

# OPERATING CURVE CHANGE FEASIBILITY ANALYSIS

## PHASE 1 REPORT

R.L. HARRIS HYDROELECTRIC PROJECT

FERC No. 2628



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## 1.0 INTRODUCTION

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Alabama Power Company (Alabama Power) owns and operates the R.L. Harris Hydroelectric Project (Harris Project), licensed by the Federal Energy Regulatory Commission (FERC or Commission) (FERC Project No. 2628). The Harris Project consists of a dam, spillway, powerhouse, and those lands and waters necessary for the operation of the hydroelectric project and enhancement and protection of environmental resources.

Harris Reservoir is maintained at or below the elevations specified by the Harris operating curve, except when storing floodwater. From May 1 through October 1, Harris Reservoir is maintained at or below elevation 793 feet mean sea level (msl), depending on inflow conditions. Between October 1 and December 1, the operating curve elevation drops to elevation 785 feet msl. The pool level remains at or below elevation 785 feet msl until April 1. From April 1 to May 1, the operating curve elevation rises to full pool at elevation 793 feet msl. During high flow conditions, U.S. Army Corps of Engineers (USACE)-approved flood control procedures in the Harris Water Control Manual (WCM) are implemented. During low flow conditions, the drought contingency curve (the red line in Figure 1-1) is intended to be used as one of several factors in evaluating reservoir operations consistent with approved drought plans.

Alabama Power is using the Integrated Licensing Process (ILP) to obtain a new license for the Harris Project from FERC. During stakeholder one-on-one meetings and at an October 19, 2017 Issue Identification Workshop, stakeholders requested that Alabama Power investigate changing the winter operating curve for the Harris Project. Stakeholders believe that a higher winter operating curve will enhance recreation opportunities on Harris Reservoir during the winter, or typical drawdown period. Based on this request, Alabama Power filed the Operating Curve Change Feasibility Analysis Study Plan to evaluate, in increments of 1 foot from 786 feet msl to 789 feet msl (i.e., 786, 787, 788, and 789 feet msl; collectively “winter pool alternatives” or “alternatives”), Alabama Power’s ability to increase the winter pool elevation and continue to meet Project purposes (Figure 1-1). Alabama Power has performed similar analyses at several of their hydroelectric projects as part of the FERC relicensing process.

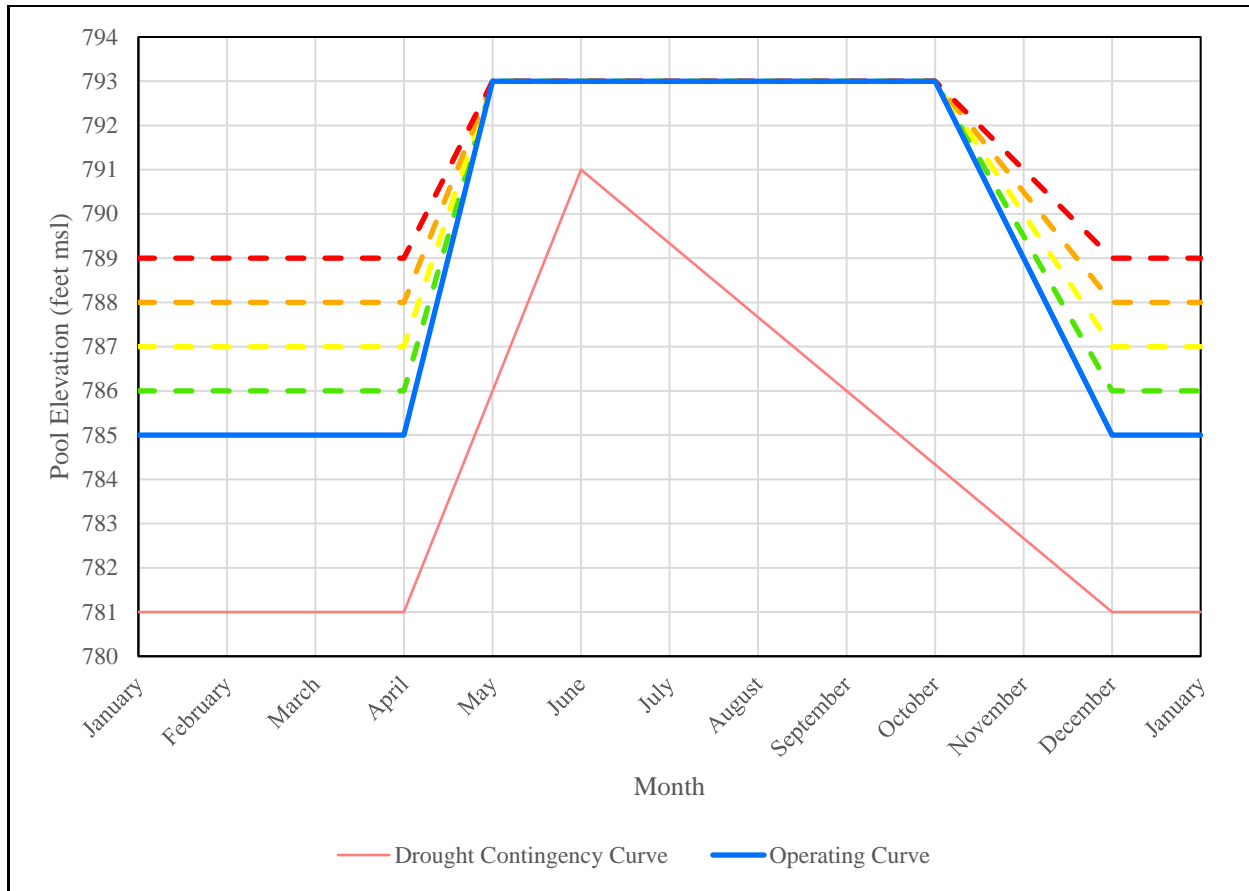
Any changes to the Harris operating guide curve could have the potential to impact downstream communities and, therefore, downstream impacts must be identified in the

analysis. Changes to the operating curve must be approved by FERC, with consultation by the USACE relating to flood control issues. The current license requires the Project to be operated in the interest of flood control based on agreement between USACE and Alabama Power, and the current operating guide curve and flood control operations are included in the USACE-issued WCM for the Harris Project. Changes to the operating curve and flood control operations would also require changes to the agreement between USACE and Alabama Power to make it consistent with the requirements in the new license. Those changes likely would involve extensive study by from the USACE.

Alabama Power performed extensive modeling and analysis of the hydrologic record and baseline information for the Project. Alabama Power developed this study report to describe the models and how they were developed and to present the Phase 1 results of the potential impacts of a winter operating curve change on hydropower generation, flood control, navigation, drought operations, Green Plan flows<sup>1</sup>, and downstream release alternatives.

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<sup>1</sup> See Section 4.2.1.1 for discussion of the Green Plan.



**Figure 1-1 Harris Operating Curve with Proposed 1-Foot Incremental Changes**

Section 2.0 of this report summarizes the geographic scope as identified in the study plan as well as describes the geographic area included in the various models used in the study. Section 3.0 then reviews the data and models, as well describes the methodology used to examine significant flood events and long-term operational impacts. Section 4.0 then discusses how the particular models for the study were developed, calibrated, and/or verified. Results of the analysis are presented in Section 5.0 and summarized in Section 6.0, which also discusses how the information in this report will inform next steps.



## 2.0 GEOGRAPHIC SCOPE AND MODEL BOUNDARIES

The FERC-approved geographic scope (i.e., the study area) of this study corresponds with the physical area and/or resources influenced by the proposed operational change, which may or may not be consistent with the Harris Project boundary. The geographic scope of analyses for each operational parameter and resource for Phase 1 is listed in Table 2-1. Section 2.1 describes the geographic areas included in the various models used in the study.

**Table 2-1 Summary of Operational Parameters, Resources, Geographic Scope and Rationale**

Operational Parameter/Resource	Geographic Scope	Rationale
Hydropower Generation	Alabama Power's Coosa and Tallapoosa Projects	Effects on hydropower generation would impact system-wide operations
Flood Control	Lake Harris and Harris Dam to Montgomery Water Works	Model parameters are set to evaluate flood operation effects to Montgomery Water Works
Navigation	ACT Basin	Model parameters are set to evaluate effects on the ACT Basin per the USACE Master Water Control Manual
Drought Operations	ACT Basin	Model parameters are set to evaluate effects on the ACT Basin per the USACE Master Water Control Manual
Green Plan Flows	Tallapoosa River downstream from Harris Dam through Horseshoe Bend	Operational influence of the Harris Project occurs from Harris Dam through Horseshoe Bend.
Downstream Release Alternatives	Tallapoosa River downstream from Harris Dam through Horseshoe Bend	Operational influence of the Harris Project occurs from Harris Dam through Horseshoe Bend.

## **2.1 Model Boundaries**

The following sections describe the Alabama-Coosa-Tallapoosa (ACT) river basin as used in the various models used in this study. The ACT network extends from Carters Dam and Allatoona Dam, both upstream of Alabama Power's hydroelectric projects on the Coosa River, and from Harris Dam, on the Tallapoosa River, to the tailwater of Claiborne Lock and Dam on the Alabama River. Regulation in the upper portion of the basin is provided by Carters and Allatoona Dams. The middle of the watershed is represented by eleven Alabama Power hydroelectric projects on the Coosa and Tallapoosa. The three additional federal projects on the Alabama River were also included where needed in the models.

### **2.1.1 Tallapoosa River**

#### **2.1.1.1 Harris Reservoir**

The Harris Reservoir extends up the Tallapoosa River 29 miles from Harris Dam, which is located at River Mile (RM) 136.7 of the Tallapoosa River, with an arm also extending up the Little Tallapoosa River. There are no other major impoundments upstream of Harris Dam. There are two operating United States Geological Survey (USGS) gages upstream of Harris Dam. The Heflin gage (No. 02412000; located approximately 26 miles upstream of Harris Dam) has 68 years of discharge and stage data. The Newell gage (No. 02413300; located 35.5 river miles upstream of the confluence of the Little Tallapoosa and Tallapoosa Rivers) has 45 years of daily average discharge and stage data. Harris Reservoir receives inflows from approximately 1,454 square miles of drainage.

#### **2.1.1.2 Harris Dam to Martin Pool**

The Tallapoosa River below Harris Dam (RM 136.7<sup>2</sup>) is an upper basin type stream with steep slopes and narrow floodplains that include rapids. It also contains two currently operating USGS gage sites, the Wadley (No. 02414500; RM 122.79) and Horseshoe Bend (No. 02414715; RM 93.7) gages. The Wadley gage has 97 years of daily flow and stage data and Horseshoe Bend has 35 years of daily flow and stage data. The stream channel is characterized by rock outcrops and a few sand bars. The stream is crossed by four highway bridges and two railroad bridges. The most populated community along this

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<sup>2</sup> River miles in this report are consistent with the georeferenced locations in the models used for the study. This resulted in slightly different river mile values than were referenced in the Harris PAD, which were based on USACE stream mileage tables.

reach of the Tallapoosa River is the City of Wadley at RM 122.97. This free-flowing reach of the Tallapoosa River ends at the Martin Dam Project (FERC No. 349) reservoir near RM 88.0.

### **2.1.1.3 Martin Reservoir**

The Martin Reservoir ranges from RM 88 to the Martin Dam at RM 60. The primary purpose of Martin Dam is hydropower generation. The Martin Reservoir receives inflows from the Tallapoosa River, representing 2,131 square miles of drainage, and local inflows from an additional 853 square miles of tributaries that flow directly into the lake.

### **2.1.1.4 Yates and Thurlow Reservoirs**

The Yates and Thurlow Project (FERC No. 2407) Dams impound the Tallapoosa River from RM 60 to RM 49.7, with the Yates pool backing up to the toe of Martin Dam. Thurlow Dam is the most downstream dam on the Tallapoosa River. These dams are located at the base of the fall line of the Tallapoosa basin. These reservoirs provide very minimal storage and simply generate power from releases at Martin Dam along with local inflows and are operated at constant levels, except during major floods. During some periods, the local inflows to these lakes are sufficient to satisfy downstream minimum flow requirements. Yates Reservoir receives inflows from approximately 3293 square miles of drainage and Thurlow Reservoir receives inflows from approximately 3308 square miles of drainage.

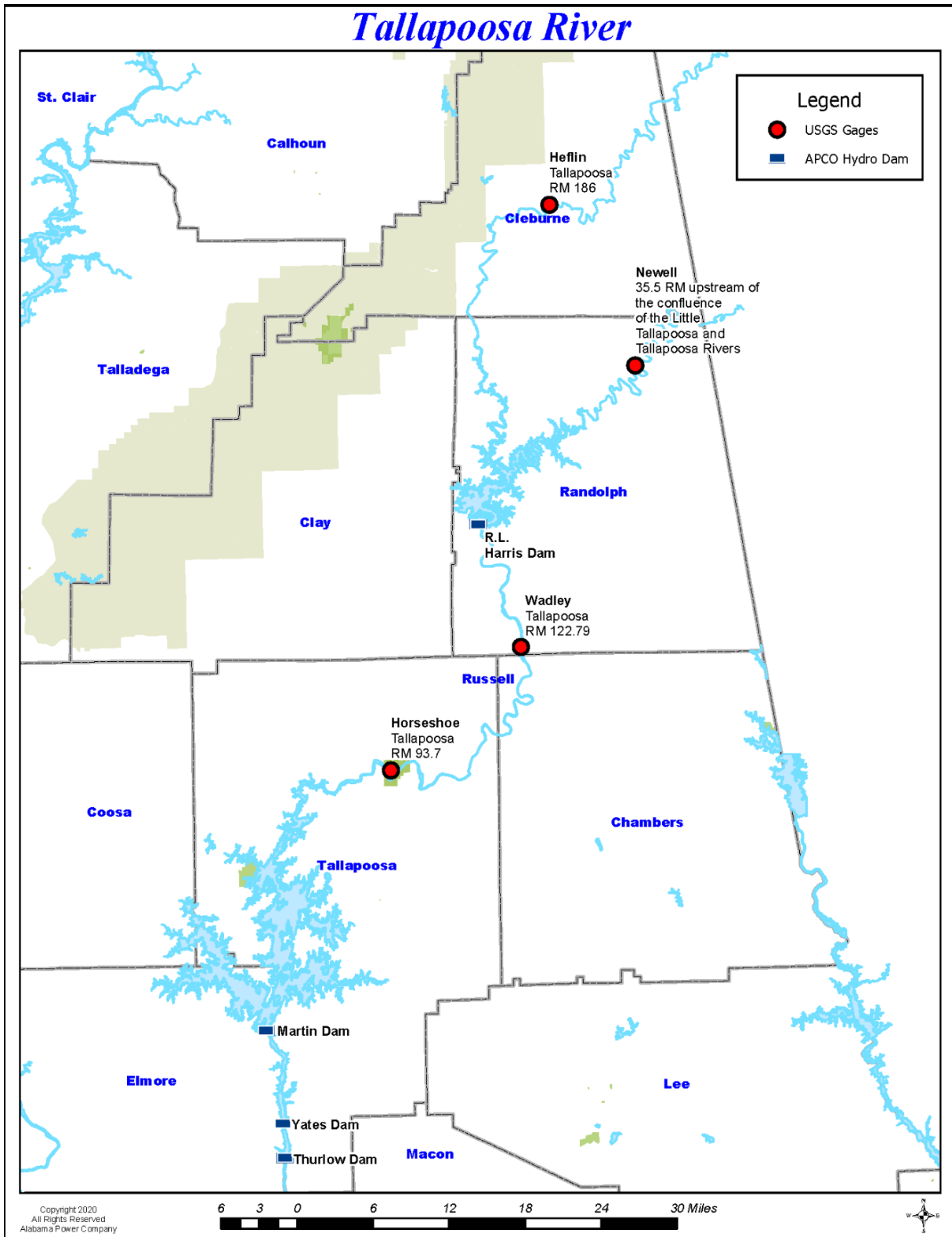
### **2.1.1.5 Lower Tallapoosa River**

The reach of river below Thurlow Dam is a free-flowing system that enters the alluvial plain with widening floodplains and much flatter slopes. This reach of the Tallapoosa River contains approximately forty-nine miles of stream and is crossed by at least three major road bridges. Alabama Highway 229 crosses at RM 39.8; a county road bridge crosses the river at RM 18.5; and U.S. Highway 231 crosses the river at RM 9.8 and is a four-lane highway. Three USGS gage sites have data on this reach. The Tallassee (RM 47.98) gage (No. 02418500) is approximately one mile downstream of Thurlow Dam and has 85 years of daily flow data (ending in 2013). The Milstead gage (No. 02419500) is located on the Alabama Highway 229 Bridge (RM 39.8) and has 26 years of daily stage data, and the most downstream gage on the Tallapoosa River is located at the Montgomery Water Works plant (No. 02419890) at RM 12.9 and has 25 years of daily flow data and 31 years

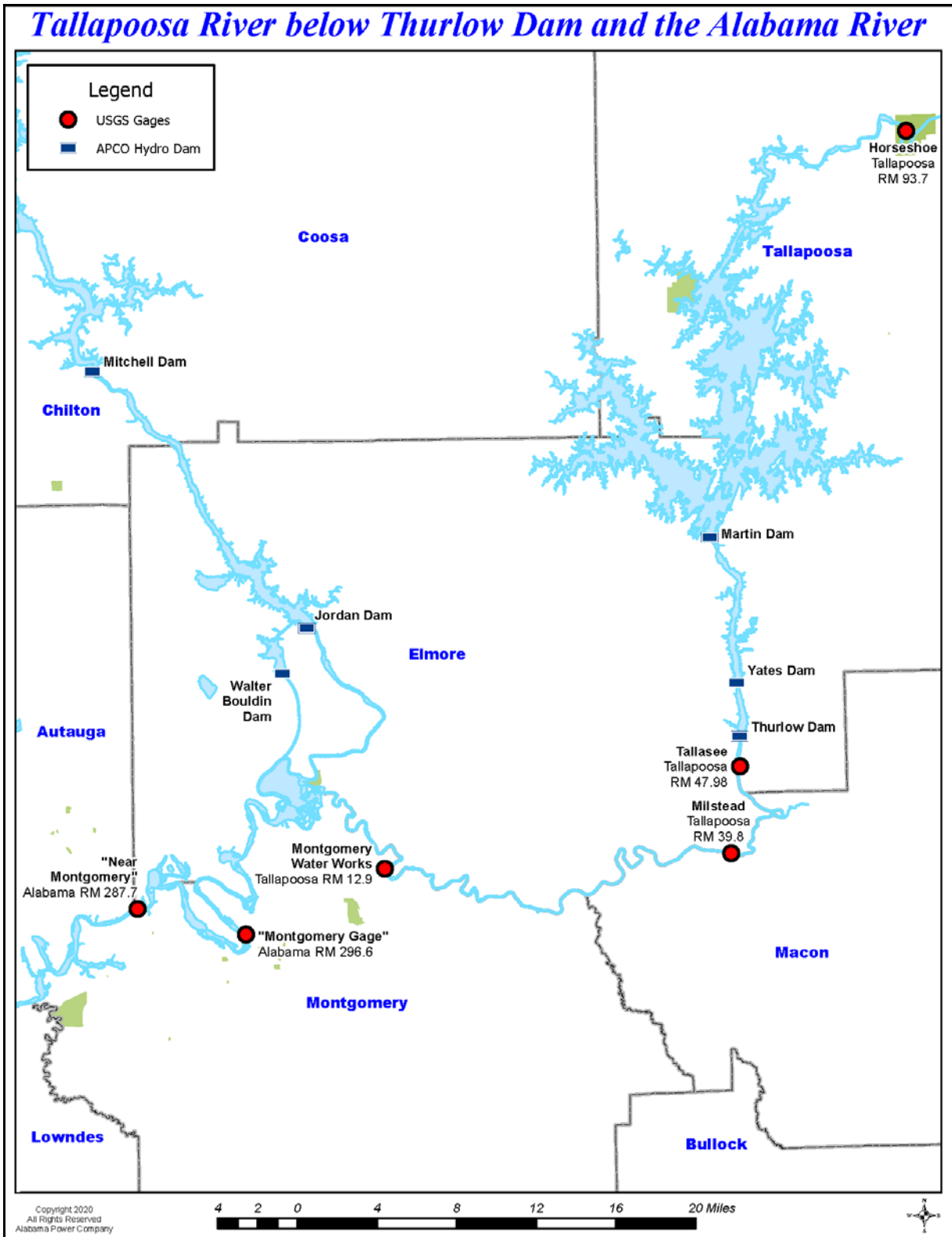
of daily stage data. A major pipeline crosses the river at RM 48.99 and the reach from the tailwaters of Thurlow to just below the pipeline remains relatively steep. The entire Tallapoosa River basin is approximately 4,687 square miles.

### **2.1.2 Alabama and Coosa Rivers**

The Tallapoosa and Coosa Rivers merge near Montgomery to form the Alabama River. Drainage area of the Coosa, at its mouth, is approximately 10,161 square miles and the Tallapoosa is 4,675 square miles at its mouth. Therefore, the Coosa River has the greatest influence on the total flows in the Alabama River with 68 percent of the drainage area. Flows from the Coosa enter the Alabama River from two sources, Jordan and Bouldin Dams. Jordan Dam was constructed on the mainstem of the Coosa River and Bouldin Dam is a diversion lake with hydroelectric power facilities that simply draw flows from Jordan Reservoir. Jordan Dam is 19 miles upstream of the confluence of the Coosa and Tallapoosa rivers. The Alabama River flows from Montgomery west to converge with the Tombigbee River forming the Mobile River. The USACE's Robert F. Henry Lock and Dam on the Alabama River at RM 245.4, is located approximately 69 miles downstream of the confluence of the Tallapoosa and Coosa Rivers. Two USGS gages are located on the Alabama River in this 69-mile reach. These gages are identified as the "near Montgomery gage" (No. 02420000) at RM 287.7 (93 years of daily discharge data and 87 years of daily stage data) and the "Montgomery gage" (No. 02419988) at RM 296.9 (49 years of daily stage data).



**Figure 2-1 Tallapoosa River Map**



**Figure 2-2 Map of the Tallapoosa River below Thurlow Dam and the Alabama River**

## 3.0 MODEL SUMMARY

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### 3.1 Overview

Study methods included using existing data (hydrologic record and baseline information) in order to develop the appropriate simulation models to evaluate, in increments of 1 foot from 786 feet msl to 789 feet msl, Alabama Power's ability to increase the winter pool elevation and continue to meet Project purposes. The simulation models developed as part of this study provide the tools needed to identify impacts to operational parameters and resources.

Alabama Power used the following data and models to conduct the feasibility analysis of the operating curve study at Lake Harris.

#### **Data**

1. Alabama-Coosa-Tallapoosa (ACT) unimpaired flow database – this database was developed by the USACE with input and data from other stakeholders in the ACT comprehensive study, including both the states of Georgia and Alabama, Alabama Power, and others. These data include average daily flows from 1939 – 2011<sup>3</sup> with regulation influences removed. This dataset was utilized in Hydrologic Engineering Center's Reservoir System Simulation (HEC-ResSim). An unsmoothed version of this dataset for 1939-2005 was utilized in the HEC-Flood Frequency Analysis (HEC-FFA).
2. Other data – Other data sources include USGS, USACE, and Alabama Power records.

#### **Models**

1. HEC-Flood Frequency Analysis (HEC-FFA) – This USACE model conforms with Technical Bulletin #17B in determining flood flow frequency. This model was used to determine the statistical frequency of flooding for one, three, and five-day flow volumes.

Note that the Study Plan stated that HEC-Statistical Software Package (HEC-SSP) is the USACE's newest version of the Flood Frequency Analysis and, therefore, would

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<sup>3</sup> Although when developing the study plan Alabama Power anticipated the dataset to include the years 1939-2016, the unimpaired dataset provided by the USACE includes 1939-2011.

be used to determine the statistical frequency of flooding on a monthly basis. HEC-SSP combines the capabilities of HEC-FFA with other HEC software, allowing for further statistical analysis of the data. The procedures used for analyzing the flow frequency (Bulletin #17B) did not change with the development of HEC-SSP. There has been no update to the inputs used in the HEC-FFA study of the Tallapoosa River; therefore, it was not necessary to use HEC-SSP for the purposes of this study.

2. HEC-River Analysis System (HEC-RAS) – This model was used in the flood study portion of evaluating the operating curve. It routes flows in the unsteady state<sup>4</sup> along the river.
3. HEC-ResSim – This model looked at operational changes at the Harris Project in conjunction with operating curve changes on a daily timestep. It was used to focus on the hourly flood study operations. This model, in conjunction with the HEC-RAS model, shows impacts, if applicable, to the Martin Dam Project operations.
4. HEC-Data Storage System and Viewer (HEC-DSSVue) – This is the USACE’s Data Storage System, which is designed to efficiently store and retrieve scientific data that is typically sequential. Data in HEC-DSS database files can be graphed, tabulated, edited, and manipulated with HEC-DSSVue. This program was used to display some of the output of the other HEC models.
5. Alabama Power Hydro Energy (HydroBudget) Model – This model is a proprietary model that was used to evaluate the net economic gains or losses that could result from proposed operating curve changes at the Harris Project.

The models, assumptions, and their ability to address the study questions were presented to HAT 1 on September 20, 2018 and September 11, 2019.

### **3.2 Significant Flood Event Impact Modeling Methodology**

Significant flood event impact models evaluate the ability of the system or facility to manage a significant flood. Alabama Power used two models to analyze these impacts: HEC-RAS and HEC-ResSim. In support of these two models, the HEC-FFA software analysis package was used to develop frequency data.

Standard hydrologic methods for deriving the 100-year flood apply to unregulated streams; however, the Tallapoosa River has been regulated during the entire period of

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<sup>4</sup> In hydraulic modeling, simulations run in the unsteady state consider the variance of flow with respect to time.



hydrologic record. Special hydrologic methods are normally required to filter out the influence of the regulation; however, the Mobile District of USACE had previously developed a database for daily unregulated flows on the Tallapoosa River. This database was used as input into the HEC-FFA software package to determine the statistical frequency of historical flood events on the Tallapoosa River. The HEC-FFA program only provided 1, 3, and 5-day average peak flows and did not define the hydrograph shape. The 5-day average peak flow approximates the volume of runoff received by a storm. A flood that occurred during March 1990 was very near a 100-year return storm; therefore, the March 1990 flood inflows into Harris Reservoir were used as a representative hydrograph and were scaled to the peaks of 100-year flow and volume from the FFA analysis. Scaling a historical event provided realistic consideration of the peak timing and representative shape of the 100-year event.

Impacts to flooding were evaluated by comparing current and alternative starting elevations as a 100-year flood at Harris Dam passed through the system. Screening of an alternative's ability to manage significant flood events was accomplished by subjecting each alternative to a representative flood over Lake Harris with a 1 percent recurrence probability. Model time steps were set to ensure a stable simulation and provide reasonable detailed results. HEC-RAS, version 5.0.7, was employed in the unsteady mode to simulate the movement of each hydrograph released from Harris Dam, combined with downstream intervening flows, to Martin Dam, and from Thurlow Dam to the Jones Bluff Lock & Dam on the Alabama River. Topographic data for the model was extracted from existing data sources. This included channel and floodplain cross-sections, Light Detection and Ranging (LiDAR) survey data and USGS topographic quad sheets (reference Section 4.1.3 below).

### **3.3 Long-Term Operational Impact Modeling Methodology**

Long term operational impacts address the management of storage and power generation, as well as frequency, magnitude, and duration of spill events and downstream release requirements over the period of record. Models used for these analyses included HEC-ResSim and Alabama Power's HydroBudget.

The HEC-ResSim model was employed to simulate the operation of the Harris Dam over the period of record. Simulations with the proposed operating curve changes were compared to the current operating curve. In order to evaluate impacts of modifying the

operating curve on downstream navigation and environmental flows, flow duration relationships were generated.

Any change in the operating curve at Harris Dam has the potential to impact power generation at Alabama Power's projects on the Coosa and Tallapoosa Rivers, as the system is operated as a whole. Alabama Power utilized its proprietary HydroBudget model to evaluate net economic impacts to hydropower generation resulting from the proposed operating curve changes.

## **4.0 MODEL AND DESIGN FLOOD DEVELOPMENT**

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The respective models summarized in Section 3.0 were developed to analyze the ability of the system or facility to manage significant floods and long-term operational impacts. This section discusses how the models were developed, calibrated, and/or verified.

### **4.1 Data Sources and Descriptions**

#### **4.1.1 Hydrologic Data**

Hydrologic data was collected in the form of stream flow historic records at established gage sites. This included Alabama Power's records of releases from its dams, the ACT unimpaired flow data, and USGS published flow records at its established gage sites. Due to the extensive stream gage data, determination of runoff hydrographs from rainfall records was not necessary. For long term evaluations, average daily flows primarily from the ACT unimpaired flow data were utilized; and, for short term evaluations, hourly flows were used. Records at some gage sites only contained average daily flows. Hourly flows were interpolated at these sites by combining the average daily flows with the estimated instantaneous peak values.

#### **4.1.2 Hydraulic Data**

Hydraulic data consisted of stream gage historical stage records, highwater marks during flood events, spillway and gage ratings at the dams, and gate operation schedules for the respective structures. Seasonal reservoir levels for Harris and Martin were represented by the published flood control guide curves.

#### **4.1.3 Topographic and Geometric Data**

Channel geometry of the streams used in the HEC-RAS model was represented by surveys of channel cross sections at selected sites. Bathymetry data from RM 136.7 to RM 123.0 was collected by survey during two different field efforts in 1999 and 2003. The 1999 surveying effort was completed by Sublett Surveying, LLC and extended from RM 136.7 to RM 130. The 2003 surveying effort was completed by Alabama Power and extended from approximately RM 130 to RM 123. Trutta Environmental Solutions collected bathymetry data for the reach of the Tallapoosa between Wadley and the Martin reservoir

in 2019 using two different survey methods. In areas with sufficient depth for boating, a Global Positional System (GPS)/Global Navigation Satellite System (GNSS) rover antenna (Trimble R10) mounted above an 200 kHz echosounder (CEE-LINE, CEE Hydrosystems) was mounted to a kayak and used to collect river bottom elevations at 1-second intervals as the surveyor paddled in a path across the river channel perpendicular to the flow. In areas where there was insufficient depth for boating, the GPS/GNSS rover antenna was mounted on a 2-meter survey rod and river bottom elevations were collected manually at approximately 10-foot intervals in a path across the river channel perpendicular to the flow. The average horizontal and vertical accuracy of these survey data was 0.08 feet and 0.15 feet, respectively. A total of 120 bathymetric cross sections between Wadley and the Martin reservoir were surveyed. Additionally, in January 2006, Alabama Power contracted Lasermap Image Plus to collect LiDAR and imagery for the reach of the Tallapoosa River from just below Tallassee to the Montgomery Water Works, and, in 2018, contracted EagleView to collect LiDAR and imagery for the Tallapoosa River downstream from Harris Dam through Horseshoe Bend.

In HEC-RAS, cross sections were drawn along the river at each location where a bathymetric cross section was collected. The data from the bathymetric cross section was imported into the model for each cross section, and LiDAR data was used for areas outside of the stream channel. Combining both datasets provided accurate representations of the terrain for the entire cross section. Dimensions of the four highway bridges spanning the Tallapoosa River between Harris Dam and Martin Reservoir were obtained from engineering drawings from the Alabama Department of Transportation. Drawings for a railroad bridge located at RM 120.9 were not available; thus, its dimensions were estimated using aerial photos and LiDAR data.

#### **4.1.4 Flood Frequency Analysis Database (HEC-FFA)**

In the 1990s, the ACT/ACF Comprehensive Water Resources Study team, led by the USACE Mobile District, developed a database of unimpaired average daily flows for gage points along the major rivers in the ACT River Basin. This database has been updated on several occasions and covered a period from 1939 through 2005, which was when the Alabama Power FFA study was completed. This database provided an excellent source of flow data for flood frequency analysis, since standard methods to develop flow frequencies (as defined by Bulletin #17B) are designed for natural flows and do not address regulated flows.

The 1997 ACT/ACF Comprehensive Water Resources Study Report defined unimpaired flows as: “. . . *historically observed flows adjusted for human influence by accounting for the construction of surface water reservoirs and for withdrawals and returns to serve municipal, industrial, thermal power, and agricultural water uses*”. The study attempted to remove augmentation to river flows induced by human activities. The purpose of developing this database was for input to reservoir system models to assist in evaluations of issues and actions for the ACT/ACF Comprehensive Study. Missing records and data gaps were estimated by transposing nearby records, and routing coefficients were developed for each river reach. The Comprehensive Study was primarily concerned with dry or drought conditions, so the data set was smoothed in order to mitigate negative low flows that were generated during the process. However, this also dampened peak flow conditions. Since the flood frequency analysis is concerned with peak flows, the smoothing algorithm had to be reversed. Alabama Power and the USACE Mobile District modified the DSSMATH macros that were developed to smooth the unimpaired flows to reverse the smoothing, thus, creating a new database with the peak values unsmoothed. The resulting database is referred to as the “unimpaired-unsmoothed” database.

#### **4.1.5 Frequency Analysis of Annual Peaks**

The flood event most commonly used to evaluate the impacts of a major flood is an event with a return period of 100 years or a 1 percent probability of recurrence. The 100-year event is used by Federal Emergency Management Agency (FEMA) for floodplain regulations and insurance determinations; therefore, it has significant legal and regulatory applications. Using the unimpaired-unsmoothed database, Alabama Power determined flows for the 10, 25, 50, 100, 250, and 500-year events for eight gages along the Tallapoosa River. Flows for these return periods were determined for 1, 3, and 5-day average flows. Bulletin #17B, “Guidelines for Determining Flood Flow Frequency, March 1982” and the USACE’s Engineering Manual, “Hydrologic Frequency Analysis, EM 1110-2-1415, March 1993” were employed in these determinations. Also, the 1992 version of the USACE’s computer software package, HEC-FFA was used in determining flow frequencies. The 1979 and 1990 flood events were compared to the results of the frequency analysis at each gage point. A report, Tallapoosa River Basin Flood Frequency Analysis, summarizing the results was published in November 2005 and is attached to this report as Appendix B for further reference. This report was reviewed by the USGS and the USACE, Mobile District. Table 4-1 reflects the study results for the Harris Dam.

