7.19897	0.0023	0.06917	185.0938	0.00365	0.41044	1.28606			
S_TwinLakeA	1.1689	2.89034	0.00609	1.619	0.00157	2.16775	0.0043	0.06496	107.125	0.00702	0.42208	0.00243			
S_TwinLakeB	1.4737	2.64575	0.00925	1.211	0.0065	1.98431	0.00593	0.06849	131.4375	0.00941	0.51774	0.53811			
S_UMMC	1.3031	2.68544	0.00983	1.33726	0.00815	2.01408	0.00672	0.08016	144.4063	0.01018	0.47966	0.40896			
S_VaughnCreek	14.36	13.18899	0.00313	8.21007	0.00157	9.89174	0.00163	0.04983	224.5	0.00322	0.32421	1.12319			
S_WestsidePark	3.1609	4.56984	0.00469	2.30699	0.00217	3.42738	0.00356	0.05812	128	0.0053	0.43899	0.79119			
S_WhiteOakCr_1	2.6847	3.74979	0.0059	1.77686	0.00351	2.81234	0.00487	0.06622	151.6875	0.00766	0.49305	0.71263			
S_WhiteOakCr_2	5.6652	8.83153	0.00409	3.98412	0.0021	6.62365	0.00282	0.05574	220.8438	0.00474	0.30411	1.13768			

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<i>Initial Loss Parameters for the HEC-HMS</i>			
Subbasin-	Initial Loss (In)	Rate (IN/HR)	Impervios (%)
1S_BigCree	0.5	0.7	0.447
kS_Big-	0.5	1.87	8.59
WeeksMil			
IS_Brashe	0.5	0.68	0.671
arCr_1S_Brushy	0.5	0.78	26.2
CreekS_CaneyC	0.5	0.34	1.73
reek_2S_CanyCr	0.5	0.42	23.1
eeek_1	0.5	0.79	20
S_Capitol			
BodyShop	0.5	0.29	45.2
S_Christw			
ayChurchS_CityofP	0.5	2.21	5.82
earlS_DryCre	0.5	2.56	31.7
ekS_Eubank	0.5	1.64	1.35
sCr_1S_Eubank	0.5	2.1	10.1
sCr_2S_Eubank	0.5	0.23	29.8
sCr_3	0.5	1.73	38.4
S_Eubank			
sCr_4S_Fairgro	0.5	2.88	22.6
undsS_Flowoo	0.5	2.1	52.7
dYMCAS_Gallatin	0.5	1.39	0
StDumpS_Haley-	0.5	3.01	8.92
Chestnut-			
BearS_Hangin	0.5	0.88	0.866
gMossSou			
thS_Hangin	0.5	0.3	4.74
gMoss_1S_Hangin	0.5	0.81	10.9
gMoss_2S_Hangin	0.5	1.17	45.5
gMoss_3S_HardyC	0.5	2.21	19.4
reekS_HogCre	0.5	1.38	16.6
ek_1S_HogCre	0.5	1.52	9.38
ek_3S_HogCre	0.5	0.51	35.6
ek_4S_HogCre	0.5	0.51	15.9
ek2S_Holcom	0.5	1.32	0
b-Still	0.5	2.41	1.49
S_HowardSteamboa			
t-HawkinsS_Jackson	0.5	2.48	2.16
HewittS_Limesto	0.5	1.16	0
neCreekS_LynchCr	0.5	0.54	0.609
_1S_LynchCr	0.5	1.34	19.8
_2S_LynchCr	0.5	0.23	41.7

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<i>Initial Loss Parameters for the HEC-HMS</i>			
Subbasin-	Initial Loss (In)	Rate (IN/HR)	Impervios (%)
_3S_Mounta	0.5	0.67	44.2
inCreekS_NeelyCr	0.5	2.02	0.927
_1S_NeelyCr	0.5	3.07	22.8
_2S_Pearl-	0.5	2.78	32.9
CanyCrS_Pearl-	0.5	2.47	0
RichlandC			
r	0.5	2.5	0.493
S_Pearl_E			
ubanksCrS_Pearl_H	0.5	3.88	26.4
angingMo			
ssS_Pearl_H	0.5	0.3	0.224
ogCreek	0.5	3.99	0.313
S_Pearl_H			
wy25S_Pearl_H	0.5	2.21	24.4
WY80S_Pearl_I	0.5	2	19.8
55S_Pearl_P	0.5	4.04	2.96
rarieBran			
chS_Pearl_P	0.5	4.12	0.0368
urpleS_PrairieB	0.5	2.5	0.0994
ranch_1S_PrairieB	0.5	1.93	0
ranch_2S_PurpleC	0.5	1.98	20.9
reek_1S_PurpleC	0.5	1.56	0
reek_2S_RenoCr	0.5	0.79	0
reekS_Rhodes	0.5	0.58	0.53
CreekS_Richlan	0.5	1.63	2.09
dCr_1S_Richlan	0.5	1.76	5.1
dCr_2S_Richlan	0.5	1.91	7.38
dCr_3S_Richlan	0.5	2.12	1.33
dCr_4S_Richlan	0.5	1.5	4.8
dCr_5S_Richlan	0.5	2.01	9.74
dCr_6	0.5	3.68	0
S_Richlan			
dCr_7S_RiverRo	0.5	3.19	0
adNS_RockyC	0.5	1.64	0
reekS_RossBar	0.5	0.8	0.736
nett	0.5	1.86	0
S_Savann			
aStWWTPS_SPearO	0.5	4.06	10.3
rchardRdS_SteenCr	0.5	1.25	0
reek_1S_SteenCr	0.5	2.17	4.34

<i>Initial Loss Parameters for the HEC-HMS</i>			
Subbasin-	Initial Loss (In)	Rate (IN/HR)	Impervios (%)
eeek_2S_Terrapi	0.5	2.11	1.02
nSkinCrS_TheVau	0.5	2.38	19.7
ItS_Tougal	0.5	0.25	56.3
ooS_TownCr	0.5	0.91	22.9
_1S_TownCr	0.5	0.89	35
_2S_TownCr	0.5	0.38	53.7
_3S_Trahon	0.5	0.99	45.5
CreekS_Trahon-	0.5	1.07	8.02
BigS_TwinLa	0.5	1.65	13.5
keA	0.5	2.02	15.2
S_TwinLa			
keB	0.5	2.45	24
S_UMMCS_Vaughn	0.5	0.3	26.4
CreekS_Westsi	0.5	1.3	3.24
deParkS_WhiteO	0.5	0.95	23.2
akCr_1S_WhiteO	0.5	0.47	8
akCr_2	0.5	0.56	25.2

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Initial Transform Values, HEC-

Subbasin-	Time of Concentration (HR)	Storage Coefficient (HR)
1S_BigCree	2.1	2.1
kS_Big-	5.75	5.75
WeeksMil		
IS_Brashe	5.76	5.76
arCr_1S_Brushy	4.04	4.04
CreekS_CaneyC	7.35	7.35
reek_2S_CanyCr	1.86	1.86
reek_1	3.45	7.11
S_Capitol		
BodyShop	1.5	1.5
S_Christw		
ayChurchS_CityofP	3.96	3.96
earlS_DryCre	4.27	4.27
ekS_Eubank	8.81	8.81
sCr_1S_Eubank	3.84	3.84
sCr_2	2.6	2.6
S_Eubank		
sCr_3S_Eubank	1.69	1.69
sCr_4S_Fairgro	1.73	1.73
undsS_Flowoo	2.02	2.02
dYMCAS_Gallatin	2.32	2.32
StDumpS_Haley-	2.59	2.59
Chestnut-		
BearS_Hangin	2.68	2.68
gMossSou		
thS_Hangin	0.989	3.05
gMoss_1S_Hangin	3.98	3.98
gMoss_2S_Hangin	2.1	2.1
gMoss_3S_HardyC	2.64	2.64
reekS_HogCre	2.9	2.9
ek_1S_HogCre	3.05	3.05
ek_3S_HogCre	1.77	1.77

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ek_4S_HogCre	1.42	1.42
ek2S_Holcom	2.82	2.82
b-Still	5.5	5.5
S_HowardSteamboa		
t-HawkinsS_Jackson	5.37	5.37
HewittS_Limesto	1.16	1.16
neCreekS_LynchCr	10.5	10.5
_1S_LynchCr	3.02	3.02
_2S_LynchCr	2.47	2.47
_3S_Mounta	3.03	3.03
inCreekS_NeelyCr	6.24	6.24
_1S_NeelyCr	4.63	4.63
_2S_Pearl-	3.06	3.06
CanyCrS_Pearl-	2.8	2.8
RichlandC		
r	2.59	2.59
S_Pearl_E		
ubanksCrS_Pearl_H	1.8	1.8
angingMo		
ssS_Pearl_H	3.38	3.38
ogCreek	2.86	2.86
S_Pearl_H		
wy25S_Pearl_H	1.55	1.55
WY80S_Pearl_I	1.13	1.13
55S_Pearl_P	2.43	2.43
rarieBran		
chS_Pearl_P	5.96	1.47
urpleS_PrairieB	3.34	3.34
ranch_1S_PrairieB	3.68	3.68
ranch_2S_PurpleC	1.98	1.98
reek_1S_PurpleC	3.95	3.95
reek_2S_RenoCr	1.75	1.75
eeK_S_Rhodes	5.62	5.62
CreekS_Richlan	8.65	8.65
dCr_1S_Richlan	4.34	4.34
dCr_2S_Richlan	3.88	3.88
dCr_3S_Richlan	5.52	5.52
dCr_4S_Richlan	6.13	6.13
dCr_5S_Richlan	4.46	4.46
dCr_6	3.44	3.44
S_Richlan		
dCr_7S_RiverRo	3.68	3.68

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adNS_RockyC	0.977	0.977
reekS_RossBar	6.07	6.07
nett	4.16	4.16
S_Savann		
aStWWTPS_SPearO	2.51	2.51
rchardRdS_SteenCr	3.01	3.01
eeek_1S_SteenCr	7.11	7.11
eeek_2S_Terrapi	7.27	7.27
nSkinCrS_TheVau	4.45	4.45
ltS_Tougal	2.65	2.65
ooS_TownCr	3.61	3.61
_1S_TownCr	3.81	3.81
_2S_TownCr	1.23	1.23
_3S_Trahon	2.76	2.76
CreekS_Trahon-	2.93	2.93
BigS_TwinLa	4.26	4.26
keA	2.19	2.19
S_TwinLa		
keB	1.86	1.86
S_UMMCS_Vaughn	1.89	1.89
CreekS_Westsi	6.5	6.5
deParkS_WhiteO	2.87	2.87
akCr_1S_WhiteO	2.39	2.39
akCr_2	4.27	4.27

<i>Initial Baseflow Parameters, HEC-HMS model</i>							
Subbasin-	Initial Type	Initial Discharge (CFS/MI2)	Initial Discharge (CFS)	Recession Constant	Threshold Type Ratio to	Threshold Flow (CFS)	Ratio To Peak
1 S_BigCreek	Discharge	10	0.55	Peak	0.1	Discharge	10
S_Big-WeeksMill							
S_BrashearCr_1							
S_CaneyCreek_2							
S_CapitolBodyShop							
S_ChristwayChurch							
S_CityofPearl							
S_DryCreek							
S_EubanksCr_1							
S_EubanksCr_2							
S_EubanksCr_3							
S_EubanksCr_4							
S_Fairgrounds							
S_FlowoodYMCA							
S_Gallatin StDump							

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Initial Reach Routing Parameters, HEC-HMS model

	Initial Type	Initial Discharge (CFS)	Length (FT)	Slope (FT/FT)	Manning's N	Space time method	Subreaches	Subinterval	Index method	Index Flow (CFS)	Index Celerity Shape	Diameter (FT)	Width	Slide Slope Left Manning'(XH:1V) s N	Right Manning's N	Cross Section	Elevation Discharge Area	Elevation width	Elevation Invert Perimeter (FT)
R_Richlan						Auto DX													
d1 R_Richlan	Discharge		26912.48	0.00126		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		25	2					
d2 R_Richlan	Discharge		5033.477	0.00019		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		30	2					
dCr_3 R_Richlan	Discharge		14969.28	0.00055		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		30	2					
dCr_4 R_Terrapi	Discharge		32935.53	0.0006		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		40	2					
nSkinCr R_Richlan	Discharge		22766.3	0.00091		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		25	2					
dCr_5 R_Richlan	Discharge		22821.96	0.00053		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		40	2					
dCr_6 R_NeelyC	Discharge		24884.27	0.00041		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		45	2					
r R_Richlan	Discharge		4825.814	0.0025		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		25	2					
dCr_7 R_Hangin	Discharge		15453.72	0.00051		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		50	2					
gMoss_1 R_Hangin	Discharge		5074.872	0.00233		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		40	2					
gMoss_2 R_Hangin	Discharge		5035.325	0.00191		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		45	2					
gMoss_3 R_White	Discharge		5578.954	0.00227		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		50	2					
Oak_1 R_White	Discharge		34030.39	0.00204		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		30	2					
Oak_2 R_RossBO	Discharge		2617.718	0.00396		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		30	2					
utflows R_PearlTr	Discharge		8304.648	0.00008		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		270	7.5					
ib	Discharge		16716.11	0.00159		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		30	2					
R_Pearl1	Discharge		11382.31	0.00008		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		270	7.5					
R_Pearl2	Discharge		5396.266	0.00006		0.05 Auto DT			Celerity		1 Trapezoid		270	7.5					
R_Unnam						Auto DX													
edTrib10	Discharge		2685.408	0.00436		0.05 Auto DT Auto DX			Celerity		2 Trapezoid		5	2					
R_Pearl3 R_Purple	Discharge		5255.395	0.00006		0.05 Auto DT Auto DX			Celerity		1 Trapezoid		270	7.5					
_1 R_Purple	Discharge		7438.2	0.00153		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		35	2					
_2	Discharge		1830.998	0.00031		0.05 Auto DT Auto DX			Celerity		3 Trapezoid		35	2					
R_Pearl4 R_Hangin	Discharge		3590.717	0.00002		0.05 Auto DT Auto DX			Celerity		1 Trapezoid		270	7.5					
gMoss_4	Discharge		9377.966	0.00028		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		55	2					
R_Pearl5 R_Unnam	Discharge		1655.702	0.00001		0.05 Auto DT Auto DX			Celerity		1 Trapezoid		270	7.5					
edTrib1 R_Unnam	Discharge		8744.314	0.00042		0.05 Auto DT Auto DX			Celerity		2 Trapezoid		15	2					
edTrib2 R_Unnam	Discharge		3889.882	0.00157		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		20	2					
edTrib3	Discharge		3375.926	0.00216		0.05 Auto			Celerity		5 Trapezoid		5	2					

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R_Unnam edTrib4	Discharge	8644.786	0.0016	DTX 0.05 Auto DT Auto DX	Celerity	5 Trapezoid	20	2										
R_Pearl6 R_Hangin gMossSou th	Discharge	2255.616	0.00007	0.05 Auto DT Auto DX	Celerity	2 Trapezoid	270	7.5										
R_Pearl7 R_HogCre ek_1 R_HogCre ek2	Discharge	1262.818	0.00049	0.05 Auto DT Auto DX	Celerity	1 Trapezoid	8	2										
R_Pearl7 R_HogCre ek_1 R_HogCre ek2	Discharge	3917.179	0.00002	0.05 Auto DT Auto DX	Celerity	1 Trapezoid	270	7.5										
R_Pearl7 R_HogCre ek_1 R_HogCre ek2	Discharge	18436.12	0.00155	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	45	2										
R_Pearl7 R_HogCre ek_1 R_HogCre ek2	Discharge	6294.605	0.0007	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	45	2										
R_Pearl7 R_HogCre ek_1 R_HogCre ek2	Discharge	4802.107	0.00089	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	45	2										
R_Pearl7 R_HogCre ek_1 R_HogCre ek2	Discharge	4003.19	0.00138	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	45	2										
R_Pearl8 R_Unnam edTrib5	Discharge	5681.122	0.00002	0.05 Auto DT Auto DX	Celerity	1 Trapezoid	270	7.5										
R_Pearl8 R_Unnam edTrib5	Discharge	2514.917	0.00328	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	10	2										
R_Pearl9 R_Unnam edTrib6	Discharge	2479.91	0.00001	0.05 Auto DT Auto DX	Celerity	1 Trapezoid	270	7.5										
R_Pearl9 R_Unnam edTrib6	Discharge	2347.646	0.00039	0.05 Auto DT Auto DX	Celerity	2 Trapezoid	25	2										
R_Pearl10 R_PrairieB ranch	Discharge	6404.957	0.00001	0.05 Auto DT Auto DX	Celerity	1 Trapezoid	270	7.5										
R_Pearl10 R_PrairieB ranch	Discharge	11047.29	0.0006	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	30	2										
R_Pearl11 R_Eubank s_1 R_Eubank s_2 R_Eubank s_3	Discharge	4983.422	0.00145	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	270	7.5										
R_Pearl11 R_Eubank s_1 R_Eubank s_2 R_Eubank s_3	Discharge	15315.7	0.00271	0.05 Auto DT Auto DX	Celerity	626 Trapezoid	20	2										
R_Pearl11 R_Eubank s_1 R_Eubank s_2 R_Eubank s_3	Discharge	6075.485	0.00434	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	20	2										
R_Pearl11 R_Eubank s_1 R_Eubank s_2 R_Eubank s_3	Discharge	2884.675	0.00128	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	20	2										
R_Pearl12 R_Unnam edTrib7	Discharge	5380.32	0.00021	0.05 Auto DT Auto DX	Celerity	4 Trapezoid	270	7.5										
R_Pearl12 R_Unnam edTrib7	Discharge	2509.056	0.0006	0.05 Auto DT Auto DX	Celerity	3 Trapezoid	10	2										
R_Pearl13 R_Unnam edTrib8	Discharge	11041.43	0.00016	0.05 Auto DT Auto DX	Celerity	4 Trapezoid	270	7.5										
R_Pearl13 R_Unnam edTrib8	Discharge	5345.366	0.00648	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	5	2										
R_Pearl14 R_Town 1 R_Town 2 R_Town 3 R_Town 4	Discharge	4840.862	0.00014	0.05 Auto DT Auto DX	Celerity	3 Trapezoid	270	7.5										
R_Pearl14 R_Town 1 R_Town 2 R_Town 3 R_Town 4	Discharge	3655.766	0.00471	0.05 Auto DT Auto DX	Celerity	8 Trapezoid	20	2										
R_Pearl14 R_Town 1 R_Town 2 R_Town 3 R_Town 4	Discharge	1030.814	0.0144	0.05 Auto DT Auto DX	Celerity	10 Trapezoid	20	2										
R_Pearl14 R_Town 1 R_Town 2 R_Town 3 R_Town 4	Discharge	12754.53	0.00313	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	20	2										
R_Pearl14 R_Town 1 R_Town 2 R_Town 3 R_Town 4	Discharge	740.256	0.00034	0.05 Auto DT Auto DX	Celerity	4 Trapezoid	20	2										
R_Pearl15 R_Lynch 2 R_Lynch 3	Discharge	6149.986	0.00016	0.05 Auto DT Auto DX	Celerity	4 Trapezoid	270	7.5										
R_Pearl15 R_Lynch 2 R_Lynch 3	Discharge	12383.13	0.0032	0.05 Auto DT Auto DX	Celerity	1 Trapezoid	20	2										
R_Pearl15 R_Lynch 2 R_Lynch 3	Discharge	816.552	0.00107	0.05 Auto DT Auto DX	Celerity	5 Trapezoid	20	2										
R_Pearl16	Discharge	8913.538	0.00011	0.05 Auto DT Auto DX	Celerity	3 Trapezoid	270	7.5										
R_Pearl17	Discharge	7143.154	0.00021	0.05 Auto DT Auto DX	Celerity	4 Trapezoid	270	7.5										
R_Pearl18	Discharge	3800.914	0.00014	0.05 Auto DT	Celerity	3 Trapezoid	270	7.5										