**Table 4-1 Frequency Flows for Harris Dam**

<b>Average Flow</b>	<b>10% 10-yr</b>	<b>4% 25-yr</b>	<b>2% 50-yr</b>	<b>1% 100-yr</b>	<b>0.25% 250-yr</b>	<b>0.05% 500-yr</b>	<b>Apr 1979</b>	<b>March 1990</b>
1-day	41,600	50,100	56,200	61,900	69,200	74,500	59,002	46,604
3-days	32,000	38,900	44,000	48,900	55,200	59,900	44,607	42,456
5-days	25,600	31,100	35,100	39,000	44,000	47,800	34,646	34,845

## **4.2 HEC-ResSim Daily Model**

The ACT HEC-ResSim model was initially developed in conjunction with USACE to replace the HEC-5 model of the basin. To calibrate the HEC-ResSim model, the HEC office and Mobile District entered conditions from 1977, 1995, and 2006 in both HEC-ResSim and HEC-5. Adjustments were made to the model and network until the ResSim model was able to reproduce the HEC-5 results. Working with the Mobile District and HEC office, a reservoir network was developed that contained current physical and operational rules for each project in the ACT basin. The ACT reservoir network, described in Section 2.0, was further refined during the recent WCM update process. Version 3.4.1 of HEC-ResSim was used to simulate the current operations, providing a baseline condition in the model.

The ACT unimpaired flow database was used for flow data from 1939 through 2011<sup>5</sup>. These data include inflow and diversions for junctions in the network, along with evaporation for each reservoir. A daily time step was used in the model, which limits some operational flexibility when compared to an hourly model but allows for many alternatives to be evaluated over a long simulation period.

Harris Dam is modeled in HEC-ResSim with both a minimum requirement and a maximum constraint at the downstream gage at Wadley. This maximum limit can be exceeded when Harris Reservoir is in flood control operations and follows the induced surcharge function. There is also a minimum release requirement based on the flow at the upstream gage of Heflin. A power generation rule applies during normal and flood operations. The project is operated in tandem with the downstream reservoir, Martin, for minimum flow operations when the pool is not being operated for flood control.

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<sup>5</sup> Although when developing the study plan Alabama Power anticipated the dataset to include the years 1939-2016, the unimpaired dataset provided by the USACE includes 1939-2011.

## **4.2.1 Operational Features**

### **4.2.1.1 Minimum Flow Operations**

The reservoir network defined by the Mobile District and Alabama Power includes the current operations for all the reservoirs in the basin as best captured by a daily model. Downstream flow requirements were included in the network. To meet these requirements, the storage projects on each river act as a system. On the Tallapoosa River, Harris and Martin work in tandem to provide the Thurlow minimum flow requirement. On the Coosa River, Logan Martin, in tandem with Weiss and H. Neely Henry developments, operates through the run-of-river reservoirs to meet the flow requirement at Jordan Dam. For each of these river systems, the projects release water based on maintaining an approximately equal percentage of available storage at each project. The downstream flow requirement does include the intervening flows between the storage project discharge and the flow requirement location so that reservoir releases may be less than the measured minimum flow.

The minimum flow requirement at Thurlow is included in the model as an operational rule at Martin, which Harris also supports by operating in tandem with Martin. This is because Yates and Thurlow are entered as flow-through projects with no operational rules, that is, the flow that enters the project also exits. The flow rule is programmed to allow a cutback during drought conditions. Depending on the month and drought intensity, the minimum flow requirement ranges from 1200 cubic feet per second (cfs) to 350 cfs. Flows at the Tallassee gage were found to meet or exceed 350 cfs for the entire period of record.

There are two minimum flow requirements modeled at Harris Dam - a minimum flow of 45 cfs at Wadley and a release based on the previous day's Heflin flow, representing the Green Plan. The downstream minimum flow at Wadley is met with a with a flow rule of 45 cfs measured at Wadley throughout the entire year. The Green Plan is represented by a daily minimum release requirement from Harris Dam based on the previous day's flow at the Heflin gage. The required release ranges from 85 cfs, when Heflin flows are less than 50 cfs, to 1,067 cfs, when Heflin flows are 900 cfs or higher. The Green Plan does include provisions for cutbacks in releases during periods of drought.

#### **4.2.1.2 Drought Operations**

The Alabama-ACT Drought Response Operations Plan (ADROP) provides for three incremental drought intensity level responses based on the severity of drought conditions in the basin. The drought intensity level (DIL), ranging from 0 to 3, is based on three triggers – basin inflow, state line flows, and composite storage.

- The basin inflow computation differs from the navigation basin inflow, because it does not include releases from Allatoona Lake and Carters Lake.
- A low state line flow trigger occurs when the Mayo’s Bar USGS gage (Gage No. 02397000) measures a flow below the monthly historical 7Q10 flow.
- Low composite conservation storage occurs when the Alabama Power projects’ composite conservation storage is less than or equal to the storage available within the drought contingency curves for the Alabama Power reservoirs.

These thresholds are evaluated on the 1<sup>st</sup> and 15<sup>th</sup> of every month in the model. The DIL increases as more of the drought indicator thresholds (or triggers) are met. The ADROP matrix defines monthly minimum flow requirements for the Coosa, Tallapoosa, and Alabama Rivers as function of DIL and time of year. Such flow requirements are modeled as daily averages. The storage volumes in the Alabama Power Coosa and Tallapoosa projects are balanced to support this release. Once a drought operation is triggered, the DIL can only recover from drought condition at a rate of one level per period.

#### **4.2.1.3 Navigation Operations**

Navigation operations in HEC-ResSim are based on basin inflows and the historical average storage usage from Alabama Power projects during a given month. Releases are made from Alabama Power projects on the Coosa and Tallapoosa Rivers, along with local inflow, in order to provide the navigation flows in the model. Basin inflow targets are designed to provide channel depths of 9.0 feet and 7.5 feet in the Alabama River below the Claiborne Lock and Dam. If a 9.0 feet channel cannot be made available due to inflows, a 7.5 feet channel is attempted, which would allow light loaded barges to move through the system. If basin inflows do not support a 7.5 feet channel, navigation releases are suspended. During drought operations, releases to support navigation would be discontinued until the DIL is equal to zero.



#### **4.2.1.4 Flood Control Operations**

The USACE-approved flood control procedures in the Harris WCM are incorporated into the daily HEC-ResSim model. The flood control zone is defined as the area below the top of the dam and above the operating curve, ranging from 785 feet to 793 feet depending on the date. The elevation 790 feet serves as a transition elevation for flood control operations. When the reservoir elevation is above the operating curve and below 790 feet, Harris is operated to keep the Wadley gage at or below a stage of 13.0 feet, with a maximum release of 13,000 cfs. If the pool elevation exceeds 790 feet and the operating curve, releases are 16,000 cfs or greater if determined by induced surcharge curves. The 45 cfs minimum flow at the Wadley site and power operations are included in the flood control operating zone.

#### **4.2.1.5 Spillway Operations**

The spillway at Harris is included in the HEC-ResSim model to capture releases from the project that exceed the turbine capacity. With the Harris flood control procedures and spillway characteristics in the daily model, spill frequency and duration can be determined. Although there is a slight underestimation of the frequency of spill (0.5 percent difference), HEC-ResSim satisfactorily models the flood control operations at Harris.

#### **4.2.1.6 Hydropower Operations**

A power guide factor was used in the HEC-ResSim model to simulate the existing generation at Harris. The power guide factor relates plant factors to the percentage of power storage remaining in the reservoir. The factors represent the hours of generation per day as a function of the remaining power storage. With full power storage available, Harris is programmed to generate 3.84 hours per day. The power guide factor creates a zone for utilizing hydropower and is comparable to the zone between the existing operating guide curve and the drought curve. Generation is employed after all flow requirements have been met.

### **4.3 HEC-ResSim Hourly Model**

An hourly model was necessary to evaluate the flood impacts resulting from the proposed operational changes. The operating rules in the daily HEC-ResSim model were adapted

for an hourly timestep. The geographic scope of the HEC-ResSim network for the purposes of the hourly model were limited to the area on the Tallapoosa River from Harris Dam downstream to the upstream end of Martin Reservoir. The physical characteristics of the watershed and projects were maintained through both daily and hourly networks in HEC-ResSim.

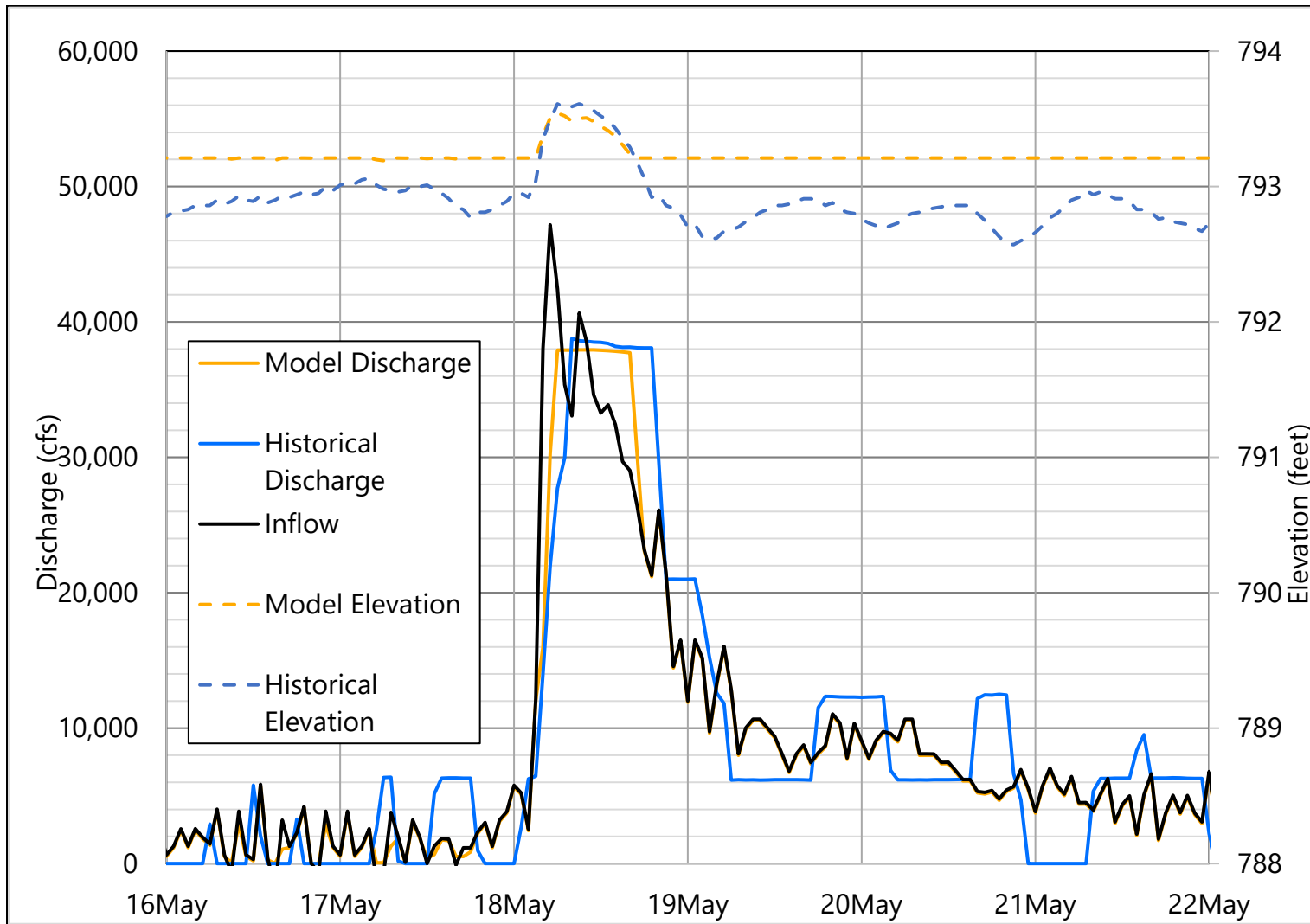
#### **4.3.1 Operational Features**

To model flood operations at Harris and to capture Martin discharges downstream, the daily HEC-ResSim model was simulated with an hourly timestep. The induced surcharge curves and flood control operations for Wadley were transferred to the hourly model, but it was necessary to alter or remove some operating rules to model the design storm.

- The Green Plan operations were removed. Minimum releases do not influence flood operations during a flood study, allowing for this rule to be excluded. The minimum flow of 45 cfs at Wadley remained in the model but was operationally insignificant in evaluating the proposed guide curve changes.
- The Martin Tandem rules were excluded from the flood study. Balancing the storage in the projects is not applicable when evaluating flood control operating rules.
- Releases specifically for generation at Harris and Martin were omitted from the operations used to analyze the proposed guide curves.
- Drought and navigation rules at Martin were not included in the model. Neither condition should influence releases when studying flood operations.

#### **4.3.2 Calibration**

Alabama Power carved out a portion of the daily HEC-ResSim model to create an hourly HEC-ResSim model for this study. The daily model was developed and calibrated by the USACE. In order to calibrate the hourly model, the May 2013 flood was used to see how well the model replicated the historical event. As shown in Figure 4-1, the model reproduces the May 2013 flood very well. The modeled Harris outflow hydrograph, peak discharge, and pool elevation in the model echo the historical data. This analysis supports that the model reflects the flood control rules accurately.



**Figure 4-1 Harris Reservoir Hourly ResSim Calibration – May 2013**

#### 4.4 Design Flood

Evaluation of the Harris Dam and Reservoir's ability to manage a large flood was based on a flood event that equals a 100-year return period (1 percent probability of recurrence) over the Lake Harris area. This event is referred to as a "Design Flood" in that it represents a critical and large flood event at Harris Dam, which is used to compare the proposed changes to the current operations at the dam. The 100-year flood is used by others, such as FEMA, to define floodplain limits and to set development and control limits for communities. However, standard methods that produce the 100-year event are generally only determined with peak flows and do not consider hydrograph shape and volume. The hydrograph shape and volume have the greatest influence on the ability of the dam to manage the flood event. Therefore, the March 1990 inflow hydrograph to Harris Lake was scaled to produce average daily values that closely matched the 1, 3, and 5-day average flows for the 1 percent recurrence values produced in the Flood Frequency Analysis of the unimpaired data set. These values are daily average values but, together, closely represent the volume and shape of the inflow hydrograph. Each 1 percent FFA value was positioned over the March 1990 hydrograph such that its duration enclosed the hourly flow values that produced the corresponding value from the March 1990 event.

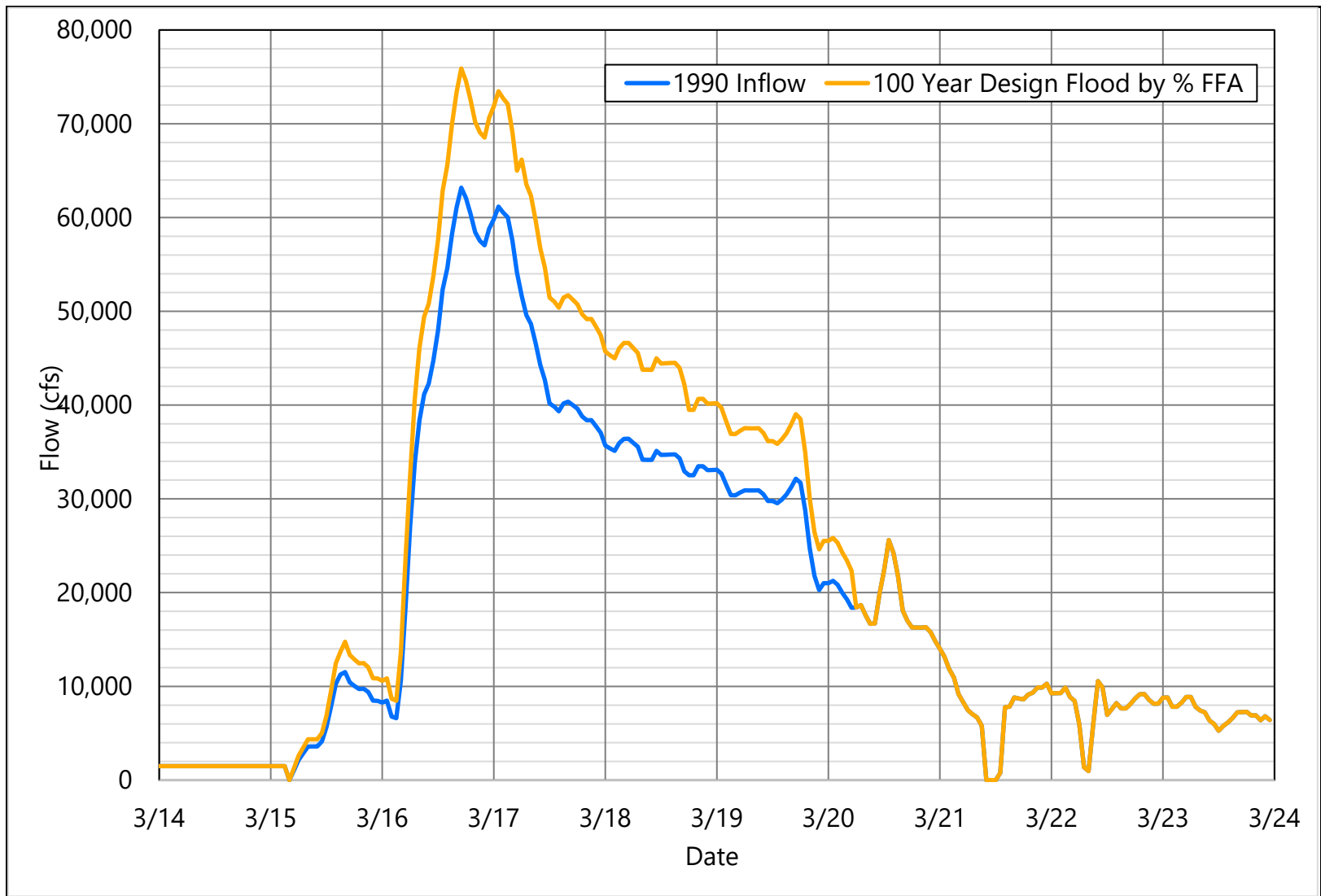
Initially, the hourly flows were scaled by ratio to bring them up to represent the 1 percent values to achieve the appropriate volume in the hydrograph. Table 4-2 below presents the final results and the final hydrograph is shown in Figure 4-2. Harris Dam operations consider the stages at Wadley gage, which is located approximately 13 miles downstream of the Dam. Therefore, 1 percent recurrence intervening flows (local inflows) between the Harris Dam and Wadley had to be included in the analysis. The intervening flow hydrograph for the Harris-Wadley reach was developed by extracting the 1990 Harris outflows from the 1990 Wadley gage flows. The hourly values had to be reduced to 3-hour running average values to get a smooth hydrograph and negative values were set as zero. Then the remaining values were adjusted to preserve the net volume of flow over the hydrograph period. The 1 percent recurrence volume, for the intervening flows between Harris and Wadley, was determined by subtracting the Harris 5-day FFA volume from the Wadley 5-day FFA volume. Then the Harris-Wadley 1990 intervening flows were scaled to produce the 1 percent recurrence hydrograph. Table 4-3 presents the results and Figure 4-3 presents the final hydrograph for the intervening Harris-Wadley flows. Section 4.5.3 describes the intervening flows used in the HEC-RAS modeling.

**Table 4-2 Hydrograph Results for 100-Year Design Flood for Harris Dam**

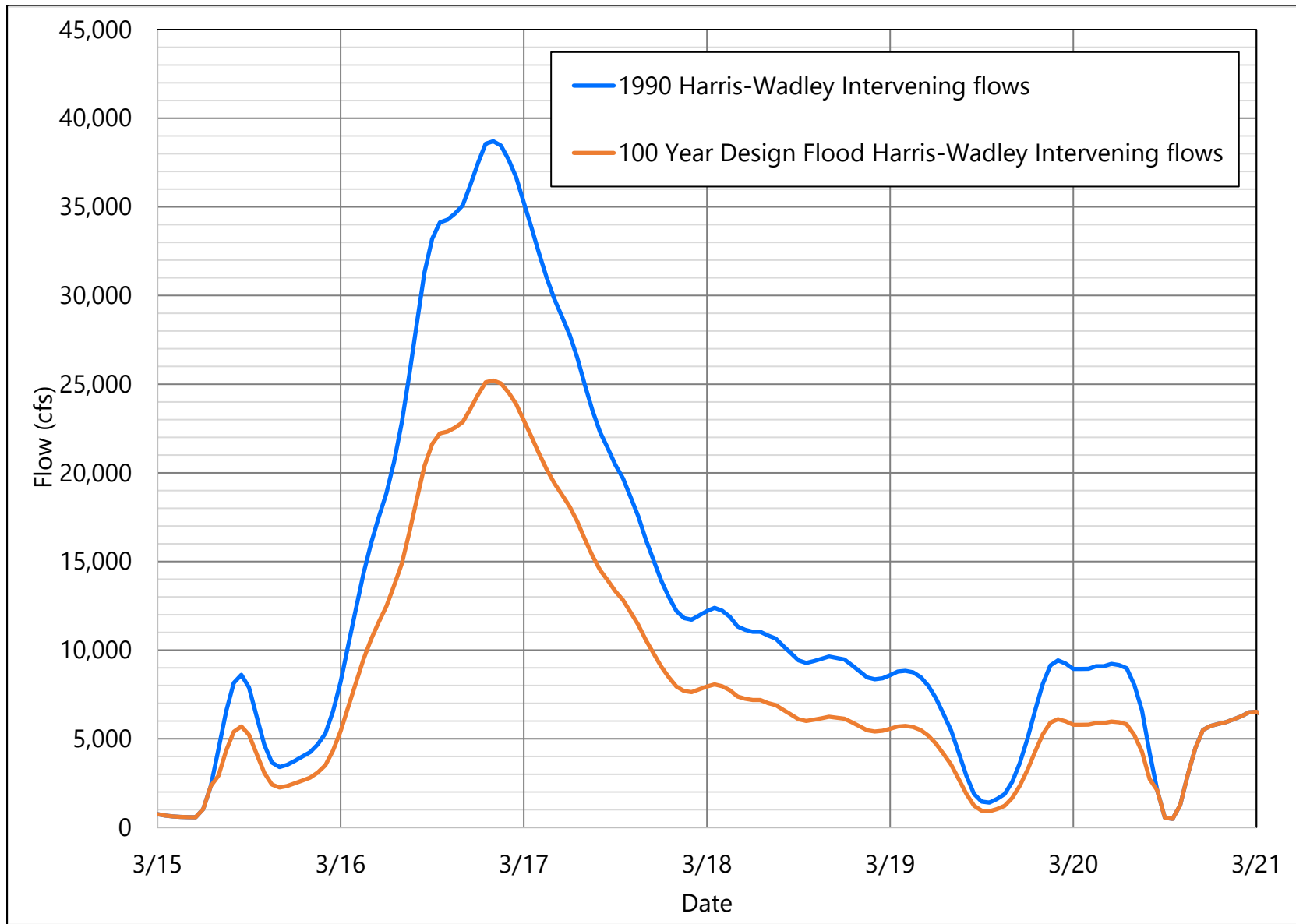
<b>Average Flow (Days)</b>	<b>Scale Factor</b>	<b>1990 Flood (cfs)</b>	<b>1% FFA (cfs)</b>	<b>Design Flood (cfs)</b>
1-day	1.20	51,531	61,900	61,961
3-days	1.28	38,170	48,900	47,489
5-days	1.21	32,110	39,000	39,702

**Table 4-3 Hydrograph Results for 100-Year Design Flood Intervening Flows for Harris-Wadley Reach**

<b>Average Flow (Days)</b>	<b>Scale Factor</b>	<b>1990 Flood (cfs)</b>	<b>1% FFA (cfs)</b>	<b>Design Flood (cfs)</b>
1-day	0.6513	32,858	21,400	21,400
3-days	0.6613	18,889	12,500	12,332
5-days	0.6477	14,358	9,300	9,358

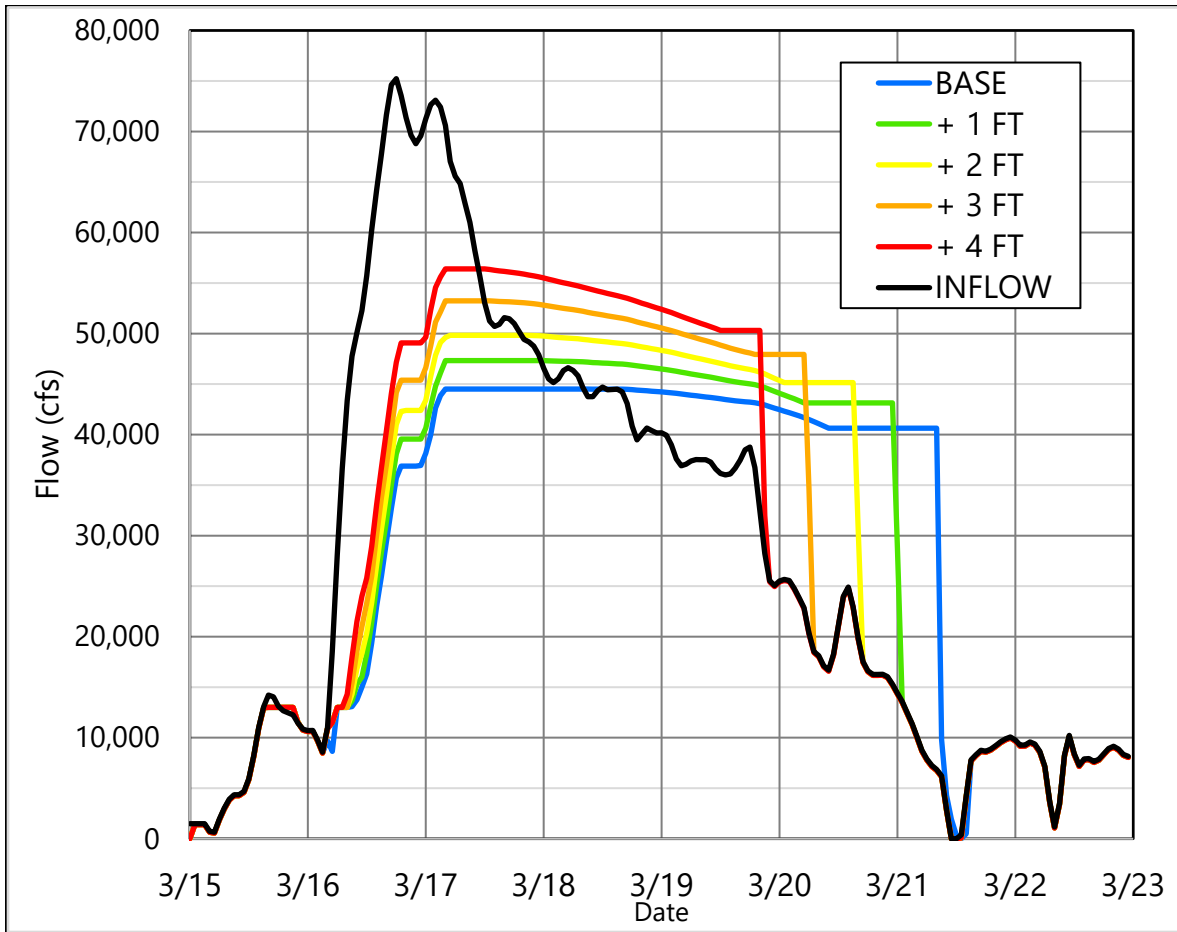


**Figure 4-2 Inflows at Harris Reservoir for 100-Year Design Flood for Harris Dam**



**Figure 4-3 Intervening Flows at Wadley for 100-Year Design Flood for Harris Dam**

Once the hourly ResSim model was calibrated, it was then used to route the design flood through Harris Dam. The resulting discharge hydrographs, shown in Figure 4-4, were then used as the upstream boundary to the Harris-Martin HEC-RAS model for routing the 100-year design storm centered over Harris downstream for each of the alternatives.



**Figure 4-4 Harris Reservoir Hourly ResSim Model-Winter Pool Evaluation**

#### 4.5 Harris-Martin HEC-RAS Model

The USACE HEC-RAS software was used to develop a hydraulic model of the Tallapoosa River from immediately downstream of Harris Dam (RM 136.7) to Martin Dam (RM 60). The model was originally developed in February 2017. The model was developed with previous versions of HEC-RAS, including at a minimum, version 5.0.4. Further revisions to the model were made in 2019 using the most recent version of the software, v5.0.7.



#### **4.5.1 HEC-RAS Model Geometry**

The 2017 model was comprised of 306 1-dimensional (1D) cross sections and 6 storage areas. The storage areas were those that can backwater during flood conditions, allowing for out-of-river storage of flood waters. In the HEC-RAS model software, storage areas are represented by stage-storage relationships. The 1D cross sections included the bathymetric data collected in 1999 and 2003 for RM 136.7 to RM 123.0; however, all other cross section bathymetry downstream of RM 123.0 only had an estimated thalweg elevation and an assumed trapezoidal or triangular shape. All cross sections' overbank areas out of the river had elevation data based on coarse USGS digital elevation model (DEM) raster data.

The 2019 model geometry incorporated the recently acquired terrain data. As discussed in Section 4.1.3, Trutta collected bathymetry data in 2019 from RM 123.0 to RM 88.0, which, in addition to the 1999 and 2003 data, provided bathymetry from the tailwater of Harris Dam (RM 136.7) to the beginning of the Martin Pool (RM 88.0). The original cross sections between RM 123.0 and RM 88.0 were removed and replaced with new cross sections placed at each of the locations where bathymetric cross sections were surveyed in 2019. The cross sections located between RM 136.7 and RM 123.0 had bathymetric data from the previous surveys and were not removed. However, the overbank areas outside of the river channel were resampled using the LiDAR data collected in 2006 to replace the less detailed USGS DEM data for all cross sections. Artificial cross sections were interpolated between the surveyed cross sections as needed to provide adequate model stability. When cross sections were interpolated, the bathymetric data within the banks of the channel was retained but the overbank terrain was updated to match the actual overbank terrain under the interpolated cross section. This was done because the bathymetry between the surveyed cross sections was unknown and interpolating between known data was a reasonable assumption, but the overland data was available from the LiDAR and did not need to be interpolated. The final geometry with all the newly surveyed and interpolated cross sections included a total of 436 cross sections.

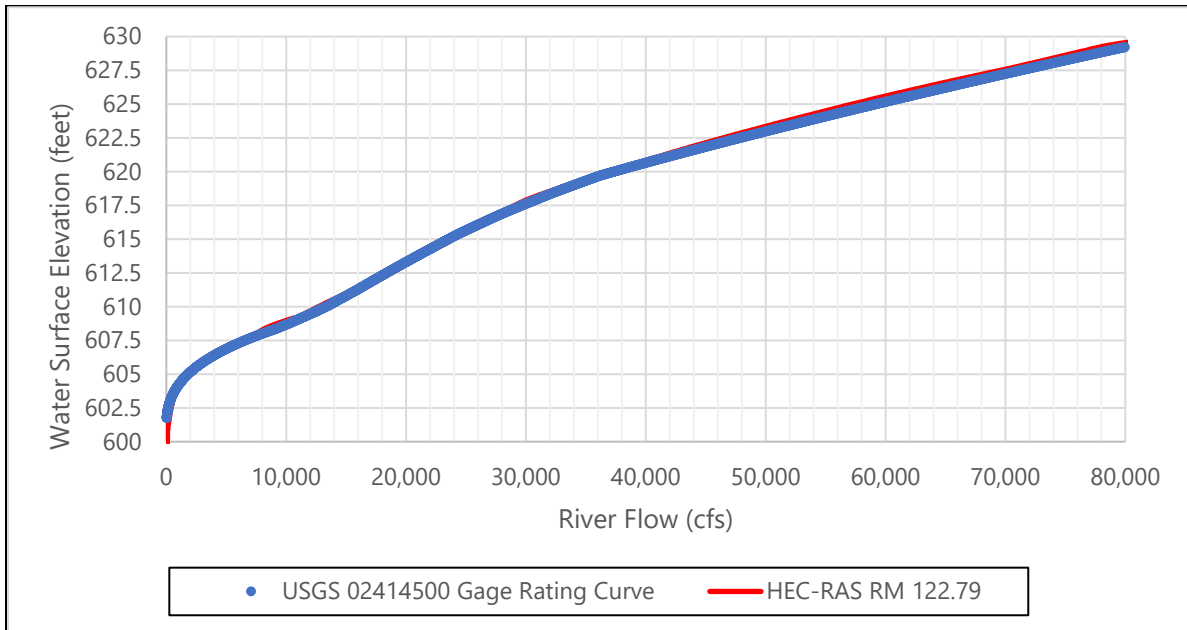
In addition to the changes to the cross sections, two of the storage areas located between RM 136.7 and RM 88.0 were replaced with 2-dimensional (2D) mesh areas and additional 2D mesh areas were added in areas that can backwater during floods. The 2D mesh areas perform the same function as the storage areas, which is to allow for flood waters to be stored outside of the main river during floods. However, unlike storage areas, 2D meshes

are composed of many cells in a connected grid with attribute data obtained from the terrain data underlying the cells. Because the storage areas are represented by stage-storage relationships, any water contained within a storage area can immediately flow back into the river no matter how large the storage area is. Unlike storage areas, the model computes the flow into and out of each cell in each 2D mesh as the river rises and falls, and water flowing into the mesh takes time to travel out of the mesh back into the river, which more accurately simulates flood routing. Due to the improved resolution of the LiDAR data that was available, the total number of offline storage where 2D meshes were used between RM 136.7 and RM 88 was 25. The 4 remaining storage areas included in the geometry are located downstream of RM 88.0 where LiDAR data was not available.

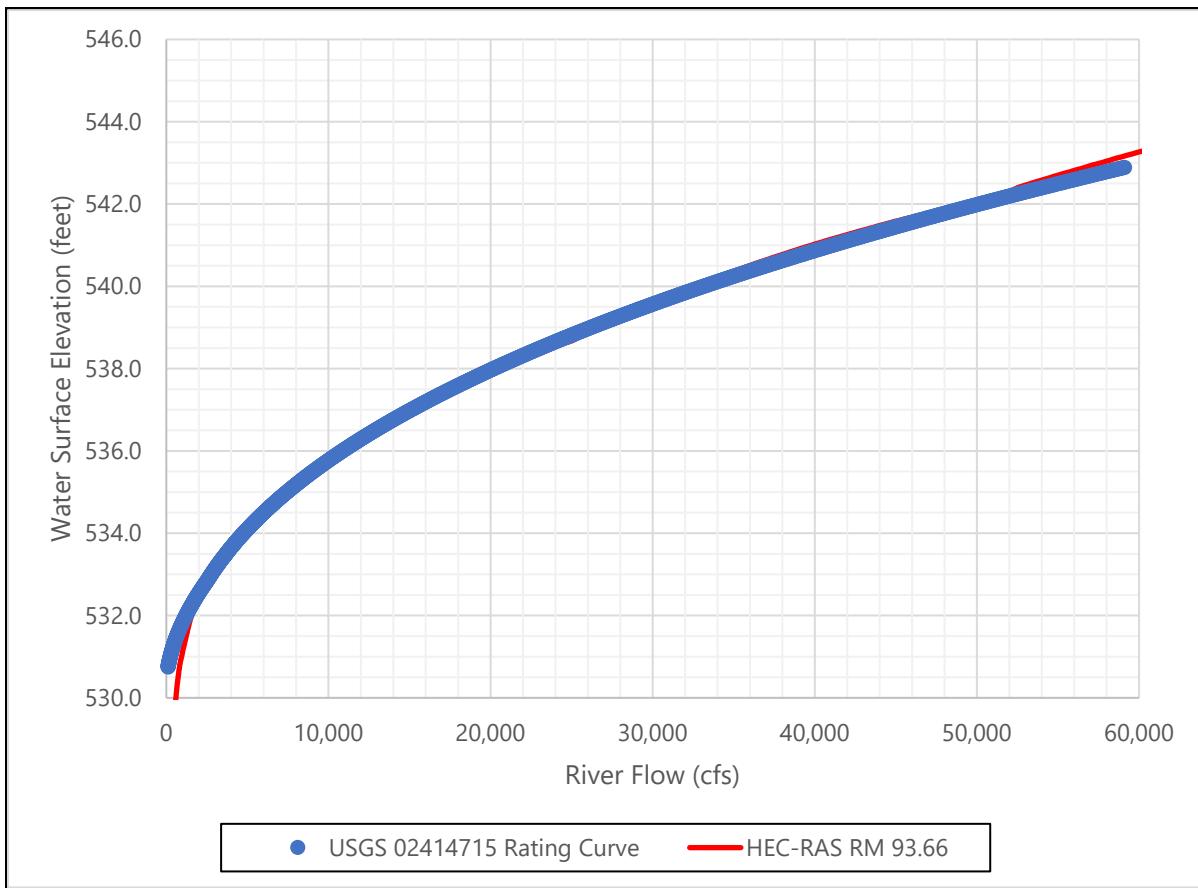
The model includes 4 highway bridges and 1 railroad bridge spanning the Tallapoosa River. Data for the 4 highway bridges was obtained from drawings provided to Alabama Power by the Alabama Department of Transportation. Data for the railroad bridge was obtained by examining aerial imagery and the LiDAR data.

#### **4.5.2 HEC-RAS Model Calibration**

Historical flow and stage data were available from the two USGS streamflow gages between the Harris Dam and start of the Martin Pool; the gage at Wadley (RM 122.79) and the gage at Horseshoe Bend (RM 93.7). Stage-discharge rating curves for the gages were obtained from the USGS website for comparison with the model results. An unsteady state rating curve flow plan was created in the HEC-RAS model that increased flow in the river from 2,000 cfs up to approximately 80,000 cfs, which provided stage data for flows in that range at the two USGS gage locations. Model calibration was completed by adjusting the Manning's roughness values in the channel and overbanks until the model matched the historical data as closely as possible over the range of flows modeled, and flow roughness factors were used to adjust the selected Manning's values in the river with flow, since roughness typically decreases as flow increases. The HEC-RAS model results of flow versus stage at the USGS gage locations for the calibration are plotted against the historical flow versus stage data of the gages and shown in Figures 4-5 and 4-6.



**Figure 4-5 Harris-Martin HEC-RAS Model Results versus USGS Wadley Gage No. 02414500**

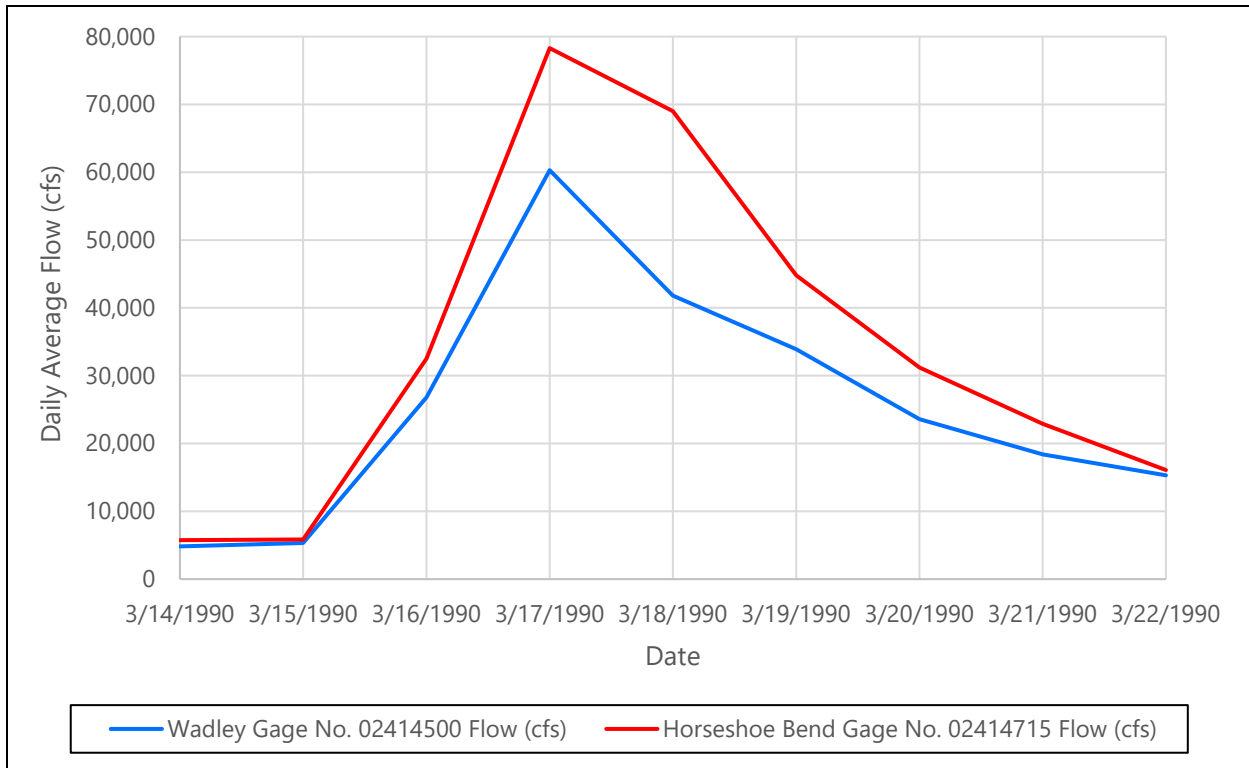


**Figure 4-6 Harris-Martin HEC-RAS Model Results versus USGS Horseshoe Bend Gage No. 02414715**

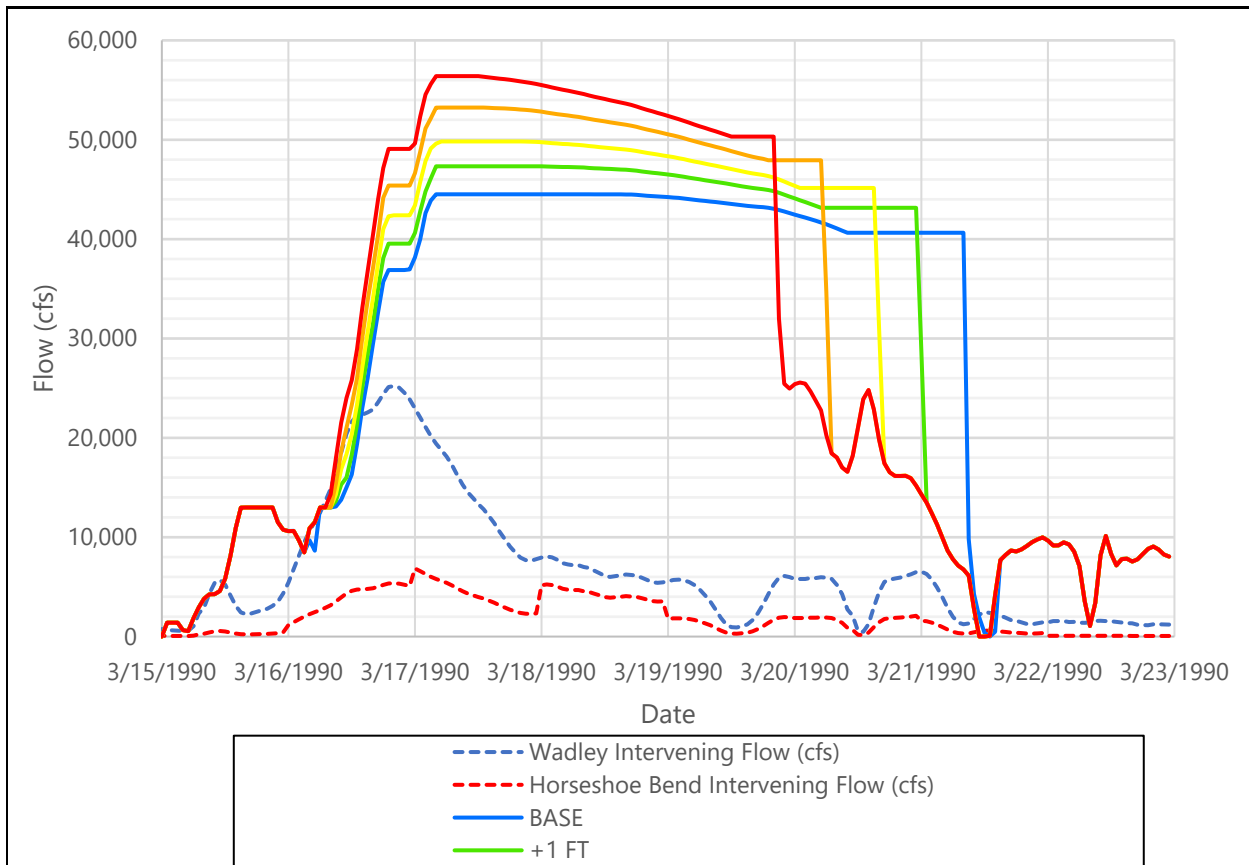
Figure 4-5 and Figure 4-6 show that the model matches closely with the historical data over the range of flows. At both gaged locations, there is some slight deviation between the model and the historical data at lower flows (approximately less than 2,000 cfs). However, the model is well calibrated to the available data for flood flow modeling.

### **4.5.3 Design Flood**

The Harris Dam outflow hydrographs derived from the HEC-ResSim modeling described in Section 4.4 were used to develop 5 unsteady flows plans in the HEC-RAS model. The model evaluated downstream impacts due to outflow from Harris Dam associated with different winter pool elevations, including the baseline condition elevation 785 feet msl and proposed elevations 786 feet msl to 789 feet msl (786, 787, 788, and 789 feet msl). The unsteady flow plans also included lateral inflows to the Tallapoosa River between the Harris Dam and start of the Martin Pool. The intervening flow hydrograph at Wadley described in Section 4.4 and shown in Figure 4-3 was added as a uniform lateral inflow to the model between RM 136.6 and RM 122.97. A second lateral inflow was added to the model downstream of Harris Dam to account for the inflow to the river between Wadley and the Horseshoe Bend gage. Hourly data was not available at the Horseshoe Bend gage for the March 1990 event. Thus, the daily average flow at both gages was compared and the ratio of the flow at Horseshoe Bend to flow at Wadley was determined. A comparison of the daily average flow hydrographs for the March 1990 event from both gages showed a similar shape (Figure 4-7). The hourly hydrograph for the Wadley intervening flow was adjusted by multiplying each hourly ordinate of the hydrograph by a ratio of the Horseshoe Bend to Wadley gages. The data was then adjusted to subtract out the flow from the Wadley gage so that the lateral inflow was only equal to the flow intervening between the two gages. The hydrograph was included as a uniform lateral inflow between RM 122.97 and RM 93.66. Figure 4-8 shows all five Harris outflow hydrographs as well as the two intervening flow hydrographs for the downstream river.



**Figure 4-7 Daily Average Flow at Wadley and Horseshoe Bend USGS Gages**



**Figure 4-8 Unsteady Flow Plan Hydrographs**

#### **4.5.4 Model Logic and Operation**

All simulations were computed using the unsteady flow analysis in the HEC-RAS model. The simulation modeled 8 days of real time based on the duration of the March 1990 event (March 15 through March 22). The computational timestep was 20 seconds, which provided model stability and accuracy. Data was output from the model at an hourly timestep, and polygon shapefiles showing the maximum extent of inundation under each scenario were saved for use in later GIS analysis.

#### **4.5.5 Model Boundary and Initial Conditions**

The upstream model boundary is located at RM 136.7, immediately downstream from the Harris Dam, and is an inflow hydrograph from the HEC-ResSim model for all simulations. The initial flow in the river was set to 2,000 cfs to ensure a stable initial computational solution. All 2D mesh areas did not have any storage volume initially, however, the 4 storage areas that are located in the Martin pool between RM 88.0 and RM 60 required an initial storage and were set to elevation 490.5 feet msl to match the downstream stage hydrograph. Two uniformly distributed lateral inflow hydrographs were included as described in Section 4.5.3. The downstream model boundary of the model is located at RM 60.8. For all simulations, a constant stage hydrograph equal to elevation 490.5 feet msl was used, which is the normal operating elevation in the Martin Pool.

#### **4.6 Yates and Thurlow**

Yates Dam is located only 7.9 miles downstream of Martin Dam. The Yates Pool forms the tailwater of Martin Dam. Yates Dam is operated at a constant pool except when large floods pass, at which time the pool rises only enough to pass the flood wave. Similarly, Thurlow Dam is located at RM 49.7, which is only 3 miles downstream of Yates and it is also operated at a constant pool. Yates and Thurlow pools have very limited storage and; therefore, do not provide appreciable attenuation of the flood wave as it passes through the two reservoirs. The Martin-centered design storm outflow hydrographs at Martin and Thurlow were compared to verify the finding that Yates and Thurlow do not appreciably change a major flood hydrograph as it passes through the system. The peak outflow at Thurlow was 19.8 percent higher than the peak released at Martin but the net volume in the hydrograph increased less than 5 percent. A simple HEC-RAS model of Yates indicated that the peak flow of the hydrograph as it passes through is not modified significantly and that the difference reflected in the 1990 flood peaks was the result of local or

intervening inflow peaking at the same time as the Martin releases. Peak discharge at Martin for the May 2003 flood was 8 percent higher than the Thurlow release with net volume increase very near 5 percent. The volume increases reflect local or intervening inflows. Time of the peak flow at Martin varied from 2 to 4 hours before the peak at Thurlow. Therefore, Martin outflow hydrographs were transferred downstream of Thurlow, excluding Yates and Thurlow from the HEC-RAS model.

#### **4.7 Lower Tallapoosa Model**

The Alabama Power project routing model for Martin indicated that the proposed operational changes would change the peak flow and volume of the Martin discharge hydrograph for the design flood. To evaluate the downstream impacts of these changes, a HEC-RAS model was developed for the lower reach of the Tallapoosa River. In order to account for the influence of the floodplain storage, the model was set up to operate in the unsteady mode.

During previous work on the Tallapoosa River, a HEC-RAS model for the lower Tallapoosa River was developed. This model included the Tallapoosa River from RM 48.12 to its mouth, the Coosa River from RM 18.74, near the toe of Jordan Dam, to its mouth, and the Alabama River from the confluence of the Coosa and Tallapoosa to R. F. Henry Lock and Dam at RM 245.4. These reaches were included in the HEC-RAS model to provide boundary points that have known data and control. The model was upgraded during this study to include better geometric data and recalibrated for this analysis. The March 2009 event was the most recent significant event and was used to verify the calibration of the lower Tallapoosa HEC-RAS model. The peak release from Thurlow was only 33,100 cfs but was also centered over the reach of the Tallapoosa below Thurlow Dam. Montgomery Water Works experienced a peak flow around 47,000 cfs. Good hourly flow and stage data was available at Thurlow Dam, Milstead, and the Montgomery Water Works; however, it appeared that the flood flows out of the channel were not significant.

Thurlow Dam is located at RM 49.7; therefore, due to this data gap, there is a small reach (1.6 miles) of the Tallapoosa that was not included in the lower Tallapoosa HEC-RAS model. Total drainage above Thurlow Dam is estimated to be 3,308 square miles and the 1.6 miles represents less than 20 square miles local drainage. This indicates that the hydrograph would not be significantly altered as it passed through this reach but the total travel time from Martin to RM 48.12 would be approximately 4 hours.

## **4.8 HydroBudget Model**

The HydroBudget Model is an analytical daily model for the determination of power production and its value by simulating actual reservoir operation. By using the HydroBudget model rather than actual generation records, Alabama Power has developed an accurate estimate of annual generation under existing conditions (baseline) to which alternatives can be compared. The model assumes that all dams are in place for the 1940-2018 period of record.

FERC has recognized the validity of this HydroBudget Model approach in estimating annual generation by accepting this method in the context of Alabama Power's relicensing of the Yates and Thurlow Project (P-2407) in the early 1990s. Alabama Power submitted the same method to evaluate the changes for the recent Martin Relicensing.

The parameters for the model include turbine discharge ratings and efficiencies, generator efficiencies, head loss, and operating guidelines. In addition, hourly power system marginal costs (lambdas) are used to calculate the most valuable use of inflows. There are no specific power requirements; therefore, when there is flow available the model will stay on the flood control guide curves. To meet flow targets downstream, Martin and Logan Martin, in tandem with the other Alabama Power storage projects, are operated as a system. This operation allows for a balanced contribution from the Tallapoosa and Coosa rivers.



## 5.0 RESULTS

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### 5.1 Hydropower Generation

Alabama Power’s HydroBudget model was used to evaluate the energy produced and value related to each of the four winter pool alternatives. Each of the alternatives was evaluated to determine the economic impact to Alabama Power customers from a hydropower generation perspective using the 2018 system lambdas. Table 5-1 shows the average annual economic impact to hydropower generation for each alternative. While the greatest annual economic loss occurs in the + 4 foot (789 feet msl) winter pool alternative, this loss represents a relatively small decrease in hydropower generation for the Alabama Power hydroelectric system as a whole.

**Table 5-1 Average Annual Impact to Alabama Power’s Hydro Generation for Each Alternative**

<b>Baseline (785 feet msl)</b>	<b>+ 1 foot</b>	<b>+ 2 feet</b>	<b>+ 3 feet</b>	<b>+ 4 feet</b>
\$0	\$(19,400)	\$(40,600)	\$(52,100)	\$(124,900)

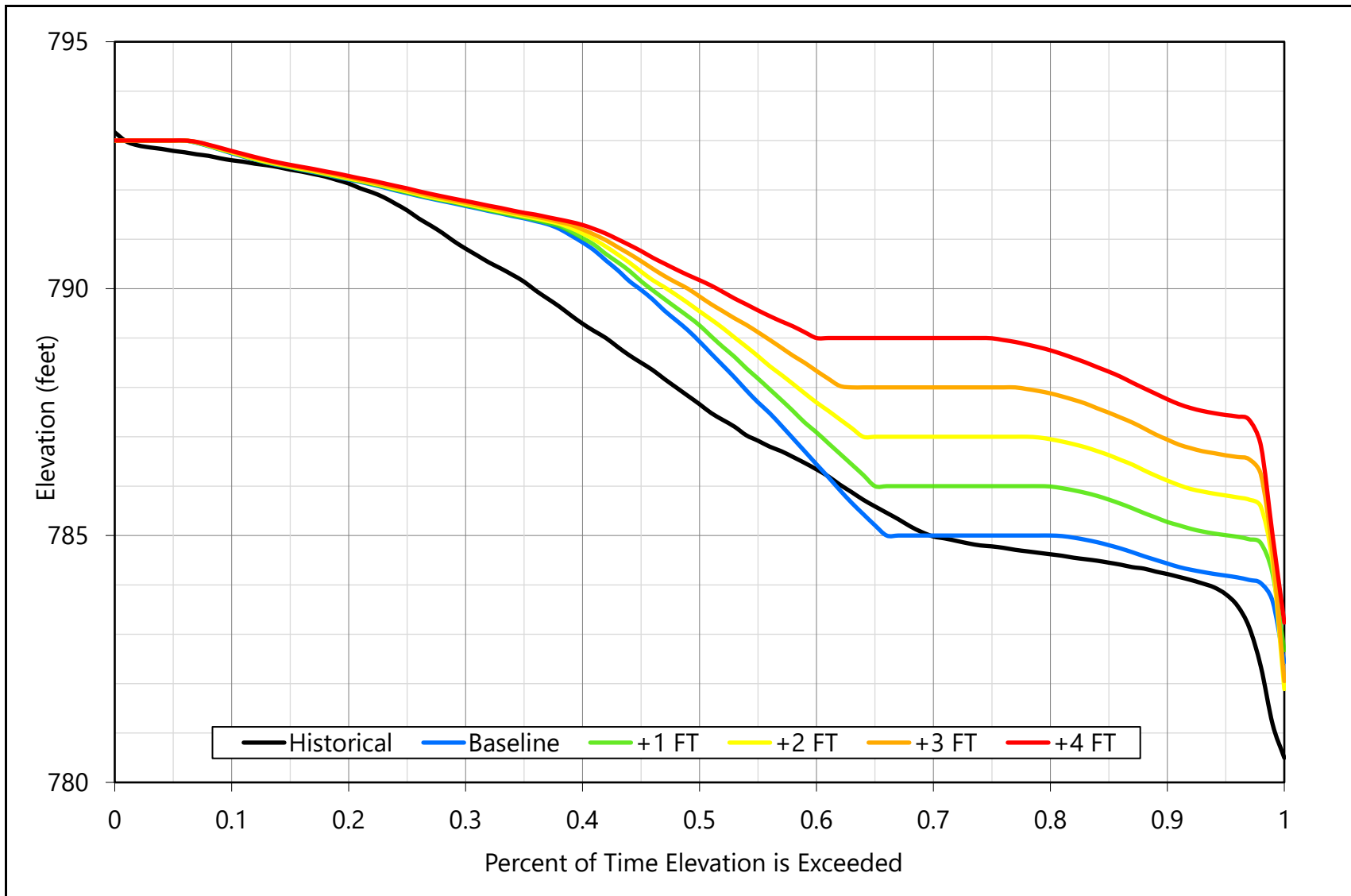
### 5.2 Flood Control

The operating curve alternatives were modeled to determine the impacts to the Harris reservoir elevation and downstream flows. The model outputs for all the alternatives were compared to the current operating curve.

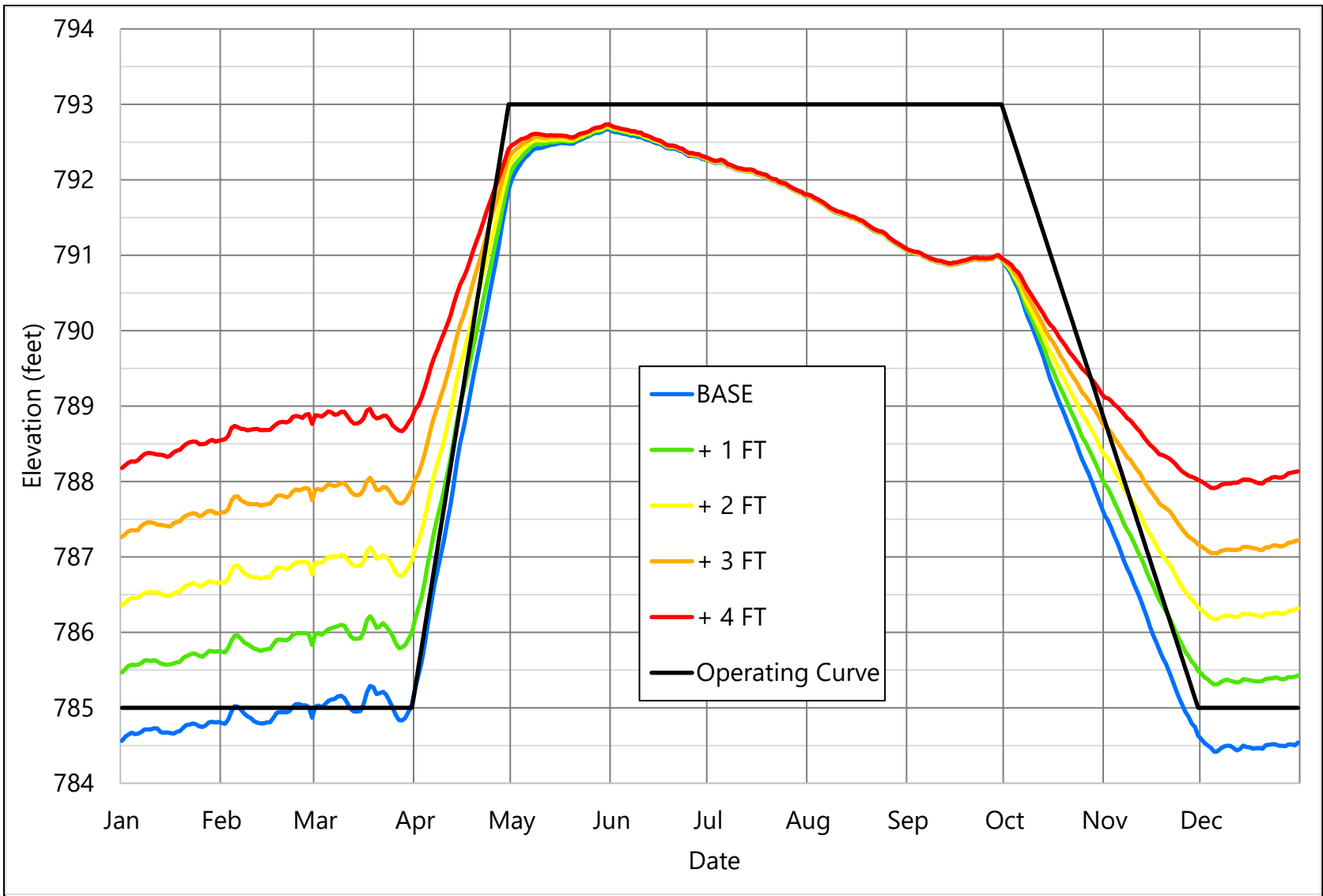
#### 5.2.1 Harris Reservoir Elevations

Over the period of record, 1939-2011, increasing the winter pool elevation for any of the 4 alternatives did not affect the amount of time the reservoir was at or above the full summer pool elevation of 793 feet msl. All alternatives exceeded 793.0 feet msl approximately 0.1 percent of the time. This is shown in the Stage Duration Frequency plot (Figure 5-1). However, the amount of time the reservoir elevation was above the operating curve for each alternative slightly decreased with each one-foot increase in the winter pool elevation. This is due to the pool reaching the operating curve sooner after a

flood event with higher winter pool elevations. Figure 5-2 shows the average daily elevation for each alternative compared to the baseline daily average.

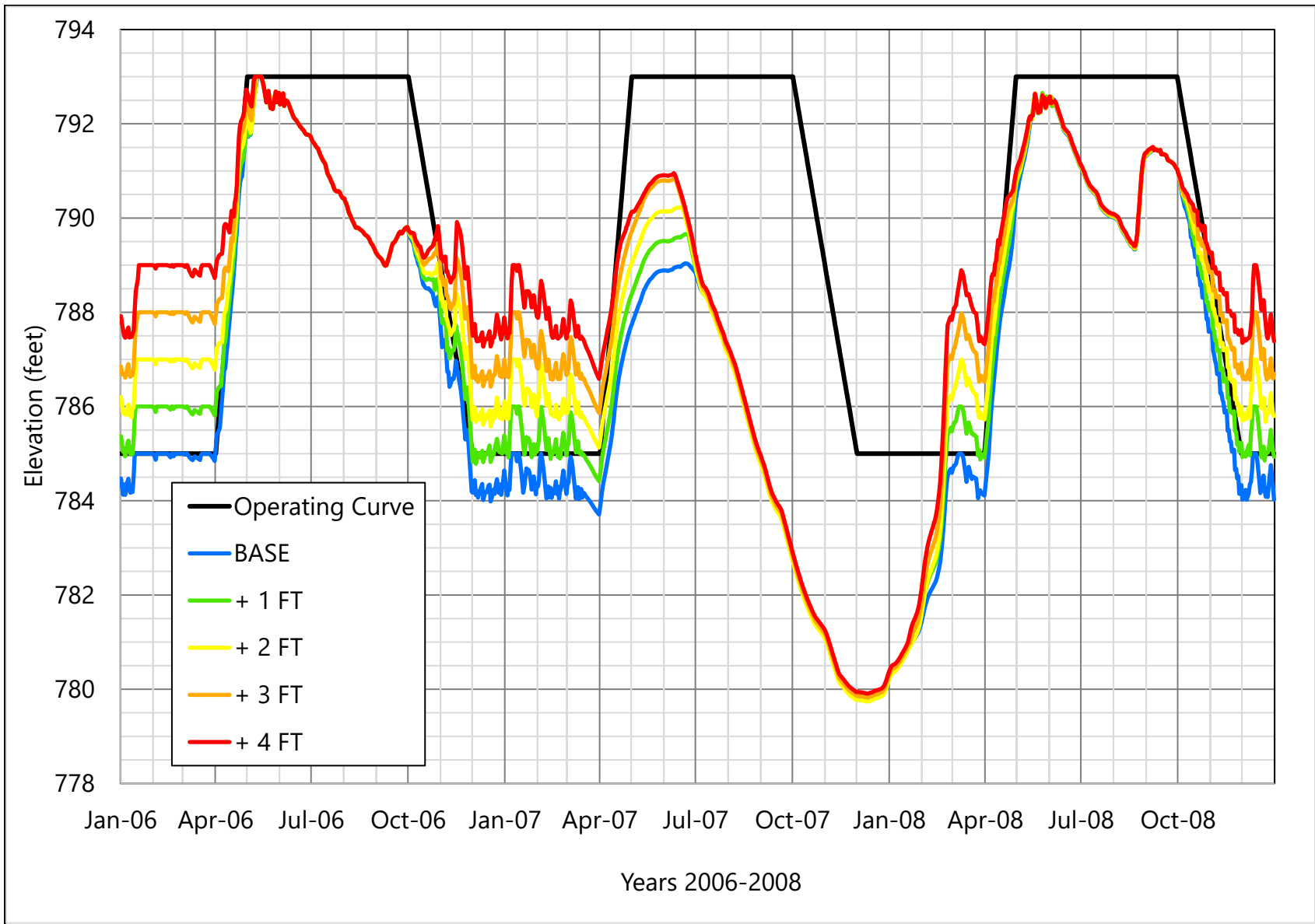


**Figure 5-1 Annual Stage Duration Frequency Curve for Operating Curve Alternatives**

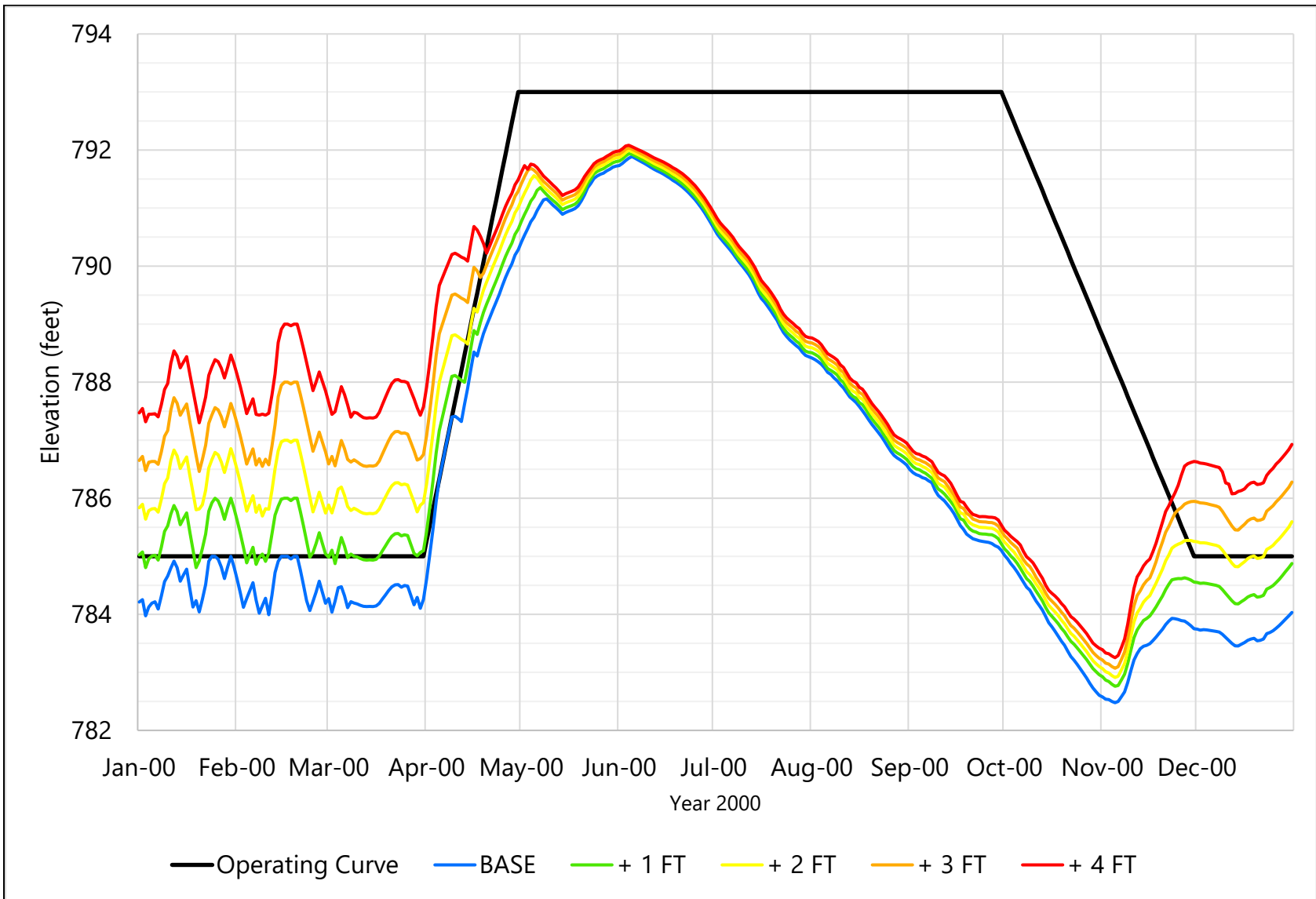


**Figure 5-2 Average Daily Elevations for Operating Curve Alternatives**

Evaluating the percent exceedance for the entire period of record can mask differences in elevations at the project during low flow years. Increasing the winter pool elevation can result in higher elevations during low flow years compared to the existing operating curve (i.e., baseline). Figure 5-3 shows how changing the winter pool elevation could have affected the peak elevation in 2006 through 2008, capturing two periods with historically low inflows. Figure 5-4 shows the elevations for each increasing winter pool alternative in 2000. Annual and monthly flow duration curves for the months a change in operations were reviewed are provided in Appendix C.