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						Auto DX													
R_RichlandCr_8	Discharge		2440.786	0.00289		0.05 Auto DT Auto DX			Celerity		10 Trapezoid		50	2					
R_Pearl19	Discharge		10654.78	0.00013		0.05 Auto DT Auto DX			Celerity		3 Trapezoid		270	7.5					
R_Cany	Discharge		13243.93	0.00172		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		35	2					
R_Pearl20	Discharge		17053.29	0.00018		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		270	7.5					
R_Pearl21	Discharge		39221.42	0.0002		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		270	7.5					
R_Pearl22	Discharge		12019.44	0.00011		0.05 Auto DT Auto DX			Celerity		3 Trapezoid		270	7.5					
R_BigCreek_1	Discharge		15782.87	0.00099		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		40	2					
R_Trahon	Discharge		30282.17	0.00133		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		5	2					
R_BigCreek_2	Discharge		6679.992	0.00116		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		40	2					
R_Pearl23	Discharge		34538.75	0.00013		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		270	7.5					
1 R_Steens_	Discharge		24614.78	0.00065		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		20	2					
R_MountainCreek	Discharge		19756.18	0.00088		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		10	2					
2 RSteens_	Discharge		42706.44	0.00073		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		30	2					
R_Pearl24	Discharge		8923.622	0.00014		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		270	7.5					
R_Pearl25	Discharge		1924.402	0.00023		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		270	7.5					
R_Pearl26	Discharge		40616.29	0.00008		0.05 Auto DT Auto DX			Celerity		3 Trapezoid		270	7.5					
R_Pearl27	Discharge		37582.25	0.00011		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		270	7.5					
R_Pearl28	Discharge		29120.68	0.0001		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		270	7.5					
R_Pearl29	Discharge		43356.77	0.0001		0.05 Auto DT Auto DX			Celerity		4 Trapezoid		270	7.5					
R_Pearl30	Discharge		8794.896	0.0002		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		270	7.5					
1 R_Lynch_	Discharge		13947.07	0.00145		0.05 Auto DT Auto DX			Celerity		5 Trapezoid		20	2					

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Final Calibrated HEC-HMS Subbasin Characteristics												
	Area	Longest Flowpath Length (MI)	Longest Flowpath Slope (FT/FT)	Centroidal Flowpath Length	Centroidal Flowpath Slope	10-85 Flowpath Length (MI)	10-85 FlowPath Slope (FT/FT)	Basin Slope (FT/FT)	Basin Relief (FT/FT)	Relief Ratio (FT)	Elongation Ratio	Drainage Density (Mi/Mi2)
S_RichlandCr_1	20.975	3.11024	0.00366	1.20846	0.00187	2.33268	0.00362	0.04921	60.96875	0.00371	0.41586	1.54659
S_RichlandCr_2	13.713	13.0574	0.00334	5.96252	0.00142	9.79305	0.00191	0.05888	231.7813	0.00336	0.44778	0.93367
S_DryCreek	29.601	13.19545	0.00429	5.89871	0.00022	9.89659	0.00188	0.10573	301.5	0.00433	0.39264	1.24777
S_RichlandCr_3	14.736	8.4217	0.00425	3.40256	0.00209	6.31627	0.00271	0.05188	210	0.00472	0.48298	0.83984
S_TerrapinSkinCr	18.005	19.01079	0.00262	9.90195	0.00164	14.25809	0.00216	0.1172	276.3125	0.00275	0.29022	1.09897
S_RichlandCr_4	14.932	3.91179	0.0075	0.81977	0.00195	2.93384	0.00587	0.06904	158.4375	0.00767	0.50236	0.87681
S_RichlandCr_5	11.384	6.30607	0.0043	2.99007	0.00197	4.72955	0.00338	0.06164	219.5	0.00659	0.52293	0.53328
S_RichlandCr_6	2.0173	1.59396	0.00319	0.67947	0.00392	1.19547	0.00286	0.03175	36.46875	0.00433	0.34379	0
S_CityofPearl	8.4798	5.24108	0.00152	2.32777	0.00034	3.93081	0.00056	0.02733	130.5625	0.00472	0.36403	0.79005
S_NeelyCr_1	5.8296	8.27927	0.00359	2.85194	0.00019	6.20945	0.00126	0.04469	199.1563	0.00456	0.39688	0.83494
S_NeelyCr_2	2.3688	21.94059	0.00173	10.50063	0.00068	16.45544	0.00097	0.06743	272.4375	0.00235	0.27981	1.34074
S_RichlandCr_7	4.0709	5.47976	0.00244	3.2941	0.00249	4.10982	0.00151	0.03634	75.9375	0.00262	0.2695	1.60068
S_EubanksCr_1	1.7129	4.27908	0.00437	1.66122	0.00299	3.20931	0.00312	0.05256	118.2188	0.00523	0.51543	0.75897
S_EubanksCr_2	3.8206	2.45586	0.01033	1.1214	0.00721	1.8419	0.00838	0.07908	138.0938	0.01065	0.51766	0.90647
S_EubanksCr_3	1.2694	2.09159	0.00926	1.11423	0.0027	1.56869	0.00519	0.07054	124.3438	0.01126	0.43247	0.84723
S_HangingMoss_1	11.24	3.24616	0.00655	1.23956	0.00096	2.43462	0.0055	0.06483	112.375	0.00656	0.43794	0.39646
S_Tougaloo	4.1197	3.05466	0.00413	1.61263	0.00103	2.291	0.00323	0.03239	101.5	0.00629	0.45924	0.16784
S_HangingMoss_2	1.8912	3.14511	0.00227	1.41862	0.0001	2.35884	0.00127	0.08749	132.875	0.008	0.40427	2.2469
S_WhiteOakCr_1	2.6847	12.47074	0.0041	0.44023	0.00015	9.35305	0.00153	0.07881	271.6563	0.00413	0.55479	1.12621
S_WhiteOakCr_2	5.6652	1.18926	0.01424	0.43054	0.00019	0.89194	0.01026	0.09606	89.5625	0.01426	0.39116	0
S_BrashearCr_1	12.994	7.91787	0.00347	3.39237	0.00189	5.9384	0.00263	0.05156	202	0.00483	0.47778	0.92978
S_RossBarnett	6.1657	3.40688	0.00369	1.04527	0.00168	2.55516	0.00329	0.04387	108.2188	0.00602	0.45548	1.01197
S_SPearOrchardRd	3.4262	3.89087	0.00358	1.95854	0.00072	2.91815	0.00324	0.0585	117.7813	0.00573	0.43196	1.49927
S_RiverRoadN	0.1444	5.56222	0.00514	2.14356	0.00359	4.17166	0.00423	0.06903	151.7813	0.00517	0.48101	1.16157
S_PurpleCreek_1	6.1148	5.29571	0.00488	2.24274	0.00162	3.97178	0.00302	0.06783	143.9688	0.00515	0.5761	0.81389
S_PurpleCreek_2	0.7878	1.98885	0.00455	1.12985	0.00359	1.49164	0.00403	0.06196	47.5625	0.00453	0.30848	4.03271
S_HangingMoss_3	2.2186	1.82754	0.00238	0.45734	0.00397	1.37066	0.00245	0.05342	31.40625	0.00325	0.39881	2.17667
S_Pearl_Purple	1.6932	4.49595	0.00471	2.02783	0.00145	3.37196	0.00299	0.05327	135.9688	0.00573	0.55954	0.89971
S_JacksonHewitt	0.4858	9.4711	0.00204	5.24987	0.00068	7.10333	0.00104	0.05961	189.375	0.00379	0.44651	1.19929

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	Area	Longest Flowpath Length (MI)	Longest Flowpath Slope (FT/FT)	Centroidal Flowpath Length	Centroidal Flowpath Slope	10-85 Flowpath Length (MI)	10-85 FlowPath Slope (FT/FT)	Basin Slope (FT/FT)	Basin Relief (FT/FT)	Relief Ratio (FT)	Elongation Ratio	Drainage Density (Mi/Mi2)
S_ChristwayChurch	2.859	13.12264	0.00319	4.28593	0.00019	9.84198	0.00157	0.06846	220.1875	0.00318	0.35243	1.10787
S_FlowoodYMCA	1.5456	1.40056	0.01158	0.59352	0.00216	1.05042	0.00932	0.03621	85.59375	0.01157	0.56151	0
S_CapitolBodyShop	0.23585	28.3259	0.00223	15.71966	0.00093	21.24443	0.00115	0.11882	333.1875	0.00223	0.24527	1.23125
S_Pearl_HangingMoss	1.5052	4.96042	0.00431	2.50226	0.00258	3.72032	0.00353	0.05235	134.4375	0.00513	0.48295	0.70004
S_HangingMossSouth	0.16996	4.00703	0.0046	1.58662	0.00146	3.00527	0.00355	0.05395	117.8438	0.00557	0.60135	0.79147
S_HogCreek_1	7.3102	5.21632	0.00526	2.14033	0.00318	3.91224	0.00282	0.05724	148.8438	0.0054	0.41507	0.8527
S_HogCreek2	4.9705	13.70276	0.00377	6.61497	0.0011	10.27707	0.0015	0.08703	281.2813	0.00389	0.41493	1.06103
S_HogCreek_3	0.29562	6.94462	0.00057	3.31205	0.00035	5.20846	0.00071	0.03545	47.34375	0.00129	0.39231	0.91025
S_HogCreek_4	0.41722	3.84478	0.00193	1.35122	0.00232	2.88359	0.00057	0.03533	51.46875	0.00254	0.45169	0.62258
S_TwinLakeA	1.1689	6.39929	0.00208	1.08643	0.00014	4.79947	0.00183	0.0462	173.2188	0.00513	0.42832	1.25097
S_Pearl_HogCreek	0.99059	3.18224	0.00175	1.83012	0.00012	2.38668	0.00218	0.07049	42.09375	0.00251	0.33374	2.79823
S_TwinLakeB	1.4737	2.11816	0.00271	0.89942	0.00155	1.58862	0.00261	0.08947	123.875	0.01108	0.45289	2.06547
S_Pearl_Hwy25	0.7645	4.25255	0.00117	2.31354	0.00165	3.18941	0.00105	0.03307	38.34375	0.00171	0.32554	1.78399
S_PrairieBranch_1	9.4389	3.69194	0.00113	1.25426	0.00002	2.76895	0.00071	0.07211	80.53125	0.00413	0.30419	3.50972
S_PrairieBranch_2	0.7813	2.45971	0.00243	0.42868	0.0026	1.84478	0.00214	0.06001	97	0.00747	0.40111	1.19297
S_EubanksCr_4	0.64261	1.07375	0.00428	0.33871	0.00016	0.80531	0.00211	0.10042	54.65625	0.00964	0.5103	4.46891
S_Pearl_PrairieBranch	0.58603	3.12892	0.00243	1.18278	0.00017	2.34669	0.00132	0.08625	52.46875	0.00318	0.35385	3.22114
S_UMMC	1.3031	2.48879	0.00293	1.44337	0.00095	1.86659	0	0.07533	48.5625	0.0037	0.34708	3.67823
S_Pearl_EubanksCr	0.72277	3.78702	0.001	2.08036	0.00004	2.84026	0.00072	0.05771	28.90625	0.00145	0.38772	1.79729
S_Fairgrounds	1.5873	6.71856	0.00439	3.11689	0.00278	5.03892	0.0027	0.04807	166.375	0.00469	0.51599	0.71044
S_Pearl_I55	0.96278	2.22308	0.00257	0.94819	0.00091	1.66731	0.00169	0.06568	44.8125	0.00382	0.44866	2.67663
S_TownCr_1	8.3137	7.77066	0.00455	3.51973	0.00319	5.828	0.00286	0.0552	215.7188	0.00526	0.35908	0.96789
S_TheVault	1.5586	2.30428	0.00483	0.94469	0.00308	1.72821	0.00409	0.04668	58.78125	0.00483	0.43463	1.78706
S_TownCr_2	0.33194	13.47638	0.00371	5.69408	0.00041	10.10729	0.00215	0.09679	297.7188	0.00418	0.40536	1.2945
S_TownCr_3	2.0979	21.77627	0.00211	11.33175	0.00112	16.3322	0.00126	0.0659	275.2188	0.00239	0.31568	1.1091
S_Pearl_HWY80	0.23581	8.2903	0.00342	3.49653	0.00104	6.21772	0.00173	0.06985	237.2813	0.00542	0.62335	0.89858
S_LynchCr_1	4.5075	7.14127	0.00482	2.9736	0.00124	5.35595	0.00193	0.06361	218.75	0.0058	0.58512	0.90112
S_WestsidePark	3.1609	11.6944	0.00323	4.94643	0.00094	8.7708	0.00137	0.04423	209.0313	0.00339	0.3704	1.394
S_LynchCr_2	4.5603	12.32481	0.0021	5.15802	0.00075	9.24361	0.00083	0.05573	175.2813	0.00269	0.35378	1.54652
S_LynchCr_3	3.6818	9.05277	0.00301	3.82277	0.00107	6.78957	0.00204	0.0602	202.4375	0.00424	0.42056	1.05148
S_GallatinStDump	1.2697	5.21246	0.00479	2.79397	0.00042	3.90935	0.00203	0.06975	145.4375	0.00528	0.30747	2.33556
S_HardyCreek	5.6221	6.98752	0.00483	2.96257	0.00163	5.24064	0.00261	0.05243	178.5	0.00484	0.32582	1.82549
S_SavannaStWWTP	0.4843	0.81071	0.00445	0.36854	0.00482	0.60803	0.00379	0.03061	23	0.00537	0.52898	0
S_CanyCreek_1	8.5408	17.8439	0.00286	4.3478	0.00009	13.38293	0.00131	0.09685	292.9063	0.00311	0.32634	1.27598

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S_Pearl-CanyCr	5.9005	8.23302	0.00284	2.83267	0.00007	6.17476	0.00146	0.06041	135.5625	0.00312	0.34032	1.4108
S_CaneyCreek_2	3.033	2.50286	0.00298	2.14286	0.00198	1.87715	0.00226	0.06647	40.78125	0.00309	0.31373	1.48455
S_Pearl-RichlandCr	0.88588	5.07226	0.00464	2.60154	0.00295	3.80419	0.00411	0.05959	134.875	0.00504	0.41178	0.85593
S_Howard-Steamboat Hawkins	16.799	19.09873	0.00252	6.35846	0.00079	14.32405	0.00113	0.06268	287.5625	0.00285	0.38382	1.11899
S_BigCreek	26.85	16.31618	0.00253	8.15741	0.00073	12.23713	0.00116	0.07656	272.8125	0.00317	0.31443	1.35522
S_TrahnCreek	4.7718	8.97929	0.00482	4.06533	0.0017	6.73446	0.00232	0.06578	234.1875	0.00494	0.53322	0.84088
S_Trahn-Big	12.19	3.7242	0.00449	2.22877	0.00364	2.79315	0.00377	0.04433	122	0.0062	0.37825	1.03805
S_SteinCreek_1	42.204	6.76559	0.00456	3.35056	0.00308	5.0742	0.00356	0.05175	169.7813	0.00475	0.33852	1.01834
S_MountainCreek	25.39	7.06275	0.00276	3.21025	0.00142	5.29706	0.0025	0.04396	119.7188	0.00321	0.46066	0.90753
S_SteinCreek_2	20.671	1.44658	0.00909	0.65297	0.00333	1.08494	0.00817	0.06373	73.625	0.00964	0.44941	2.66997
S_Holcomb-Still	14.046	4.82133	0.0053	1.81719	0.00349	3.616	0.00322	0.05493	150.3438	0.00591	0.33898	1.15211
S_RhodesCreek	37.116	5.25456	0.00582	2.42423	0.00236	3.94092	0.00452	0.06348	173.8438	0.00627	0.46909	0.66583
S_VaughnCreek	14.36	9.59863	0.00311	3.29523	0.00199	7.19897	0.0023	0.06917	185.0938	0.00365	0.41044	1.28606
S_Haley-Chestnut-Bear	37.595	2.89034	0.00609	1.619	0.00157	2.16775	0.0043	0.06496	107.125	0.00702	0.42208	0.00243
S_RockyCreek	26.633	2.64575	0.00925	1.211	0.0065	1.98431	0.00593	0.06849	131.4375	0.00941	0.51774	0.53811
S_BrushyCreek	23.908	2.68544	0.00983	1.33726	0.00815	2.01408	0.00672	0.08016	144.4063	0.01018	0.47966	0.40896
S_Big-WeeksMill	21.083	13.18899	0.00313	8.21007	0.00157	9.89174	0.00163	0.04983	224.5	0.00322	0.32421	1.12319
S_LimestoneCreek	37.909	4.56984	0.00469	2.30699	0.00217	3.42738	0.00356	0.05812	128	0.0053	0.43899	0.79119
S_RenoCreek	23.437	3.74979	0.0059	1.77686	0.00351	2.81234	0.00487	0.06622	151.6875	0.00766	0.49305	0.71263
Subbasin-1	1.3139	8.83153	0.00409	3.98412	0.0021	6.62365	0.00282	0.05574	220.8438	0.00474	0.30411	1.13768

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Final Calibrated HEC-HMS Loss Parameters				
	Initial	Maximum Storage		
	Loss (In)	(IN)	Constant Rate (IN/HR)	Impervious (%)
Subbasin-1	0.05	2.5	0.70002	0.447
S_BigCreek	0.05	2.5	1.87002	8.59
S_Big-WeeksMill	0.05	2.5	0.67998	0.671
S_BrashearCr_1	0.05	2	0.28519	26.2
S_BrushyCreek	0.05	2.5	0.3400002	1.73
S_CaneyCreek_2	0.05	2.5	0.168	23.1
S_CanyCreek_1	0.05	2.5	0.316	20
S_CapitolBodyShop	0.05	2	0.106031	45.2
S_ChristwayChurch	0.05	2	0.808	5.82
S_CityofPearl	0.05	2.5	2.56002	23.775
S_DryCreek	0.05	2.5	0.656	1.35
S_EubanksCr_1	0.05	2.5	2.1	10.1
S_EubanksCr_2	0.05	2.5	0.2299998	29.8
S_EubanksCr_3	0.05	2.5	1.72998	38.4
S_EubanksCr_4	0.05	2.5	2.88	22.6
S_Fairgrounds	0.05	2.5	2.1	39.525
S_FlowoodYMCA	0.05	2	0.50822	0
S_GallatinStDump	0.05	2.5	1.204	8.92
S_Haley-Chestnut- Bear	0.05	2.5	0.88002	0.866
S_HangingMossSou th	0.05	2	0.10969	4.74
S_HangingMoss_1	0.05	2	0.296156	10.9
S_HangingMoss_2	0.05	2	0.427781	45.5
S_HangingMoss_3	0.05	2	0.808	19.4
S_HardyCreek	0.05	2.5	0.552	16.6
S_HogCreek_1	0.05	2	0.55574	9.38
S_HogCreek_3	0.05	2	0.186469	35.6
S_HogCreek_4	0.05	2	0.186469	15.9
S_HogCreek2	0.05	2	0.4826	0
S_Holcomb-Still	0.05	2.5	2.41002	1.49
S_Howard-Steamboat-Hawkins	0.05	2.5	2.47998	2.16
S_JacksonHewitt	0.05	2	0.42412	0

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S_LimestoneCreek	0.05	2.5	0.54	0.609
S_LynchCr_1	0.05	0.75	0.2512463	19.8
S_LynchCr_2	0.05	0.75	0.04312	41.7
S_LynchCr_3	0.05	0.75	0.1256288	44.2
S_MountainCreek	0.05	2.5	2.02002	0.927
S_NeelyCr_1	0.05	2.5	3.07002	17.1
S_NeelyCr_2	0.05	0.75	0.5212463	32.9
S_Pearl-CanyCr	0.05	2.5	0.988	0
S_Pearl-RichlandCr	0.05	2.5	1	0.493
S_Pearl_EubanksCr	0.05	2.5	1.552	26.4
S_Pearl_HangingM oss	0.05	2	0.10969	0.224
S_Pearl_HogCreek	0.05	2	1.458844	0.313
S_Pearl_Hwy25	0.05	2	0.808	24.4
S_Pearl_HWY80	0.05	0.75	0.3749962	19.8
S_Pearl_I55	0.05	2.5	4.03998	2.22
S_Pearl_PrairieBran ch	0.05	2.5	4.12002	0.0368
S_Pearl_Purple	0.05	2	0.9141	0.0994
S_PrairieBranch_1	0.05	2.5	1.93002	0
S_PrairieBranch_2	0.05	2.5	1.98	20.9
S_PurpleCreek_1	0.05	2	0.5704	0
S_PurpleCreek_2	0.05	2	0.28885	0
S_RenoCreek	0.05	2.5	0.5800002	0.53
S_RhodesCreek	0.05	2.5	1.63002	2.09
S_RichlandCr_1	0.05	2.5	0.704	5.1
S_RichlandCr_2	0.05	2.5	0.764	7.38
S_RichlandCr_3	0.05	2.5	0.848	1.33
S_RichlandCr_4	0.05	2.5	0.6	4.8
S_RichlandCr_5	0.05	2.5	0.804	9.74
S_RichlandCr_6	0.05	2.5	1.472	0
S_RichlandCr_7	0.05	2.5	1.276	0
S_RiverRoadN	0.05	2	0.59962	0
S_RockyCreek	0.05	2.5	0.79998	0.736
S_RossBarnett	0.05	2	0.68006	0
S_SavannaStWWTP	0.05	2.5	1.624	10.3