**Figure 5-3 Effects of Winter Pool Increases 2006-2008**

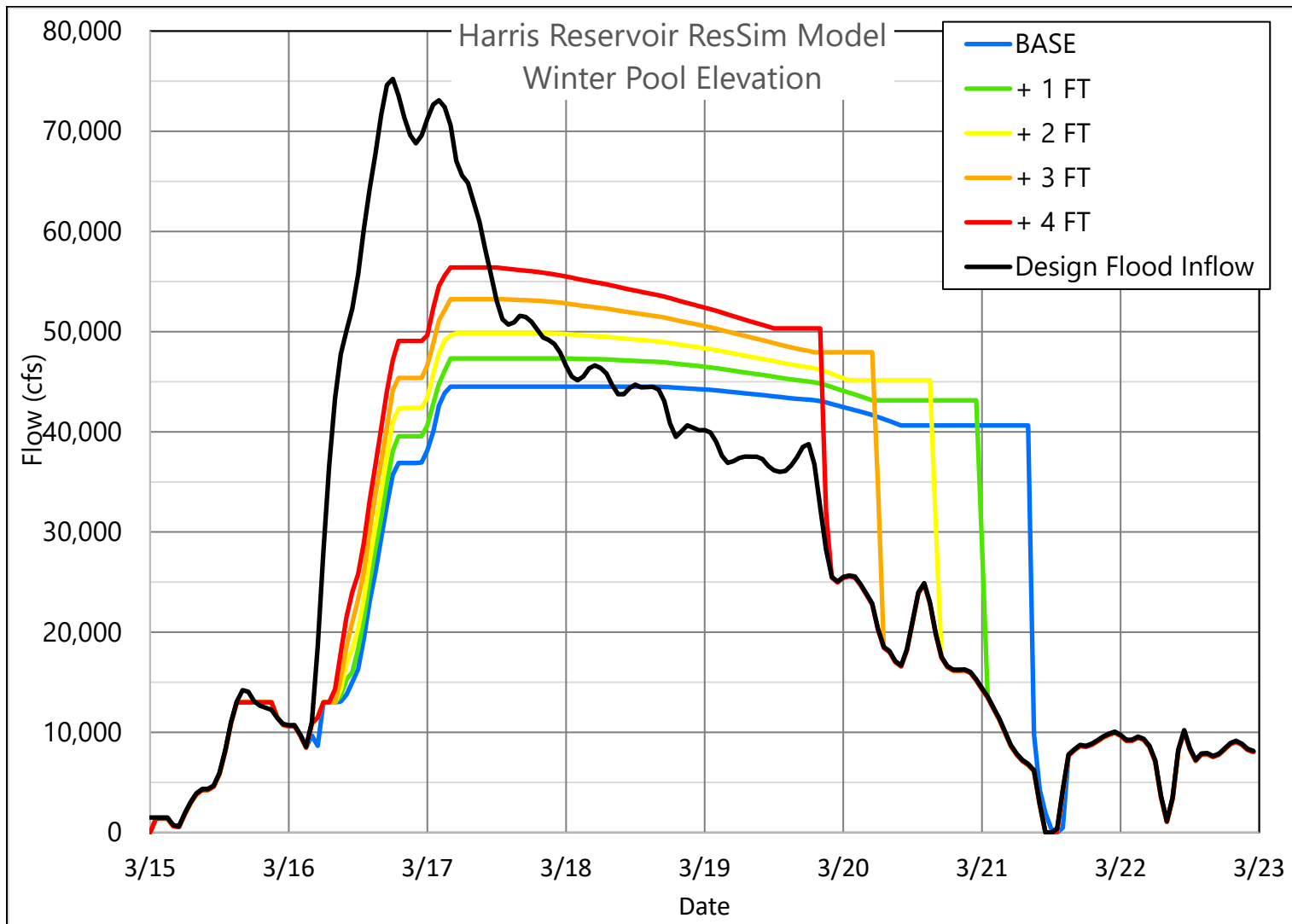


**Figure 5-4 Effects of Winter Pool Increases 2000**

### **5.2.2 Downstream Effects of 100-Year Design Flood**

The Harris 100-year design flood was routed through the hourly ResSim for each alternative and resulting outflow hydrographs were used as the upstream boundary condition in the Harris-Martin HEC-RAS model. Figure 5-5 shows the upstream boundary hydrographs for the alternatives. These simulations revealed the net upstream influence of the proposed operational changes.

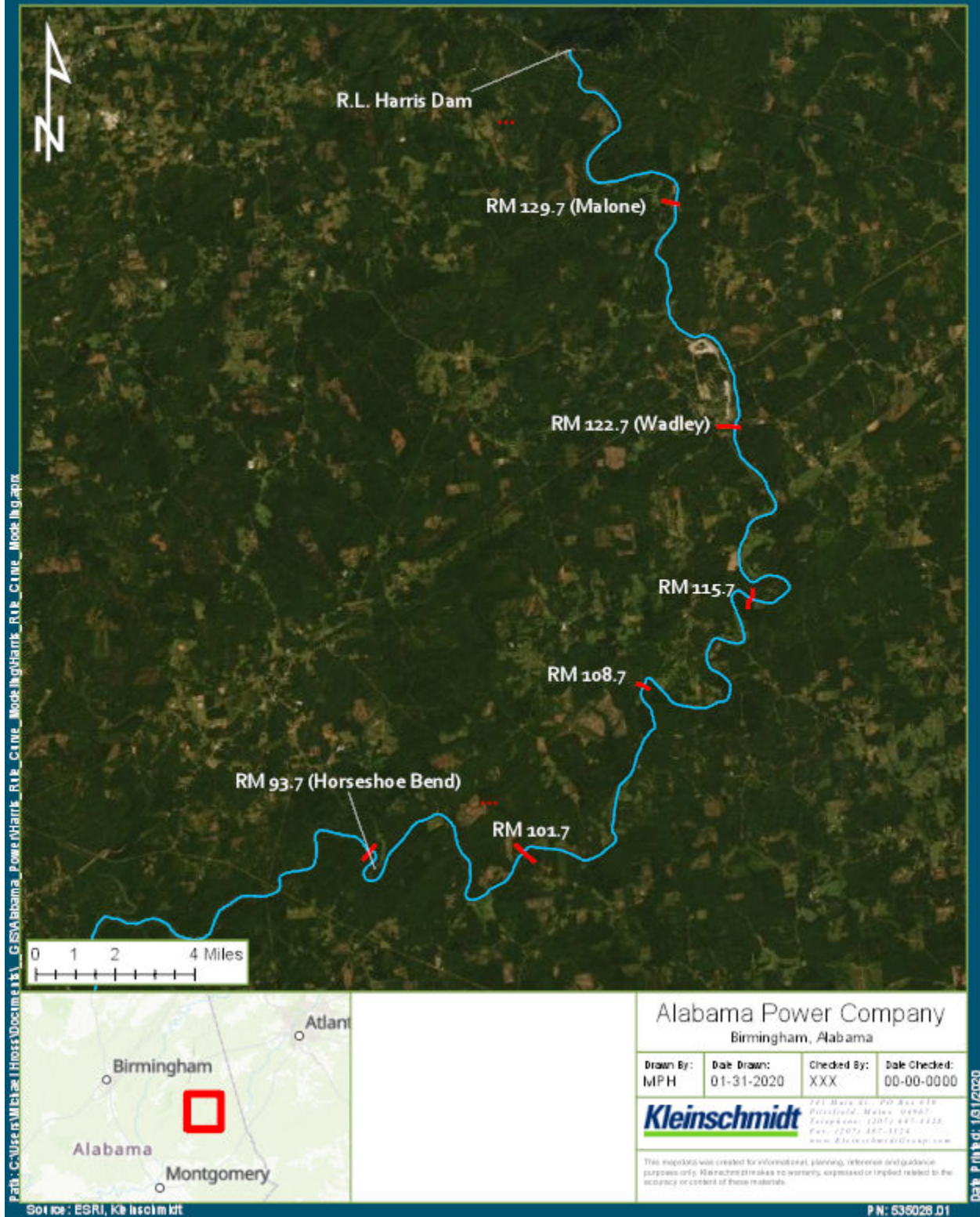




**Figure 5-5 Outflow Hydrographs from the 100-Year Design Flood Routed through the Harris Reservoir ResSim Model**

Outflow hydrographs from baseline operations and the four winter pool increase alternatives were routed in the Harris-Martin HEC-RAS model. Results show that the higher the winter pool elevation, the greater the outflow from Harris Dam and subsequent flooding associated with the outflow. The effects of the increase in winter pool have been quantified in terms of increase in flooding area, increase in depth of flooding, and the increase in duration of flooding over baseline. Six locations downstream of the dam were selected for close analysis, and the differences in flooding at these six locations are described in the following sections. Figure 5-6 shows the location of the selected areas in relation to the Harris Dam.

# Downstream Results Locations



**Figure 5-6 Location of Selected Areas to Illustrate Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

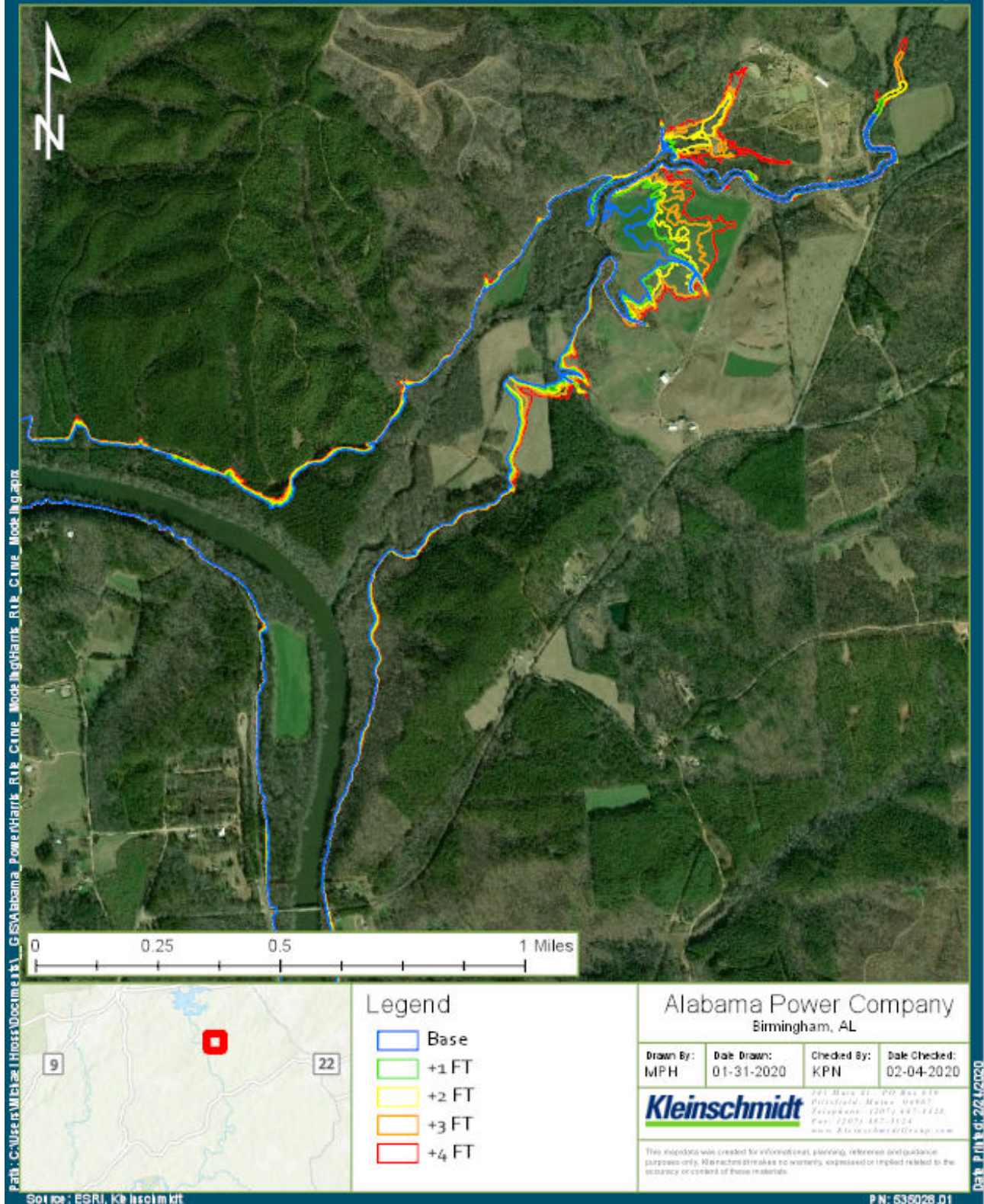
### 5.2.2.1 Increases in Inundated Areas

The extent of flooding downstream of Harris Dam increases as the winter pool elevation increases. Generally, the banks of the Tallapoosa River downstream of Harris are steep, which helps to confine the flood flows even during the highest operating curve change simulations. Where flooding is most often exacerbated are areas where tributaries are flowing into the Tallapoosa River. Often these tributaries are associated with low lying floodplains on either side, and these areas are affected the greatest. Table 5-2 shows the total increase in inundated area, measured in acres, resulting from the different winter pool alternatives. The values reflect the overbank areas outside of the river that are inundated by any amount of depth. Figures 5-7 through 5-12 show inundation boundaries for the baseline and four winter pool increase alternatives run using the HEC-RAS model.

**Table 5-2 Total Acres Inundated Downstream of Harris Dam Based on Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

<b>Elevation</b>	<b>Total Inundation Area (acres)</b>	<b>Increase over Baseline (acres)</b>	<b>Percent Increase over Baseline</b>
Baseline (785 feet msl)	6,105	-	-
+ 1 foot	6,403	298	4.9%
+ 2 feet	6,590	485	7.9%
+ 3 feet	6,791	686	11.2%
+ 4 feet	6,995	889	14.6%

# RM 129.7 (Malone) Flood Boundary



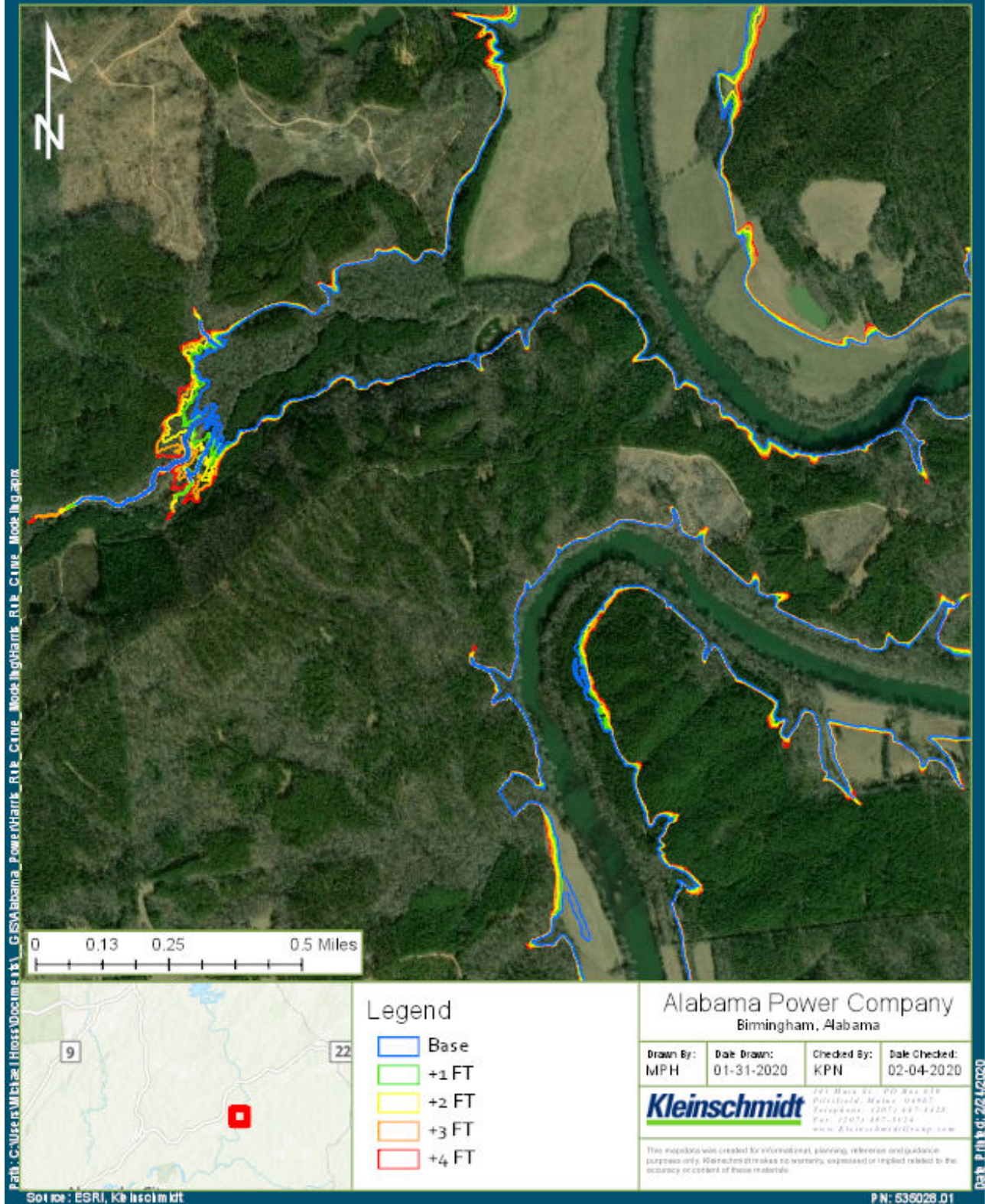
**Figure 5-7 Extent of Flooding at RM 129.7 (Malone) from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

# RM 122.7 (Wadley) Flood Boundary



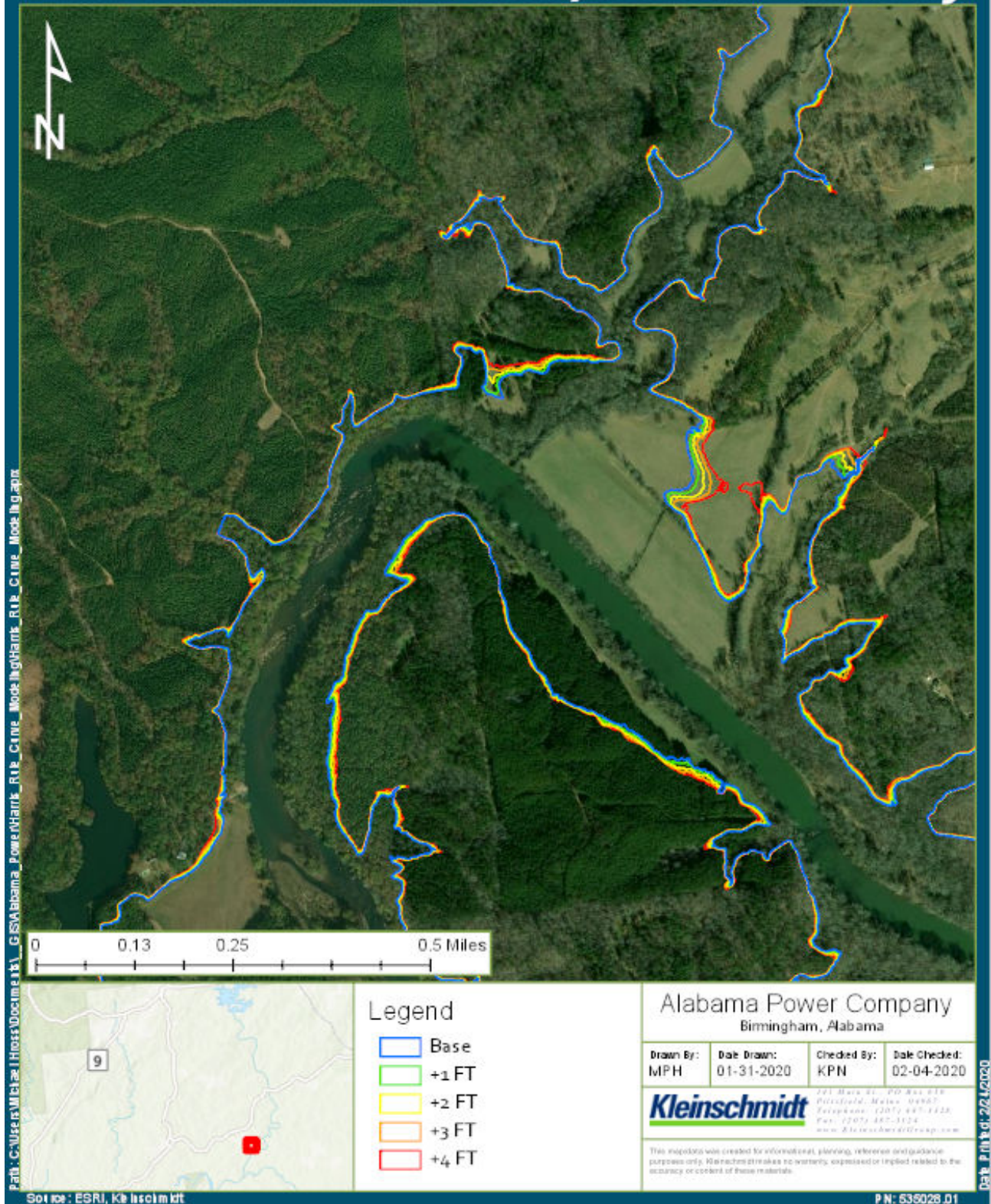
**Figure 5-8 Extent of Flooding at RM 122.7 (Wadley) from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

# RM 115.7 Flood Boundary



**Figure 5-9 Extent of Flooding at RM 115.7 from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

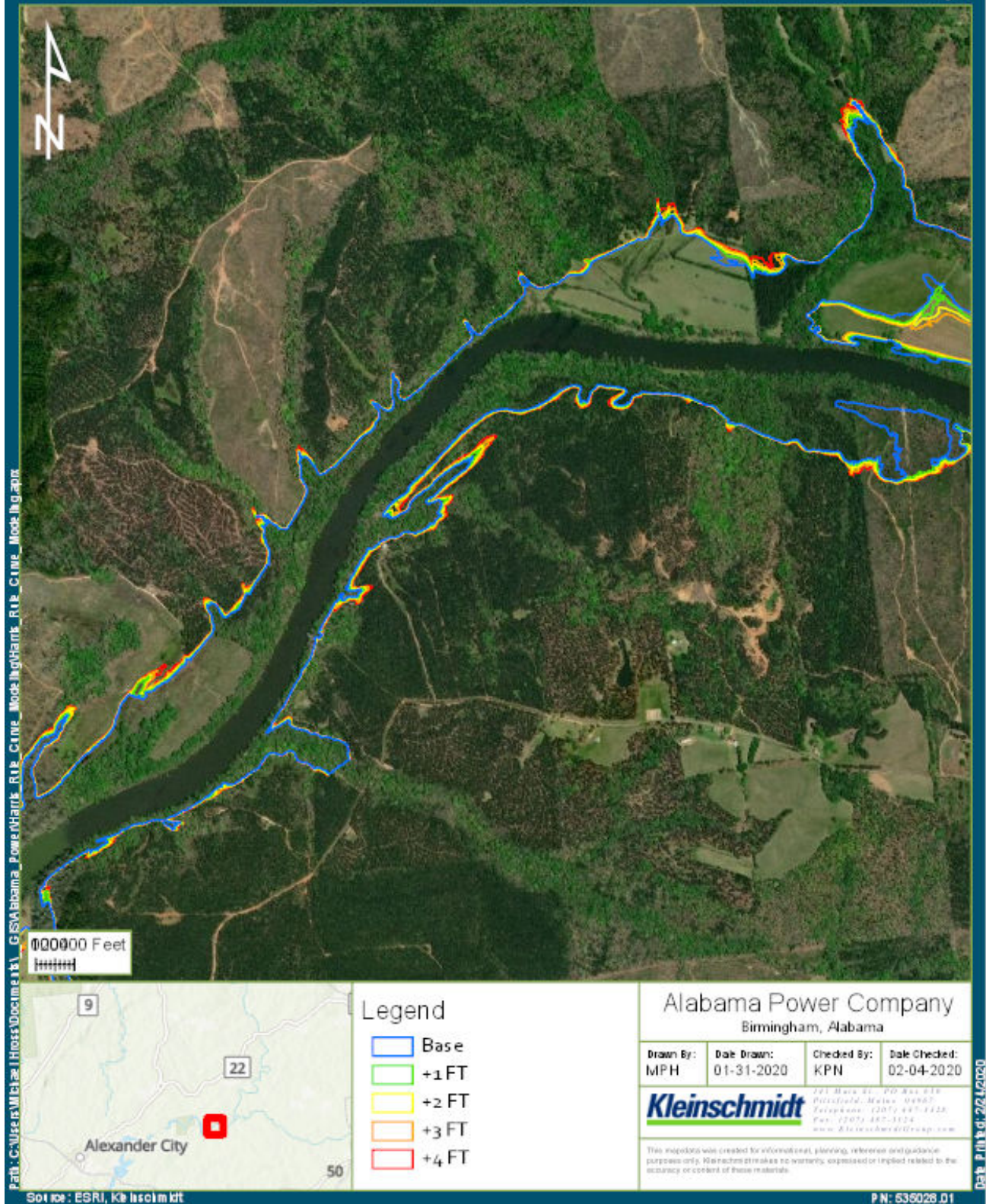
# RM 108.7 Flood Boundary



**Figure 5-10 Extent of Flooding at RM 108.7 from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

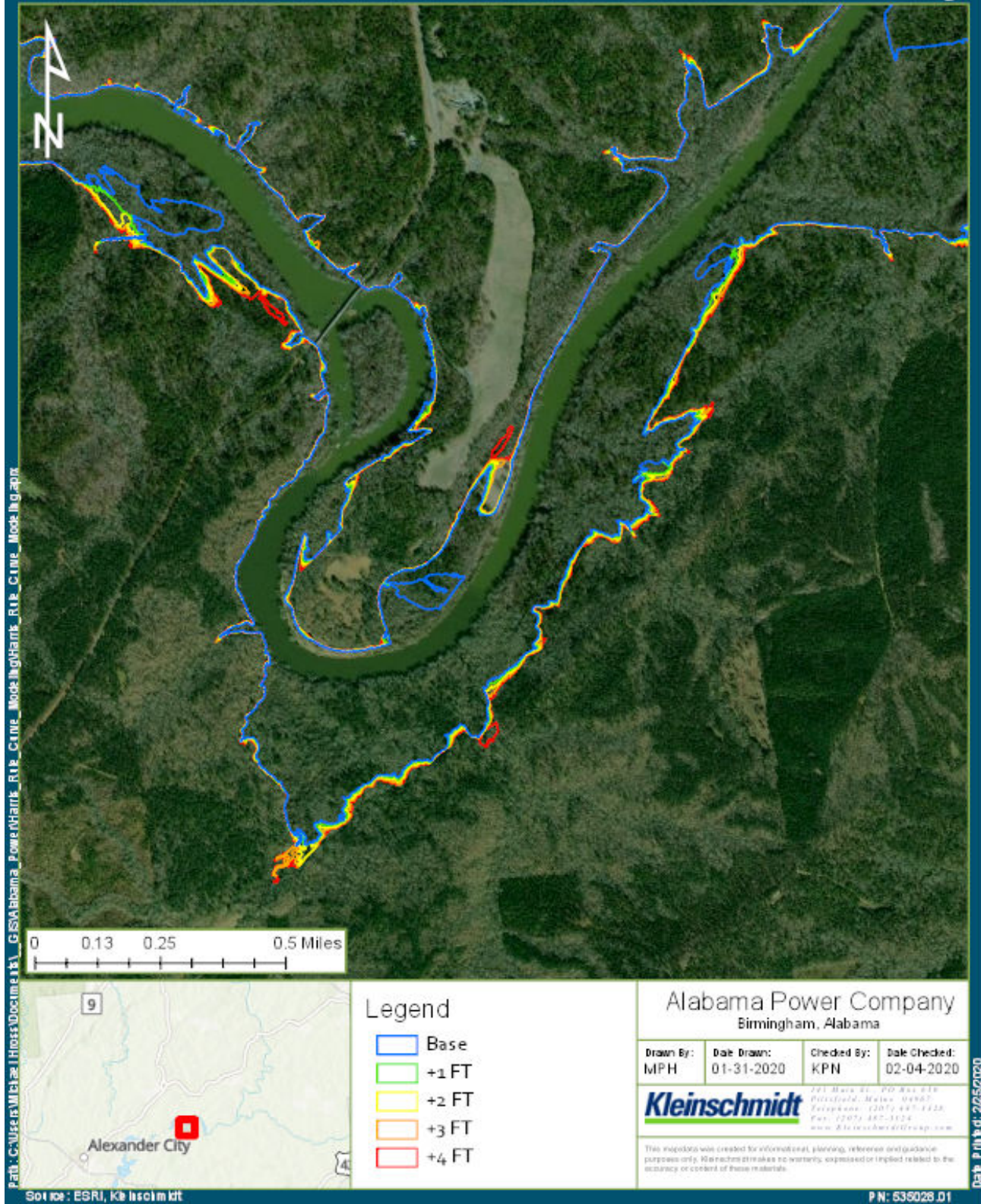


# RM 101.7 Flood Boundary



**Figure 5-11 Extent of Flooding at RM 101.7 from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

# RM 93.7 (Horseshoe Bend) Flood Boundary



**Figure 5-12 Extent of Flooding at RM 93.7 (Horseshoe Bend) from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

### 5.2.2.2 Increases in Flood Depth

The proposed increase in winter pool would not only result in an increase in the total area affected by flooding, but the depth of flooding would increase for the entire length of the Tallapoosa River between Harris Dam and Lake Martin. Table 5-3 shows the increase in the maximum water surface elevation that would occur at the 6 selected locations for the different winter pool increase scenarios.

**Table 5-3 Changes in Maximum Downstream Water Surface Elevations Resulting from Change in Winter Operating Curve**

Location	Distance from Dam (miles)	Max Water Surface Rise (feet)			
		+ 1 foot	+ 2 feet	+ 3 feet	+ 4 feet
RM 129.7 (Malone, AL)	7	0.5	1.0	1.6	2.2
RM 122.7 (Wadley, AL)	14	0.5	1.1	1.7	2.4
RM 115.7	21	0.6	1.1	1.8	2.5
RM 108.7	28	0.5	1.0	1.6	2.2
RM 101.7	35	0.4	0.7	1.1	1.4
RM 93.7 (Horseshoe Bend)	43	0.3	0.7	1.0	1.4

Table 5-3 shows that a 1-foot increase in the winter pool elevation will raise the maximum flood elevation downstream of the dam by a minimum of 0.3 foot and raising the winter pool 4 feet would result in the maximum water surface increasing by more than 2 feet. As shown in the figures in Section 5.1.2.1, much of the flood water is confined to the area near the channel, but areas that were affected by flooding under the baseline/existing condition would see increased depth of flooding with any change in the winter pool elevation. The increased flooding depth generally decreases moving downstream from Harris Dam, as is expected as the flood hydrographs are attenuated (i.e., the volume of discharge is stretched out over time, reducing the peak of the hydrograph) due to flow being stored in the floodplain adjacent to the river. However, there is a shoal complex between RM 113.6 and RM 114.8 that is constricting the flow and causing the incremental water surface rise at RM 115.7 to be greater than might be expected due to its distance from the dam and the trend of decreasing rise exhibited at the other locations.

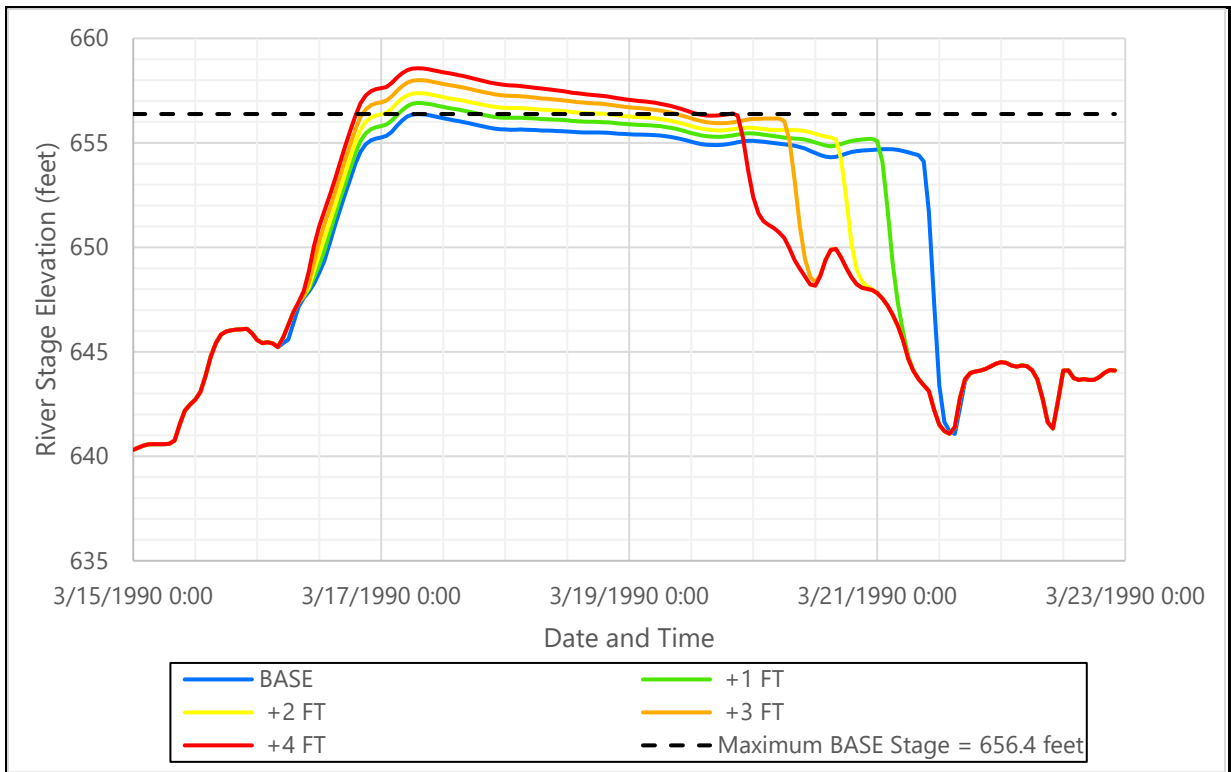
### 5.2.2.3 Increases in Flood Duration

The duration of flooding above baseline for each alternative was determined at multiple locations downstream of the Harris Dam. Table 5-4 below provides the results of the flood duration comparison and shows how long the stage in the river would exceed the baseline case maximum water surface elevation. A 1-foot increase in the winter pool elevation causes the maximum water surface elevation in the river downstream from the dam to exceed the baseline maximum water surface for a minimum of 12 hours. A 4-foot increase in the winter pool elevation causes the maximum water surface elevation in the river downstream from the dam to exceed the baseline maximum water surface for a minimum of 43 hours.

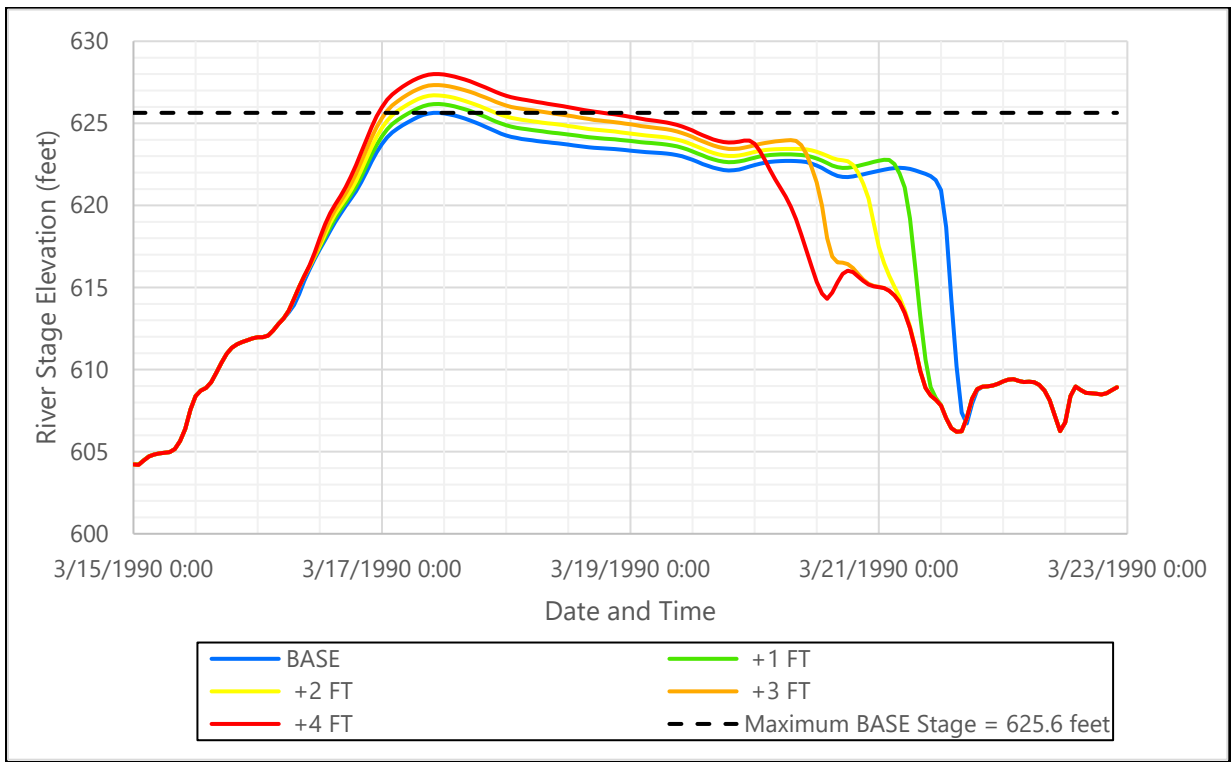
**Table 5-4 Changes in Flood Duration Resulting from Change in Winter Operating Curve**

Location	Distance from Dam (miles)	Duration above Baseline Condition Max Elevation (hours)			
		+ 1 foot	+ 2 feet	+ 3 feet	+ 4 feet
RM 129.7 (Malone, AL)	7	15	43	61	67
RM 122.7 (Wadley, AL)	14	12	19	32	43
RM 115.7	21	13	21	35	46
RM 108.7	28	14	26	38	48
RM 101.7	35	17	27	40	48
RM 93.7 (Horseshoe Bend)	43	18	29	39	47

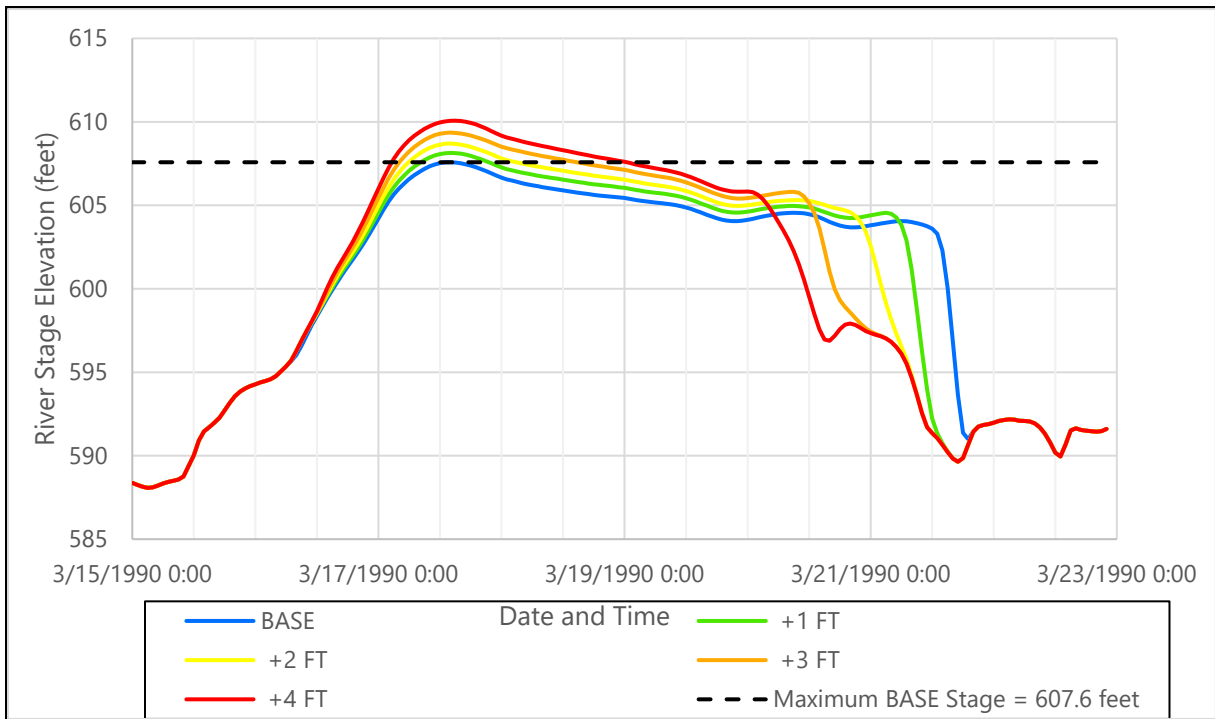
Stage hydrographs at the 6 selected locations downstream of the dam are provided in Figures 5-13 to 5-18, showing how the flood stage for the proposed increases in winter pool will compare to baseline.



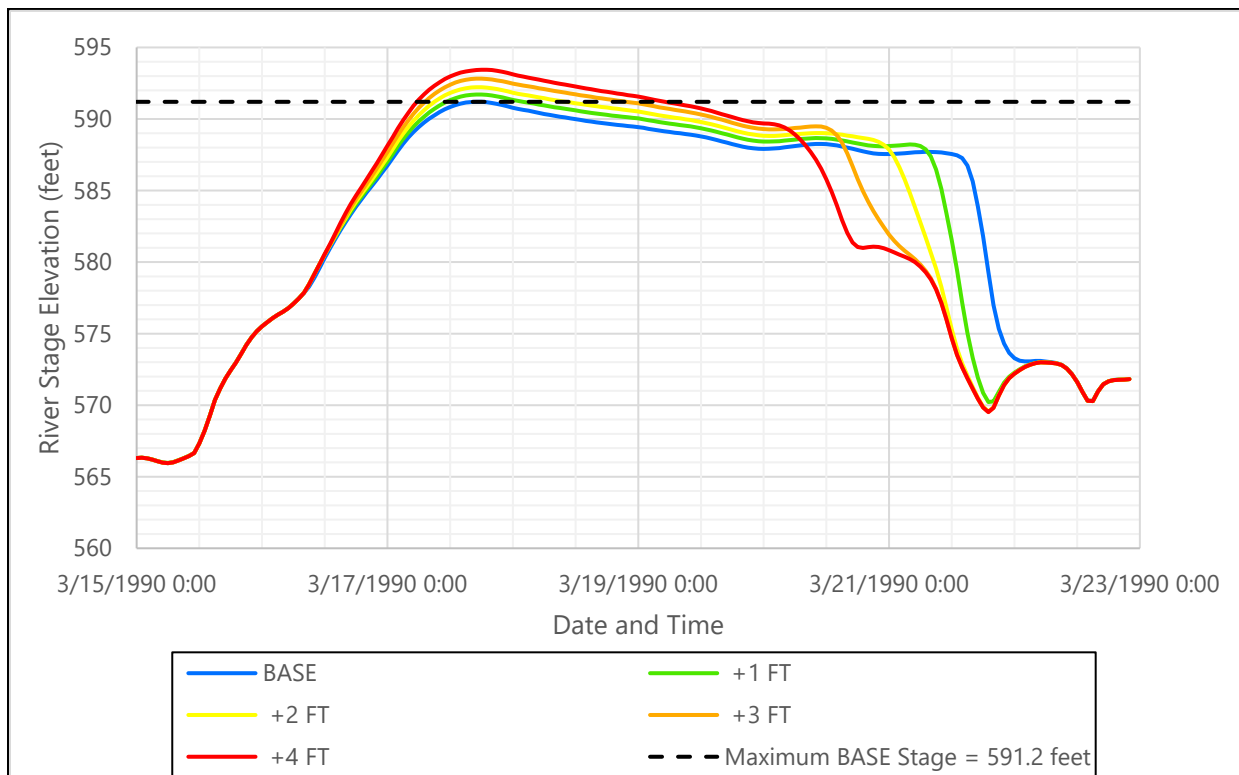
**Figure 5-13 Tallapoosa River Stage Hydrographs at RM 129.7 (Malone) from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**



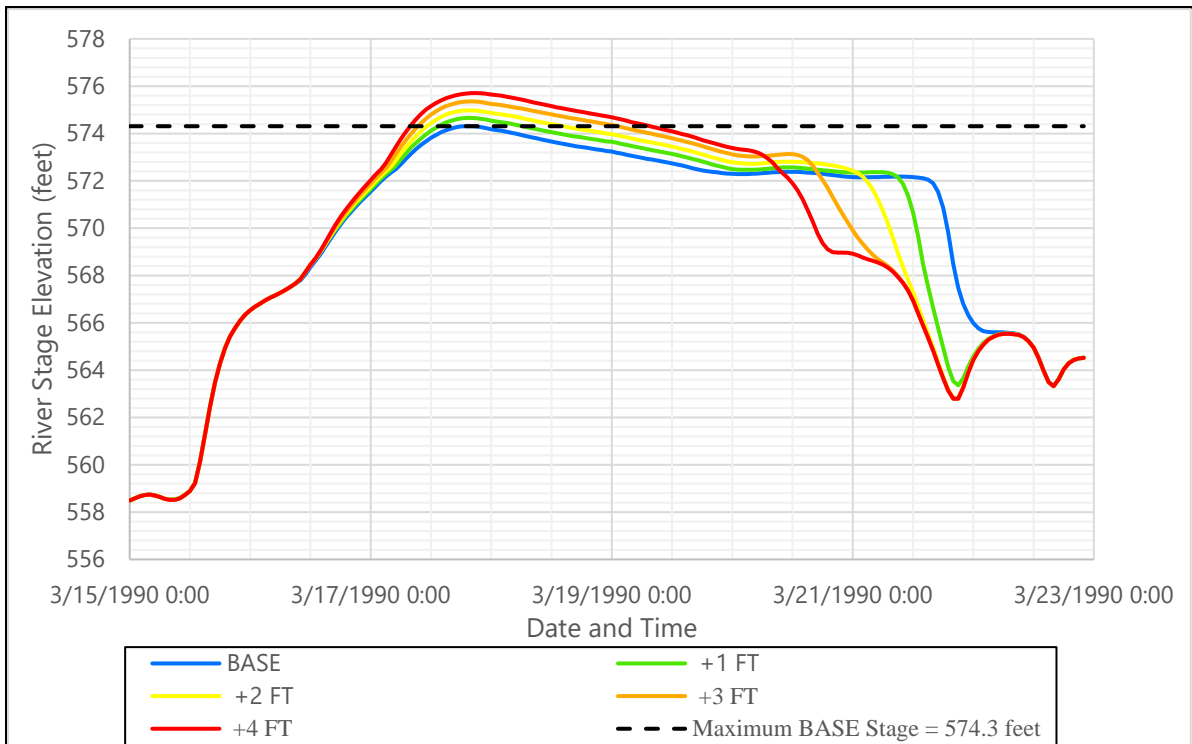
**Figure 5-14 Tallapoosa River Stage Hydrographs at RM 122.7 (Wadley) from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**



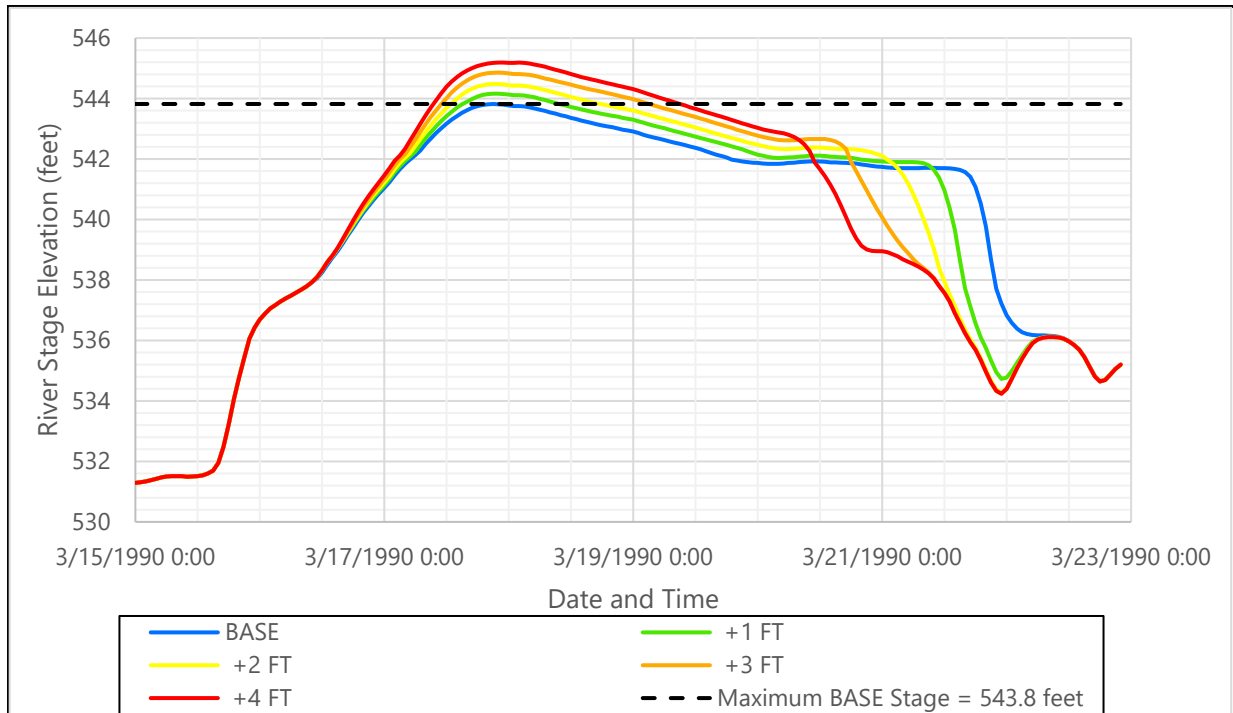
**Figure 5-15 Tallapoosa River Stage Hydrographs at RM 115.7 from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**



**Figure 5-16 Tallapoosa River Stage Hydrographs at RM 108.7 from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**



**Figure 5-17 Tallapoosa River Stage Hydrographs at RM 101.7 from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**



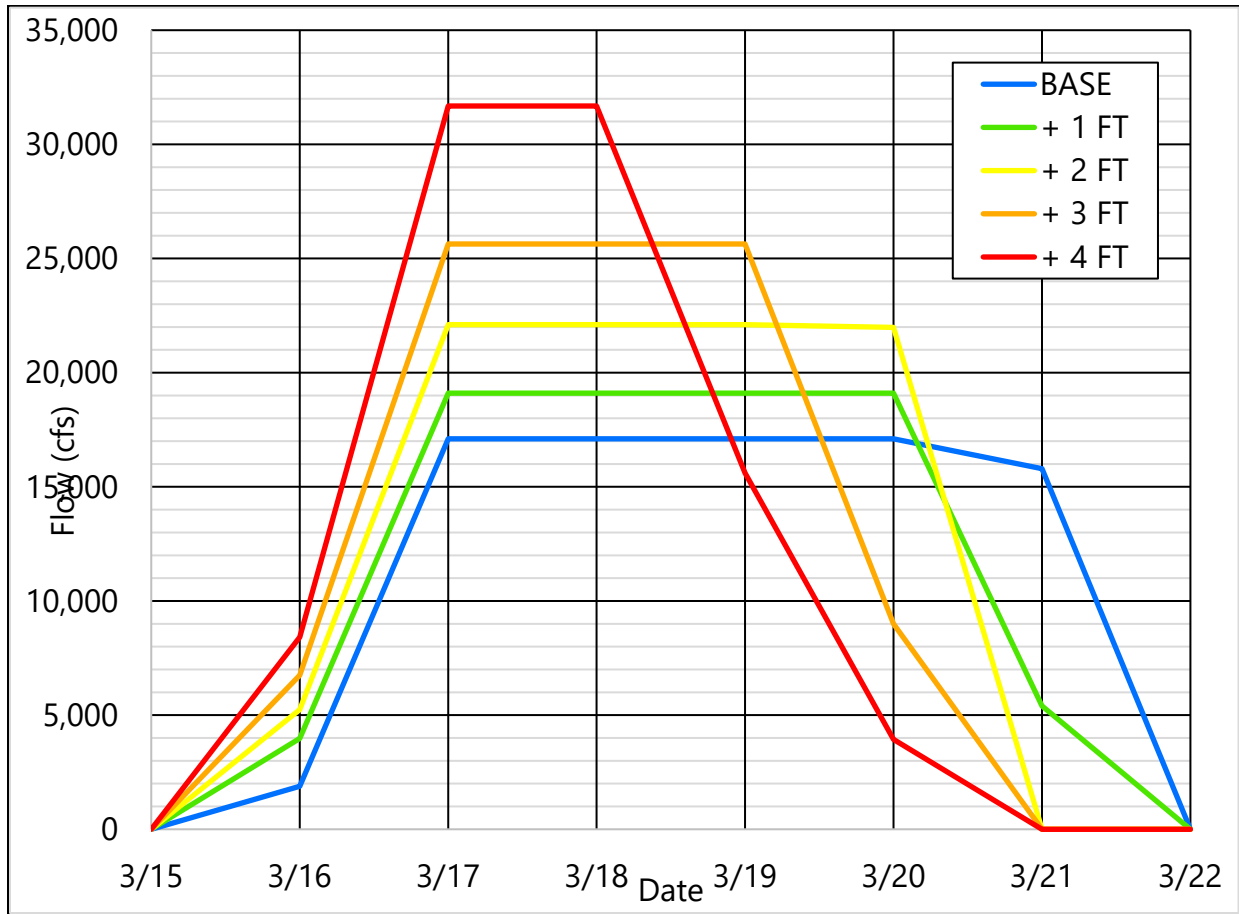
**Figure 5-18 Tallapoosa River Stage Hydrographs at RM 93.7 (Horseshoe Bend) from Results of 100-Year Design Flood in Harris-Martin HEC-RAS Model**

### **5.2.3 Period of Record Spill Analysis**

While the HEC-ResSim model closely replicates the Harris flood control procedures, the ACT unimpaired flow data used for the inflows at the reservoir are averaged over five days. This level of averaging works well for simulations over long time periods but smooths out high inflows during flood events. In contrast, the HydroBudget model uses replicated historical daily flow as inflow data, which better represents inflows during flood events than the ACT unimpaired flow data. This results in the HydroBudget more accurately capturing the flood control releases, including those released through the turbines at plant capacity, as well as through the spillway. Therefore, in addition to evaluating impacts to hydropower generation, HydroBudget is a useful tool for evaluating the increased frequency and duration of flood control operations, including spill, resulting from a change in operations. It should be noted that while HydroBudget does a very good job of evaluating impacts to hydropower generation and a satisfactory job of predicting changes to spill with varying scenarios, HEC-ResSim is still very applicable to evaluating day to day operations.

Once it was determined that the HydroBudget model provides a baseline that closely replicates historical flood control operations, it was then used to determine the increase to frequency, magnitude, and duration of operations at turbine capacity and spill days for baseline and each alternative for the period of record. Figure 5-19 demonstrates the resulting change in magnitude and duration of releases due to each 1-foot increase in winter pool for the modeled 1990 spill event.



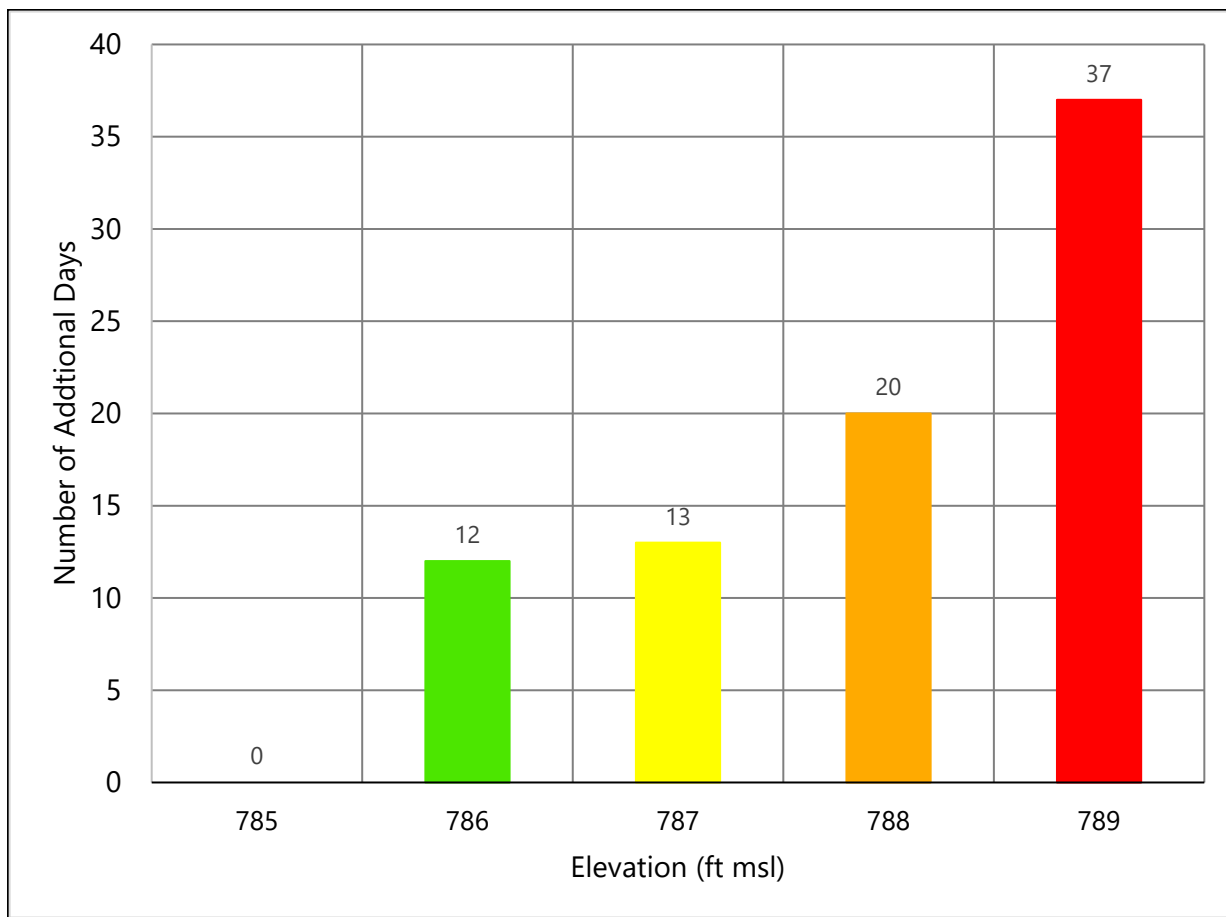


**Figure 5-19 Change in Magnitude and Duration of Release for Modeled 1990 Spill Event**

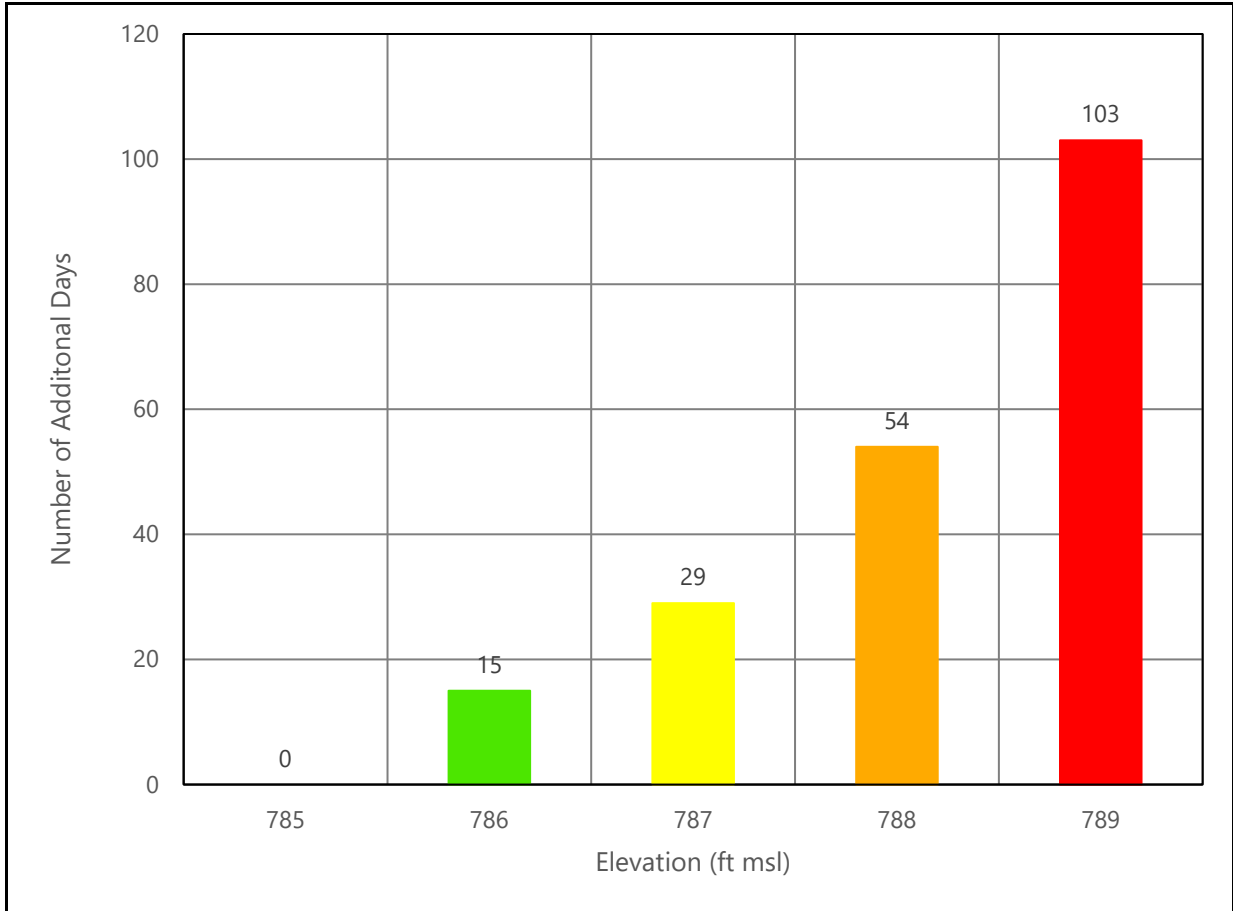
For the period of record included in the HydroBudget model (1940-2018), spill occurred at Harris 0.2 percent of the time under baseline operations. With each 1 foot increase in winter pool, the frequency of spill increases, as shown in Table 5-4. The frequency of spill with a 4 feet higher winter pool is approximately 0.2 percent higher, meaning that spill occurred at Harris approximately 0.4 percent of the time. Releases at plant capacity occurred from 0.7 percent to 1.0 percent of the time. A graphical representation of the additional days of spill and turbine capacity operations can be found in Figure 5-20 and Figure 5-21.

**Table 5-5 Percentage of Time Spent in Turbine Capacity and Spillway Operations for Each Alternative**

Elevation	Spillway Operations	Turbine Capacity
Baseline (785 feet msl)	0.2%	0.7%
+ 1 foot	0.3%	0.7%
+ 2 feet	0.3%	0.8%
+ 3 feet	0.3%	0.8%
+ 4 feet	0.4%	1.0%



**Figure 5-20 Additional Days of Spill for Each Alternative at Harris Reservoir**



**Figure 5-21 Additional Days of Capacity Operations for Each Alternative at Harris Reservoir**

### 5.3 Navigation

Each of the alternatives were evaluated to determine impacts to navigation releases (Table 5-6) The number of days over the period of record that each alternative supported a navigation channel of 9 feet, 7.5 feet, or no navigation, were compared. No changes were found to the amount of time that navigation channel depth was provided under each alternative. Navigation levels are triggered by inflow for the ACT basin. The required basin inflow to support each navigation channel depth includes a volume historically contributed by the storage projects on the Coosa and Tallapoosa Rivers and USACE's assumptions for dredging the navigation channel in the Alabama River. Altering the winter pool elevation at Harris would not impact this trigger.

**Table 5-6 Winter Pool Alternatives at Harris Dam and Navigation Releases**

Percentage of Time in Each Navigation Level					
Navigation Channel Depth	Baseline (785 feet msl)	+1 foot	+2 feet	+3 feet	+4 feet
9.0 feet	73%	73%	73%	73%	73%
7.5 feet	6%	6%	6%	6%	6%
None	21%	21%	21%	21%	21%

#### 5.4 Drought Operations

Alabama Power evaluated how drought operations may be positively or adversely affected by increasing the winter pool at Harris. According to ADROP, DILs are triggered based on a combination of low basin inflows, low state-line flow, and basin-wide composite storage. For each alternative, there is no significant change in the percentage of time spent over the period of record in each DIL (Table 5-7). This is likely due to the minimal additional storage that may be afforded during the winter months with a higher Harris Reservoir winter pool.

**Table 5-7 Evaluation of Drought Operations and Winter Pool Alternatives**

Percent of Time in Each Drought Intensity Level (DIL)					
DIL	Baseline (785 feet msl)	+ 1 foot	+ 2 feet	+ 3 feet	+ 4 feet
0	81%	81%	81%	81%	81%
1	13%	13%	13%	13%	14%
2	4%	4%	4%	4%	4%
3	1%	1%	1%	1%	1%

#### 5.5 Green Plan Flows

The Green Plan minimum releases from Harris were met or exceeded for the period of record for all alternatives. No changes were found in the ability to pass Green Plan flows from Harris Dam due to an increase in the winter pool. With the discharge target based on flows upstream of the reservoir at Heflin, the required releases were the same for all alternatives.