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S_SpearOrchardRd	0.05	2	0.45703	0
S_SteenCreek_1	0.05	2.5	2.17002	4.34
S_SteenCreek_2	0.05	2.5	2.11002	1.02
S_TerrapinSkinCr	0.05	2.5	0.952	19.7
S_TheVault	0.05	2.5	0.2500002	42.225
S_Tougaloo	0.05	2.5	0.91002	22.9
S_TownCr_1	0.05	2.5	0.88998	26.25
S_TownCr_2	0.05	2.5	0.3799998	40.275
S_TownCr_3	0.05	2.5	0.99	34.125
S_TrahonCreek	0.05	2.5	1.06998	8.02
S_Trahon-Big	0.05	2.5	1.65	13.5
S_TwinLakeA	0.05	2	0.73857	15.2
S_TwinLakeB	0.05	2	0.8958	24
S_UMMC	0.05	2.5	0.3	26.4
S_VaughnCreek	0.05	2.5	1.30002	3.24
S_WestsidePark	0.05	0.75	0.1781213	23.2
S_WhiteOakCr_1	0.05	2	0.171844	8
S_WhiteOakCr_2	0.05	2	0.0341249	25.2

<i>Final Calibrated HEC-HMS Transform Values</i>		
	Time Concentration of (HR)	Storage Coefficient (HR)
Subbasin-1	1.68	2.1
S_BigCreek	4.6	5.75
S_Big-WeeksMill	4.608	5.76
S_BrashearCr_1	3.232	2.586
S_BrushyCreek	5.88	7.35
S_CaneyCreek_2	1.3392	1.674
S_CanyCreek_1	2.484	3.105
S_CapitolBodyShop	1.2	1
S_ChristwayChurch	3.168	2.534
S_CityofPearl	3.416	6.67
S_DryCreek	6.3432	7.929
S_EubanksCr_1	3.072	3.84
S_EubanksCr_2	2.08	2.6
S_EubanksCr_3	1.352	1.69
S_EubanksCr_4	1.384	1.73
S_Fairgrounds	1.616	3.15
S_FlowoodYMCA	1.856	1.485
S_GallatinStDump	1.8648	2.331
S_Haley-Chestnut Bear	2.144	2.68
S_HangingMossSouth	0.7912	0.633
S_HangingMoss_1	3.184	2.547
S_HangingMoss_2	1.68	1.34
S_HangingMoss_3	2.112	1.69
S_HardyCreek	2.088	2.61
S_HogCreek_1	2.44	1.95
S_HogCreek_3	1.416	1.133
S_HogCreek_4	1.136	0.909
S_HogCreek2	2.256	1.805

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S_Holcomb-Still	4.4	5.5
S_Howard-Steamboat-Hawkins		
S_JacksonHewitt	4.296	5.37
S_LimestoneCreek	0.928	0.742
S_LynchCr_1	8.4	10.5
S_LynchCr_2	2.416	1.933
S_LynchCr_3	1.976	1.581
S_MountainCreek	2.424	1.939
S_NeelyCr_1	4.992	6.24
S_NeelyCr_2	3.704	7.24
S_Pearl-CanyCr	2.448	1.958
S_Pearl-RichlandCr	2.016	2.52
S_Pearl_EubanksCr	1.8648	2.331
S_Pearl_HangingMoss	1.296	1.62
S_Pearl_HogCreek	2.704	2.163
S_Pearl_Hwy25	2.288	1.83
S_Pearl_HWY80	1.24	0.99
S_Pearl_I55	0.904	0.723
S_Pearl_PrairieBranch	1.944	3.8
S_Pearl_Purple	4.768	5.96
S_PrairieBranch_1	2.672	2.138
S_PrairieBranch_2	2.944	3.68
S_PurpleCreek_1	1.584	1.98
S_PurpleCreek_2	3.16	2.53
S_RenoCreek	1.4	1.1
S_RhodesCreek	4.496	5.62
S_RichlandCr_1	6.92	8.65
S_RichlandCr_2	3.1248	3.906
S_RichlandCr_3	2.7936	3.492
S_RichlandCr_4	3.9744	4.968
S_RichlandCr_5	4.4136	5.517
S_RichlandCr_6	3.2112	4.014
S_RichlandCr_7	2.4768	3.096
S_RiverRoadN	2.6496	3.312
	0.7816	0.6253

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S_RockyCreek	4.856	6.07
S_RossBarnett	3.328	2.662
S_SavannaStWWTP	1.8072	2.259
S_SPearOrchardRd	2.408	1.926
S_SteenCreek_1	5.688	7.11
S_SteenCreek_2	5.816	7.27
S_TerrapinSkinCr	3.204	4.005
S_TheVault	2.12	4.14
S_Tougaloo	2.888	3.61
S_TownCr_1	3.048	5.95
S_TownCr_2	0.984	1.93
S_TownCr_3	2.208	4.31
S_TrahonCreek	2.344	2.93
S_Trahon-Big	3.408	4.26
S_TwinLakeA	1.752	1.402
S_TwinLakeB	1.488	1.19
S_UMMC	1.512	1.89
S_VaughnCreek	5.2	6.5
S_WestsidePark	2.296	1.837
S_WhiteOakCr_1	1.912	1.53
S_WhiteOakCr_2	3.416	2.733

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	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
1	303.58	n	0.2	0.07	0.048	0.07	0.2		
2	303.22	n	0.2	0.07	0.045	0.07	0.2		
3	303.17	n	0.2	0.07	0.045	0.07	0.2		
4	303.03	n	0.2	0.07	0.042	0.07	0.2		
5	303.01	Lat Struct							
6	302.93	n	0.2	0.07	0.042	0.07	0.18		
7	302.8	n	0.2	0.07	0.042	0.07	0.18		
8	302.68	n	0.18	0.07	0.042	0.07	0.18		
9	302.5	n	0.18	0.07	0.07	0.042	0.07	0.18	
10	302.05	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18
11	301.86	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18
12	301.73	n	0.18	0.07	0.07	0.042	0.07	0.18	
13	301.54	n	0.18	0.07	0.042	0.07	0.18		
14	301	Lat Struct							
15	300.74	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18
16	300.47	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18
17	300.12	n	0.18	0.07	0.042	0.07	0.18		
18	299.62	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18
19	299.45	Lat Struct							

<i>Final Calibrated HEC-RAS Model Manning's N Values (Land Roughness Parameter) for Existing Conditions Frctn</i>									
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
20	299.02	n	0.18	0.07	0.042	0.07	0.18		
21	298.81	n	0.18	0.07	0.042	0.07	0.18		
22	298.47	n	0.18	0.07	0.042	0.07	0.18		
23	298.06	n	0.18	0.07	0.07	0.042	0.07	0.18	
24	297.87	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18
25	297.73	n	0.18	0.07	0.042	0.07	0.18		
26	297.66	n	0.18	0.07	0.042	0.07	0.18		
27	297.47	n	0.18	0.07	0.042	0.07	0.18		
28	297.22	n	0.18	0.07	0.042	0.07	0.18		
29	296.83	n	0.18	0.07	0.042	0.07	0.18		
30	296.36	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18
31	296.1	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18
32	295.63	n	0.18	0.07	0.04	0.07	0.18		
33	295.37	n	0.18	0.07	0.04	0.07	0.18		
34	295.14	n	0.18	0.07	0.04	0.07	0.18		
35	294.93	n	0.18	0.07	0.04	0.07	0.18		
36	294.66	n	0.18	0.07	0.04	0.07	0.18		
37	294.54	n	0.18	0.07	0.04	0.07	0.18		
38	294.5	Bridge							
39	294.43	n	0.18	0.065	0.04	0.065	0.18		

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<i>Final Calibrated HEC-RAS Model Manning's N Values (Land Roughness Parameter) for Existing Conditions Frctn</i>									
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
40	294.15	n	0.16	0.065	0.04	0.065	0.16		
41	293.87	n	0.16	0.065	0.04	0.065	0.16		
42	293.57	n	0.16	0.065	0.04	0.065	0.16	0.065	0.18
43	293.4	Lat Struct							
44	292.83	n	0.16	0.065	0.04	0.065	0.16		
45	292.62	n	0.16	0.065	0.04	0.065	0.16		
46	292.52	n	0.16	0.065	0.04	0.065	0.16		
47	292.43	n	0.16	0.065	0.04	0.065	0.16		
48	292.39	Bridge							
49	292.38	n	0.12	0.04	0.12				
50	292.37	Lat Struct							
51	292.35	n	0.16	0.065	0.04	0.065	0.16		
52	292.15	n	0.16	0.065	0.04	0.065	0.16		
53	291.95	n	0.16	0.04	0.16				
54	291.9	Lat Struct							
55	291.62	n	0.16	0.04	0.16				
56	291.55	Lat Struct							
57	291.4	n	0.16	0.04	0.16				
58	290.96	n	0.16	0.04	0.16				
59	290.61	n	0.16	0.04	0.16				

<i>Final Calibrated HEC-RAS Model Manning's N Values (Land Roughness Parameter) for Existing Conditions Frctn</i>									
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
60	290.36	n	0.16	0.04	0.16				
61	290.13	n	0.16	0.04	0.16				
62	290.1	Bridge							
63	290.06	n	0.16	0.04	0.18				
64	289.91	n	0.16	0.04	0.18				
65	289.73	n	0.16	0.04	0.12				
66	289.6	n	0.16	0.04	0.12				
67	289.58	Lat Struct							
68	289.37	n	0.16	0.042	0.16				
69	289.35	Bridge							
70	289.32	n	0.1	0.0425	0.16				
71	289.28	n	0.1	0.042	0.16				
72	289.25	n	0.1	0.042	0.16				
73	289.18	n	0.1	0.042	0.16				
74	289.16	Bridge							
75	289.14	n	0.2	0.0425	0.16				
76	289.1	Lat Struct							
77	288.94	n	0.08	0.042	0.065				
78	288.81	n	0.065	0.042	0.065				
79	288.8	Bridge							

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	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
80	288.76	n	0.065	0.0425	0.065				
81	288.63	n	0.065	0.042	0.055				
82	288.49	n	0.065	0.042	0.075				
83	288.4	Bridge							
84	288.32	n	0.065	0.0425	0.065				
85	288.19	n	0.065	0.042	0.065				
86	288.04	n	0.065	0.042	0.065				
87	288.035	Bridge							
88	288.03	n	0.065	0.0425	0.065	0.15	0.055	0.18	
89	287.89	n	0.065	0.042	0.065	0.15	0.055		
90	287.75	n	0.065	0.042	0.065	0.15			
91	287.61	n	0.065	0.042	0.065	0.15			
92	287.45	n	0.065	0.042	0.065	0.15			
93	287.18	n	0.13	0.042	0.15	0.055			
94	286.94	n	0.15	0.042	0.15	0.055			
95	286.85	n	0.15	0.042	0.15	0.055			
96	286.33	n	0.15	0.042	0.15	0.075			
97	286.31	n	0.15	0.042	0.15	0.075			
98	286.09	n	0.15	0.042	0.15	0.075			
99	286.05	Lat Struct							

<i>Final Calibrated HEC-RAS Model Manning's N Values (Land Roughness Parameter) for Existing Conditions Frctn</i>									
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
100	286.01	n	0.15	0.042	0.15	0.075			
101	285.9	Lat Struct							
102	285.81	n	0.15	0.042	0.15				
103	285.8	n	0.15	0.042	0.15				
104	285.65	n	0.15	0.042	0.15				
105	285.44	n	0.15	0.042	0.15				
106	285.31	n	0.15	0.042	0.15				
107	285.06	n	0.15	0.042	0.15				
108	284.21	n	0.15	0.042	0.15				
109	283.41	n	0.15	0.042	0.15				
110	282.56	n	0.15	0.042	0.15				
111	282.15	n	0.15	0.042	0.15				
112	281.87	n	0.15	0.042	0.15				
113	281.53	n	0.15	0.042	0.15				
114	281.12	n	0.15	0.042	0.15				
115	280.79	n	0.15	0.042	0.15				
116	280.52	n	0.15	0.042	0.15				
117	280.18	n	0.15	0.042	0.15				
118	279.79	n	0.15	0.042	0.15				
119	279.42	n	0.15	0.042	0.15				

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<i>Final Calibrated HEC-RAS Model Manning's N Values (Land Roughness Parameter) for Existing Conditions Frctn</i>									
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
120	278.98	n	0.15	0.042	0.15				
121	278.68	n	0.15	0.042	0.15				
122	278.33	n	0.15	0.042	0.15				
123	278.01	n	0.15	0.042	0.15				
124	277.53	n	0.15	0.042	0.15				
125	277.25	n	0.15	0.042	0.15				
126	276.9	n	0.15	0.042	0.15				
127	276.55	n	0.15	0.042	0.15				
128	275.9	n	0.15	0.042	0.15				
129	275.17	n	0.15	0.042	0.15				
130	274.78	n	0.15	0.042	0.15				
131	274.46	n	0.15	0.042	0.15				
132	274.15	Lat Struct							
133	274.1	n	0.15	0.042	0.15				
134	274.09	Lat Struct							
135	273.8	n	0.15	0.042	0.15				
136	273.44	n	0.15	0.042	0.15				
137	273.05	n	0.15	0.042	0.15				
138	272.78	n	0.15	0.042	0.15				
139	272.44	n	0.15	0.042	0.15				

<i>Final Calibrated HEC-RAS Model Manning's N Values (Land Roughness Parameter) for Existing Conditions Frctn</i>									
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7
140	272.3	Lat Struct							
141	272.2	n	0.15	0.042	0.15	0.042	0.15		
142	272.18	Lat Struct							
143	272.06	n	0.15	0.042	0.15				
144	271.46	n	0.15	0.042	0.15				
145	271.4	Lat Struct							
146	271.11	n	0.15	0.042	0.15				
147	270.77	n	0.15	0.042	0.15				
148	270.45	n	0.15	0.042	0.15				
149	270	n	0.15	0.042	0.15				
150	268.62	n	0.15	0.042	0.15				
151	267.01	n	0.15	0.042	0.15				

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Final Calibrated Ineffective Areas for Existing Conditions																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev			Right	Elev		Right	Elev		Right	Elev				Elev		Right	Elev	
1	303.58	1731	3967.52	274.3	5530.02	6862.75	272.54	7797.18	10033.7	271.31	12530.64	14491.42	278.69	15747.55	16896.45	280.63											
2	303.22	2475.49	3443.63	279.57	3994.78	6579.63	273.21	8798.96	12454.31	270.9	13272.06	14460.78	276.18	15110.29	15870.1	282.09											
3	303.17	2254.9	3313.73	282.29	3431.37	4186.27	278.44	4382.35	4980.39	275.05	5862.75	6333.33	272.41	8501.31	12449.09	271.15	13019.61	13813.73	274.52	14382.35	14705.88	276.26					
4	303.03	3107.84	7176.47	280.33	8167.1	12114.88	266.46	12147.06	12529.41	270.38	13078.43	14029.41	275.2														
5	302.93	4795.34	7317.4	278.44	7549.02	7797.79	272.56	8315.93	13616.19	271.54																	
6	302.8	5318.63	7300.25	278.22	7480.39	8063.73	273.62	8553.52	12903.39	268.46																	
7	302.68	5772.06	6029.41	278.29	6897.06	7705.88	274.97	8569.19	11984.33	272.23																	
8	302.5	5781.86	8175.25	277.91	8992.17	12099.22	271.23																				
9	302.05	5730.39	9041.67	277.69	9221.81	9719.36	273.32	9796.57	10148.28	266.16	11167.1	12026.11	269.23														
10	301.86	5335.78	5884.8	278.22	7180.15	9178.92	276.63	10344.65	12336.81	269.77																	
11	301.73	2136.03	5009.8	277.61	5738.97	9299.02	278.22	10563.97	12647.52	270.15																	
12	301.54	797.79	5910.54	278.19	6305.15	9444.85	277.89	10302.7	13316.62	267.34																	
13	300.74	674.02	7996.32	278.44	9007.35	11090.69	275.88	11504.29	12193.63	270.15	12300.86	12775.74	267.74	13403.8	14583.33	265.78											

Pearl River Basin, Mississippi Federal Flood Risk Management
Project Draft Appendix E – Hydrologic and Hydraulic Model

Final Calibrated Ineffective Areas for Existing Conditions																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
14	300.47	686.27	8651.96	278.59	9411.76	11299.02	273.17	12438.73	12732.84	268.34	13051.47	13590.69	264.57	13823.53	14203.43	269.1											
15	300.12	1210.17	8164.83	277.31	8318.01	10248.16	268.39	10370.71	12254.9	269.77	13005.51	13710.17	264.87														
16	299.62		11780.02	264.72	12622.55		268.44																				
17	299.02		10582	266.68																							
18	298.81		9550	267.29																							
19	298.47		9090	263.37	9800		262.11																				
20	298.06		10200	268.04	11100		269.75																				
21	297.87		9479	266.08	10200		266.83																				
22	297.73		8590	263.3	9290		264.89																				
23	297.66		8095.35	269.95																							
24	297.47		7300	269.55	8100		277.38																				
25	297.22	1540.18	5330.7	267.59	5902.5	6732.54	277.85																				
26	296.83	10.54	3752.31	274.27	4047.43	5839.26	269.65	6640.32	7051.38	259.5	7051.38	7588.93	266.93														

Pearl River Basin, Mississippi Federal Flood Risk Management
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<i>Final Calibrated Ineffective Areas for Existing Conditions</i>																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
27	296.36	488.8	1586.3	273.53	2305.67	3061.92	270.89	3956.52	4989.46	267.55	5026.35	6234.52	270.54														
28	296.1	55.34	569.17	267.64	727.27	1446.64	265.5	2213.44	3185.77	263.12	3249.01	5320.16	269.33														
29	295.63	86.96	1881.42	266.41	2031.62	3130.43	266.41	3486.17	3818.18	265.8	4237.15	4837.94	267.91	4964.43	5707.51	275.6											
30	295.37	230.57	691.7	271.23	1162.06	1577.08	270.78	1955.2	2637.68	265.5	2683.79	3098.81	265.2	3790.51	4011.86	268.89	4067.19	5441.37	267.16	5459.82	6372.86	272.21					
31	295.14	1162.06	2996.05	269.9	3446.64	3636.36	267.79	3667.98	5264.82	266.43																	
32	294.93	498.02	924.9	264.62	948.62	1083	264.62	1462.45	1711.46	263.72	1861.66	2802.37	267.19														
33	294.66	65.54	390.14	261.86	992.51	2019.35	260.78																				
34	294.54	131.09	365.17	258.52	780.27	1201.62	262.91	1741.57	2331.46	273.47																	
35	294.43	1816.48	2539.33	276.78																							
36	294.15	4.37	83.02	282.09	380.15	1109.86	258.59	1586.14	2831.46	259.346																	
37	293.87	8.74	201	265.03	1022.47	2272.16	267.44	2997.5	4360.8	265.93	4421.97	5898.88	267.54														
38	293.57	0	800	272.31	828.96	2696.63	262.96	3136.08	4654.18	262.81	4734.08	7171.04	266.88	7360.8	7550.56	281.06											
39	292.83	30.77	4692.31	271.26	4923.08	5892.31	261.91	6400	7984.62	260.25																	

Pearl River Basin, Mississippi Federal Flood Risk Management
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<i>Final Calibrated Ineffective Areas for Existing Conditions</i>																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
40	292.62	246.15	5600	269.95	5646.15	6123.08	262.96	7030.77	7523.08	261.16	7600	8292.31	265.53														
41	292.52	960	6547.69	264.42																							
42	292.43		6301.54	268.84	6880		257.09																				
43	292.38		5107.69	270.5	6104.62		258.34																				
44	292.35		2218.14	265.38	2674.63		258.89																				
45	292.15		2441.79	260.98	3158.7		265.73																				
46	291.95		2724.26	261.73	3389.71		258.97																				
47	291.62		2459.56	266.38	3599.26		250.18																				
48	291.4		1647.06	260.23	2131.74		254.2																				
49	290.96		495.1	257.01	1193.63		251.86																				
50	290.61		692.4	255.69	1039.22		254.75																				
51	290.36		582.11	258.44	1738.66		259.2																				
52	290.13		716.91	260.4	1508.58		264.23																				