## **5.6 Downstream Release Alternatives**

Alabama Power evaluated the impact of the various alternatives on the release alternatives included in the Downstream Release Alternatives Study Plan. This included the Pre-Green Plan alternative which includes only peaking operations and an alternative replacing the Green Plan flows with a continuous minimum flow of 150 cfs. The modified Green Plan alternative with an altered release pattern was not modeled because the details of this alternative have yet to be determined. Note that the model includes a cutback in releases from Harris for the continuous minimum flow when Heflin flows are less than 50 cfs, just as it does for Green Plan flows. Model results indicated that raising the winter operating curve would not affect Alabama Power's ability to return to Pre-Green Plan operations or to pass a continuous minimum flow of 150 cfs from Harris Dam due to an increase in the winter pool.

## 6.0 CONCLUSIONS

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Alabama Power will use the information in this report and apply it to Phase 2 of the Operating Curve Change Feasibility Study Plan (Table 6-1). The Phase 1 modeling results combined with other environmental study analyses will result in a final recommendation from Alabama Power on any operating curve change at Harris.

The Phase 1 HEC-RAS modeling using the HEC-ResSim output indicates that a 1-foot increase in the winter pool elevation at the Harris Dam will result in increased area, depth, and duration of flooding at points downstream of Harris Dam. Due to the natural channel geometry, for long stretches of the Tallapoosa River there is not significantly more area affected by increases in the winter pool; however, there are increases in the areas affected by flooding where tributary streams with low lying floodplains enter the Tallapoosa River. The proposed operating curve changes not only increase inundation areas but also increase the depth of flooding. For areas affected under the baseline case, flooding is worse due to the increase in maximum flood levels (depth). Additionally, for the length of the river, the duration that the maximum baseline case flood elevations are equaled or exceeded are increased in places for more than 12 hours with a 1-foot increase in the operating curve and for more than 43 hours with a 4-foot increase in the operating curve.

**Table 6-1 Phase 2 Resource Impacts Analysis**

Resource	Method	
	Lake Harris	Tallapoosa River Downstream of Harris Dam through Horseshoe Bend
Water Quality	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>Existing information</li> <li>EFDC and HEC-ResSim</li> </ul>	<ul style="list-style-type: none"> <li>Existing information</li> <li>EFDC to evaluate potential effects on dissolved oxygen from unit discharge in the tailrace</li> </ul>
Water Use	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>Existing information - Water Quantity, Water Use, and Discharges Report</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>Existing information - Water Quantity, Water Use, and Discharges Report</li> </ul>
Erosion and Sedimentation (including invasive species)	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>FERC-approved Erosion and Sedimentation Study</li> <li>LIDAR, aerial imagery, historic photos, GIS</li> <li>Quantitative and qualitative evaluation of areas most susceptible to increase in nuisance aquatic vegetation</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>FERC-approved Erosion and Sedimentation Study</li> <li>LIDAR, aerial imagery, historic photos, GIS</li> </ul>
Aquatics	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>Existing information on the Harris Reservoir fishery</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>Other FERC approved studies as appropriate</li> </ul>
Wildlife and Terrestrial Resources- including Threatened, and Endangered Species	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>FERC-approved Threatened and Endangered Species Study</li> <li>GIS</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>FERC-approved Threatened and Endangered Species Study</li> <li>GIS</li> </ul>
Terrestrial Wetlands	<ul style="list-style-type: none"> <li>Existing reservoir wetland data</li> <li>Phase 1 results</li> <li>LIDAR, aerial imagery, expert opinions, and GIS</li> </ul>	<ul style="list-style-type: none"> <li>Existing wetlands data</li> <li>National Wetland Inventory maps</li> <li>Phase 1 results</li> <li>LIDAR, aerial imagery, expert opinions, and GIS</li> </ul>
Recreation Resources	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>FERC-approved Recreation Evaluation Study</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1 results</li> <li>FERC-approved Recreation Evaluation Study</li> </ul>

Resource	Method	
	Lake Harris	Tallapoosa River Downstream of Harris Dam through Horseshoe Bend
	<ul style="list-style-type: none"> <li>• LIDAR data</li> </ul>	<ul style="list-style-type: none"> <li>• LIDAR data</li> </ul>
Cultural Resources	<ul style="list-style-type: none"> <li>• Phase 1 results</li> <li>• LIDAR, aerial imagery, expert opinions, and GIS</li> </ul>	<ul style="list-style-type: none"> <li>• Phase 1 results</li> <li>• LIDAR, aerial imagery, expert opinions, and GIS</li> </ul>



## **APPENDIX A**

### **ACRONYMS AND ABBREVIATIONS**

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## ACRONYMS AND ABBREVIATIONS

### **A**

A&I	Agricultural and Industrial
ACFWRU	Alabama Cooperative Fish and Wildlife Research Unit
ACF	Apalachicola-Chattahoochee-Flint (River Basin)
ACT	Alabama-Coosa-Tallapoosa (River Basin)
ADCNR	Alabama Department of Conservation and Natural Resources
ADECA	Alabama Department of Economic and Community Affairs
ADEM	Alabama Department of Environmental Management
ADROP	Alabama-ACT Drought Response Operations Plan
AHC	Alabama Historical Commission
Alabama Power	Alabama Power Company
AMP	Adaptive Management Plan
ALNHP	Alabama Natural Heritage Program
APE	Area of Potential Effects
ARA	Alabama Rivers Alliance
ASSF	Alabama State Site File
ATV	All-Terrain Vehicle
AWIC	Alabama Water Improvement Commission
AWW	Alabama Water Watch

### **B**

BA	Biological Assessment
B.A.S.S.	Bass Anglers Sportsmen Society
BCC	Birds of Conservation Concern
BLM	U.S. Bureau of Land Management
BOD	Biological Oxygen Demand

### **C**

°C	Degrees Celsius or Centigrade
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulation
cfs	Cubic Feet per Second
cfu	Colony Forming Unit
CLEAR	Community Livability for the East Alabama Region
CPUE	Catch-per-unit-effort
CWA	Clean Water Act

## ***D***

DEM	Digital Elevation Model
DIL	Drought Intensity Level
DO	Dissolved Oxygen
dsf	day-second-feet

## ***E***

EAP	Emergency Action Plan
ECOS	Environmental Conservation Online System
EFDC	Environmental Fluid Dynamics Code
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act

## ***F***

°F	Degrees Fahrenheit
ft	Feet
F&W	Fish and Wildlife
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FNU	Formazin Nephelometric Unit
FOIA	Freedom of Information Act
FPA	Federal Power Act

## ***G***

GCN	Greatest Conservation Need
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning Systems
GSA	Geological Survey of Alabama

## ***H***

Harris Project	R.L. Harris Hydroelectric Project
HAT	Harris Action Team
HEC	Hydrologic Engineering Center
HEC-DSSVue	HEC-Data Storage System and Viewer
HEC-FFA	HEC-Flood Frequency Analysis
HEC-RAS	HEC-River Analysis System
HEC-ResSim	HEC-Reservoir System Simulation Model
HEC-SSP	HEC-Statistical Software Package

HDSS	High Definition Stream Survey
hp	Horsepower
HPMP	Historic Properties Management Plan
HPUE	Harvest-per-unit-effort
HSB	Horseshoe Bend National Military Park

## ***I***

IBI	Index of Biological Integrity
IDP	Inadvertent Discovery Plan
IIC	Intercompany Interchange Contract
IVM	Integrated Vegetation Management
ILP	Integrated Licensing Process
IPaC	Information Planning and Conservation
ISR	Initial Study Report

## ***J***

JTU	Jackson Turbidity Units
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## ***K***

kV	Kilovolt
kva	Kilovolt-amp
kHz	Kilohertz

## ***L***

LIDAR	Light Detection and Ranging
LWF	Limited Warm-water Fishery
LWPOA	Lake Wedowee Property Owners' Association

## ***M***

m	Meter
m <sup>3</sup>	Cubic Meter
M&I	Municipal and Industrial
mg/L	Milligrams per liter
ml	Milliliter
mgd	Million Gallons per Day
µg/L	Microgram per liter
µs/cm	Microsiemens per centimeter
mi <sup>2</sup>	Square Miles
MOU	Memorandum of Understanding

MPN	Most Probable Number
MRLC	Multi-Resolution Land Characteristics
msl	Mean Sea Level
MW	Megawatt
MWh	Megawatt Hour

## ***N***

n	Number of Samples
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory

## ***O***

OAR	Office of Archaeological Resources
OAW	Outstanding Alabama Water
ORV	Off-road Vehicle
OWR	Office of Water Resources

## ***P***

PA	Programmatic Agreement
PAD	Pre-Application Document
PDF	Portable Document Format
pH	Potential of Hydrogen
PID	Preliminary Information Document
PLP	Preliminary Licensing Proposal
Project	R.L. Harris Hydroelectric Project
PUB	Palustrine Unconsolidated Bottom
PURPA	Public Utility Regulatory Policies Act
PWC	Personal Watercraft
PWS	Public Water Supply

## ***Q***

QA/QC                      Quality Assurance/Quality Control

## ***R***

RM                          River Mile  
RTE                        Rare, Threatened and Endangered  
RV                         Recreational Vehicle

## ***S***

S                            Swimming  
SCORP                    State Comprehensive Outdoor Recreation Plan  
SCP                        Shoreline Compliance Program  
SD1                        Scoping Document 1  
SH                         Shellfish Harvesting  
SHPO                     State Historic Preservation Office  
Skyline WMA            James D. Martin-Skyline Wildlife Management Area  
SMP                        Shoreline Management Plan  
SU                         Standard Units

## ***T***

T&E                        Threatened and Endangered  
TCP                        Traditional Cultural Properties  
TMDL                      Total Maximum Daily Load  
TNC                        The Nature Conservancy  
TRB                        Tallapoosa River Basin  
TSI                         Trophic State Index  
TSS                        Total Suspended Solids  
TVA                        Tennessee Valley Authority

## ***U***

USDA                      U.S. Department of Agriculture  
USGS                      U.S. Geological Survey  
USACE                    U.S. Army Corps of Engineers  
USFWS                    U.S. Fish and Wildlife Service

***W***

WCM

WMA

WMP

WQC

Water Control Manual

Wildlife Management Area

Wildlife Management Plan

Water Quality Certification

## **APPENDIX B**

### **TALLAPOOSA RIVER BASIN FLOOD FREQUENCY ANALYSIS**

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# TALLAPOOSA RIVER BASIN FLOOD FREQUENCY ANALYSIS

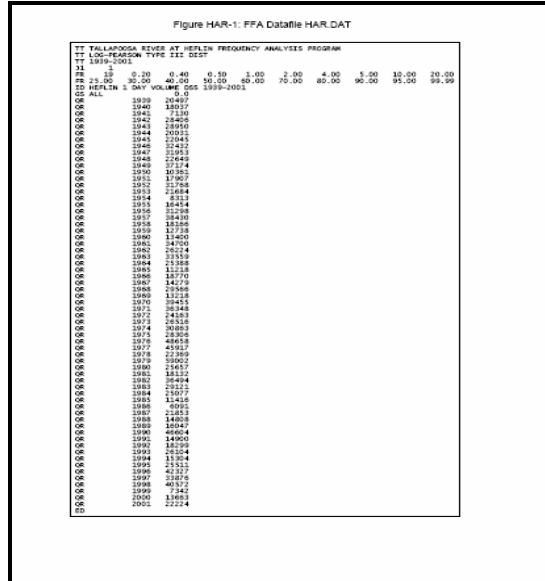
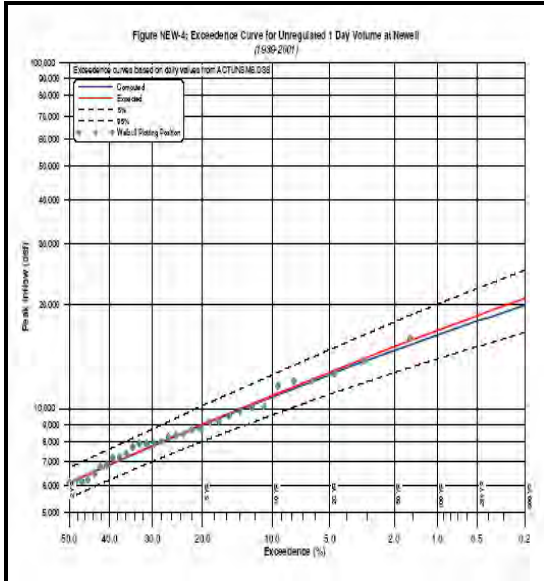
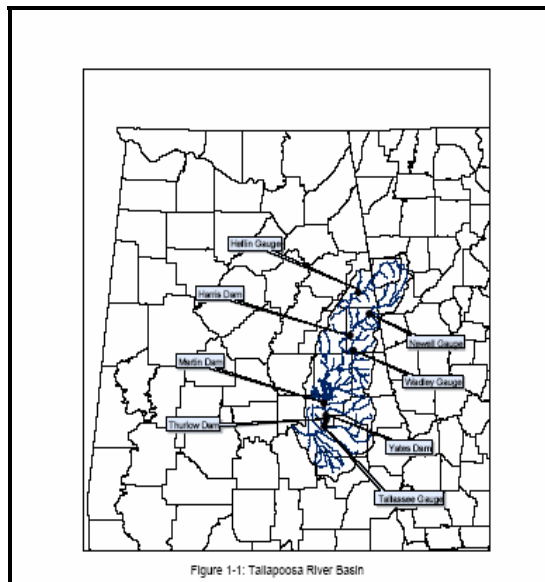


Table HAR-3: Regulation Impact on Flood Recurrences at Harris

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval (years)	Regulated Discharge (cfs)	Recurrence Interval (years)
1976		48,658	10	46,935	10
1977		48,917	10	46,110	10
1978		23,268	1	22,028	1
1979		59,002	50	59,073	50
1980		28,837	2	24,369	2
1981		18,382	1	17,875	1
1982		36,494	5	34,625	5
1983	11/7/83	28,121	2	28,793	2
1984	9/3/84	25,077	2	18,880	1
1985	5/6/85	11,418	1	11,780	1
1986	11/7/86	6,291	1	6,862	1
1987	3/2/87	21,883	1	14,060	1
1988	11/2/88	14,828	1	11,763	1
1989	6/23/89	18,027	1	14,270	1
1990	3/17/90	42,604	10	38,960	5
1991	2/21/91	14,204	1	14,560	1
1992	12/1/92	18,299	1	13,434	1
1993	3/8/93	26,144	2	13,058	1
1994	7/28/94	18,304	1	10,585	1
1995	10/6/95	25,511	2	18,305	1
1996	2/3/96	43,251	10	18,932	1
1997	3/2/97	33,878	2	24,824	2
1998	3/12/98	43,625	1	24,184	2
1999	6/28/99	7,242	1	7,198	1
2000	4/4/00	13,683	1	13,938	1
2001	3/24/01	22,224	1	12,445	1



**Southern Company**  
Southern Company Generation  
Hydro Services  
Reservoir Management

## **INTRODUCTION**

This report describes the flood frequency analysis for rivers of the Tallapoosa River Basin from headwaters of the Tallapoosa River and Little Tallapoosa River in north Georgia to just below the Thurlow Dam at Tallassee, Alabama.

Recurrence intervals for one up to 500 years were determined of flow records by fitting a Pearson Type III frequency distribution curve to the logarithms of the annual daily peak flows and also to annual peak flood volumes for the years 1939 through 2001. These frequency distributions were determined for four Alabama Power Company hydro projects and also for four gauge sites in the Tallapoosa River Basins. Procedures as contained in Bulletin #17B, "Guidelines for Determining Flood Flow Frequency, March 1982" and the U S Army Corps of Engineers' Engineering Manual, "Hydrologic Frequency Analysis, EM 1110-2-1415, March 1993" were employed in these determinations. Also, the 1992 version of the COE's computer model, HEC-FFA (Flood Frequency Analysis) was used in determining flow frequencies.

## **DRAINAGE BASIN DESCRIPTION**

The Tallapoosa River Basin begins in Northwest Georgia and flows southwest where it terminates in the south central portion of Alabama. In Northwest Georgia, there are two headwater rivers, Tallapoosa River, Haralson County, and Little Tallapoosa River, Carroll County. From Carroll County, the Little Tallapoosa River flows 88 miles downstream to join the Tallapoosa River. Ten miles downstream of the confluence of the Tallapoosa and Little Tallapoosa Rivers is Harris Dam, Alabama Power Company's hydro project. The Tallapoosa River Basin has a drainage area of 1,453 square miles at this point.

From Harris Dam, the Tallapoosa River flows 78.5 miles downstream to the largest reservoir on the system formed by Martin Dam. Immediately downstream are two additional hydro plants, Yates and Thurlow. The Tallapoosa River Basin has 3,308 square miles to this point; the total drainage area of the basin is 4,675 square miles. Forty-seven miles downstream is the confluence of the Tallapoosa and Coosa Rivers to form the Alabama River. The Tallapoosa River Basin has a varied composition of basin characteristics with forest cover, agricultural lands and urban areas. There have been changes in this drainage basin during this study time period. There have also been changes in agriculture practices that impact runoff characteristics. However, these changes have not been measured and are not addressed in this study.

With four major dams in the Tallapoosa River Basin, flood flows are impacted considerably. Due to this large degree of regulation and the fact that these projects have been constructed at differing times during the last ninety years presents difficulties in developing a database for determining flood frequencies. Technical Bulletin #17B states that its procedures for determining flood flow frequencies do not cover watersheds where flood flows have been appreciably altered by regulation. The following describes how this and other flow record problems have been addressed.

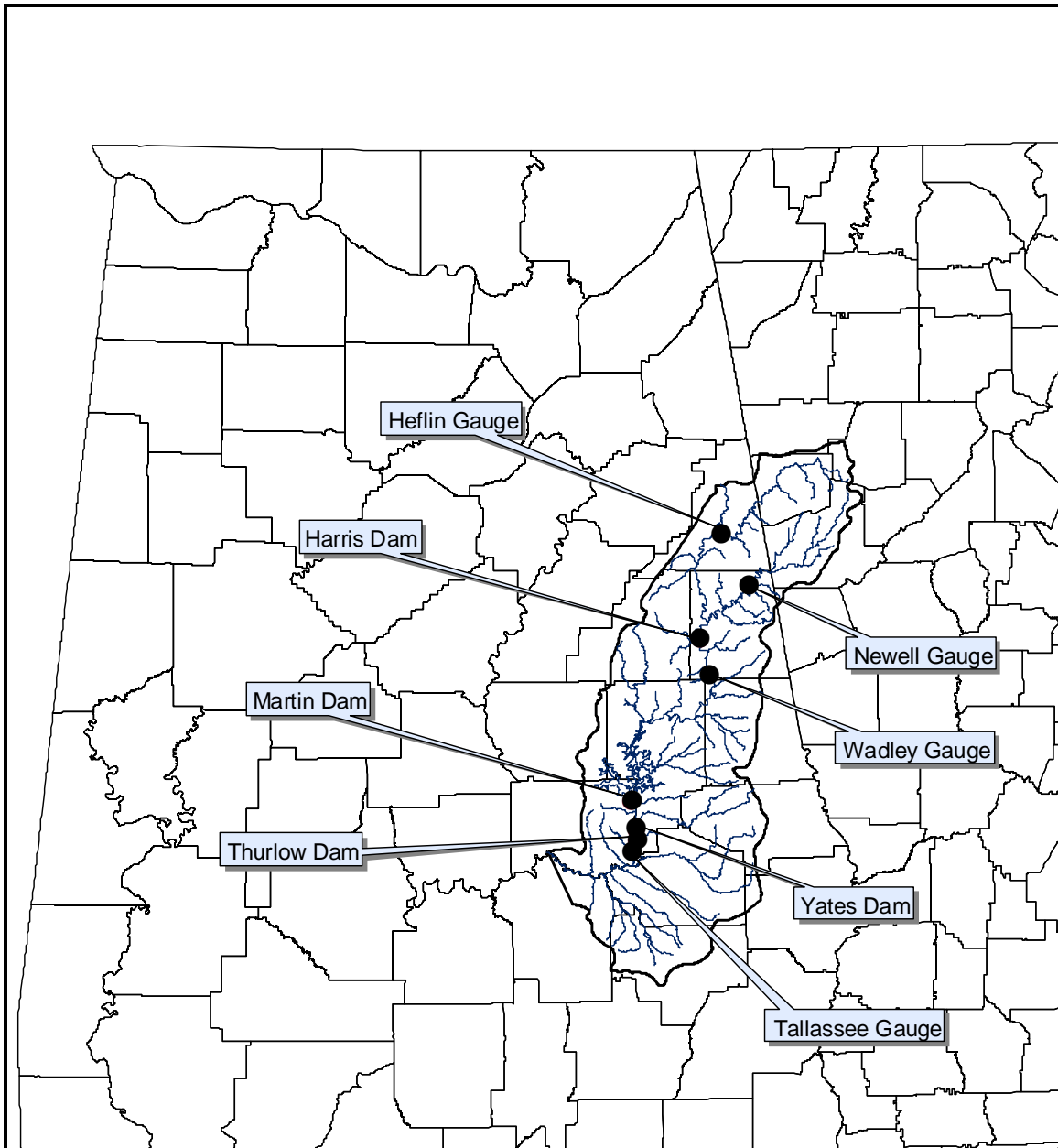


Figure 1-1: Tallapoosa River Basin

**DATA**

In the 1990's the Mobile District COE developed an unimpaired flow daily record for points along major rivers in the Alabama-Coosa-Tallapoosa (ACT) River Basins. This daily flow data set, which was updated in 2002, covers a period from 1939 through 2001 and was prepared for surface water models conducted in the tri-state water compact negotiations. The COE's dataset covers the entire ACT Basin which provides a uniform dataset for each reservoir along the Coosa River.

From the COE's 1997 report, ACT/ACF Comprehensive Water Resources Study – Surface Water Availability: Unimpaired Flow, unimpaired flows are defined as,

*“. . . historically observed flows adjusted for human influence by accounting for the construction of surface water reservoirs and for withdrawals and returns to serve municipal, industrial, thermal power, and agricultural water uses”.*

Basically, the COE removed augmentation to river flows from the potential sources as listed above. Reservoir regulation can significantly alter both high and low flows in the river, which will skew any statistical analysis. The purpose for the COE developing this data set was for input to reservoir system models (e.g., HEC-5) to assist in evaluations that took place in the ACT/ACF Comprehensive Study. By the COE developing an unimpaired daily flow dataset for the ACT/ACF Comprehensive Study, they have also created a useful dataset for analyzing statistical flows.

In the COE's compiling daily flow records, missing records were transposed from nearby records, and routing coefficients were developed for each river reach. Most surface water models were primarily concerned with either dry or drought conditions, so most of this data set was smoothed in order to avoid any negative flow numbers. However, this dampens high flow conditions. In order that this flow data set maybe useful for flood frequency analyses, the smoothing of flow values was removed from the data. This was accomplished by modifying the DSSMATH macros which were developed by the Mobile District COE to construct unimpaired flows as contained in their cumulative flow dataset, ACTCUM6.DSS. Appendix I contains the macros as developed by the Mobile District COE. Appendix II contains the modified macros used to develop a non-smoothed cumulative dataset, ACTUNSM6.DSS, which was used in these flood frequency analyses.

Another useful application of unimpaired flow datasets is that they can provide the means of evaluating the effects of reservoir regulation. This can be achieved by comparing two approaches. One approach is to route the unimpaired flows (by modeling with HEC-RAS) without any reservoirs in place to provide an evaluation of the effects that regulation has had on specific historical flood events. Another approach is to route these same unimpaired flows in a river with reservoirs in place and with altered reservoir flood control procedures to evaluate if these altered procedures might provide a more optimum condition. By comparing the results of these two approaches, differences of elevations and differences of flow hydrographs can be determined.

In order that the unimpaired flow datasets may be used for river routings, it is necessary to change the time step of the data from daily to hourly. This can be approached in a two step process. First, using utility portion of the COE's program DSSVUE, the time step can be changed from daily to hourly. However,

this creates a 'stair-step' in the data. Thus, an algorithm needs to be applied to smooth these hourly values without reducing the peaks. Appendix III contains the mathematical basis for smoothing hourly values without reducing the peaks.

The primary locations in the Tallapoosa River Basin as defined in the COE's dataset are at the four gauge locations Heflin, Newell, Wadley, and Tallassee) and four Alabama Power Company hydro facilities (Harris, Martin, Thurlow, and Yates Dam).

There several reasons for using the unimpaired daily flow data set as developed by the Mobile District COE (after the data has been unsmoothed). One reason is that Bulletin #17B states that its procedures "do not cover watersheds where flood flows are appreciably altered by reservoir regulation..." The use of the COE's dataset addresses that point. Another reason for using the COE's dataset is that it covers sixty-one years. A longer length of record provides greater accuracy and confidence in the results. It is also important to cover more than one hydrologic cycle. In the Southeastern United States, the drought to drought hydrologic cycle has a length of approximately thirty years.

The COE's manual, "Hydrologic Frequency Analysis, EM 1110-2-1415, March 1993", also provides that frequency analysis may be performed on peak annual flood volumes in a similar fashion as laid out Bulletin #17B for peak annual flows. Peak annual three-day and five-day volumes were obtained by taking running three-day and five-day summations of flows of the unimpaired flow data sets.

A regional skew coefficient is necessary in determining a log Pearson Type III frequency distribution. Bulletin #17B, "Guidelines for Determining Flood Flow Frequency, March 1982", provides such regional skew coefficients. From Plate I, Figure 14-1, 'Generalize Skew Coefficients of Annual Maximum Streamflow Logarithms' in this bulletin, the regional skew coefficient is '0.0' for the Tallapoosa River Basin. Figure 2 illustrates the generalized skew coefficients from Bulletin #17B.

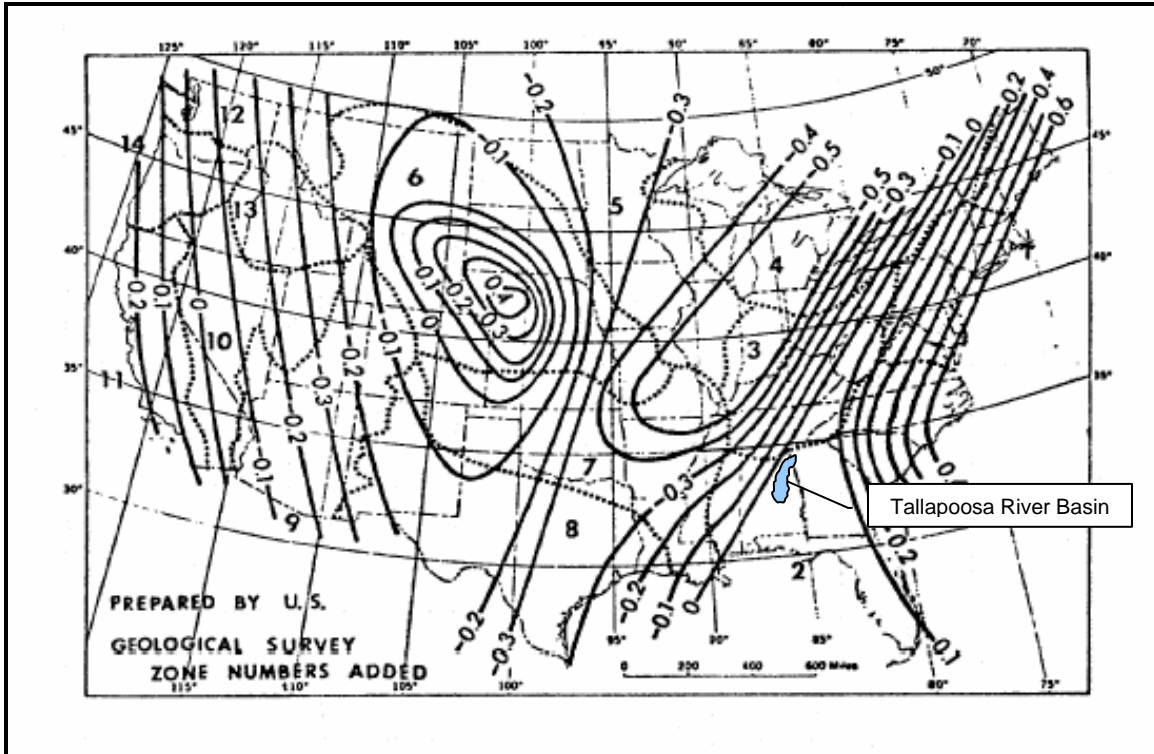


Figure 2: Generalized Skew Coefficients for Tallapoosa River Basin

## ANALYSIS

The following tabs in this report list the datasets which were used in the HEC-FFA program to determine the flood frequencies for each location within the Tallapoosa Basin. These datasets are for the one day peak annual flow and also for three and five day volume peak annual flows. These datasets cover sixty-three years of records for periods of 1939 through 2001. There is no instantaneous peak flow values used in these datasets; each dataset reflects daily flow values. From these datasets, HEC-FFA provides a computed log-Pearson Type III frequency distributions for recurrence intervals of one up to 500 years.

Confidence limits for the recurrence intervals were determined by the HEC-FFA program. Additionally, Weibull plotting positions are provided for each ranked annual flood event. Weibull plotting positions do not necessarily represent the recurrence interval for each respective annual peak flow, but they do provide a validating comparison with the frequency distribution curve. Results for the peak daily flow frequency are illustrated in tables and charts for each location under its respective Tab. Results for the peak volume frequencies are also illustrated.

Flood frequency curves that are based on a log-Pearson Type III distribution contain a bias which is due to the statistical computations being based on a finite number of data ordinates. Bulletin #17B discusses procedures for eliminating this bias by an adjustment called an 'expected probability adjustment'. HEC-FFA

performs this adjustment with results shown in Summary Tables under the heading, 'Expected Probability' for the 1, 2, 5, 10, 25, 50, 100, 250 and 500 year daily peak floods for the each location within the Tallapoosa Basin. Also contained in each tab is a table which shows the degree of flood flow augmentation afforded by the storage projects in the Tallapoosa Basin since 1983, which is the year that the last project (Harris) was completed in the Tallapoosa Basin. The following charts illustrate flood frequencies for the Tallapoosa Basin for the one, three and five day volume peak annual floods. Also in these charts are several major historical floods to compare with the frequencies. These historical floods provide a perspective to the magnitude of several recent floods (i.e., the April of 1979 and the February and March floods of 1990) and also illustrate that major historical floods may not be of the same magnitude uniformly within a river basin. This aspect is significant as flood control procedures are evaluated for it illustrates the need for flood control procedures to be flexible in order to maximize the flood control capabilities that the reservoirs may provide.