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Final Calibrated Ineffective Areas for Existing Conditions																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
53	290.06		488.66	269.89	1181.07		259.46																				
54	289.91		626.53	254.69	1292.89		256.51																				
55	289.73		954.04	256.53	1950.37		255.33																				
56	289.6	79.35	589.77	254.1	737.75	980.09	254.36	1654.41	3345.31	256.78																	
57	289.37	25.15	1441.92	267.24	1500.6	2229.94	258.57																				
58	289.32	244.31	718.56	261.01	768.86	1544.91	260.52	1595.21	1817.96	258.76	1861.08	2141.32	255.77														
59	289.28	218.75	612.13	260.73	711.4	1413.6	259.7	1501.84	1698.53	257.36	1735.29	1961.4	254.65														
60	289.25		1750	258.94																							
61	289.18	117.37	461.08	270.98	586.83	1211.38	265.62	1261.68	1567.66	261.66																	
62	289.14	75.45	926.35	260.3	976.65	1173.65	258.12	1202.99	1366.47	257.36	2282.48	2412.68	274.97														
63	288.94	200.06	773.59	257.0754	1194.85	1306.68	252.24	1776.96	1988.36	255.25	2219.67	2328.43	273.34														
64	288.81	35.78	260.05	260.35	716.91	1051.47	255.59	1132.35	1294.12	256.03	1422.75	1534.13	264.65	1645.56	2064.67	265.611	2078.74	2173.71	271.02								
65	288.76	0	290.44	256.76	889.71	1139.71	257.89	1420.4	2032.31	269.3173																	

Pearl River Basin, Mississippi Federal Flood Risk Management
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Final Calibrated Ineffective Areas for Existing Conditions																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
66	288.63	120.1	501.84	254.451	960.78	2294.73	257.61	2342.22	2418.81	267.63																	
67	288.49	51.68	356.2	252.334	969.56	1205.47	255.413	1424.02	1955.88	273.88	2118.87	2303.31	274.1	2335.48	3086.09	273.27											
68	288.32	63.75	458.35	260.91	837.19	1416.22	260.606	2389.65	2960.07	270.279	3282.04	3357.49	270.5														
69	288.19	132.58	651.59	256.735	1342.52	1544.12	248.99	1733.02	2140.53	259.601	2458.63	2908.98	267.378	2950.9	3096.72	271.773	3466.47	3600.6	271.95								
70	288.04	19.61	441.18	271.53	500	1274.51	251.03	1480.39	1901.96	270.63	2544.12	2941.18	250.05	3093.14	3691.18	267.7676	3723.13	4046.68	270.9462	4246.32	4427.08	271.53					
71	288.03	485.29	818.63	251.26	1093.7	1427.02	256.2967	1514.71	1985.29	269.5744	2524.51	2926.47	251.1854	3122.11	3484.84	270.105	3490.2	3647.06	270.18	3691.18	4509.8	271.98					
72	287.89	53.92	269.61	265.97	485.29	1406.86	255.8138	1784.31	2039.22	257.53	2848.04	3877.45	257.96	4241.2	4339.25	271.5359											
73	287.75	31.45	382.39	267.56	490.2	1073.53	252.89	2171.57	2470.59	253.94																	
74	287.61	18.54	191.35	267.543	314.77	1296.36	259.0035	1849.26	2018.38	256.38	2176.31	2404.24	265.4271														
75	287.45	18.38	136.03	266.96	279.16	1400.48	253.808	2150.74	3198.53	269.7																	
76	287.18	81.5	184.44	266.96	244.08	673.01	258.8859	1226.8	1389.81	261.5484	2153.11	2543.43	262.7993	2723.65	3135.42	272.2309	3718.63	4254.78	260.697								
77	286.94	54.49	946.72	261.9141	1908.69	2084.57	261.7506	2127.45	3234.07	257.6915	3452.8	3611.54	268.041	3748.86	5280.14	263.223											
78	286.85	0	4200	275	4201	6131.83	262.59	6862.75	7900.74	254.07	9333.33	9950.98	252.257														

Pearl River Basin, Mississippi Federal Flood Risk Management
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Final Calibrated Ineffective Areas for Existing Conditions																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
79	286.33	318.61	4950.97	275	5215.69	8667.81	263.195	8779.41	9937.5	252.109	10455.88	11183.82	253.17														
80	286.31	0	4000	275	4001	9342.67	263.35	9375	10340.07	252.114	10998.77	11335.78	253.47														
81	286.09	442.51	10077.84	263.6229	11351.1	12913.6	253.5638	14351.8	15485.33	262.6204	15640.32	18826.59	272.6673														
82	286.01	245.08	1892.12	266.0221	2244.41	7871.9	263.0736	7951.23	9784.53	257.5508	12107.84	13156.86	249.6495	13941.18	14931.37	270											
83	285.81	980.39	3558.82	269.37	3772.93	7351.38	263.2679	7656.81	9009.82	257.6131	10715.69	10931.35	263.4141	12147.06	13774.51	248.8686	14205.88	14431.37	253.472	14490.2	15078.43	264.62					
84	285.8	1058.82	2901.96	268.3624	3656.86	7362.75	262.2946	7637.25	9088.24	256.32	10803.92	11049.02	262.47	12294.12	12901.96	245.5948	13019.61	13784.31	250.08	14107.84	14490.2	255.53	14539.22	14980.39	264.67		
85	285.65	931.37	3460.78	267.26	3627.45	7254.9	261.98	7627.45	12490.2	257.8384	12941.18	14254.9	249.62	14313.73	14745.1	259.5	14813.73	15264.71	263.19	15333.33	15656.86	272.99					
86	285.44	401.96	1000	268.2427	1127.45	1303.92	267.56	2088.24	6127.45	263.338	6696.08	7656.86	261.68	7931.37	9019.61	253.54	10245.1	10529.41	261.61	10911.76	12960.78	254.52	13480.39	14235.29	256.33	14303.92	14980.39
87	285.31	68.63	794.12	269.2942	892.165	3117.6	266.8113	4931.37	7754.9	261.1565	8294.12	12725.49	254.295	13352.94	13764.71	245.4005	13843.14	14196.08	247.7364	14441.18	14735.29	260.4					
88	285.06	117.65	3490.2	266.3583	5225.49	8960.78	260.1797	9127.45	13303.92	253.8427	13960.78	14666.67	251.13														
89	284.21	94.36	1329.66	268.9972	2101.72	5850.49	265.306	6802.7	8852.94	263.72	9933.82	10122.55	262.81	10302.7	11555.15	254.5234	12095.59	12473.04	249.7716								
90	283.41	2736.06	5608.53	264.3467	6882.35	8754.9	263.56	9401.96	10294.12	261.88	10480.39	12519.61	254.1431	12980.39	14647.06	252.6464											
91	282.56	318.63	3149.51	269.4518	3993.08	6860.73	262.5096	7475.49	8235.29	263.27	10330.88	10735.29	261.61	10845.59	13345.59	256.7123	13406.86	14007.35	253.77	14808.62	17271.92	252.0322					

Pearl River Basin, Mississippi Federal Flood Risk Management
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Final Calibrated Ineffective Areas for Existing Conditions																												
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left	
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																			
92	282.15	582.11	7735.91	267.51	7873.77	8517.16	258.03	8731.62	10968.14	261.93	11029.41	11305.15	257.29	11841.3	12683.82	253.29	13863.36	15196.08	248.07	15839.46	16329.66	258.34	16804.54	18903.19	261.66	49		
93	281.87	6121.32	8841.91	268.37	9283.09	10992.65	255.70	11158.09	12279.41	244.62	13694.85	14595.59	254.3	16066.18	19044.12	260.10	20202.21	21047.79	269.42									
94	281.53	6280.64	8716.3	267.48	9650.74	11473.65	245.02	12545.96	13342.52	247.13	13495.71	22089.46	261.60															
95	281.12	7169.12	8700.98	266.88	8992.03	10263.48	245.47	11268.54	11820.01	242.94	12132.35	19745.71	260.55	20220.59	22012.87	265.98												
96	280.79	5713.85	6648.28	267.66	7000.57	9129.89	263.09	10477.94	10952.82	252.36	11060.05	12454.04	255.18	12607.23	22686.89	261.51												
97	280.52	5821.08	6326.59	269.3	6737.95	9510.64	260.25	10738.36	11090.69	248.64	11228.55	12683.82	252.11	12944.24	22886.03	260.25												
98	280.18	5300.25	6142.77	269.60	7705.27	9359.68	257.99	9600.97	9884.53	253.47	9911.15	11106.19	247.28	12086.4	12316.18	246.98	12484.68	13587.62	255.27	13694.85	23820.46	259.34	67					
99	279.79	8180.15	9117.65	264.32	10036.76	10753.68	261.46	11286.76	11893.38	254.37	12169.12	12867.65	242.46	13400.74	13694.85	253.77	14779.41	16966.91	255.73	17077.21	25459.56	259.65						
100	279.42	3431.37	5438.11	259.22	6694.24	7291.67	261.68	7582.72	9405.64	244.79	11305.15	12377.45	256.05	12530.64	12714.46	253.77	12837.01	13327.21	254.65	13572.3	22671.57	259.57	29					
101	278.98	2405.02	2987.13	266.96	6893.38	7674.63	244.44	8792.89	10952.82	255.70	12637.87	13449.75	249.2	13909.31	14522.06	254.47	14828.43	21599.27	259.57	29								
102	278.68	4120.71	5055.15	267.89	6112.13	6357.23	260.85	7230.39	12071.08	249.25	12852.33	13174.02	255.93	13327.21	19577.21	258.22	19745.71	20021.45	263.49									
103	278.33	8700.98	9267.77	258.04	10125.61	11259.19	249.42	11672.79	14093.14	255.05	14261.64	15042.89	252.06	15333.95	15900.74	254.7	16636.03	22870.71	259.09	9								
104	278.01	4049.71	4895.2	262.62	5028.69	7364.9	252.1	7709.76	9678.85	250.53	9990.34	12960.66	255.85	13427.9	20113.89	260.92												

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Final Calibrated Ineffective Areas for Existing Conditions																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
10 5	277. 53	5654. 39	8741.0 1	252.61 24	8799.8 1	9105.7 3	248.88	9784.7 1	10745. 2	251.86	10950. 35	12227. 9	256.08														
10 6	277. 25	5584. 31	8324.4 3	250.47 87	8887.3 8	8976.6 6	246.74	9535.8 5	11710. 65	256.5	11844. 37	18020. 7	259.69 65														
10 7	276. 9	1353. 5	1823.8 1	283.49 44	1858.2 5	3494.1 4	277.93 65	3529.7 8	3966.0 1	271.08	3995.7 3	4956.7 9	266.22 41	5118.8 1	5814.0 6	263.03 61	6443.2 8	8126.8 5	246.59 66	8493.4 1	9663.0 8	249.27	9699.6 5	11676. 33	255.25 27		
10 8	276. 55	496.8 5	3093.3 7	277.74	3128.1	3675.1 9	269.74	3727.3	6640.7 8	249.91	7376.9	9607.2 1	246.96 48	9780.8 4	16030. 76	258.74											
10 9	275. 9	351.5 4	1216.9 1	275.46 51	1290.9	2054.4 1	270.06 53	3384.5	3934.3 3	245.30 83	4343.0 4	5271.4 7	247.20 84	5299.4 1	7282.4 9	252.76 51	7382.3 5	13382. 35	258.04	13558. 82	13960. 78	267.36					
11 0	275. 17	3400. 37	5154.6 9	246	5702.9 1	6083.0 2	253.12	6152.0 9	11076. 1	256.15 34																	
11 1	274. 78	1064	1949.5 7	302.63	2304.5 2	2630.7 8	264.03	2684.5 6	2978.5 6	250.96	3000.0 7	3760.1 6	247.01	4222.6 6	6234.0 3	252.88	6656.8 6	11490. 2	256.80 91								
11 2	274. 46	2136. 6	2665.9 9	242.06	2990.7 4	3141.9 9	245.98	3166.4 6	4027.2 7	252.02	4297.7 9	4855.3 9	251.56	5859.0 7	10062. 5	256.98	10393. 24	12033. 8	266.28								
11 3	274. 1	315.4 9	2695.2 1	258.32	3686.7 6	4389.8 6	250.78	10122. 82	10330. 14	264.35	10402. 25	11772. 39	266.86														
11 4	273. 8	740.2 8	1987.6 1	307.29	2636.6 2	4725.6 3	259.95	5547.0 4	6206.2	251.81	6723.3 8	9096.3 4	256.03	9177.4 6	12676. 06	262.81											
11 5	273. 44	3184. 52	6229.0 1	261.50 15	6678.5 9	9132.6 7	255.82 97	11439. 14	12960. 27	267.00 12																	
11 6	273. 05	3447. 92	6089.9 3	255.22	6349.6 8	11507. 54	257.36																				
11 7	272. 78	1225. 49	2460.7 8	250.95	2872.5 5	3862.7 5	251.86	3950.9 8	4166.6 7	258.79	5313.7 3	6588.2 4	253.07	6754.9	7480.3 9	252.46	7558.8 2	7882.3 5	255.93	9401.9 6	10588. 24	256.68	10764. 71	11352. 94	259.85		

Final Calibrated Ineffective Areas for Existing Conditions																											
	RS	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev	RS	Left	Right	Elev	Left	Right	Elev	Left
	Left	Right	Elev	Left	Right	Elev	Left	Right	Elev																		
118	272.44	1533.11	2580.85	256.3774	3055.15	3948.53	252.61	4080.88	4764.71	249.6	4775.74	5371.32	252.91	6197.7	7796.97	255.9251	8988.97	9341.91	248.39	10897.06	11580.88	256.08	12044.12	12738.97	261.06	12981.62	13731.62
119	272.06	1608.53	4315.92	255.5814	4392.88	5353.69	250.1256	5438.06	5900.54	260.15	6029.41	6392.16	259.1	6858.53	7193.95	260.15	7272.33	7997.82	254.345	8656.86	8852.94	243.97	9294.12	12343.14	264.55		

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<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
1	303.58	n	0.2	0.07	0.048	0.07	0.2			
2	303.22	n	0.2	0.07	0.045	0.07	0.2			
3	303.17	n	0.2	0.07	0.045	0.07	0.2			
4	303.03	n	0.2	0.07	0.042	0.07	0.2			
5	303.01	Lat Struct								
6	302.93	n	0.2	0.07	0.042	0.07	0.18			
7	302.8	n	0.2	0.07	0.042	0.07	0.18			
8	302.68	n	0.18	0.07	0.042	0.07	0.18			
9	302.5	n	0.18	0.07	0.07	0.042	0.07	0.18		
10	302.05	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18	
11	301.86	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18	
12	301.73	n	0.18	0.07	0.07	0.042	0.07	0.18		
13	301.54	n	0.18	0.07	0.042	0.07	0.18			
14	301	Lat Struct								
15	300.74	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18	
16	300.47	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18	
17	300.12	n	0.18	0.07	0.042	0.07	0.18			
18	299.62	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18	
19	299.45	Lat Struct								
20	299.02	n	0.18	0.07	0.042	0.07	0.18			

<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
21	298.81	n	0.18	0.07	0.042	0.07	0.18			
22	298.47	n	0.18	0.07	0.042	0.07	0.18			
23	298.06	n	0.18	0.07	0.07	0.042	0.07	0.18		
24	297.87	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18	
25	297.73	n	0.18	0.07	0.042	0.07	0.18			
26	297.66	n	0.18	0.07	0.042	0.07	0.18			
27	297.47	n	0.18	0.07	0.042	0.07	0.18			
28	297.22	n	0.18	0.07	0.042	0.07	0.18			
29	296.83	n	0.18	0.07	0.042	0.07	0.18			
30	296.36	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18	
31	296.1	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18	
32	295.63	n	0.18	0.07	0.04	0.07	0.18			
33	295.37	n	0.18	0.07	0.04	0.07	0.18			
34	295.14	n	0.18	0.05	0.07	0.04	0.07	0.05	0.18	
35	294.93	n	0.05	0.07	0.04	0.05	0.18			
36	294.66	n	0.18	0.05	0.07	0.04	0.05	0.18	0.05	0.18
37	294.54	n	0.18	0.05	0.04	0.05	0.18	0.05	0.18	
38	294.5	Bridge								
39	294.43	n	0.18	0.05	0.04	0.05	0.18			
40	294.15	n	0.16	0.05	0.04	0.05	0.16			

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<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
41	293.87	n	0.16	0.05	0.16	0.05	0.04	0.05	0.16	
42	293.57	n	0.16	0.05	0.04	0.05	0.18			
43	293.4	Lat Struct								
44	292.83	n	0.16	0.05	0.16	0.05	0.065	0.04	0.065	0.16
45	292.62	n	0.16	0.05	0.16	0.05	0.065	0.04	0.05	0.16
46	292.52	n	0.16	0.05	0.16	0.05	0.065	0.04	0.065	0.16
47	292.43	n	0.16	0.05	0.16	0.05	0.065	0.04	0.065	0.16
48	292.39	Bridge								
49	292.38	n	0.65	0.04	0.12					
50	292.37	Lat Struct								
51	292.35	n	0.5	0.16	0.05	0.04	0.065	0.16		
52	292.15	n	0.05	0.065	0.04	0.065	0.16			
53	291.95	n	0.05	0.04	0.16					
54	291.9	Lat Struct								
55	291.62	n	0.05	0.16	0.05	0.04	0.05	0.16		
56	291.55	Lat Struct								
57	291.4	n	0.05	0.04	0.05	0.16				
58	290.96	n	0.05	0.04	0.05	0.16				
59	290.61	n	0.05	0.04	0.05	0.16				
60	290.36	n	0.05	0.04	0.05	0.16				

<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
61	290.13	n	0.05	0.04	0.05	0.16				
62	290.1	Bridge								
63	290.06	n	0.16	0.05	0.04	0.05	0.18			
64	289.91	n	0.05	0.04	0.05	0.16				
65	289.73	n	0.05	0.04	0.05	0.12				
66	289.6	n	0.05	0.04	0.12					
67	289.58	Lat Struct								
68	289.37	n	0.16	0.05	0.042	0.16				
69	289.35	Bridge								
70	289.32	n	0.1	0.05	0.1	0.05	0.1	0.05	0.0425	0.16
71	289.28	n	0.1	0.05	0.1	0.05	0.042	0.16		
72	289.25	n	0.1	0.05	0.1	0.05	0.042	0.16		
73	289.18	n	0.1	0.05	0.1	0.05	0.042	0.16		
74	289.16	Bridge								
75	289.14	n	0.05	0.2	0.05	0.0425	0.16			
76	289.1	Lat Struct								
77	288.94	n	0.05	0.042	0.05	0.065				
78	288.81	n	0.065	0.05	0.042	0.05	0.065			
79	288.8	Bridge								
80	288.76	n	0.05	0.0425	0.05	0.065				

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<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
81	288.63	n	0.05	0.042	0.05	0.055				
82	288.49	n	0.05	0.042	0.075					
83	288.4	Bridge								
84	288.32	n	0.05	0.0425	0.05	0.065				
85	288.19	n	0.05	0.042	0.05	0.065				
86	288.04	n	0.065	0.05	0.042	0.065				
87	288.035	Bridge								
88	288.03	n	0.065	0.05	0.0425	0.05	0.065	0.15	0.055	0.18
89	287.89	n	0.065	0.05	0.042	0.05	0.15	0.055		
90	287.75	n	0.05	0.042	0.05	0.15				
91	287.61	n	0.05	0.042	0.05	0.065	0.15			
92	287.45	n	0.065	0.05	0.042	0.05	0.065	0.15		
93	287.18	n	0.13	0.05	0.042	0.05	0.15	0.055		
94	286.94	n	0.15	0.042	0.05	0.15	0.055			
95	286.9	n	0.15	0.042	0.05	0.15	0.055			
96	286.85	n	0.15	0.042	0.05	0.15	0.055			
97	286.33	n	0.15	0.05	0.042	0.042	0.15	0.075		
98	286.32	Inl Struct								
99	286.31	n	0.15	0.045	0.15	0.075				
100	286.09	n	0.15	0.042	0.15	0.075				

<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
101	286.05	Lat Struct								
102	286.01	n	0.15	0.042	0.15	0.075				
103	285.9	Lat Struct								
104	285.81	n	0.15	0.042	0.15					
105	285.8	n	0.15	0.042	0.15					
106	285.65	n	0.15	0.042	0.15					
107	285.44	n	0.15	0.042	0.15					
108	285.31	n	0.15	0.042	0.15					
109	285.06	n	0.15	0.042	0.15					
110	284.21	n	0.15	0.042	0.15					
111	283.41	n	0.15	0.042	0.15					
112	282.56	n	0.15	0.042	0.15					
113	282.15	n	0.15	0.042	0.15					
114	281.87	n	0.15	0.042	0.15					
115	281.53	n	0.15	0.042	0.15					
116	281.12	n	0.15	0.042	0.15					
117	280.79	n	0.15	0.042	0.15					
118	280.52	n	0.15	0.042	0.15					
119	280.18	n	0.15	0.042	0.15					
120	279.79	n	0.15	0.042	0.15					

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<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
121	279.42	n	0.15	0.042	0.15					
122	278.98	n	0.15	0.042	0.15					
123	278.68	n	0.15	0.042	0.15					
124	278.33	n	0.15	0.042	0.15					
125	278.01	n	0.15	0.042	0.15					
126	277.53	n	0.15	0.042	0.15					
127	277.25	n	0.15	0.042	0.15					
128	276.9	n	0.15	0.042	0.15					
129	276.55	n	0.15	0.042	0.15					
130	275.9	n	0.15	0.042	0.15					
131	275.17	n	0.15	0.042	0.15					
132	274.78	n	0.15	0.042	0.15					
133	274.46	n	0.15	0.042	0.15					
134	274.15	Lat Struct								
135	274.1	n	0.15	0.042	0.15					
136	274.09	Lat Struct								
137	273.8	n	0.15	0.042	0.15					
138	273.44	n	0.15	0.042	0.15					
139	273.05	n	0.15	0.042	0.15					
140	272.78	n	0.15	0.042	0.15					

<i>Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative C</i>										
	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8
141	272.44	n	0.15	0.042	0.15					
142	272.3	Lat Struct								
143	272.2	n	0.15	0.042	0.15	0.042	0.15			
144	272.18	Lat Struct								
145	272.06	n	0.15	0.042	0.15					
146	271.46	n	0.15	0.042	0.15					
147	271.4	Lat Struct								
148	271.11	n	0.15	0.042	0.15					
149	270.77	n	0.15	0.042	0.15					
150	270.45	n	0.15	0.042	0.15					
151	270	n	0.15	0.042	0.15					
152	268.62	n	0.15	0.042	0.15					
153	267.01	n	0.15	0.042	0.15					

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Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative D1

River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13
1	303.58	n	0.2	0.07	0.048	0.07	0.2							
2	303.22	n	0.2	0.07	0.045	0.07	0.2							
3	303.17	n	0.2	0.07	0.045	0.07	0.2							
4	303.03	n	0.2	0.07	0.042	0.07	0.2							
5	303.01	Lat Struct												
6	302.93	n	0.2	0.07	0.042	0.07	0.18							
7	302.8	n	0.2	0.07	0.042	0.07	0.18							
8	302.68	n	0.18	0.07	0.042	0.07	0.18							
9	302.5	n	0.18	0.07	0.07	0.042	0.07	0.18						
10	302.05	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18					
11	301.86	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18					
12	301.73	n	0.18	0.07	0.07	0.042	0.07	0.18						
13	301.54	n	0.18	0.07	0.042	0.07	0.18							
14	301	Lat Struct												
15	300.74	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18					
16	300.47	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18					
17	300.12	n	0.18	0.07	0.042	0.07	0.18							
18	299.62	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18					
19	299.45	Lat Struct												
20	299.02	n	0.18	0.07	0.042	0.07	0.18							
21	298.81	n	0.18	0.07	0.042	0.07	0.18							
22	298.47	n	0.18	0.07	0.042	0.07	0.18							
23	298.06	n	0.18	0.07	0.07	0.042	0.07	0.18						
24	297.87	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18					
25	297.73	n	0.18	0.07	0.042	0.07	0.18							
26	297.66	n	0.18	0.07	0.042	0.07	0.18							
27	297.47	n	0.18	0.07	0.042	0.07	0.18							
28	297.22	n	0.18	0.07	0.042	0.07	0.18							
29	296.83	n	0.18	0.07	0.042	0.07	0.18							
30	296.36	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18					
31	296.1	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18					
32	295.63	n	0.18	0.07	0.04	0.07	0.18							
33	295.37	n	0.18	0.07	0.04	0.07	0.18							
34	295.14	n	0.18	0.05	0.04	0.05	0.07	0.18						
35	294.93	n	0.18	0.05	0.04	0.05	0.07	0.18						
36	294.66	n	0.18	0.05	0.04	0.05	0.18							
37	294.54	n	0.18	0.05	0.05	0.05	0.18	0.05	0.18					
38	294.5	Bridge												
39	294.43	n	0.18	0.05	0.04	0.05	0.18	0.05	0.18					
40	294.15	n	0.16	0.05	0.04	0.05	0.16							
41	293.87	n	0.16	0.05	0.04	0.05	0.16							
42	293.57	n	0.16	0.05	0.04	0.05	0.16	0.065	0.18					

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Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative D1

River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13
43	293.4	Lat Struct												
44	292.83	n	0.16	0.05	0.16	0.04	0.065	0.16						
45	292.62	n	0.16	0.05	0.16	0.04	0.065	0.16						
46	292.52	n	0.16	0.05	0.16	0.04	0.05	0.065	0.16					
47	292.43	n	0.16	0.05	0.16	0.04	0.065	0.16						
48	292.39	Bridge												
49	292.38	n	0.12	0.05	0.12	0.05	0.04	0.05	0.12					
50	292.37	Lat Struct												
51	292.35	n	0.16	0.05	0.16	0.05	0.04	0.065	0.016					
52	292.15	n	0.16	0.05	0.04	0.065	0.16							
53	291.95	n	0.16	0.05	0.04	0.16								
54	291.9	Lat Struct												
55	291.62	n	0.16	0.04	0.05	0.16								
56	291.55	Lat Struct												
57	291.4	n	0.16	0.05	0.04	0.05	0.16							
58	290.96	n	0.16	0.05	0.04	0.05	0.16							
59	290.61	n	0.16	0.05	0.04	0.05	0.16							
60	290.36	n	0.16	0.05	0.04	0.05	0.16							
61	290.13	n	0.16	0.05	0.04	0.05	0.16							
62	290.1	Bridge												
63	290.06	n	0.16	0.05	0.04	0.05	0.18							
64	289.91	n	0.16	0.05	0.04	0.05	0.18							
65	289.73	n	0.16	0.05	0.04	0.05	0.12							
66	289.6	n	0.16	0.05	0.04	0.05	0.12							
67	289.58	Lat Struct												
68	289.37	n	0.16	0.05	0.042	0.05	0.16							
69	289.35	Bridge												
70	289.32	n	0.1	0.05	0.0425	0.05	0.16							
71	289.28	n	0.1	0.05	0.1	0.05	0.042	0.16						
72	289.25	n	0.1	0.05	0.1	0.05	0.042	0.16						
73	289.18	n	0.1	0.05	0.1	0.05	0.042	0.16						
74	289.16	Bridge												
75	289.14	n	0.2	0.05	0.2	0.05	0.042	0.16						
76	289.1	Lat Struct												
77	288.94	n	0.08	0.05	0.042	0.05	0.065							
78	288.81	n	0.065	0.05	0.042	0.05	0.065							
79	288.8	Bridge												
80	288.76	n	0.065	0.05	0.0425	0.05	0.065							
81	288.63	n	0.065	0.05	0.042	0.05	0.065							
82	288.49	n	0.065	0.042	0.05	0.075								
83	288.4	Bridge												
84	288.32	n	0.065	0.05	0.0425	0.05	0.065							
85	288.29*	n	0.0537	0.05	0.0425	0.0369	0.0369	0.037	0.0483	0.0612	0.0612	0.065	0.065	0.065
86	288.26*	n	0.0425	0.04	0.035	0.0312	0.0312	0.0314	0.0465	0.0575	0.0575	0.065	0.065	0.065

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Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative D1

River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13
87	288.24	Inl Struct												
88	288.22*	n	0.0312	0.03	0.0275	0.0256	0.0256	0.0259	0.0448	0.0538	0.0538	0.065	0.065	0.065
89	288.19	n	0.02	0.02	0.02	0.05	0.065							
90	288.12*	n	0.065	0.056	0.05	0.048	0.042	0.042	0.042	0.05	0.057	0.057	0.057	0.065
91	288.04	n	0.065	0.05	0.042	0.05	0.065							
92	288.035	Bridge												
93	288.03	n	0.065	0.05	0.0425	0.05	0.065	0.15	0.055	0.18				
94	287.89	n	0.065	0.05	0.042	0.065	0.15	0.055						
95	287.75	n	0.065	0.05	0.042	0.05	0.065	0.15						
96	287.61	n	0.065	0.05	0.042	0.05	0.065	0.15						
97	287.45	n	0.065	0.05	0.042	0.05	0.065	0.15						
98	287.18	n	0.13	0.05	0.042	0.015	0.055							
99	286.94	n	0.15	0.05	0.042	0.05	0.015	0.055						
100	286.85	n	0.15	0.05	0.042	0.05	0.15	0.055						
101	286.33	n	0.15	0.042	0.15	0.075								
102	286.31	n	0.15	0.042	0.15	0.075								
103	286.09	n	0.15	0.042	0.15	0.075								
104	286.05	Lat Struct												
105	286.01	n	0.15	0.042	0.15	0.075								
106	285.9	Lat Struct												
107	285.81	n	0.15	0.042	0.15									
108	285.8	n	0.15	0.042	0.15									
109	285.65	n	0.15	0.042	0.15									
110	285.44	n	0.15	0.042	0.15									
111	285.31	n	0.15	0.042	0.15									
112	285.06	n	0.15	0.042	0.15									
113	284.21	n	0.15	0.042	0.15									
114	283.41	n	0.15	0.042	0.15									
115	282.56	n	0.15	0.042	0.15									
116	282.15	n	0.15	0.042	0.15									
117	281.87	n	0.15	0.042	0.15									
118	281.53	n	0.15	0.042	0.15									
119	281.12	n	0.15	0.042	0.15									
120	280.79	n	0.15	0.042	0.15									
121	280.52	n	0.15	0.042	0.15									
122	280.18	n	0.15	0.042	0.15									
123	279.79	n	0.15	0.042	0.15									
124	279.42	n	0.15	0.042	0.15									
125	278.98	n	0.15	0.042	0.15									
126	278.68	n	0.15	0.042	0.15									
127	278.33	n	0.15	0.042	0.15									
128	278.01	n	0.15	0.042	0.15									
129	277.53	n	0.15	0.042	0.15									
130	277.25	n	0.15	0.042	0.15									

Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative D1

River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13
131	276.9	n	0.15	0.042	0.15									
132	276.55	n	0.15	0.042	0.15									
133	275.9	n	0.15	0.042	0.15									
134	275.17	n	0.15	0.042	0.15									
135	274.78	n	0.15	0.042	0.15									
136	274.46	n	0.15	0.042	0.15									
137	274.15	Lat Struct												
138	274.1	n	0.15	0.042	0.15									
139	274.09	Lat Struct												
140	273.8	n	0.15	0.042	0.15									
141	273.44	n	0.15	0.042	0.15									
142	273.05	n	0.15	0.042	0.15									
143	272.78	n	0.15	0.042	0.15									
144	272.44	n	0.15	0.042	0.15									
145	272.3	Lat Struct												
146	272.2	n	0.15	0.042	0.15	0.042	0.15							
147	272.18	Lat Struct												
148	272.06	n	0.15	0.042	0.15									
149	271.46	n	0.15	0.042	0.15									
150	271.4	Lat Struct												
151	271.11	n	0.15	0.042	0.15									
152	270.77	n	0.15	0.042	0.15									
153	270.45	n	0.15	0.042	0.15									
154	270	n	0.15	0.042	0.15									
155	268.62	n	0.15	0.042	0.15									
156	267.01	n	0.15	0.042	0.15									

Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative E

River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13
1	303.58	n	0.2	0.07	0.048	0.07	0.2							
2	303.22	n	0.2	0.07	0.045	0.07	0.2							
3	303.17	n	0.2	0.07	0.045	0.07	0.2							
4	303.03	n	0.2	0.07	0.042	0.07	0.2							
5	303.01	Lat Struct												
6	302.93	n	0.2	0.07	0.042	0.07	0.18							
7	302.8	n	0.2	0.07	0.042	0.07	0.18							

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Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative E															
River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13	
8	302.68	n	0.18	0.07	0.042	0.07	0.18								
9	302.5	n	0.18	0.07	0.07	0.042	0.07	0.18							
10	302.05	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18						
11	301.86	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18						
12	301.73	n	0.18	0.07	0.07	0.042	0.07	0.18							
13	301.54	n	0.18	0.07	0.042	0.07	0.18								
14	301	Lat Struct													
15	300.74	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18						
16	300.47	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18						
17	300.12	n	0.18	0.07	0.042	0.07	0.18								
18	299.62	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18						
19	299.45	Lat Struct													
20	299.02	n	0.18	0.07	0.042	0.07	0.18								
21	298.81	n	0.18	0.07	0.042	0.07	0.18								
22	298.47	n	0.18	0.07	0.042	0.07	0.18								
23	298.06	n	0.18	0.07	0.07	0.042	0.07	0.18							
24	297.87	n	0.18	0.07	0.18	0.07	0.042	0.07	0.18						
25	297.73	n	0.18	0.07	0.042	0.07	0.18								
26	297.66	n	0.18	0.07	0.042	0.07	0.18								
27	297.47	n	0.18	0.07	0.042	0.07	0.18								
28	297.22	n	0.18	0.07	0.042	0.07	0.18								
29	296.83	n	0.18	0.07	0.042	0.07	0.18								
30	296.36	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18						
31	296.1	n	0.18	0.07	0.042	0.07	0.18	0.07	0.18						
32	295.63	n	0.18	0.07	0.04	0.07	0.18								
33	295.37	n	0.18	0.07	0.04	0.07	0.18								
34	295.14	n	0.18	0.05	0.04	0.05	0.07	0.18							

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Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative E															
River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13	
35	294.93	n	0.18	0.05	0.04	0.05	0.07	0.18							
36	294.66	n	0.18	0.05	0.04	0.05	0.18								
37	294.54	n	0.18	0.05	0.05	0.05	0.18	0.05	0.18						
38	294.5	Bridge													
39	294.43	n	0.18	0.05	0.04	0.05	0.18	0.05	0.18						
40	294.15	n	0.16	0.05	0.04	0.05	0.16								
41	293.87	n	0.16	0.05	0.04	0.05	0.16								
42	293.57	n	0.16	0.05	0.04	0.05	0.16	0.065	0.18						
43	293.4	Lat Struct													
44	292.83	n	0.16	0.05	0.16	0.04	0.065	0.16							
45	292.62	n	0.16	0.05	0.16	0.04	0.065	0.16							
46	292.52	n	0.16	0.05	0.16	0.04	0.05	0.065	0.16						
47	292.43	n	0.16	0.05	0.16	0.04	0.065	0.16							
48	292.39	Bridge													
49	292.38	n	0.12	0.05	0.12	0.05	0.04	0.05	0.12						
50	292.37	Lat Struct													
51	292.35	n	0.16	0.05	0.16	0.05	0.04	0.065	0.016						
52	292.15	n	0.16	0.05	0.04	0.065	0.16								
53	291.95	n	0.16	0.05	0.04	0.16									
54	291.9	Lat Struct													
55	291.62	n	0.16	0.04	0.05	0.16									
56	291.55	Lat Struct													
57	291.4	n	0.16	0.05	0.04	0.05	0.16								
58	290.96	n	0.16	0.05	0.04	0.05	0.16								
59	290.61	n	0.16	0.05	0.04	0.05	0.16								
60	290.36	n	0.16	0.05	0.04	0.05	0.16								
61	290.13	n	0.16	0.05	0.04	0.05	0.16								

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Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative E															
River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13	
62	290.1	Bridge													
63	290.06	n	0.16	0.05	0.04	0.05	0.18								
64	289.91	n	0.16	0.05	0.04	0.05	0.18								
65	289.73	n	0.16	0.05	0.04	0.05	0.12								
66	289.6	n	0.16	0.05	0.04	0.05	0.12								
67	289.58	Lat Struct													
68	289.37	n	0.16	0.05	0.042	0.05	0.16								
69	289.35	Bridge													
70	289.32	n	0.1	0.05	0.0425	0.05	0.16								
71	289.28	n	0.1	0.05	0.1	0.05	0.042	0.16							
72	289.25	n	0.1	0.05	0.1	0.05	0.042	0.16							
73	289.18	n	0.1	0.05	0.1	0.05	0.042	0.16							
74	289.16	Bridge													
75	289.14	n	0.2	0.05	0.2	0.05	0.042	0.16							
76	289.1	Lat Struct													
77	288.94	n	0.08	0.05	0.042	0.05	0.065								
78	288.81	n	0.065	0.05	0.042	0.05	0.065								
79	288.8	Bridge													
80	288.76	n	0.065	0.05	0.0425	0.05	0.065								
81	288.63	n	0.065	0.05	0.042	0.05	0.065								
82	288.49	n	0.065	0.042	0.05	0.075									
83	288.4	Bridge													
84	288.32	n	0.065	0.05	0.0425	0.05	0.065								
85	288.26*	n	0.065	0.055	0.0491	0.0422	0.0422	0.0423	0.0491	0.0575	0.0575	0.05	0.065	0.065	0.065
86	288.19	n	0.02	0.02	0.02	0.05	0.065								
87	288.12*	n	0.065	0.056	0.05	0.042	0.042	0.05	0.057	0.057	0.057	0.065	0.065		
88	288.04	n	0.065	0.05	0.042	0.05	0.065								

Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative E															
River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13	
89	288.035	Bridge													
90	288.03	n	0.065	0.05	0.0425	0.05	0.065	0.15	0.055	0.18					
91	287.89	n	0.065	0.05	0.042	0.065	0.15	0.055							
92	287.75	n	0.065	0.05	0.042	0.05	0.065	0.15							
93	287.61	n	0.065	0.05	0.042	0.05	0.065	0.15							
94	287.45	n	0.065	0.05	0.042	0.05	0.065	0.15							
95	287.18	n	0.13	0.05	0.042	0.015	0.055								
96	286.94	n	0.15	0.05	0.042	0.05	0.015	0.055							
97	286.85	n	0.15	0.05	0.042	0.05	0.15	0.055							
98	286.33	n	0.15	0.042	0.15	0.075									
99	286.31	n	0.15	0.042	0.15	0.075									
100	286.09	n	0.15	0.042	0.15	0.075									
101	286.05	Lat Struct													
102	286.01	n	0.15	0.042	0.15	0.075									
103	285.9	Lat Struct													
104	285.81	n	0.15	0.042	0.15										
105	285.8	n	0.15	0.042	0.15										
106	285.65	n	0.15	0.042	0.15										
107	285.44	n	0.15	0.042	0.15										
108	285.31	n	0.15	0.042	0.15										
109	285.06	n	0.15	0.042	0.15										
110	284.21	n	0.15	0.042	0.15										
111	283.41	n	0.15	0.042	0.15										
112	282.56	n	0.15	0.042	0.15										
113	282.15	n	0.15	0.042	0.15										
114	281.87	n	0.15	0.042	0.15										
115	281.53	n	0.15	0.042	0.15										

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Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative E															
River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13	
116	281.12	n	0.15	0.042	0.15										
117	280.79	n	0.15	0.042	0.15										
118	280.52	n	0.15	0.042	0.15										
119	280.18	n	0.15	0.042	0.15										
120	279.79	n	0.15	0.042	0.15										
121	279.42	n	0.15	0.042	0.15										
122	278.98	n	0.15	0.042	0.15										
123	278.68	n	0.15	0.042	0.15										
124	278.33	n	0.15	0.042	0.15										
125	278.01	n	0.15	0.042	0.15										
126	277.53	n	0.15	0.042	0.15										
127	277.25	n	0.15	0.042	0.15										
128	276.9	n	0.15	0.042	0.15										
129	276.55	n	0.15	0.042	0.15										
130	275.9	n	0.15	0.042	0.15										
131	275.17	n	0.15	0.042	0.15										
132	274.78	n	0.15	0.042	0.15										
133	274.46	n	0.15	0.042	0.15										
134	274.15	Lat Struct													
135	274.1	n	0.15	0.042	0.15										
136	274.09	Lat Struct													
137	273.8	n	0.15	0.042	0.15										
138	273.44	n	0.15	0.042	0.15										
139	273.05	n	0.15	0.042	0.15										
140	272.78	n	0.15	0.042	0.15										
141	272.44	n	0.15	0.042	0.15										
142	272.3	Lat Struct													

Final Calibrated HEC-HMS Model Manning's N Values (Land Roughness Parameter) for Alternative E															
River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5	n #6	n #7	n #8	n #9	n #10	n #11	n #12	n #13	
143	272.2	n	0.15	0.042	0.15	0.042	0.15								
144	272.18	Lat Struct													
145	272.06	n	0.15	0.042	0.15										
146	271.46	n	0.15	0.042	0.15										
147	271.4	Lat Struct													
148	271.11	n	0.15	0.042	0.15										
149	270.77	n	0.15	0.042	0.15										
150	270.45	n	0.15	0.042	0.15										
151	270	n	0.15	0.042	0.15										
152	268.62	n	0.15	0.042	0.15										
153	267.01	n	0.15	0.042	0.15										