Figure 3: Unregulated 1 Day Volume Flood Recurrence

Location	RM	10YR	25YR	50YR	100YR	250 YR	500 YR	Apr-79	Feb-90	Modify Apr-79	Modify Mar-90
Heflin	186.62	14,300	18,400	21,500	24,900	29,500	33,300	22,202	22,202	12%	12%
Newell	182.27	10,800	13,100	14,700	16,300	18,300	19,900	9,137	11,613	78%	40%
Harris	139.10	41,100	49,500	55,500	61,200	66,600	73,500	59,002	46,604	4%	31%
Wadley	120.00	48,000	58,500	66,100	73,500	80,800	90,300	68,567	75,976	7%	-3%
Martin	60.60	86,100	103,000	116,000	128,000	143,000	155,000	114,551	125,019	12%	2%
Yates	52.70	89,100	108,000	122,000	136,000	154,000	167,000	114,552	141,920	19%	-4%
Thurlow	49.70	90,400	108,000	121,000	134,000	150,000	162,000	104,491	140,790	28%	-5%
Tallassee	47.98	90,600	109,000	122,000	134,000	150,000	162,000	105,151	141,539	27%	-5%

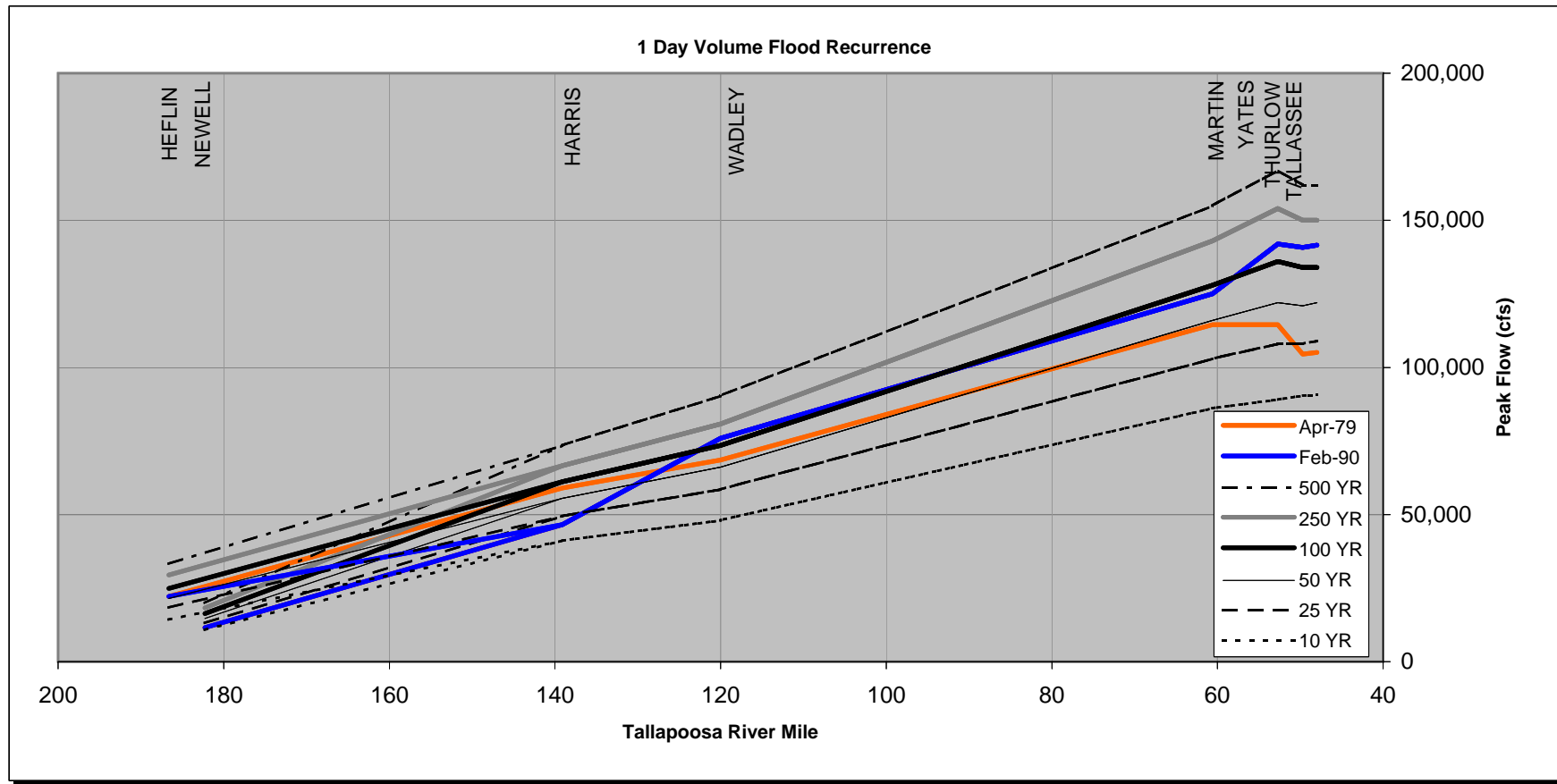




Figure 4: Unregulated 3 Day Volume Flood Recurrence

Location	RM	10YR	25YR	50YR	100YR	250 YR	500 YR	Apr-79	Feb-90	Modify Apr-79	Modify Mar-90
Heflin	186.62	36,400	47,100	55,600	64,500	77,100	87,300	56,106	56,206	15%	15%
Newell	182.27	27,400	33,000	36,900	40,600	45,300	48,800	25,341	30,215	60%	34%
Harris	139.10	96,400	117,000	132,000	147,000	162,000	181,000	133,820	127,368	10%	15%
Wadley	120.00	113,000	138,000	156,000	174,000	191,000	214,000	153,693	175,176	13%	-1%
Martin	60.60	198,000	244,000	278,000	313,000	360,000	396,000	277,337	310,830	13%	1%
Yates	52.70	203,000	252,000	290,000	329,000	382,000	423,000	277,340	353,516	19%	-7%
Thurlow	49.70	206,000	253,000	288,000	323,000	370,000	407,000	245,692	351,594	31%	-8%
Tallassee	47.98	207,000	254,000	289,000	324,000	371,000	408,000	245,574	351,594	32%	-8%

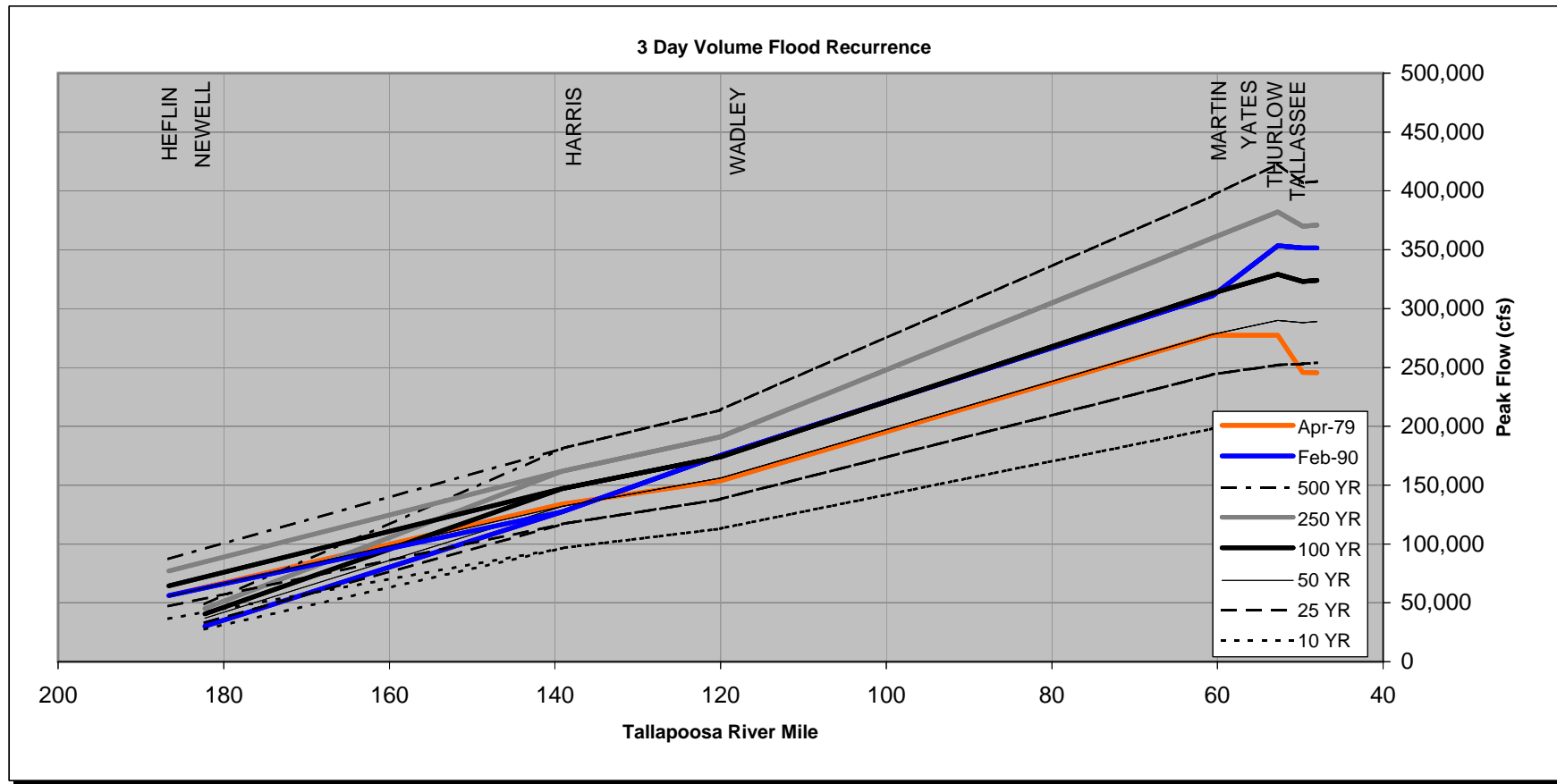


Figure 5: Unregulated 5 Day Volume Flood Recurrence

Location	RM	10YR	25YR	50YR	100YR	250 YR	500 YR	Apr-79	Feb-90	Modify Apr-79	Modify Mar-90
Heflin	186.62	45,100	58,800	70,200	82,700	101,000	117,000	64,100	68,110	29%	21%
Newell	182.27	36,100	43,200	48,300	53,100	59,100	63,500	32,195	42,111	65%	26%
Harris	139.10	129,000	157,000	177,000	197,000	216,000	241,000	173,229	174,227	14%	13%
Wadley	120.00	152,000	187,000	213,000	239,000	264,000	299,000	199,244	235,281	20%	2%
Martin	60.60	260,000	320,000	365,000	410,000	471,000	518,000	341,312	392,413	20%	4%
Yates	52.70	264,000	323,000	368,000	413,000	473,000	519,000	341,317	433,854	21%	-5%
Thurlow	49.70	269,000	330,000	375,000	420,000	481,000	528,000	307,886	431,496	36%	-3%
Tallassee	47.98	270,000	331,000	376,000	422,000	483,000	530,000	307,886	431,496	37%	-2%

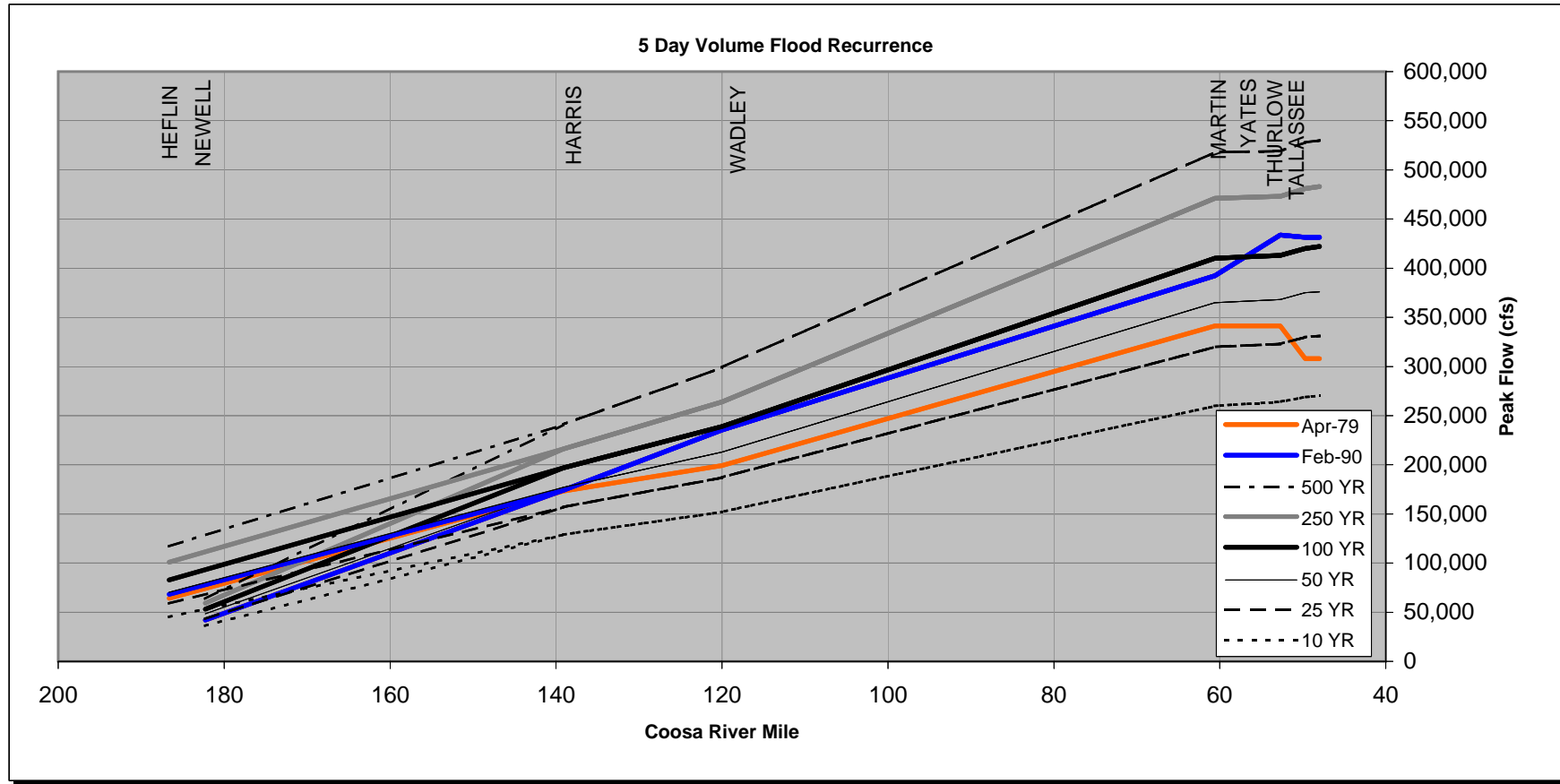


Figure HEF-1: FFA Datfile HEF.DAT

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FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID HEFLIN DSS 1939-2001
GS ALL 0.0
QR 1939 4481
QR 1940 4550
QR 1941 2087
QR 1942 9520
QR 1943 8722
QR 1944 6100
QR 1945 4020
QR 1946 10090
QR 1947 11173
QR 1948 6841
QR 1949 13168
QR 1950 3090
QR 1951 7126
QR 1952 9577
QR 1953 7931
QR 1954 6721
QR 1955 4501
QR 1956 6781
QR 1957 8501
QR 1958 4591
QR 1959 6421
QR 1960 4822
QR 1961 17502
QR 1962 8702
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QR 1969 3662
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QR 1973 7902
QR 1974 9292
QR 1975 6522
QR 1976 13102
QR 1977 30202
QR 1978 6732
QR 1979 22202
QR 1980 7982
QR 1981 5591
QR 1982 17601
QR 1983 7792
QR 1984 10002
QR 1985 4492
QR 1986 1702
QR 1987 6612
QR 1988 4752
QR 1989 5744
QR 1990 22202
QR 1991 6662
QR 1992 6352
QR 1993 6342
QR 1994 5594
QR 1995 7805
QR 1996 11906
QR 1997 8545
QR 1998 9245
QR 1999 2908
QR 2000 5085
QR 2001 6985
ED

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Figure HEF-3: FFA Datafile HEF5.DAT

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TT TALLAPOOSA RIVER AT HEFLIN FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 5 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID HEFLIN 5 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 17533
QR 1940 16467
QR 1941 8965
QR 1942 29451
QR 1943 31435
QR 1944 18257
QR 1945 12563
QR 1946 38195
QR 1947 37773
QR 1948 23307
QR 1949 52787
QR 1950 9752
QR 1951 21768
QR 1952 28813
QR 1953 25545
QR 1954 18606
QR 1955 13065
QR 1956 23545
QR 1957 27705
QR 1958 13885
QR 1959 19655
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QR 1963 25830
QR 1964 26710
QR 1965 13060
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QR 1982 51325
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QR 1985 15150
QR 1986 5167
QR 1987 20268
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ED

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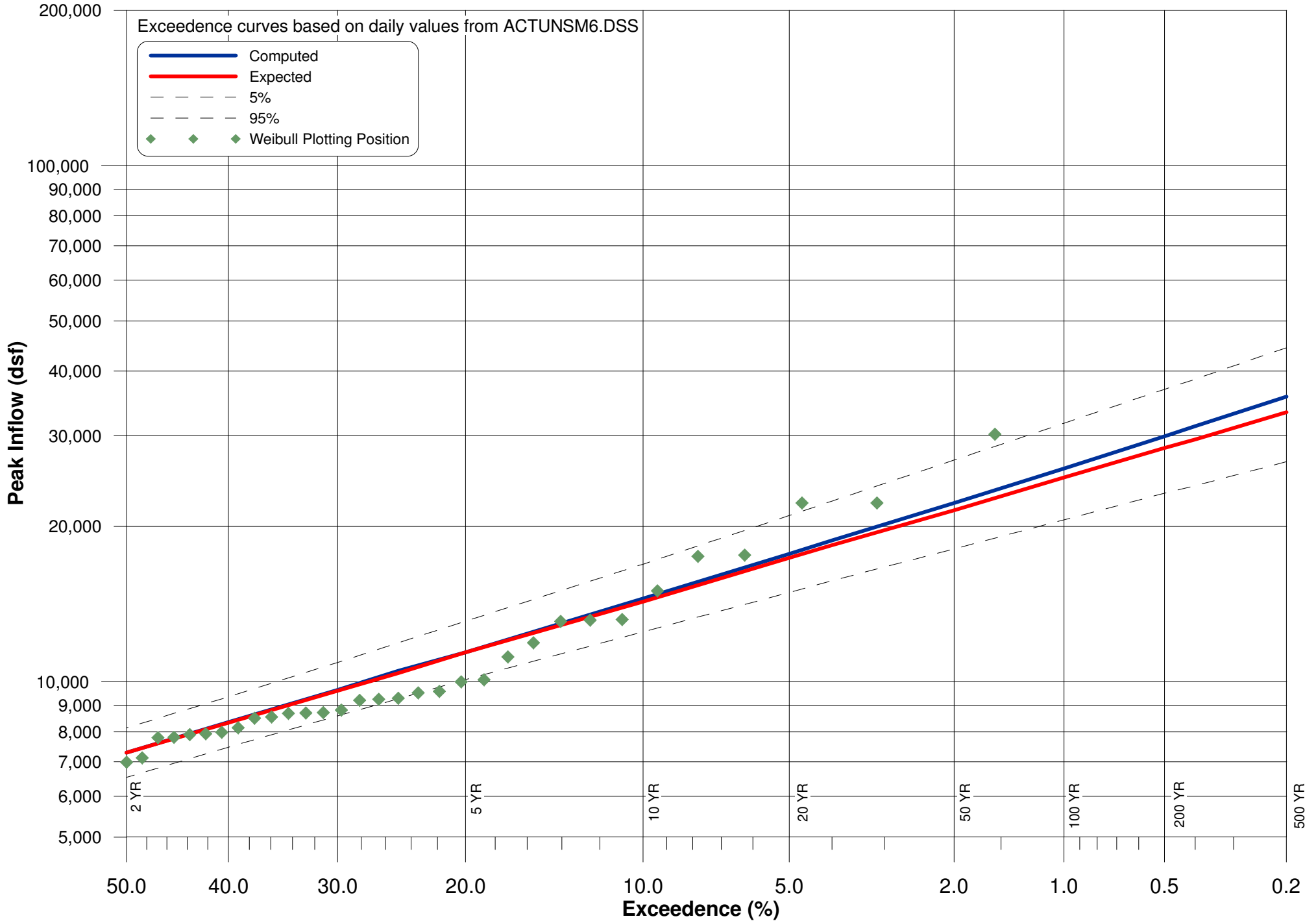
Table HEF-1: Rankings of Flood Events at Heflin

HELFIN			
Rank	Yr	Flow (cfs)	Position
1	1977	30,202	1.56
2	1979	22,202	3.13
3	1990	22,202	4.69
4	1982	17,601	6.25
5	1961	17,502	7.81
6	1968	15,002	9.38
7	1970	13,202	10.94
8	1949	13,168	12.50
9	1976	13,102	14.06
10	1996	11,906	15.63
11	1947	11,173	17.19
12	1946	10,090	18.75
13	1984	10,002	20.31
14	1952	9,577	21.88
15	1942	9,520	23.44
16	1974	9,292	25.00
17	1998	9,245	26.56
18	1963	9,202	28.13
19	1967	8,812	29.69
20	1943	8,722	31.25
21	1962	8,702	32.81
22	1972	8,682	34.38
23	1997	8,545	35.94
24	1957	8,501	37.50
25	1964	8,152	39.06
26	1980	7,982	40.63
27	1953	7,931	42.19
28	1973	7,902	43.75
29	1995	7,805	45.31
30	1983	7,792	46.88
31	1951	7,126	48.44
32	2001	6,985	50.00
33	1948	6,841	51.56
34	1956	6,781	53.13
35	1978	6,732	54.69
36	1954	6,721	56.25
37	1991	6,662	57.81
38	1966	6,622	59.38
39	1987	6,612	60.94
40	1975	6,522	62.50
41	1959	6,421	64.06
42	1992	6,352	65.63
43	1993	6,342	67.19
44	1971	6,102	68.75
45	1944	6,100	70.31
46	1989	5,744	71.88
47	1994	5,594	73.44
48	1981	5,591	75.00
49	2000	5,085	76.56
50	1960	4,822	78.13
51	1988	4,752	79.69
52	1958	4,591	81.25
53	1940	4,550	82.81
54	1955	4,501	84.38
55	1985	4,492	85.94
56	1939	4,481	87.50
57	1945	4,020	89.06
58	1965	3,972	90.63
59	1969	3,662	92.19
60	1950	3,090	93.75
61	1999	2,908	95.31
62	1941	2,087	96.88
63	1986	1,702	98.44

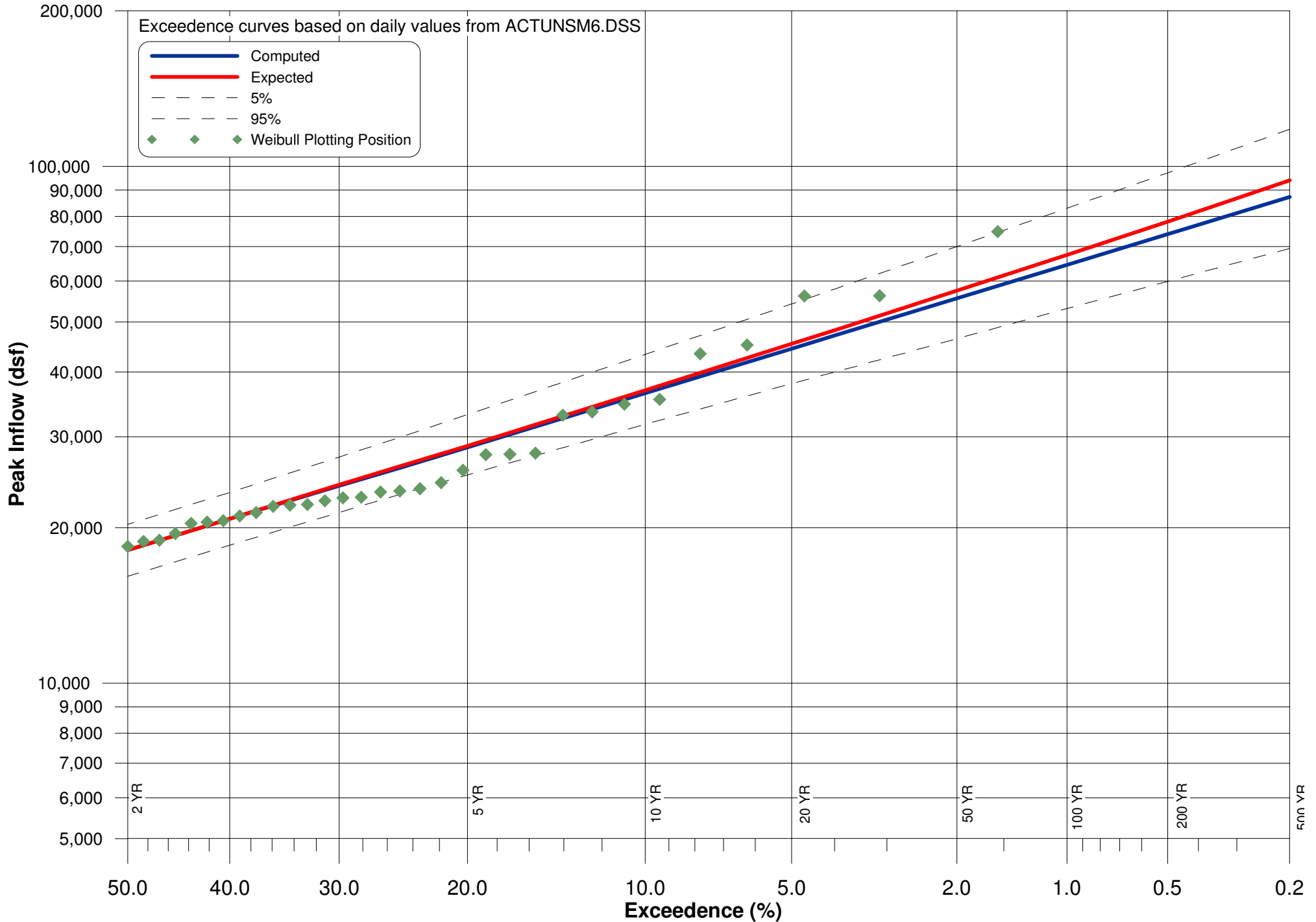
HELFIN - 3 DAY			
Rank	Yr	Flow (cfs)	Position
1	1977	74,806	1.56
2	1990	56,206	3.13
3	1979	56,106	4.69
4	1961	45,106	6.25
5	1982	43,403	7.81
6	1949	35,400	9.38
7	1976	34,686	10.94
8	1970	33,506	12.50
9	1996	33,018	14.06
10	1947	27,876	15.63
11	1968	27,736	17.19
12	1984	27,696	18.75
13	1946	25,824	20.31
14	1998	24,435	21.88
15	1974	23,786	23.44
16	1942	23,544	25.00
17	1967	23,436	26.56
18	1943	22,917	28.13
19	1972	22,846	29.69
20	1962	22,546	31.25
21	1997	22,185	32.81
22	1952	22,108	34.38
23	1964	21,996	35.94
24	1963	21,386	37.50
25	1953	21,073	39.06
26	1995	20,625	40.63
27	1957	20,503	42.19
28	1980	20,376	43.75
29	1973	19,486	45.31
30	1951	18,910	46.88
31	1983	18,806	48.44
32	1956	18,403	50.00
33	1959	17,163	51.56
34	1966	17,066	53.13
35	1978	17,026	54.69
36	1948	16,938	56.25
37	2001	16,725	57.81
38	1975	16,586	59.38
39	1987	16,475	60.94
40	1991	16,256	62.50
41	1954	15,973	64.06
42	1971	15,566	65.63
43	1992	15,296	67.19
44	1993	15,106	68.75
45	1944	14,242	70.31
46	1989	13,832	71.88
47	1939	13,244	73.44
48	1981	12,383	75.00
49	1960	12,156	76.56
50	1985	11,456	78.13
51	1994	11,302	79.69
52	1958	11,103	81.25
53	2000	10,905	82.81
54	1988	10,876	84.38
55	1940	10,736	85.94
56	1969	9,986	87.50
57	1955	9,783	89.06
58	1965	9,086	90.63
59	1945	8,987	92.19
60	1950	7,498	93.75
61	1999	6,824	95.31
62	1941	5,344	96.88
63	1986	3,895	98.44

HELFIN - 5 DAY			
Rank	Yr	Flow (cfs)	Position
1	1977	86,440	1.56
2	1990	68,110	3.13
3	1979	64,100	4.69
4	1961	62,610	6.25
5	1949	52,787	7.81
6	1982	51,325	9.38
7	1970	41,090	10.94
8	1976	40,730	12.50
9	1996	40,270	14.06
10	1984	38,200	15.63
11	1946	38,195	17.19
12	1947	37,773	18.75
13	1968	34,610	20.31
14	1998	31,955	21.88
15	1943	31,435	23.44
16	1974	29,730	25.00
17	1967	29,460	26.56
18	1942	29,451	28.13
19	1972	29,440	29.69
20	1997	29,245	31.25
21	1952	28,813	32.81
22	1962	28,710	34.38
23	1995	28,105	35.94
24	1957	27,705	37.50
25	1964	26,710	39.06
26	1966	26,610	40.63
27	1980	25,930	42.19
28	1963	25,830	43.75
29	1953	25,545	45.31
30	1983	24,430	46.88
31	1973	23,990	48.44
32	1956	23,545	50.00
33	1948	23,307	51.56
34	1975	22,060	53.13
35	1978	21,810	54.69
36	1951	21,768	56.25
37	1991	21,560	57.81
38	1971	20,690	59.38
39	1987	20,268	60.94
40	1959	19,655	62.50
41	2001	19,415	64.06
42	1992	18,620	65.63
43	1954	18,606	67.19
44	1944	18,257	68.75
45	1993	18,160	70.31
46	1939	17,533	71.88
47	1989	17,050	73.44
48	1940	16,467	75.00
49	1960	15,380	76.56
50	1985	15,150	78.13
51	1981	14,648	79.69
52	1969	13,970	81.25
53	1958	13,885	82.81
54	2000	13,125	84.38
55	1955	13,065	85.94
56	1965	13,060	87.50
57	1994	12,974	89.06
58	1988	12,950	90.63
59	1945	12,563	92.19
60	1999	10,195	93.75
61	1950	9,752	95.31
62	1941	8,965	96.88
63	1986	5,167	98.44

**Figure HEF- 4: Exceedence Curve for Unregulated 1 Day Volume at Heflin**  
(1939-2001)



**Figure HEF- 5: Exceedence Curve for Unregulated 3 Day Volume at Heflin**  
(1939-2001)





**Figure HEF- 6: Exceedence Curve for Unregulated 5 Day Volume at Heflin**  
*(1939-2001)*

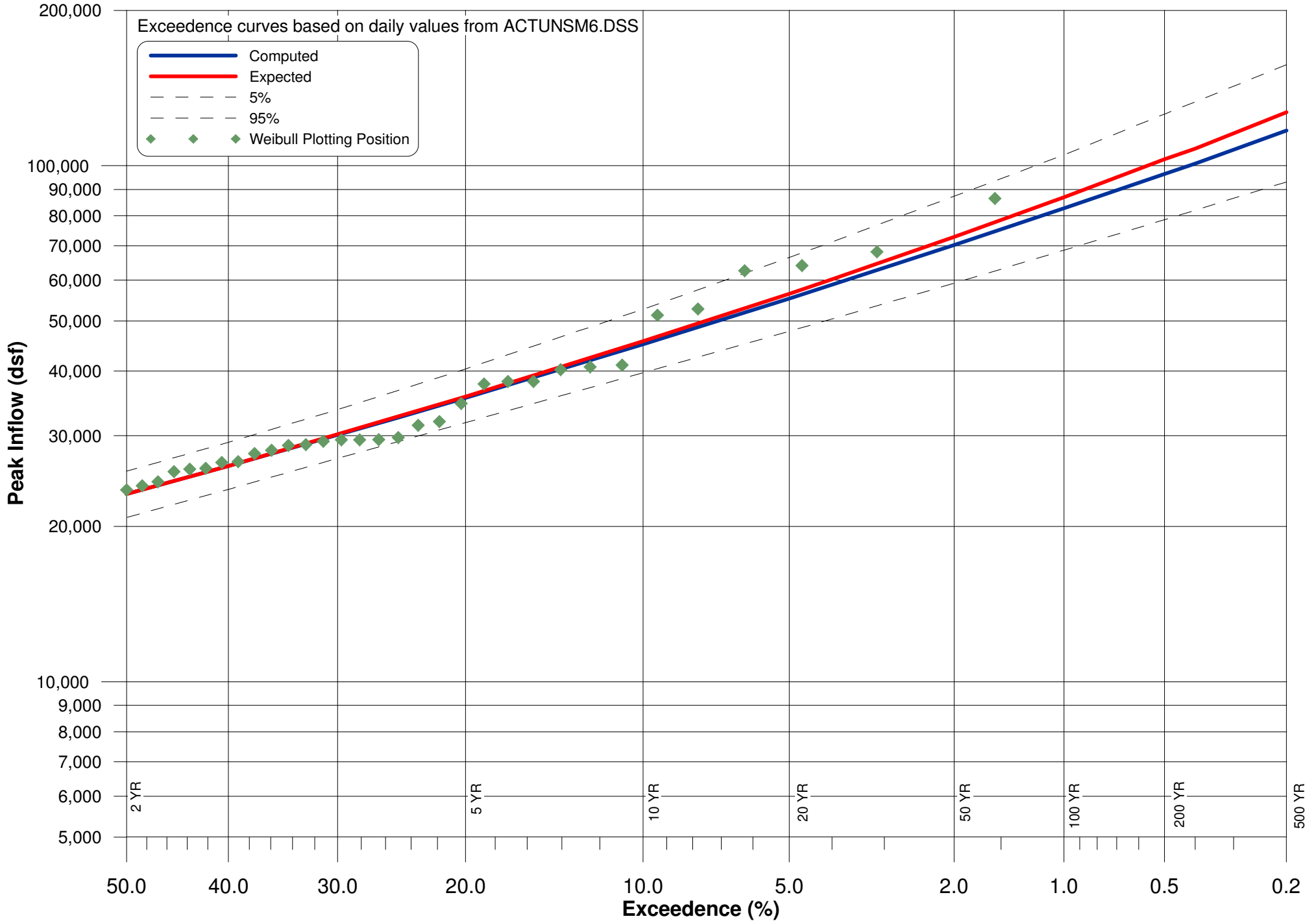


Table HEF-2: Summary of FFA Results for Heflin

HEFLIN DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
33,300	35,700	0.20	44,400	26,700
29,500	31,300	0.40	38,600	24,000
28,400	29,900	0.50	36,900	23,200
24,900	25,900	1.00	31,700	20,600
21,500	22,200	2.00	26,900	18,100
18,400	18,800	4.00	22,400	15,700
17,400	17,700	5.00	21,000	14,900
14,300	14,500	10.00	16,900	12,500
11,400	11,400	20.00	13,100	10,100
10,400	10,500	25.00	11,900	9,270
9,610	9,650	30.00	10,900	8,590
8,330	8,350	40.00	9,350	7,470
7,290	7,290	50.00	8,140	6,530
6,380	6,370	60.00	7,120	5,680
5,530	5,510	70.00	6,180	4,880
4,680	4,650	80.00	5,270	4,070
3,710	3,660	90.00	4,250	3,140
3,060	3,000	95.00	3,560	2,530
1,030	891	99.99	1,350	716
MEAN	3.8627		HISTORIC EVENTS	0
STANDARD DEV	0.2290		HIGH OUTLIERS	0
COMPUTED SKEW	0.0389		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	0.0000		SYSTEM EVENTS	63

HEFLIN 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
87,300	94,000	0.20	118,000	69,400
77,100	81,900	0.40	102,000	62,200
74,000	78,200	0.50	97,200	59,900
64,500	67,400	1.00	83,000	53,100
55,600	57,500	2.00	70,000	46,400
47,100	48,200	4.00	57,900	40,000
44,400	45,400	5.00	54,200	38,000
36,400	36,900	10.00	43,300	31,700
28,600	28,800	20.00	33,100	25,300
26,100	26,300	25.00	29,900	23,200
24,100	24,200	30.00	27,400	21,400
20,800	20,800	40.00	23,400	18,500
18,100	18,100	50.00	20,300	16,100
15,700	15,700	60.00	17,600	14,000
13,600	13,500	70.00	15,200	11,900
11,400	11,300	80.00	12,900	9,870
8,960	8,850	90.00	10,300	7,550
7,350	7,200	95.00	8,600	6,030
2,360	2,040	99.99	3,130	1,630
MEAN	4.2570		HISTORIC EVENTS	0
STANDARD DEV	0.2376		HIGH OUTLIERS	0
COMPUTED SKEW	-0.0349		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	0.0000		SYSTEM EVENTS	63