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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	303.58	Max WS	2020-Feb	78093	246.61	280.8		280.92	0.000075	2.7	111667	13796.37	0.1	
Pearl River	Upper	303.58	Max WS	2020-Jan	33226	246.61	276.1		276.17	0.000069	1.82	57105.62	9449	0.07	
Pearl River	Upper	303.58	Max WS	2017	41972	246.61	277.4		277.42	0.000069	2.04	69038.84	10096.37	0.08	
Pearl River	Upper	303.58	Max WS	2022	59897	246.61	279.3		279.4	0.000068	2.45	90902.67	12860.98	0.09	
Pearl River	Upper	303.58	Max WS	1979-current calibration	13149 4	246.61	286.1		286.2	0.000067	2.91	192654.8	15985.42	0.09	
Pearl River	Upper	303.58	Max WS	1000yearhigh	16272 0	246.61	287.6		287.67	0.000079	3.27	216592	16825.82	0.1	
Pearl River	Upper	303.58	Max WS	500yearhigh	14042 8	246.61	286.5		286.55	0.000071	3.03	198135.5	16134.81	0.1	
Pearl River	Upper	303.58	Max WS	200yearhigh	11489 8	246.61	284.4		284.46	0.000074	2.93	165102.5	15586.73	0.1	
Pearl River	Upper	303.58	Max WS	100Year_High- LeveeInflows	98223	246.61	283.1		283.12	0.000073	2.82	144384.2	15500.26	0.1	
Pearl River	Upper	303.58	Max WS	50Year_High	83409	246.61	281.6		281.66	0.000072	2.7	122217.4	14760.49	0.1	
Pearl River	Upper	303.58	Max WS	25yearhigh	70198	246.61	280.3		280.39	0.000073	2.57	103451.1	13302.18	0.09	
Pearl River	Upper	303.58	Max WS	10yearhigh	54791	246.61	278.7		278.78	0.000068	2.33	83371.28	11841.33	0.08	

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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch EI	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	303.58	Max WS	5yearhigh	44388	246.61	277.6		277.69	0.000069	2.11	71727.48	10293.11		0.08
Pearl River	Upper	303.58	Max WS	C-1000year	162816	246.76	286		286.1	0.000103	3.75	190010.9	15947.11		0.12
Pearl River	Upper	303.58	Max WS	C-500year	140602	246.76	284.5		284.58	0.000105	3.67	166216.8	15591.31		0.12
Pearl River	Upper	303.58	Max WS	C-200year	115080	246.76	282.6		282.73	0.000105	3.52	137407	15372.98		0.12
Pearl River	Upper	303.58	Max WS	C-100	98327	246.76	281.3		281.41	0.000102	3.37	117774.3	14413.38		0.12
Pearl River	Upper	303.58	Max WS	C-50year	83453	246.76	280		280.09	0.000101	3.25	98786.73	13177.18		0.12
Pearl River	Upper	303.58	Max WS	C-25year	70223	246.76	278.8		278.9	0.000096	3	84026.84	12164.06		0.11
Pearl River	Upper	303.58	Max WS	C-10year	54800	246.76	277.2		277.31	0.000099	2.73	67366.59	9967.09		0.1
Pearl River	Upper	303.58	Max WS	C-5year	44388	246.76	276.3		276.34	0.0001	2.42	58092.17	9581.09		0.09
Pearl River	Upper	303.58	Max WS	D-1000yr	162777	246.76	286.2		286.32	0.000098	3.68	193752.5	16044.27		0.12
Pearl River	Upper	303.58	Max WS	D-500yr	140585	246.76	284.7		284.81	0.0001	3.6	169879.1	15622.17		0.12
Pearl River	Upper	303.58	Max WS	D-200yr	115067	246.76	282.8		282.94	0.0001	3.45	140819.4	15434.85		0.12
Pearl River	Upper	303.58	Max WS	D-100yr	98327	246.76	281.5		281.6	0.000098	3.32	120612.7	14746.89		0.12

Pearl River Basin, Mississippi Federal Flood Risk Management
Project Draft Appendix E – Hydrologic and Hydraulic Model

Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	303.58	Max WS	D-50yr	83433	246.76	280.2		280.34	0.000095	3.17	102101.7	13252.76	0.12	
Pearl River	Upper	303.58	Max WS	D-25yr	70223	246.76	279		279.1	0.000091	2.94	86559.66	12515.65	0.11	
Pearl River	Upper	303.58	Max WS	D-10yr	54800	246.76	277.5		277.53	0.000094	2.66	69570.37	10141.66	0.1	
Pearl River	Upper	303.58	Max WS	D-5yr	44388	246.76	276.5		276.53	0.000095	2.37	59949.84	9665.81	0.09	
Pearl River	Upper	303.58	Max WS	E-1000yr	162797	246.76	286.2		286.32	0.000098	3.69	193640.4	16041.37	0.12	
Pearl River	Upper	303.58	Max WS	E-500yr	140569	246.76	284.7		284.81	0.0001	3.6	169771.3	15620.92	0.12	
Pearl River	Upper	303.58	Max WS	E-200yr	115080	246.76	282.8		282.94	0.0001	3.46	140753	15433.64	0.12	
Pearl River	Upper	303.58	Max WS	E-100yr	98327	246.76	281.5		281.6	0.000098	3.32	120566.8	14744.17	0.12	
Pearl River	Upper	303.58	Max WS	E-50yr	83433	246.76	280.2		280.34	0.000095	3.17	102074.7	13252.17	0.12	
Pearl River	Upper	303.58	Max WS	E-25yr	70223	246.76	279		279.1	0.000091	2.94	86539.84	12513.2	0.11	
Pearl River	Upper	303.58	Max WS	E-10yr	54800	246.76	277.5		277.53	0.000094	2.66	69563.52	10140.96	0.1	
Pearl River	Upper	303.58	Max WS	E-5yr	44388	246.76	276.5		276.53	0.000095	2.37	59949.84	9665.81	0.09	

Pearl River Basin, Mississippi Federal Flood Risk Management
Project Draft Appendix E – Hydrologic and Hydraulic Model

Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch EI	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	294.43	Max WS	2020-Feb	73569	236.03	276.9		277.23	0.000118	4.71	27446.96	1837.43		0.15
Pearl River	Upper	294.43	Max WS	2020-Jan	33124	236.03	270.8		270.87	0.000114	2.89	16855.71	1322.49		0.11
Pearl River	Upper	294.43	Max WS	2017	40319	236.03	272		272.18	0.00012	3.29	18244.9	1339.39		0.12
Pearl River	Upper	294.43	Max WS	2022	59406	236.03	274.9		275.18	0.000115	4.22	21452.04	1467.2		0.14
Pearl River	Upper	294.43	Max WS	1979-current calibration	116929	236.03	282.9		283.3	0.000145	5.93	41298.03	2531.65		0.18
Pearl River	Upper	294.43	Max WS	1000yearhigh	136269	236.03	284		284.55	0.000171	6.59	44208.28	2535.45		0.19
Pearl River	Upper	294.43	Max WS	500yearhigh	120458	236.03	283.1		283.53	0.00015	6.06	41823.63	2532.33		0.18
Pearl River	Upper	294.43	Max WS	200yearhigh	104346	236.03	280.8		281.23	0.000144	5.69	36132.1	2491.85		0.17
Pearl River	Upper	294.43	Max WS	100Year_High-LeveeInflows	91642	236.03	279.4		279.77	0.000133	5.3	32727.88	2359.4		0.17
Pearl River	Upper	294.43	Max WS	50Year_High	79392	236.03	277.8		278.07	0.000122	4.91	28987.32	1989.16		0.16
Pearl River	Upper	294.43	Max WS	25yearhigh	67028	236.03	276.2		276.44	0.00012	4.52	22814.48	1691.81		0.15
Pearl River	Upper	294.43	Max WS	10yearhigh	52515	236.03	274		274.21	0.000114	3.9	20418.46	1365.93		0.13
Pearl River	Upper	294.43	Max WS	5yearhigh	42586	236.03	272.5		272.67	0.000118	3.39	18773.92	1344.55		0.12

Pearl River Basin, Mississippi Federal Flood Risk Management
Project Draft Appendix E – Hydrologic and Hydraulic Model

Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	294.43	Max WS	C-1000year	148673	236.59	281.4		281.61	0.000091	4.65	48477.59	2512.62	0.14	
Pearl River	Upper	294.43	Max WS	C-500year	132982	236.59	279.2		279.39	0.000091	4.46	43162.49	2330.19	0.14	
Pearl River	Upper	294.43	Max WS	C-200year	106306	236.59	276.8		276.97	0.000081	3.98	31491.46	1688.79	0.13	
Pearl River	Upper	294.43	Max WS	C-100	92198	236.59	275		275.16	0.000075	3.68	29520.14	1386.2	0.12	
Pearl River	Upper	294.43	Max WS	C-50year	80680	236.59	273.5		273.67	0.000069	3.4	27894.24	1364.02	0.12	
Pearl River	Upper	294.43	Max WS	C-25year	69092	236.59	272.2		272.31	0.000063	3.07	26425.84	1350.86	0.11	
Pearl River	Upper	294.43	Max WS	C-10year	53964	236.59	270.1		270.23	0.000059	2.62	24175.61	1331.69	0.09	
Pearl River	Upper	294.43	Max WS	C-5year	44591	236.59	268.3		268.37	0.000065	2.36	22169.99	1314.9	0.09	
Pearl River	Upper	294.43	Max WS	D-1000yr	147540	236.59	281.8		282.02	0.000087	4.51	45847.01	2516.4	0.13	
Pearl River	Upper	294.43	Max WS	D-500yr	131986	236.59	279.8		280	0.000087	4.36	38786.17	2375.16	0.13	
Pearl River	Upper	294.43	Max WS	D-200yr	105898	236.59	277.6		277.73	0.000073	3.8	35572.12	1874.45	0.12	
Pearl River	Upper	294.43	Max WS	D-100yr	92433	236.59	275.9		276.07	0.000068	3.55	33212.09	1573.14	0.12	

Pearl River Basin, Mississippi Federal Flood Risk Management
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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch EI	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	294.43	Max WS	D-50yr	79773	236.59	274.5		274.61	0.000061	3.26	31182.1	1393.22		0.11
Pearl River	Upper	294.43	Max WS	D-25yr	67401	236.59	273.1		273.22	0.000057	2.93	29285.83	1374.36		0.1
Pearl River	Upper	294.43	Max WS	D-10yr	54722	236.59	271.2		271.31	0.000056	2.61	26705.75	1352.85		0.09
Pearl River	Upper	294.43	Max WS	D-5yr	43309	236.59	269.5		269.53	0.000059	2.27	24338.75	1335.83		0.08
Pearl River	Upper	294.43	Max WS	E-1000yr	147563	236.59	281.8		282.01	0.000087	4.51	45805.78	2516.26		0.13
Pearl River	Upper	294.43	Max WS	E-500yr	132035	236.59	279.8		279.98	0.000088	4.36	38749.35	2374.46		0.13
Pearl River	Upper	294.43	Max WS	E-200yr	106062	236.59	277.6		277.72	0.000073	3.81	35548.33	1874.09		0.12
Pearl River	Upper	294.43	Max WS	E-100yr	92185	236.59	275.9		276.06	0.000068	3.54	33193.91	1571.87		0.12
Pearl River	Upper	294.43	Max WS	E-50yr	79814	236.59	274.5		274.61	0.000062	3.26	31170.24	1393.07		0.11
Pearl River	Upper	294.43	Max WS	E-25yr	67449	236.59	273.1		273.22	0.000057	2.93	29278.12	1374.3		0.1
Pearl River	Upper	294.43	Max WS	E-10yr	54742	236.59	271.2		271.31	0.000056	2.61	26702.62	1352.82		0.09
Pearl River	Upper	294.43	Max WS	E-5yr	43290	236.59	269.5		269.53	0.000059	2.27	24335.82	1335.81		0.08

Pearl River Basin, Mississippi Federal Flood Risk Management
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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	288.76	Max WS	2020-Feb	72657	237.04	270.3		270.56	0.000338	5.34	21985.46	1505.74	0.18	
Pearl River	Upper	288.76	Max WS	2020-Jan	32841	237.04	265		265.12	0.000284	3.59	13547.15	1336.74	0.13	
Pearl River	Upper	288.76	Max WS	2017	39515	237.04	266		266.15	0.000322	4.02	14655.82	1354.2	0.15	
Pearl River	Upper	288.76	Max WS	2022	58845	237.04	268.8		269.09	0.000343	4.95	17881.16	1438.01	0.17	
Pearl River	Upper	288.76	Max WS	1979-current calibration	120860	237.04	274.8		275.23	0.00037	6.84	28947.91	1607.75	0.21	
Pearl River	Upper	288.76	Max WS	1000yearhigh	125115	237.04	276.2		276.61	0.000324	6.58	31286.73	1642.33	0.2	
Pearl River	Upper	288.76	Max WS	500yearhigh	118610	237.04	275.4		275.79	0.000328	6.52	29946.95	1637.35	0.2	
Pearl River	Upper	288.76	Max WS	200yearhigh	101727	237.04	273.8		274.12	0.000304	6.08	27341.43	1573	0.19	
Pearl River	Upper	288.76	Max WS	100Year_High-LeveeInflows	86853	237.04	272.3		272.64	0.000307	5.63	25115.73	1538.7	0.18	
Pearl River	Upper	288.76	Max WS	50Year_High	75932	237.04	271.1		271.44	0.00031	5.28	23319.92	1519.89	0.17	
Pearl River	Upper	288.76	Max WS	25yearhigh	64304	237.04	270		270.25	0.000294	4.81	21594.97	1501.5	0.16	
Pearl River	Upper	288.76	Max WS	10yearhigh	51099	237.04	268.3		268.54	0.000297	4.43	17317.29	1415.79	0.15	

Pearl River Basin, Mississippi Federal Flood Risk Management
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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch EI	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	288.76	Max WS	5yearhigh	42414	237.04	266.7		266.87	0.000302	4.1	15465.73	1366.78		0.15
Pearl River	Upper	288.76	Max WS	C-1000year	142871	237.04	275.7		275.91	0.000197	5.07	37516.52	1621.86		0.16
Pearl River	Upper	288.76	Max WS	C-500year	125600	237.04	274.5		274.69	0.000175	4.67	35614.84	1563.52		0.15
Pearl River	Upper	288.76	Max WS	C-200year	106755	237.04	272.9		273.05	0.000156	4.27	33132.7	1547.93		0.14
Pearl River	Upper	288.76	Max WS	C-100	93488	237.04	271.5		271.62	0.000152	3.98	30966.82	1515.94		0.13
Pearl River	Upper	288.76	Max WS	C-50year	81780	237.04	270.3		270.47	0.00015	3.68	29272.84	1494.01		0.12
Pearl River	Upper	288.76	Max WS	C-25year	69101	237.04	269.2		269.37	0.000147	3.4	25393.78	1473.57		0.12
Pearl River	Upper	288.76	Max WS	C-10year	53136	237.04	267.6		267.67	0.000125	2.84	23465.92	1443.79		0.1
Pearl River	Upper	288.76	Max WS	C-5year	43511	237.04	266		266.11	0.000118	2.54	21685.98	1392.66		0.09
Pearl River	Upper	288.76	Max WS	D-1000yr	141405	237.04	275.9		276.32	0.00028	6.06	31214.8	1613.82		0.19
Pearl River	Upper	288.76	Max WS	D-500yr	124160	237.04	274.7		274.99	0.000256	5.66	29167.41	1561.47		0.18
Pearl River	Upper	288.76	Max WS	D-200yr	106173	237.04	273		273.34	0.000234	5.25	26677.13	1533.54		0.17
Pearl River	Upper	288.76	Max WS	D-100yr	92850	237.04	271.7		271.93	0.000231	4.93	24584	1501.12		0.16

Pearl River Basin, Mississippi Federal Flood Risk Management
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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	288.76	Max WS	D-50yr	81083	237.04	270.5		270.73	0.00023	4.58	23159.64	1204.01	0.15	
Pearl River	Upper	288.76	Max WS	D-25yr	68276	237.04	269.4		269.63	0.000212	4.09	21884.58	1194.89	0.14	
Pearl River	Upper	288.76	Max WS	D-10yr	54643	237.04	267.9		268	0.000194	3.6	20000.73	1174.26	0.13	
Pearl River	Upper	288.76	Max WS	D-5yr	43144	237.04	266.2		266.32	0.00018	3.17	18096.54	1132.13	0.11	
Pearl River	Upper	288.76	Max WS	E-1000yr	141598	237.04	275.9		276.27	0.000283	6.09	31135.72	1613.52	0.19	
Pearl River	Upper	288.76	Max WS	E-500yr	124234	237.04	274.6		274.94	0.000258	5.68	29089.6	1557.37	0.18	
Pearl River	Upper	288.76	Max WS	E-200yr	106270	237.04	273		273.29	0.000236	5.27	26604.13	1533.1	0.17	
Pearl River	Upper	288.76	Max WS	E-100yr	93087	237.04	271.6		271.9	0.000233	4.95	24537.65	1500.3	0.16	
Pearl River	Upper	288.76	Max WS	E-50yr	81149	237.04	270.5		270.7	0.000231	4.59	23117.02	1203.71	0.15	
Pearl River	Upper	288.76	Max WS	E-25yr	68340	237.04	269.4		269.6	0.000213	4.1	21850.2	1194.64	0.14	
Pearl River	Upper	288.76	Max WS	E-10yr	54672	237.04	267.8		267.98	0.000195	3.61	19973.93	1173.9	0.13	
Pearl River	Upper	288.76	Max WS	E-5yr	43136	237.04	266.2		266.31	0.000181	3.17	18074.74	1131.49	0.12	

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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch EI	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	288.32	Max WS	2020-Feb	72660	225.7	269.7		269.87	0.000263	4.58	24825.85	1919.78	0.16	
Pearl River	Upper	288.32	Max WS	2020-Jan	32825	225.7	264.6		264.7	0.000199	2.9	17770.2	1503.39	0.11	
Pearl River	Upper	288.32	Max WS	2017	39509	225.7	265.6		265.66	0.000226	3.25	19065.78	1541.19	0.12	
Pearl River	Upper	288.32	Max WS	2022	58820	225.7	268.3		268.48	0.00024	4.02	22917.6	1732.14	0.14	
Pearl River	Upper	288.32	Max WS	1979-current calibration	120885	225.7	273.9		274.18	0.000281	5.81	35457.34	2284.61	0.18	
Pearl River	Upper	288.32	Max WS	1000yearhigh	124868	225.7	275.4		275.67	0.000237	5.5	38974.52	2336.8	0.17	
Pearl River	Upper	288.32	Max WS	500yearhigh	118168	225.7	274.6		274.86	0.00024	5.45	37108.5	2303.69	0.17	
Pearl River	Upper	288.32	Max WS	200yearhigh	102424	225.7	273.1		273.3	0.000229	5.15	33593.8	2256.47	0.17	
Pearl River	Upper	288.32	Max WS	100Year_High-LeveeInflows	87474	225.7	271.7		271.93	0.000231	4.77	30622.43	2179.13	0.16	
Pearl River	Upper	288.32	Max WS	50Year_High	76116	225.7	270.6		270.78	0.000231	4.45	28241.32	2023.34	0.15	
Pearl River	Upper	288.32	Max WS	25yearhigh	64247	225.7	269.5		269.67	0.000225	4.09	24600.64	1905.75	0.14	
Pearl River	Upper	288.32	Max WS	10yearhigh	51061	225.7	267.9		268.04	0.000205	3.58	22341.77	1678.17	0.13	
Pearl River	Upper	288.32	Max WS	5yearhigh	42411	225.7	266.3		266.4	0.000211	3.31	20080.37	1560.8	0.12	

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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	288.32	Max WS	C-1000year	142291	225.7	275.2		275.33	0.000128	4.23	46379.06	2302.69	0.13	
Pearl River	Upper	288.32	Max WS	C-500year	125453	225.7	274		274.1	0.000116	3.94	43619.02	2268.16	0.12	
Pearl River	Upper	288.32	Max WS	C-200year	107202	225.7	272.4		272.55	0.000104	3.61	40177.96	2208.78	0.11	
Pearl River	Upper	288.32	Max WS	C-100	93556	225.7	271.1		271.17	0.000101	3.37	37249.07	2047.4	0.11	
Pearl River	Upper	288.32	Max WS	C-50year	81630	225.7	270		270.06	0.000101	3.14	33343.01	1961.69	0.1	
Pearl River	Upper	288.32	Max WS	C-25year	68975	225.7	268.9		269.02	0.000092	2.79	31837.19	1820.93	0.09	
Pearl River	Upper	288.32	Max WS	C-10year	53116	225.7	267.4		267.41	0.000077	2.32	29574.07	1623.91	0.08	
Pearl River	Upper	288.32	Max WS	C-5year	43463	225.7	265.8		265.89	0.000072	2.06	27433.5	1583.44	0.07	
Pearl River	Upper	288.32	Max WS	D-1000yr	141118	225.7	275.4		275.63	0.000169	4.8	42270.2	2308.45	0.14	
Pearl River	Upper	288.32	Max WS	D-500yr	124648	225.7	274.2		274.39	0.000156	4.52	39505.63	2258.96	0.14	
Pearl River	Upper	288.32	Max WS	D-200yr	106862	225.7	272.7		272.86	0.000142	4.19	36145.15	2204.05	0.13	
Pearl River	Upper	288.32	Max WS	D-100yr	93150	225.7	271.4		271.5	0.000139	3.94	33239.11	2086.38	0.13	

Pearl River Basin, Mississippi Federal Flood Risk Management
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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch EI	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	288.32	Max WS	D-50yr	80989	225.7	270.2		270.34	0.000143	3.72	29093.44	1947.11	0.12	
Pearl River	Upper	288.32	Max WS	D-25yr	68107	225.7	269.2		269.28	0.00013	3.31	27583.81	1799.39	0.11	
Pearl River	Upper	288.32	Max WS	D-10yr	53221	225.7	267.6		267.7	0.000113	2.84	25423.24	1594.66	0.1	
Pearl River	Upper	288.32	Max WS	D-5yr	43097	225.7	266		266.07	0.000107	2.55	23187.41	1548.37	0.09	
Pearl River	Upper	288.32	Max WS	E-1000yr	141493	225.7	275.4		275.57	0.000172	4.85	42049.84	2305.23	0.15	
Pearl River	Upper	288.32	Max WS	E-500yr	124816	225.7	274.1		274.34	0.000159	4.55	39291.18	2257.32	0.14	
Pearl River	Upper	288.32	Max WS	E-200yr	106978	225.7	272.7		272.82	0.000144	4.23	35947.74	2201.8	0.13	
Pearl River	Upper	288.32	Max WS	E-100yr	93346	225.7	271.3		271.47	0.000141	3.97	33077.36	2069.42	0.13	
Pearl River	Upper	288.32	Max WS	E-50yr	81052	225.7	270.2		270.3	0.000145	3.75	28947.51	1945.6	0.12	
Pearl River	Upper	288.32	Max WS	E-25yr	68185	225.7	269.1		269.25	0.000132	3.34	27451.33	1796.43	0.11	
Pearl River	Upper	288.32	Max WS	E-10yr	53236	225.7	267.6		267.68	0.000114	2.86	25300.8	1593.81	0.1	
Pearl River	Upper	288.32	Max WS	E-5yr	43108	225.7	266		266.05	0.000109	2.57	23069.95	1547.75	0.09	

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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	267.01	Max WS	2020-Feb	72552	216.04	256.9	244.17	257.03	0.0002	5.12	106506.9	14493.27	0.15	
Pearl River	Upper	267.01	Max WS	2020-Jan	33448	216.04	252.6	232.38	252.66	0.000197	3.9	48879.12	9754.43	0.12	
Pearl River	Upper	267.01	Max WS	2017	32171	216.04	252.2	232.08	252.32	0.000199	3.92	45571.23	9254.53	0.12	
Pearl River	Upper	267.01	Max WS	2022	57463	216.04	255.9	238.42	256	0.000201	4.76	91764.98	14325.09	0.14	
Pearl River	Upper	267.01	Max WS	1979-current calibration	12692 4	216.04	259.9	249.12	260.03	0.0002	6	150904	14980.9	0.17	
Pearl River	Upper	267.01	Max WS	1000yearhigh	15501 4	216.04	261.4	251.49	261.57	0.0002	6.15	174293.5	15129.55	0.17	
Pearl River	Upper	267.01	Max WS	500yearhigh	14075 7	216.04	260.7	249.33	260.8	0.0002	6.08	162593	15045.27	0.17	
Pearl River	Upper	267.01	Max WS	200yearhigh	11941 7	216.04	259.5	248.19	259.59	0.0002	5.96	144314.4	14950.95	0.17	
Pearl River	Upper	267.01	Max WS	100Year_High- LeveeInflows	10339 4	216.04	258.5	247.22	258.6	0.0002	5.85	129451.6	14818.72	0.16	
Pearl River	Upper	267.01	Max WS	50Year_High	87644	216.04	257.7	246	257.84	0.000201	5.51	118299.2	14684.49	0.16	
Pearl River	Upper	267.01	Max WS	25yearhigh	71906	216.04	256.8	244.08	256.98	0.000201	5.11	105927.2	14485.35	0.15	
Pearl River	Upper	267.01	Max WS	10yearhigh	53494	216.04	255.5	237.69	255.68	0.000201	4.68	87237.91	14280.68	0.14	

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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model														
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl #
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Pearl River	Upper	267.01	Max WS	5yearhigh	43150	216.04	254.1	234.94	254.24	0.000199	4.31	67092.15	13461.65	0.13
Pearl River	Upper	267.01	Max WS	C-1000year	166186	216.04	262	252.4	262.16	0.0002	6.2	183287.4	15194.02	0.17
Pearl River	Upper	267.01	Max WS	C-500year	145120	216.04	260.9	250.34	261.04	0.0002	6.1	166238.6	15071.58	0.17
Pearl River	Upper	267.01	Max WS	C-200year	122820	216.04	259.7	249.14	259.79	0.0002	5.98	147301.5	14964.53	0.17
Pearl River	Upper	267.01	Max WS	C-100	108019	216.04	258.8	247.77	258.9	0.0002	5.88	133875	14868.68	0.17
Pearl River	Upper	267.01	Max WS	C-50year	93362	216.04	258	246.36	258.11	0.0002	5.65	122195.6	14710.81	0.16
Pearl River	Upper	267.01	Max WS	C-25year	76372	216.04	257.1	244.75	257.26	0.0002	5.21	109836.8	14538.64	0.15
Pearl River	Upper	267.01	Max WS	C-10year	56022	216.04	255.8	238.23	255.89	0.000201	4.73	90138.45	14309.15	0.14
Pearl River	Upper	267.01	Max WS	C-5year	43876	216.04	254.3	235.14	254.4	0.000194	4.28	69237.37	13690.95	0.13
Pearl River	Upper	267.01	Max WS	D-1000yr	165305	216.04	262	252.35	262.12	0.0002	6.19	182578.2	15188.95	0.17
Pearl River	Upper	267.01	Max WS	D-500yr	144705	216.04	260.9	250.31	261.02	0.0002	6.1	165890.5	15069.07	0.17
Pearl River	Upper	267.01	Max WS	D-200yr	122575	216.04	259.6	249.13	259.78	0.0002	5.98	147086	14963.55	0.17
Pearl River	Upper	267.01	Max WS	D-100yr	107657	216.04	258.7	247.78	258.87	0.0002	5.88	133529	14864.77	0.17

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Summary Results a Selected Cross Sections for Various Scenarios for HEC-Ras Model															
River	Reac h	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude Chl	#
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Pearl River	Upper	267.01	Max WS	D-50yr	92697	216.04	257.9	246.36	258.08	0.000201	5.64	121755.8	14707.85	0.16	
Pearl River	Upper	267.01	Max WS	D-25yr	76101	216.04	257.1	244.71	257.24	0.0002	5.2	109621.7	14535.71	0.15	
Pearl River	Upper	267.01	Max WS	D-10yr	55954	216.04	255.7	238.22	255.88	0.000201	4.73	90061.22	14308.39	0.14	
Pearl River	Upper	267.01	Max WS	D-5yr	43650	216.04	254.2	235.08	254.35	0.000196	4.29	68566.91	13621.48	0.13	
Pearl River	Upper	267.01	Max WS	E-1000yr	16538 3	216.04	262	252.36	262.12	0.0002	6.19	182640.3	15189.39	0.17	
Pearl River	Upper	267.01	Max WS	E-500yr	14472 4	216.04	260.9	250.31	261.02	0.0002	6.1	165907.5	15069.19	0.17	
Pearl River	Upper	267.01	Max WS	E-200yr	12260 3	216.04	259.6	249.13	259.78	0.0002	5.98	147109.8	14963.66	0.17	
Pearl River	Upper	267.01	Max WS	E-100yr	10771 3	216.04	258.7	247.77	258.88	0.0002	5.88	133581.1	14865.36	0.17	
Pearl River	Upper	267.01	Max WS	E-50yr	92720	216.04	257.9	246.35	258.08	0.0002	5.64	121771.9	14707.96	0.16	
Pearl River	Upper	267.01	Max WS	E-25yr	76122	216.04	257.1	244.71	257.24	0.0002	5.2	109637.7	14535.93	0.15	
Pearl River	Upper	267.01	Max WS	E-10yr	55962	216.04	255.7	238.23	255.88	0.000201	4.73	90069.74	14308.47	0.14	
Pearl River	Upper	267.01	Max WS	E-5yr	43648	216.04	254.2	235.08	254.35	0.000196	4.29	68561.48	13620.92	0.13	

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<i>Alternative C Stage Flow Relationship at Proposed Dam, as developed by 2-Dimensional Model</i>				
Ordinate	US RC Flow (cfs)	US RC Elevation (ft)	DS RC Flow (cfs)	DS RC Elevation (ft)
1	0	242.33	0	242.07
2	0	242.33	0	242.07
3	0	242.33	0	242.07
4	0	248.79	0	242.07
5	0	249.72	0	242.07
6	0	250.68	0	242.07
7	0	251.68	0	242.07
8	0	252.69	0	242.07
9	0	253.72	0	242.07
10	0	254.77	0	242.07
11	0	255.82	0	242.07
12	0	256.88	0	242.07
13	0	257.94	0	242.07
14	2087.18	258.67	2087.18	243.02
15	3001.67	258.86	3001.67	244.16
16	3216.32	258.9	3216.32	245.03
17	3259.38	258.91	3259.38	245.45
18	3315.06	258.92	3315.06	245.7
19	3373.14	258.93	3373.14	245.9
20	3440.54	258.94	3440.54	246.08
21	3479.62	258.95	3479.62	246.23
22	3547.05	258.96	3547.05	246.37
23	3612.07	258.97	3612.07	246.51
24	3677.54	258.98	3677.54	246.64
25	3725.88	258.99	3725.88	246.74
26	3778.75	259	3778.75	246.84
27	3833.54	259.01	3833.54	246.94
28	3890.27	259.02	3890.27	247.04
29	3934.47	259.03	3934.47	247.12
30	3991.09	259.04	3991.09	247.2
31	4059.23	259.05	4059.23	247.28
32	4204.78	259.07	4204.78	247.41
33	4511.86	259.13	4511.86	247.64
34	4923.67	259.19	4923.67	247.99
35	5254.62	259.25	5254.62	248.34
36	5557.21	259.29	5557.21	248.65
37	5873.53	259.34	5873.53	248.98
38	6152.88	259.39	6152.88	249.29
39	6385.44	259.42	6385.44	249.58
40	6548.59	259.44	6548.59	249.83
41	6712.52	259.47	6712.52	250.03
42	6979.56	259.51	6979.56	250.27
43	7349.72	259.56	7349.72	250.56
44	7654.07	259.6	7654.07	250.84
45	7910.7	259.64	7910.7	251.11

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46	8121.46	259.67	8121.46	251.34
47	8314.47	259.69	8314.47	251.55
48	8491.74	259.72	8491.74	251.75
49	8639.43	259.74	8639.43	251.92
50	8766.44	259.75	8766.44	252.08
51	8864.02	259.77	8864.02	252.21
52	8942.19	259.78	8942.19	252.34
53	8989.51	259.78	8989.51	252.45
54	9031.21	259.79	9031.21	252.54
55	9076.63	259.79	9076.63	252.63
56	9180.76	259.81	9180.76	252.72
57	9371.31	259.83	9371.31	252.84
58	9625.35	259.87	9625.35	252.99
59	9779.43	259.89	9779.43	253.13
60	9910	259.9	9910	253.26
61	10014.48	259.92	10014.48	253.37
62	10108.31	259.93	10108.31	253.47
63	10174.05	259.94	10174.05	253.57
64	10347.18	259.96	10347.18	253.68
65	10567.79	259.99	10567.79	253.8
66	10893.11	260.03	10893.11	253.98
67	11104.92	260.05	11104.92	254.13
68	11307.42	260.07	11307.42	254.28
69	11546.82	260.1	11546.82	254.44
70	11758.21	260.12	11758.21	254.59
71	11959.6	260.14	11959.6	254.74
72	12160.49	260.16	12160.49	254.88
73	12361.3	260.18	12361.3	255.02
74	12561.96	260.2	12561.96	255.16
75	12762.8	260.22	12762.8	255.3
76	12963.37	260.24	12963.37	255.43
77	13195.66	260.26	13195.66	255.56
78	13415.97	260.28	13415.97	255.7
79	13617.18	260.3	13617.18	255.83
80	13817.68	260.31	13817.68	255.95
81	13969.09	260.33	13969.09	256.07
82	14232.3	260.35	14232.3	256.2
83	14392.67	260.36	14392.67	256.33
84	14494.24	260.37	14494.24	256.43
85	14594.19	260.38	14594.19	256.52
86	14598.65	260.38	14598.65	256.58
87	14688.05	260.39	14688.05	256.65
88	14731.89	260.39	14731.89	256.71
89	14830.48	260.4	14830.48	256.77
90	14930.5	260.41	14930.5	256.84
91	14996.87	260.42	14996.87	256.9

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92	15094.37	260.43	15094.37	256.95
93	15132.19	260.43	15132.19	257
94	15196.85	260.43	15196.85	257.05
95	15198.49	260.43	15198.49	257.08
96	15198.51	260.43	15198.51	257.11
97	15198.56	260.43	15198.56	257.13
98	15198.58	260.43	15198.58	257.15
99	15102.73	260.43	15102.73	257.15
100	15098.78	260.43	15098.78	257.16
101	15098.72	260.43	15098.72	257.17
102	15098.74	260.43	15098.74	257.18
103	15064.94	260.42	15064.94	257.19
104	15000.47	260.42	15000.47	257.18
105	14958.84	260.41	14958.84	257.18
106	14902.08	260.41	14902.08	257.17
107	14899.08	260.41	14899.08	257.17
108	14898.97	260.41	14898.97	257.17
109	14865.36	260.41	14865.36	257.17
110	14807.04	260.4	14807.04	257.16
111	14799.33	260.4	14799.33	257.15
112	14765.52	260.4	14765.52	257.15
113	14700.84	260.39	14700.84	257.13
114	14609.93	260.38	14609.93	257.11
115	14503.88	260.37	14503.88	257.08
116	14377.13	260.36	14377.13	257.05
117	14268.41	260.35	14268.41	257.01
118	14201.29	260.35	14201.29	256.98
119	14071.2	260.34	14071.2	256.94
120	14001.51	260.33	14001.51	256.9
121	13904.27	260.32	13904.27	256.86
122	13804.41	260.31	13804.41	256.82
123	13750.88	260.31	13750.88	256.79
124	13701.1	260.3	13701.1	256.76
125	13867.04	260.32	13867.04	256.77
126	14430.04	260.37	14430.04	256.85
127	15073.14	260.42	15073.14	257
128	15456.19	260.46	15456.19	257.13
129	15668.44	260.47	15668.44	257.24
130	15918.85	260.49	15918.85	257.34
131	16218.21	260.52	16218.21	257.46
132	16503.26	260.54	16503.26	257.56
133	16803.36	260.57	16803.36	257.68
134	17159.68	260.59	17159.68	257.8
135	17496.59	260.62	17496.59	257.92
136	17814.09	260.65	17814.09	258.04
137	18160.9	260.67	18160.9	258.16
138	18534.16	260.7	18534.16	258.28
139	19171.47	260.75	19171.47	258.44

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140	19695.27	260.79	19695.27	258.61
141	20098.81	260.82	20098.81	258.75
142	20462.12	260.84	20462.12	258.89
143	20707.73	260.86	20707.73	258.99
144	21021.16	260.89	21021.16	259.1
145	21405.52	260.91	21405.52	259.21
146	21664.95	260.93	21664.95	259.31
147	22005.79	260.96	22005.79	259.41
148	22362.58	260.98	22362.58	259.51
149	22621.65	261	22621.65	259.6
150	22869.29	261.02	22869.29	259.68
151	23028.23	261.03	23028.23	259.75
152	23230.85	261.04	23230.85	259.82
153	23558.29	261.06	23558.29	259.89
154	23979.09	261.09	23979.09	259.99
155	24225.09	261.11	24225.09	260.06
156	24426.27	261.12	24426.27	260.13
157	24621.87	261.14	24621.87	260.19
158	25017.42	261.16	25017.42	260.27
159	25578.48	261.2	25578.48	260.36
160	26284.72	261.25	26284.72	260.49
161	26640.53	261.28	26640.53	260.58
162	26946.89	261.3	26946.89	260.66
163	27202.73	261.32	27202.73	260.73
164	27502.99	261.35	27502.99	260.8
165	277734.64	261.37	27734.65	260.86
166	28067.66	261.4	28067.66	260.92
167	28459.34	261.44	28459.34	260.99
168	28844.77	261.47	28844.77	261.06
169	29135.26	261.51	29135.26	261.12
170	29437.86	261.55	29437.86	261.18
171	29721.19	261.59	29721.19	261.24
172	30104.3	261.64	30104.3	261.31
173	30379.25	261.68	30379.25	261.37
174	30751.76	261.73	30751.76	261.43
175	31103.82	261.78	31103.82	261.5
176	31476.49	261.83	31476.49	261.56
177	31831.96	261.88	31831.96	261.63
178	32385.52	261.95	32385.52	261.71
179	32816.91	262.01	32816.91	261.78
180	33414.05	262.09	33414.05	261.87
181	33959.75	262.16	33959.75	261.96
182	34902.62	262.27	34902.62	262.07
183	35778.1	262.38	35778.1	262.19
184	36821.26	262.51	36821.26	262.32
185	38202.92	262.66	38202.92	262.48
186	40024.33	262.86	40024.33	262.69

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187	41269.68	263.03	41269.68	262.87
188	42104.93	263.16	42104.93	263.01
189	42932.07	263.29	42932.07	263.14
190	43646.38	263.4	43646.38	263.26
191	44491.79	263.51	44491.79	263.38
192	45285.63	263.63	45285.63	263.5
193	45916.91	263.72	45916.91	263.6
194	46613.62	263.82	46613.62	263.7
195	47085.58	263.91	47085.58	263.79
196	47541.59	263.99	47541.59	263.87
197	48081.7	264.06	48081.7	263.95
198	48632.45	264.14	48632.45	264.03
199	49116.8	264.21	49116.8	264.1
200	49597.55	264.28	49597.55	264.17
201	50064.07	264.35	50064.07	264.24
202	50662.14	264.41	50662.14	264.31
203	51178.27	264.48	51178.27	264.37
204	51616.09	264.54	51616.09	264.44
205	52133.28	264.6	52133.28	264.5
206	52478.07	264.66	52478.07	264.55
207	52918.07	264.71	52918.07	264.61
208	53363.21	264.77	53363.21	264.67
209	53803.25	264.82	53803.25	264.72
210	54173.09	264.87	54173.09	264.77
211	54656.55	264.92	54656.55	264.82
212	55072.91	264.97	55072.91	264.87
213	55326.43	265.01	55326.43	264.91
214	55613.19	265.05	55613.19	264.95
215	55864.38	265.09	55864.38	264.99
216	56145.24	265.12	56145.24	265.02
217	56408.65	265.16	56408.65	265.06
218	56760	265.19	56760	265.1
219	57111.9	265.23	57111.9	265.13
220	57403.65	265.27	57403.65	265.17
221	57665.89	265.3	57665.89	265.2
222	58031.13	265.33	58031.13	265.23
223	58376.1	265.37	58376.1	265.27
224	58608.64	265.4	58608.64	265.3
225	58899.84	265.43	58899.84	265.33
226	59166.56	265.46	59166.56	265.36
227	59513.93	265.49	59513.93	265.39
228	59688.11	265.52	59688.11	265.42
229	60032.61	265.55	60032.61	265.45
230	60289.11	265.58	60289.11	265.48
231	60628.94	265.61	60628.94	265.51
232	60882.61	265.64	60882.61	265.54

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233	61057.52	265.66	61057.52	265.56
234	61332.89	265.69	61332.89	265.59
235	61574.66	265.71	61574.66	265.61
236	61750.36	265.73	61750.36	265.64
237	61940.75	265.75	61940.75	265.66
238	62272.54	265.78	62272.54	265.68
239	62383.41	265.8	62383.41	265.7
240	62516.46	265.82	62516.46	265.72
241	62648.4	265.83	62648.4	265.74
242	62900.57	265.85	62900.57	265.76
243	63038.02	265.87	63038.02	265.77
244	63072.88	265.89	63072.88	265.79
245	63236.43	265.9	63236.43	265.8
246	63591.8	265.93	63591.8	265.83
247	63626.22	265.94	63626.22	265.84
248	63881.47	265.95	63881.47	265.86
249	64074.5	265.97	64074.5	265.87
250	64063.6	265.98	64063.6	265.89
251	64199.31	265.99	64199.31	265.9
252	64445.37	266.01	64445.37	265.92
253	64644.45	266.03	64644.45	265.93
254	64776.86	266.05	64776.86	265.95
255	64818.93	266.06	64818.93	265.96
256	65175.99	266.08	65175.99	265.98
257	65187.94	266.09	65187.94	265.99
258	65528.09	266.11	65528.09	266.02
259	65767.5	266.13	65767.5	266.04
260	66188.79	266.16	66188.79	266.07
261	66834.48	266.2	66834.48	266.1
262	67254.12	266.24	67254.12	266.14
263	67653.79	266.27	67653.79	266.17
264	67985.62	266.3	67985.62	266.2
265	68598.09	266.34	68598.09	266.24
266	69176.86	266.38	69176.86	266.28
267	69715	266.43	69715	266.33
268	70277.81	266.47	70277.81	266.37
269	70963.66	266.52	70963.66	266.42
270	71548.27	266.57	71548.27	266.47
271	71997.94	266.61	71997.94	266.51
272	72434.27	266.65	72434.27	266.55
273	72882.8	266.69	72882.8	266.59
274	73217.31	266.73	73217.31	266.63
275	73548.33	266.76	73548.33	266.66
276	73738.21	266.79	73738.21	266.69
277	74021.24	266.81	74021.24	266.71
278	74237.8	266.84	74237.8	266.74

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279	74371.86	266.86	74371.86	266.76
280	74338.65	266.87	74338.65	266.77
281	74597.45	266.89	74597.45	266.79
282	74874.18	266.91	74874.18	266.81
283	75011.47	266.92	75011.47	266.82
284	74915.41	266.93	74915.41	266.83
285	75093.73	266.95	75093.73	266.85
286	75285.51	266.96	75285.51	266.86
287	75266	266.97	75266	266.87
288	75429.58	266.98	75429.58	266.88
289	75431.5	266.99	75431.5	266.89
290	75304.97	266.99	75304.97	266.89
291	75469.27	267	75469.27	266.9
292	75486.99	267	75486.99	266.91
293	75600.37	267.01	75600.37	266.91
294	75494.02	267.01	75494.02	266.91
295	75489.23	267.02	75489.23	266.92
296	75542.84	267.02	75542.84	266.92
297	75186.66	267.01	75186.66	266.91
298	74939.77	266.99	74939.77	266.9
299	74939.13	266.99	74939.13	266.89
300	74661.95	266.98	74661.95	266.88
301	74581.75	266.97	74581.75	266.87
302	74195.48	266.95	74195.48	266.85
303	73912.3	266.93	73912.3	266.84
304	73614.73	266.91	73614.73	266.82
305	73256.13	266.89	73256.13	266.8
306	72779.21	266.86	72779.21	266.77
307	72410.72	266.83	72410.72	266.74
308	72104.15	266.81	72104.15	266.71
309	71646.66	266.78	71646.66	266.68
310	71250.23	266.74	71250.23	266.65
311	70734.94	266.71	70734.94	266.62
312	70403.17	266.68	70403.17	266.59
313	69876.7	266.64	69876.7	266.55
314	69433.9	266.61	69433.9	266.52
315	68816.15	266.57	68816.15	266.48
316	68480.88	266.53	68480.88	266.44
317	67760.44	266.48	67760.44	266.39
318	67142.8	266.43	67142.8	266.34
319	66410.51	266.38	66410.51	266.29
320	65602.03	266.32	65602.03	266.23
321	64931.93	266.26	64931.93	266.17
322	64376.95	266.21	64376.95	266.12
323	63746.71	266.16	63746.71	266.07
324	63198.49	266.1	63198.49	266.02

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325	62490.1	266.05	62490.1	265.96
326	62073.94	266	62073.94	265.91
327	61600.95	265.95	61600.95	265.86
328	61030.26	265.9	61030.26	265.81
329	60645.39	265.85	60645.39	265.77
330	59995.68	265.8	59995.68	265.71
331	59599.39	265.75	59599.39	265.67
332	59066.89	265.71	59066.89	265.62
333	58725.07	265.66	58725.07	265.57
334	58389.94	265.62	58389.94	265.54
335	57947.02	265.58	57947.02	265.49
338	56552.21	265.45	56552.21	265.36
339	56123.25	265.4	56123.25	265.31
340	55413.68	265.35	55413.68	265.26
341	54833.48	265.29	54833.48	265.2
342	54178.74	265.23	54178.74	265.14
343	53336.49	265.16	53336.49	265.08
344	52317.26	265.08	52317.26	264.99
345	51175.96	264.99	51175.96	264.9
346	50080.77	264.89	50080.77	264.8
347	48957.68	264.78	48957.68	264.7
348	47892.11	264.68	47892.11	264.6
349	46818.72	264.57	46818.72	264.49
350	45837.68	264.47	45837.68	264.39
351	44964	264.37	44964	264.29
352	44134.64	264.27	44134.64	264.19
353	43263.01	264.17	43263.01	264.09
354	42469.17	264.07	42469.17	263.99
355	41885.67	263.98	41885.67	263.9
356	41642.66	263.92	41642.66	263.83
357	41832.68	263.88	41832.68	263.79
358	41936.66	263.86	41936.66	263.77
359	42212.75	263.85	42212.75	263.76
360	42684.29	263.86	42684.29	263.77
361	42612.59	263.85	42612.59	263.76
362	42336.63	263.82	42336.63	263.73
363	42122.03	263.8	42122.03	263.7
364	41823.2	263.77	41823.2	263.67
365	41553.68	263.73	41553.68	263.64
366	41278.4	263.69	41278.4	263.6
367	40856.79	263.65	40856.79	263.56
368	40523.27	263.61	40523.27	263.51
369	40147.89	263.57	40147.89	263.47
370	39764.83	263.52	39764.83	263.43
371	39367.56	263.47	39367.56	263.38
372	38956.24	263.42	38956.24	263.33

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373	38560.35	263.37	38560.35	263.28
374	38224.29	263.33	38224.29	263.23
375	37791.83	263.27	37791.83	263.18
376	37539	263.23	37539	263.13
377	37129.48	263.18	37129.48	263.08
378	36686.93	263.13	36686.93	263.03
379	36391.59	263.08	36391.59	262.98
380	36127.04	263.03	36127.04	262.93
381	35871.64	262.99	35871.64	262.89
382	35627.34	262.95	35627.34	262.85
383	35331.61	262.91	35331.61	262.8
384	35127.23	262.87	35127.23	262.76
385	34744.64	262.82	34744.64	262.72
386	34499.96	262.78	34499.96	262.67
387	34369.63	262.75	34369.63	262.64
388	34143.57	262.71	34143.57	262.6
389	33985.32	262.68	33985.32	262.57
390	33701.67	262.64	33701.67	262.52
391	33499.06	262.61	33499.06	262.49
392	33214.74	262.57	33214.74	262.45
393	33066.82	262.54	33066.82	262.41
394	32870.59	262.51	32870.59	262.38
395	32666.22	262.47	32666.22	262.34
396	32438.88	262.44	32438.88	262.3
397	32282.87	262.41	32282.87	262.27
398	32166.71	262.38	32166.71	262.24
399	31973.77	262.35	31973.77	262.21
400	31790.72	262.32	31790.72	262.18
401	31673.48	262.29	31673.48	262.15
402	31567.47	262.27	31567.47	262.13
403	31418.74	262.25	31418.74	262.1
404	31316.54	262.22	31316.54	262.08
405	31215.59	262.2	31215.59	262.05
406	31116.16	262.18	31116.16	262.03
407	30979.49	262.16	30979.49	262.01
408	30886.18	262.14	30886.18	261.99
409	30817.28	262.12	30817.28	261.97
410	30719.75	262.1	30719.75	261.95
411	30621.27	262.09	30621.27	261.93
412	30484.19	262.06	30484.19	261.9
413	30391.63	262.05	30391.63	261.88
414	30292.71	262.03	30292.71	261.86
415	30193.85	262.01	30193.85	261.84
416	30125.5	262	30125.5	261.83
417	30073.99	261.98	30073.99	261.81
418	29977.65	261.97	29977.65	261.79

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419	29879.69	261.95	29879.69	261.77
420	29785.55	261.93	29785.55	261.75
421	29683.52	261.92	29683.52	261.74
422	29589.07	261.9	29589.07	261.72
423	29500	261.88	29500	261.7
424	29393.45	261.87	29393.45	261.68
425	29379.87	261.86	29379.87	261.67
426	29285.95	261.84	29285.95	261.65
427	29192.21	261.83	29192.21	261.63
428	29179.98	261.82	29179.98	261.62
429	29086.88	261.8	29086.88	261.61
430	28993.54	261.79	28993.54	261.59
431	28981.6	261.78	28981.6	261.58
432	28893.03	261.77	28893.03	261.57
433	28796.76	261.76	28796.76	261.55
434	28699.2	261.74	28699.2	261.53
435	28641.91	261.73	28641.91	261.52
436	28546.19	261.72	28546.19	261.5
437	28417.01	261.7	28417.01	261.48
438	28351.76	261.68	28351.76	261.46
439	28294.84	261.67	28294.84	261.45
440	28211.96	261.66	28211.96	261.44
441	28100.53	261.64	28100.53	261.42
442	28037.63	261.63	28037.63	261.4
443	27993.47	261.62	27993.47	261.39
444	27888.28	261.61	27888.28	261.37
445	27846.36	261.6	27846.36	261.36
446	27794.55	261.59	27794.55	261.34
447	27699.1	261.58	27699.1	261.33
448	27648.54	261.57	27648.54	261.32
449	27595.79	261.56	27595.79	261.3
450	27590.77	261.55	27590.77	261.29
451	27502.14	261.54	27502.14	261.28
452	27449.02	261.53	27449.02	261.27
453	27315.29	261.52	27315.29	261.25
454	27295.99	261.51	27295.99	261.24
455	27291.71	261.5	27291.71	261.23
456	27246.96	261.5	27246.96	261.22
457	27195.09	261.49	27195.09	261.21
458	27146.82	261.48	27146.82	261.2
459	27100.22	261.47	27100.22	261.19
460	27091.41	261.47	27091.41	261.18
461	27089.35	261.46	27089.35	261.17
462	27044.07	261.46	27044.07	261.16
463	26998.85	261.45	26998.85	261.16
464	27038.98	261.45	27038.98	261.16

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465	27025.22	261.45	27025.22	261.15
466	26989.7	261.44	26989.7	261.14
467	26987.62	261.44	26987.62	261.14
468	26953.06	261.44	26953.06	261.13
469	26984.73	261.44	26984.73	261.13
470	26899.17	261.43	26899.17	261.12
471	26889.78	261.42	26889.78	261.11
472	26887.6	261.42	26887.6	261.11
473	26795.92	261.41	26795.92	261.1
474	26790	261.41	26790	261.09
475	26701.97	261.4	26701.97	261.08
476	26691.65	261.39	26691.65	261.08
477	26598.63	261.38	26598.63	261.06
478	26592.01	261.38	26592.01	261.06
479	26503.9	261.37	26503.9	261.04
480	26493.14	261.37	26493.14	261.04
481	26404.5	261.36	26404.5	261.02
482	26393.03	261.35	26393.03	261.02
483	26298.12	261.34	26298.12	261
484	26292.35	261.34	26292.35	261
485	26213.74	261.33	26213.74	260.98
486	26194.12	261.33	26194.12	260.98
487	26099.24	261.32	26099.24	260.96
488	26016.76	261.31	26016.76	260.95
489	25919.4	261.3	25919.4	260.93
490	25856.85	261.29	25856.85	260.92
491	25815.12	261.28	25815.12	260.91
492	25796.06	261.28	25796.06	260.9
493	25716.59	261.27	25716.59	260.89
494	25695.44	261.27	25695.44	260.88
495	25597.79	261.26	25597.79	260.86
496	25502.13	261.25	25502.13	260.84
497	25403.87	261.24	25403.87	260.83
498	25354.47	261.23	25354.47	260.81
499	25256.6	261.22	25256.6	260.8
500	25157.63	261.21	25157.63	260.78
501	25097.67	261.21	25097.67	260.76
502	25004.63	261.2	25004.63	260.74
503	24905.82	261.19	24905.82	260.73
504	24857.01	261.18	24857.01	260.71
505	24720.61	261.17	24720.61	260.69
506	24658.42	261.16	24658.42	260.67
507	24519.55	261.15	24519.65	260.65
508	24410.5	261.14	24410.5	260.63
509	24342.21	261.14	24342.21	260.61
510	24163.87	261.12	24163.87	260.58

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511	24004.19	261.11	24004.19	260.55
512	23911.8	261.1	23911.8	260.53
513	23803.44	261.09	23803.44	260.5
514	23665.01	261.08	23665.01	260.48
515	23602	261.08	23602	260.46
516	23460.91	261.06	23460.91	260.43
517	23306.07	261.05	23306.07	260.4
518	23162.13	261.04	23162.13	260.37
519	23020.11	261.03	23020.11	260.34
520	22905.67	261.02	22905.67	260.31
521	22763.67	261.01	22763.67	260.28
522	22699.3	261	22699.3	260.26
523	22596.42	261	22596.42	260.23
524	22458.58	260.99	22458.58	260.2
525	22357.27	260.98	22357.27	260.17
526	22215.88	260.97	22215.88	260.14
527	22064	260.96	22064	260.11
528	21995.6	260.95	21995.6	260.08
529	21859.38	260.95	21859.38	260.05
530	21744.16	260.94	21744.16	260.02
531	21616.54	260.93	21616.54	259.99
532	21460.2	260.92	21460.2	259.95
533	21317.19	260.91	21317.19	259.92
534	21216.74	260.9	21216.74	259.88
535	21019.46	260.89	21019.46	259.84
536	20903.23	260.88	20903.23	259.81
537	20719.79	260.86	20719.79	259.76
538	20617.68	260.86	20617.68	259.73
539	20498.83	260.85	20498.83	259.69
540	20361.58	260.84	20361.58	259.65
541	20204.62	260.83	20204.62	259.61
542	20062.06	260.82	20062.06	259.57
543	19919.25	260.81	19919.25	259.53
544	19762.73	260.79	19762.73	259.49
545	19619.69	260.78	19619.69	259.44
546	19504.88	260.77	19504.88	259.4
547	19363.11	260.76	19363.11	259.36
548	19205.88	260.75	19205.88	259.31
549	19063.64	260.74	19063.64	259.27
550	18906.22	260.73	18906.22	259.22
551	18723.03	260.72	18723.03	259.17
552	18569.88	260.7	18569.88	259.12
553	18385.64	260.69	18385.64	259.06
554	18222.3	260.68	18222.3	259.01
555	18024.53	260.66	18024.53	258.95
556	17824.98	260.65	17824.98	258.89

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557	17671.43	260.63	17671.43	258.83
558	17431.98	260.62	17431.98	258.77
559	17272.31	260.6	17272.31	258.71
560	17073.52	260.59	17073.52	258.64
561	16873.91	260.57	16873.91	258.57
562	16724.45	260.56	16724.45	258.51
563	16573.44	260.55	16573.44	258.45
564	16424.96	360.54	1624.96	258.38
565	16227.88	260.52	16227.88	258.32
566	16068.71	260.51	16068.71	258.25
567	15925.72	260.49	15925.72	258.19
568	15769.13	260.48	15769.13	258.12
569	15626.2	260.47	15626.2	258.06
570	15509.79	260.46	15509.79	258
571	15369.42	260.45	15369.42	257.94
572	15226.85	260.44	15226.85	257.87
573	15110.27	260.43	15110.27	257.81
574	14970.03	260.41	14970.03	257.75
575	14827.56	260.4	14827.56	257.69
576	14710.77	260.39	14710.77	257.63
577	14570.76	260.38	14570.76	257.57
578	14468.12	260.37	14468.12	257.51
579	14312.39	260.36	14312.39	257.44
580	14178.08	260.35	14178.08	257.38
581	14052.72	260.33	14052.72	257.31
582	13905.85	260.32	13905.85	257.24
583	13772.05	260.31	13772.05	257.17
584	13613.52	260.3	13613.52	257.1
585	13511.94	260.29	13511.94	257.03
586	13405.13	260.28	13405.13	256.97
587	13273.09	260.26	13273.09	256.91
588	13131.13	260.25	13131.13	256.84
589	12974.52	260.24	12974.52	256.76
590	12870.92	260.23	12870.92	256.69
591	12715.24	260.21	12715.24	256.62
592	12606.15	260.2	12606.15	256.54
593	12436.26	260.19	12436.26	256.47
594	12331.92	260.18	12331.92	256.39
595	12214.86	260.16	12214.86	256.32
596	12076.46	260.15	12076.46	256.24
597	11934.67	260.14	11934.67	256.16
598	11833.27	260.13	11833.27	256.09
599	11716.18	260.11	11716.18	256.01
600	11578.26	260.1	11578.26	255.93
601	11474.45	260.09	11474.45	255.86
602	11290.73	260.07	11290.73	255.77

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603	11139.05	260.05	11139.05	255.68
604	11019.08	260.04	11019.08	255.59
605	10918.6	260.03	10918.6	255.51
606	10783.29	260.01	10783.29	255.42
607	10679.81	260	10679.81	255.34
608	10545.49	259.98	10545.49	255.25
609	10399.05	259.97	10399.05	255.16
610	10247.42	259.95	10247.42	255.06
611	10143.55	259.93	10143.55	254.97
612	10006.06	259.92	10006.06	254.88
613	9906.09	259.9	9906.09	254.79
614	9782.23	259.89	9782.23	254.7
615	9659.83	259.87	9659.83	254.6
616	9535.37	259.85	9535.37	254.51
617	9417.99	259.84	9417.99	254.41
618	9315.61	259.83	9315.61	254.31
619	9222.09	259.81	9222.09	254.23
620	9115.84	259.8	9115.84	254.13
621	8992.36	259.78	8992.36	254.03
622	8877.66	259.77	8877.66	253.94
623	8771.06	259.75	8771.06	253.84
624	8676.65	259.74	8676.65	253.74
625	8580.83	259.73	8580.83	253.65
626	8490.98	259.72	8490.98	253.55
627	8396.63	259.7	8396.63	253.46
628	8293.23	259.69	8293.23	253.37
629	8190.64	259.68	8190.64	253.27
630	8107.04	259.66	8107.04	253.17
631	8026.13	259.65	8026.13	253.08
632	7947.27	259.64	7947.27	252.99
633	7887.82	259.63	7887.82	252.91
634	7807.62	259.62	7807.62	252.82
635	7756.51	259.62	7756.51	252.74
636	7696.83	259.61	7696.83	252.66
637	7627.63	259.6	7627.63	252.59
638	7567.83	259.59	7567.83	252.51
639	7504.84	259.58	7504.84	252.43
640	7434.18	259.57	7434.18	252.35
641	7360.73	259.56	7360.73	252.28
642	7298.87	259.55	7298.87	252.2
643	7209.39	259.54	7209.39	252.12
644	7140.61	259.53	7140.61	252.03
645	7060.37	259.52	7060.37	251.95
646	7025.37	259.51	7025.37	251.88
647	6964.69	259.5	6964.69	251.81
648	6930.5	259.5	6930.5	251.74

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649	6881.1	259.49	6881.1	251.67
650	6813.69	259.48	6813.69	251.61
651	6748.66	259.47	6748.66	251.53
652	6702.74	259.47	6702.74	251.46
653	6687.95	259.46	6687.95	251.41
654	6649.53	259.46	6649.53	251.35
655	6620.19	259.45	6620.19	251.3
656	6572.88	259.45	6572.88	251.25
657	6525.52	259.44	6525.52	251.19
658	6484.71	259.43	6484.71	251.14
659	6446.88	259.43	6446.88	251.08
660	6406.32	259.42	6406.32	251.03
661	6375.6	259.42	6375.6	250.98
662	6343.61	259.41	6343.61	250.93
663	6313.44	259.41	6313.44	250.89
664	6299.26	259.41	6299.26	250