HEFLIN 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
117,000	127,000	0.20	157,000	93,000
101,000	108,000	0.40	133,000	82,000
96,400	103,000	0.50	126,000	78,600
82,700	86,900	1.00	105,000	68,600
70,200	72,800	2.00	87,300	59,200
58,800	60,300	4.00	71,200	50,500
55,300	56,500	5.00	66,400	47,800
45,100	45,700	10.00	52,700	39,700
35,500	35,700	20.00	40,400	31,800
32,500	32,700	25.00	36,700	29,200
30,100	30,200	30.00	33,700	27,100
26,200	26,200	40.00	29,100	23,600
23,100	23,100	50.00	25,600	20,800
20,400	20,400	60.00	22,600	18,300
18,000	17,900	70.00	20,000	16,000
15,600	15,500	80.00	17,400	13,700
12,800	12,700	90.00	14,500	11,000
11,000	10,800	95.00	12,600	9,270
5,160	4,730	99.99	6,420	3,880
MEAN	4.3741		HISTORIC EVENTS	0
STANDARD DEV	0.2136		HIGH OUTLIERS	0
COMPUTED SKEW	0.3812		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	0.0000		SYSTEM EVENTS	63

Table HEF-3: Regulation Impact on Flood Recurrences at Heflin

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval	Regulated Discharge (cfs)	Recurrence Interval
1976	3/17/1976	13,102	7	NO UPSTREAM REGULATION	
1977	3/31/1977	30,202	200		
1978	1/26/1978	6,732	1		
1979	3/5/1979	22,202	50		
1980	4/15/1980	7,982	2		
1981	2/11/1981	5,591	1		
1982	2/4/1982	17,601	19		
1983	4/10/1983	7,792	2		
1984	5/5/1984	10,002	3		
1985	2/2/1985	4,492	1		
1986	3/14/1986	1,702	1		
1987	3/1/1987	6,612	1		
1988	1/20/1988	4,752	1		
1989	6/23/1989	5,744	1		
1990	3/18/1990	22,202	50		
1991	2/21/1991	6,662	1		
1992	2/26/1992	6,352	1		
1993	1/13/1993	6,342	1		
1994	7/28/1994	5,594	1		
1995	2/18/1995	7,805	2		
1996	3/8/1996	11,906	5		
1997	3/1/1997	8,545	2		
1998	3/9/1998	9,245	3		
1999	6/29/1999	2,908	1		
2000	4/4/2000	5,085	1		
2001	3/21/2001	6,985	1		

Figure NEW-1: FFA Datafile NEW.DAT

TT LITTLE TALLAPOOSA RIVER AT NEWELL FREQUENCY ANALYSIS PROGRAM										
TT LOG-PEARSON TYPE III DIST										
TT 1939-2001										
J1	1									
FR	19	0.20	0.40	0.50	1.00	2.00	4.00	5.00	10.00	20.00
FR	25.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	95.00	99.99
ID	NEWELL DSS 1939-2001									
GS	ALL		0.0							
QR		1939	4080							
QR		1940	4143							
QR		1941	1902							
QR		1942	8666							
QR		1943	7940							
QR		1944	5554							
QR		1945	3661							
QR		1946	9185							
QR		1947	10170							
QR		1948	6228							
QR		1949	11986							
QR		1950	2815							
QR		1951	6488							
QR		1952	8718							
QR		1953	7221							
QR		1954	6120							
QR		1955	4099							
QR		1956	6174							
QR		1957	7739							
QR		1958	4181							
QR		1959	5847							
QR		1960	4391							
QR		1961	15930							
QR		1962	7922							
QR		1963	8377							
QR		1964	7422							
QR		1965	3618							
QR		1966	6029							
QR		1967	8022							
QR		1968	13655							
QR		1969	3336							
QR		1970	12019							
QR		1971	5558							
QR		1972	7906							
QR		1973	7196							
QR		1974	8461							
QR		1975	5941							
QR		1976	12607							
QR		1977	6877							
QR		1978	4997							
QR		1979	9137							
QR		1980	5227							
QR		1981	5379							
QR		1982	10105							
QR		1983	6024							
QR		1984	4977							
QR		1985	3359							
QR		1986	1706							
QR		1987	5447							
QR		1988	2509							
QR		1989	4209							
QR		1990	11613							
QR		1991	4033							
QR		1992	5091							
QR		1993	6122							
QR		1994	3667							
QR		1995	6783							
QR		1996	9837							
QR		1997	8272							
QR		1998	9505							
QR		1999	2145							
QR		2000	3500							
QR		2001	5118							

Figure NEW-2: FFA Datafile NEW3.DAT

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TT LITTLE TALLAPOOSA RIVER AT NEWELL FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 3 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID NEWELL 3 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 12060
QR 1940 9778
QR 1941 4871
QR 1942 21433
QR 1943 20863
QR 1944 12968
QR 1945 8187
QR 1946 23509
QR 1947 25375
QR 1948 15422
QR 1949 32223
QR 1950 6834
QR 1951 17218
QR 1952 20128
QR 1953 19187
QR 1954 14546
QR 1955 8913
QR 1956 16757
QR 1957 18667
QR 1958 10114
QR 1959 15630
QR 1960 11072
QR 1961 41056
QR 1962 20527
QR 1963 19471
QR 1964 20027
QR 1965 8278
QR 1966 15541
QR 1967 21337
QR 1968 25250
QR 1969 9098
QR 1970 30506
QR 1971 14181
QR 1972 20806
QR 1973 17748
QR 1974 21662
QR 1975 15110
QR 1976 32351
QR 1977 18611
QR 1978 13831
QR 1979 25341
QR 1980 13032
QR 1981 14525
QR 1982 26065
QR 1983 16264
QR 1984 13293
QR 1985 8985
QR 1986 4054
QR 1987 13972
QR 1988 6061
QR 1989 11312
QR 1990 30215
QR 1991 10706
QR 1992 11944
QR 1993 14996
QR 1994 7471
QR 1995 12642
QR 1996 22471
QR 1997 21914
QR 1998 26345
QR 1999 4713
QR 2000 9720
QR 2001 13374

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Figure NEW-3: FFA Datafile NEW5.DAT

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TT LITTLE TALLAPOOSA RIVER AT NEWELL FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 5 DAY VOLUME
J1      1
FR      19      0.20      0.40      0.50      1.00      2.00      4.00      5.00      10.00      20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID NEWELL 5 DAY VOLUME DSS 1939-2001
GS ALL      0.0
QR      1939      15969
QR      1940      14998
QR      1941       8172
QR      1942      26814
QR      1943      28620
QR      1944      16627
QR      1945      11446
QR      1946      34772
QR      1947      34387
QR      1948      21223
QR      1949      48051
QR      1950       8892
QR      1951      19825
QR      1952      26236
QR      1953      23263
QR      1954      16949
QR      1955      11907
QR      1956      21443
QR      1957      25227
QR      1958      12652
QR      1959      17904
QR      1960      14012
QR      1961      56991
QR      1962      26144
QR      1963      23522
QR      1964      24325
QR      1965      11902
QR      1966      24232
QR      1967      26826
QR      1968      31512
QR      1969      12731
QR      1970      37419
QR      1971      18855
QR      1972      26817
QR      1973      21858
QR      1974      27082
QR      1975      20103
QR      1976      41365
QR      1977      25345
QR      1978      19055
QR      1979      32195
QR      1980      18516
QR      1981      18447
QR      1982      33275
QR      1983      22801
QR      1984      20532
QR      1985      12883
QR      1986       5393
QR      1987      19122
QR      1988       7708
QR      1989      15101
QR      1990      42111
QR      1991      15009
QR      1992      15833
QR      1993      20578
QR      1994       9661
QR      1995      19005
QR      1996      28835
QR      1997      30318
QR      1998      34995
QR      1999       5792
QR      2000      13530
QR      2001      18090

```

Table NEW-1: Rankings of Flood Events at Newell

NEWELL				NEWELL - 3 DAY				NEWELL - 5 DAY			
Rank	Yr	Flow (cfs)	Position	Rank	Yr	Flow (cfs)	Position	Rank	Yr	Flow (cfs)	Position
1	1961	15,930	1.56	1	1961	41,056	1.56	1	1961	56,991	1.56
2	1968	13,655	3.13	2	1976	32,351	3.13	2	1949	48,051	3.13
3	1976	12,607	4.69	3	1949	32,223	4.69	3	1990	42,111	4.69
4	1970	12,019	6.25	4	1970	30,506	6.25	4	1976	41,365	6.25
5	1949	11,986	7.81	5	1990	30,215	7.81	5	1970	37,419	7.81
6	1990	11,613	9.38	6	1998	26,345	9.38	6	1998	34,995	9.38
7	1947	10,170	10.94	7	1982	26,065	10.94	7	1946	34,772	10.94
8	1982	10,105	12.50	8	1947	25,375	12.50	8	1947	34,387	12.50
9	1996	9,837	14.06	9	1979	25,341	14.06	9	1982	33,275	14.06
10	1998	9,505	15.63	10	1968	25,250	15.63	10	1979	32,195	15.63
11	1946	9,185	17.19	11	1946	23,509	17.19	11	1968	31,512	17.19
12	1979	9,137	18.75	12	1996	22,471	18.75	12	1997	30,318	18.75
13	1952	8,718	20.31	13	1997	21,914	20.31	13	1996	28,835	20.31
14	1942	8,666	21.88	14	1974	21,662	21.88	14	1943	28,620	21.88
15	1974	8,461	23.44	15	1942	21,433	23.44	15	1974	27,082	23.44
16	1963	8,377	25.00	16	1967	21,337	25.00	16	1967	26,826	25.00
17	1997	8,272	26.56	17	1943	20,863	26.56	17	1972	26,817	26.56
18	1967	8,022	28.13	18	1972	20,806	28.13	18	1942	26,814	28.13
19	1943	7,940	29.69	19	1962	20,527	29.69	19	1952	26,236	29.69
20	1962	7,922	31.25	20	1952	20,128	31.25	20	1962	26,144	31.25
21	1972	7,906	32.81	21	1964	20,027	32.81	21	1977	25,345	32.81
22	1957	7,739	34.38	22	1963	19,471	34.38	22	1957	25,227	34.38
23	1964	7,422	35.94	23	1953	19,187	35.94	23	1964	24,325	35.94
24	1953	7,221	37.50	24	1957	18,667	37.50	24	1966	24,232	37.50
25	1973	7,196	39.06	25	1977	18,611	39.06	25	1963	23,522	39.06
26	1977	6,877	40.63	26	1973	17,748	40.63	26	1953	23,263	40.63
27	1995	6,783	42.19	27	1951	17,218	42.19	27	1983	22,801	42.19
28	1951	6,488	43.75	28	1956	16,757	43.75	28	1973	21,858	43.75
29	1948	6,228	45.31	29	1983	16,264	45.31	29	1956	21,443	45.31
30	1956	6,174	46.88	30	1959	15,630	46.88	30	1948	21,223	46.88
31	1993	6,122	48.44	31	1966	15,541	48.44	31	1993	20,578	48.44
32	1954	6,120	50.00	32	1948	15,422	50.00	32	1984	20,532	50.00
33	1966	6,029	51.56	33	1975	15,110	51.56	33	1975	20,103	51.56
34	1983	6,024	53.13	34	1993	14,996	53.13	34	1951	19,825	53.13
35	1975	5,941	54.69	35	1954	14,546	54.69	35	1987	19,122	54.69
36	1959	5,847	56.25	36	1981	14,525	56.25	36	1978	19,055	56.25
37	1971	5,558	57.81	37	1971	14,181	57.81	37	1995	19,005	57.81
38	1944	5,554	59.38	38	1987	13,972	59.38	38	1971	18,855	59.38
39	1987	5,447	60.94	39	1978	13,831	60.94	39	1980	18,516	60.94
40	1981	5,379	62.50	40	2001	13,374	62.50	40	1981	18,447	62.50
41	1980	5,227	64.06	41	1984	13,293	64.06	41	2001	18,090	64.06
42	2001	5,118	65.63	42	1980	13,032	65.63	42	1959	17,904	65.63
43	1992	5,091	67.19	43	1944	12,968	67.19	43	1954	16,949	67.19
44	1978	4,997	68.75	44	1995	12,642	68.75	44	1944	16,627	68.75
45	1984	4,977	70.31	45	1939	12,060	70.31	45	1939	15,969	70.31
46	1960	4,391	71.88	46	1992	11,944	71.88	46	1992	15,833	71.88
47	1989	4,209	73.44	47	1989	11,312	73.44	47	1989	15,101	73.44
48	1958	4,181	75.00	48	1960	11,072	75.00	48	1991	15,009	75.00
49	1940	4,143	76.56	49	1991	10,706	76.56	49	1940	14,998	76.56
50	1955	4,099	78.13	50	1958	10,114	78.13	50	1960	14,012	78.13
51	1939	4,080	79.69	51	1940	9,778	79.69	51	2000	13,530	79.69
52	1991	4,033	81.25	52	2000	9,720	81.25	52	1985	12,883	81.25
53	1994	3,667	82.81	53	1969	9,098	82.81	53	1969	12,731	82.81
54	1945	3,661	84.38	54	1985	8,985	84.38	54	1958	12,652	84.38
55	1965	3,618	85.94	55	1955	8,913	85.94	55	1955	11,907	85.94
56	2000	3,500	87.50	56	1965	8,278	87.50	56	1965	11,902	87.50
57	1985	3,359	89.06	57	1945	8,187	89.06	57	1945	11,446	89.06
58	1969	3,336	90.63	58	1994	7,471	90.63	58	1994	9,661	90.63
59	1950	2,815	92.19	59	1950	6,834	92.19	59	1950	8,892	92.19
60	1988	2,509	93.75	60	1988	6,061	93.75	60	1941	8,172	93.75
61	1999	2,145	95.31	61	1941	4,871	95.31	61	1988	7,708	95.31
62	1941	1,902	96.88	62	1999	4,713	96.88	62	1999	5,792	96.88
63	1986	1,706	98.44	63	1986	4,054	98.44	63	1986	5,393	98.44

Table NEW-2: Summary of FFA Results for Newell

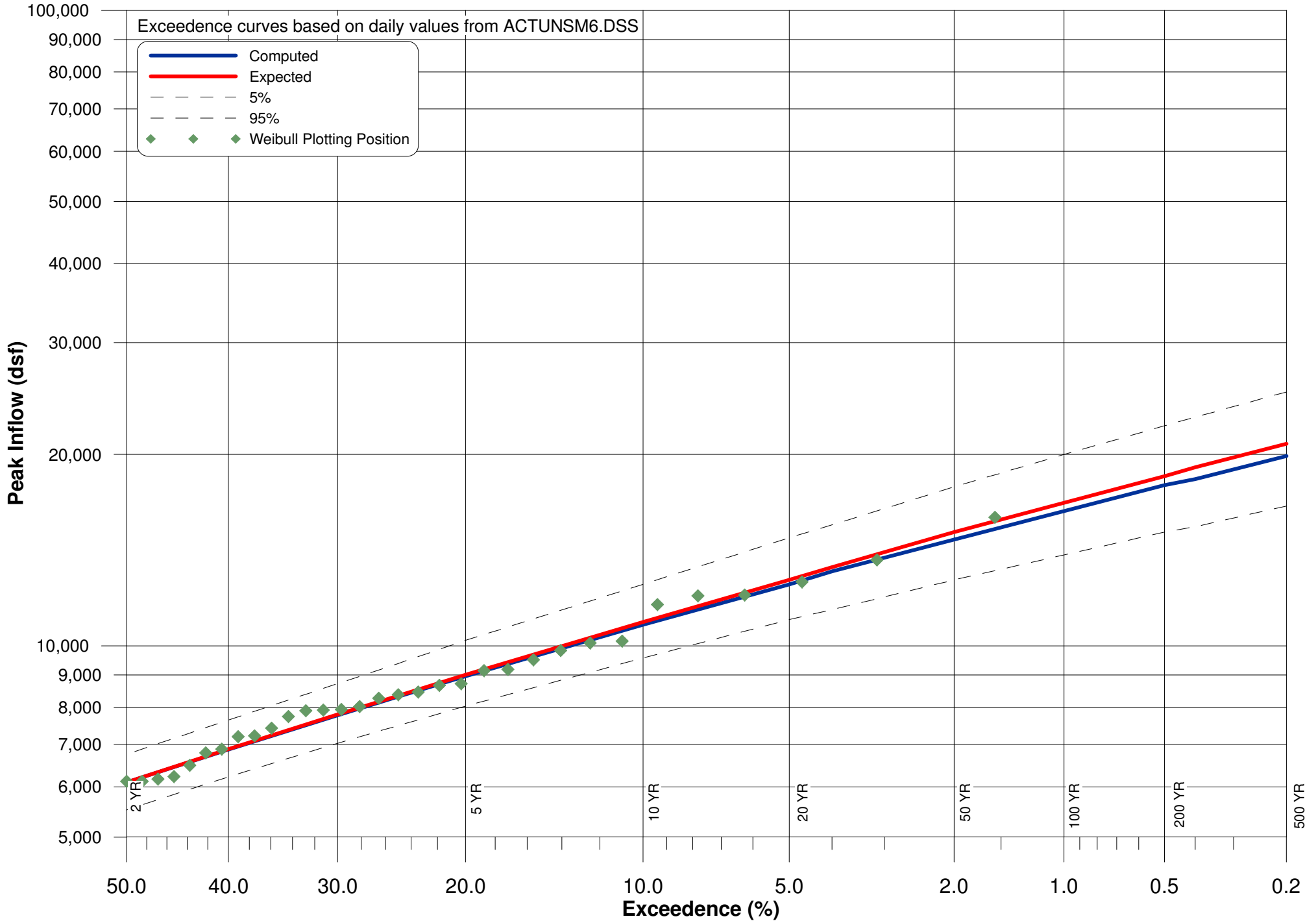
NEWELL DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
19,900	20,800	0.20	25,100	16,600
18,300	19,100	0.40	22,900	15,400
17,900	18,500	0.50	22,200	15,100
16,300	16,800	1.00	20,000	13,900
14,700	15,100	2.00	17,800	12,700
13,100	13,300	4.00	15,500	11,400
12,500	12,700	5.00	14,800	11,000
10,800	10,900	10.00	12,500	9,570
8,960	9,010	20.00	10,200	8,040
8,320	8,350	25.00	9,380	7,490
7,780	7,800	30.00	8,720	7,030
6,870	6,880	40.00	7,640	6,220
6,100	6,100	50.00	6,750	5,520
5,400	5,390	60.00	5,960	4,870
4,720	4,700	70.00	5,220	4,220
4,020	3,990	80.00	4,470	3,540
3,180	3,140	90.00	3,600	2,730
2,610	2,550	95.00	3,000	2,180
734	617	99.99	976	503
MEAN	3.7750		HISTORIC EVENTS	0
STANDARD DEV	0.2079		HIGH OUTLIERS	0
COMPUTED SKEW	-0.4285		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63

NEWELL 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
48,800	50,900	0.20	61,600	40,700
45,300	47,000	0.40	56,600	38,200
44,200	45,700	0.50	55,000	37,300
40,600	41,800	1.00	49,900	34,600
36,900	37,700	2.00	44,700	31,700
33,000	33,500	4.00	39,300	28,700
31,700	32,100	5.00	37,500	27,600
27,400	27,700	10.00	31,900	24,200
22,800	22,900	20.00	26,000	20,400
21,100	21,200	25.00	23,900	19,000
19,800	19,800	30.00	22,300	17,800
17,400	17,500	40.00	19,500	15,700
15,400	15,400	50.00	17,100	13,900
13,600	13,600	60.00	15,100	12,200
11,800	11,800	70.00	13,100	10,600
9,990	9,920	80.00	11,200	8,780
7,810	7,700	90.00	8,870	6,670
6,300	6,160	95.00	7,300	5,240
1,550	1,270	99.99	2,110	1,030
MEAN	4.1744		HISTORIC EVENTS	0
STANDARD DEV	0.2141		HIGH OUTLIERS	0
COMPUTED SKEW	-0.5305		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.4000		SYSTEM EVENTS	63

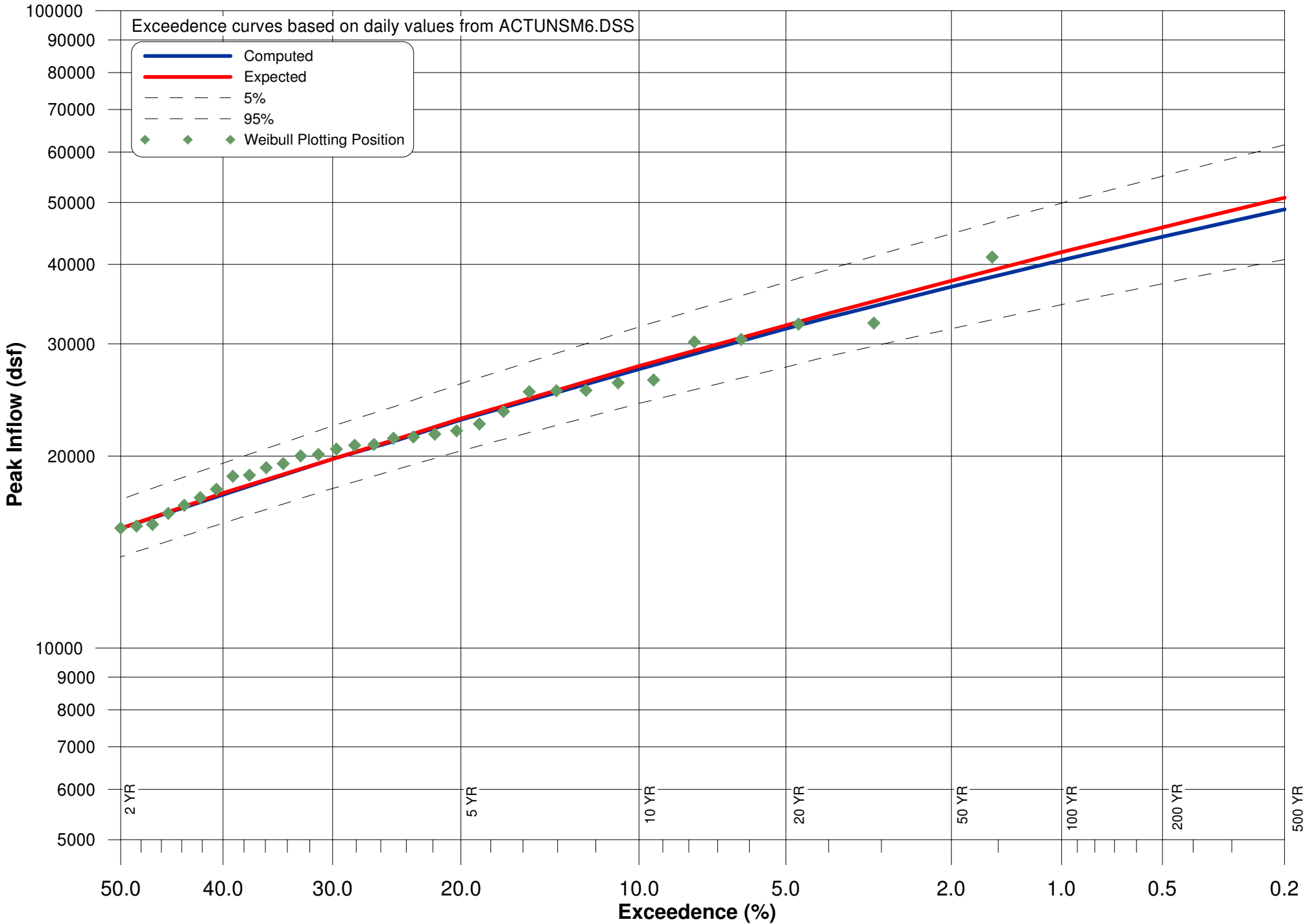
NEWELL 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
63,500	66,100	0.20	79,700	53,200
59,100	61,200	0.40	73,400	49,900
57,700	59,600	0.50	71,400	48,800
53,100	54,500	1.00	64,900	45,300
48,300	49,300	2.00	58,200	41,600
43,200	43,900	4.00	51,400	37,700
41,600	42,200	5.00	49,100	36,300
36,100	36,400	10.00	41,900	31,900
30,100	30,200	20.00	34,200	27,000
28,000	28,100	25.00	31,600	25,200
26,200	26,300	30.00	29,400	23,600
23,200	23,200	40.00	25,800	20,900
20,500	20,500	50.00	22,800	18,600
18,200	18,100	60.00	20,100	16,400
15,800	15,800	70.00	17,500	14,200
13,400	13,300	80.00	15,000	11,800
10,500	10,400	90.00	11,900	9,030
8,540	8,350	95.00	9,860	7,120
2,160	1,780	99.99	2,910	1,450
MEAN	4.2988		HISTORIC EVENTS	0
STANDARD DEV	0.2099		HIGH OUTLIERS	0
COMPUTED SKEW	-0.4889		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.4000		SYSTEM EVENTS	63



**Figure NEW-4: Exceedence Curve for Unregulated 1 Day Volume at Newell**  
 (1939-2001)



**Figure NEW-5: Exceedence Curve for Unregulated 3 Day Volume at Newell**  
(1939-2001)



**Figure NEW-6: Exceedence Curve for Unregulated 5 Day Volume at Newell**  
*(1939-2001)*

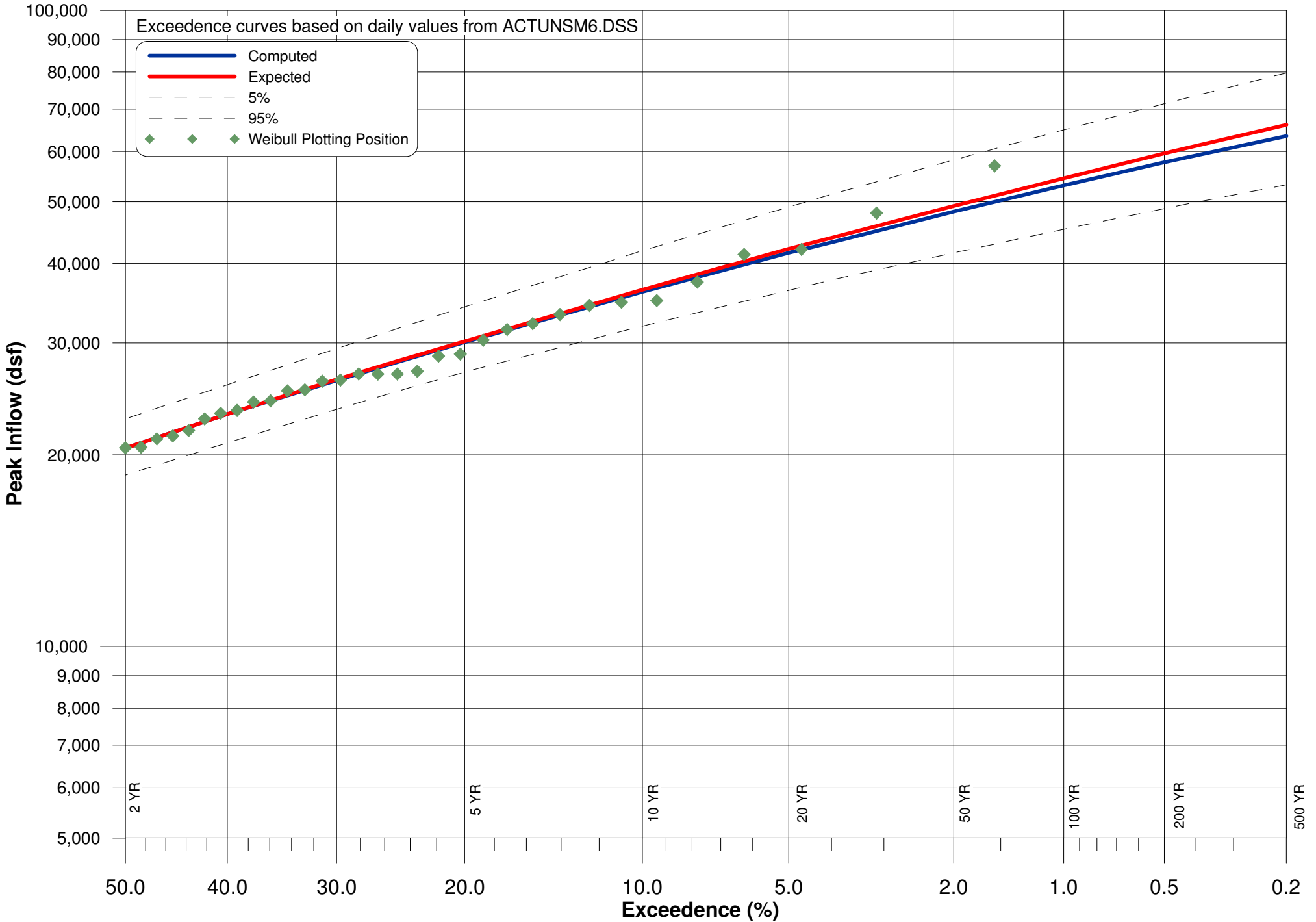


Figure HAR-1: FFA Datafile HAR.DAT

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TT TALLAPOOSA RIVER AT HEFLIN FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID HEFLIN 1 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 20497
QR 1940 18037
QR 1941 7130
QR 1942 28406
QR 1943 28950
QR 1944 20031
QR 1945 22045
QR 1946 32432
QR 1947 31953
QR 1948 22649
QR 1949 37174
QR 1950 10361
QR 1951 17907
QR 1952 31768
QR 1953 21684
QR 1954 8313
QR 1955 16454
QR 1956 31298
QR 1957 38430
QR 1958 18166
QR 1959 12738
QR 1960 13400
QR 1961 34700
QR 1962 26224
QR 1963 33559
QR 1964 25388
QR 1965 11218
QR 1966 18770
QR 1967 14279
QR 1968 29566
QR 1969 13218
QR 1970 39455
QR 1971 36348
QR 1972 24163
QR 1973 26516
QR 1974 30863
QR 1975 28306
QR 1976 48658
QR 1977 45917
QR 1978 22369
QR 1979 59002
QR 1980 25657
QR 1981 18132
QR 1982 36494
QR 1983 29121
QR 1984 25077
QR 1985 11416
QR 1986 6091
QR 1987 21853
QR 1988 14808
QR 1989 16047
QR 1990 46604
QR 1991 14900
QR 1992 18299
QR 1993 26104
QR 1994 15304
QR 1995 25511
QR 1996 42327
QR 1997 33876
QR 1998 40572
QR 1999 7342
QR 2000 13663
QR 2001 22224
ED

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Figure HAR-2: FFA Datafile HAR3.DAT

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TT TALLAPOOSA RIVER AT HARRIS INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 3 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID HARRIS 3 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 48229
QR 1940 38554
QR 1941 16545
QR 1942 69301
QR 1943 69068
QR 1944 42239
QR 1945 38197
QR 1946 68833
QR 1947 75351
QR 1948 48655
QR 1949 98355
QR 1950 21725
QR 1951 44181
QR 1952 67042
QR 1953 57340
QR 1954 22555
QR 1955 31984
QR 1956 79759
QR 1957 80381
QR 1958 39495
QR 1959 35748
QR 1960 31651
QR 1961 85805
QR 1962 59930
QR 1963 79913
QR 1964 60886
QR 1965 30270
QR 1966 45328
QR 1967 36437
QR 1968 69089
QR 1969 33960
QR 1970 94317
QR 1971 84623
QR 1972 61517
QR 1973 57318
QR 1974 70370
QR 1975 64978
QR 1976 104332
QR 1977 125178
QR 1978 54919
QR 1979 133820
QR 1980 57667
QR 1981 41805
QR 1982 98341
QR 1983 68404
QR 1984 56732
QR 1985 29778
QR 1986 13795
QR 1987 51792
QR 1988 29718
QR 1989 36741
QR 1990 127368
QR 1991 40645
QR 1992 49010
QR 1993 50949
QR 1994 32802
QR 1995 53545
QR 1996 77857
QR 1997 76283
QR 1998 90593
QR 1999 17637
QR 2000 36900
QR 2001 53359
ED

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Figure HAR-3: FFA Datafile HAR5.DAT

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TT TALLAPOOSA RIVER AT HARRIS INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 5 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID HARRIS 5 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 63487
QR 1940 55586
QR 1941 26416
QR 1942 86164
QR 1943 96295
QR 1944 54247
QR 1945 51217
QR 1946 98627
QR 1947 100638
QR 1948 66331
QR 1949 154798
QR 1950 29066
QR 1951 52844
QR 1952 86845
QR 1953 70198
QR 1954 29348
QR 1955 43949
QR 1956 97581
QR 1957 103266
QR 1958 51573
QR 1959 48908
QR 1960 44338
QR 1961 136097
QR 1962 75183
QR 1963 94802
QR 1964 82432
QR 1965 42217
QR 1966 73249
QR 1967 50854
QR 1968 85101
QR 1969 47043
QR 1970 120839
QR 1971 108436
QR 1972 92696
QR 1973 73238
QR 1974 90161
QR 1975 91826
QR 1976 138645
QR 1977 171365
QR 1978 72334
QR 1979 173229
QR 1980 78263
QR 1981 50899
QR 1982 136324
QR 1983 86551
QR 1984 87988
QR 1985 43169
QR 1986 18515
QR 1987 66327
QR 1988 36182
QR 1989 48665
QR 1990 174227
QR 1991 55560
QR 1992 63981
QR 1993 67148
QR 1994 41236
QR 1995 77562
QR 1996 107487
QR 1997 98869
QR 1998 116097
QR 1999 23168
QR 2000 48860
QR 2001 64007
ED

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Table HAR-1: Rankings of Flood Events at Harris

HARRIS			
Rank	Yr	Flow (cfs)	Position
1	1979	59,002	1.56
2	1976	48,658	3.13
3	1990	46,604	4.69
4	1977	45,917	6.25
5	1996	42,327	7.81
6	1998	40,572	9.38
7	1970	39,455	10.94
8	1957	38,430	12.50
9	1949	37,174	14.06
10	1982	36,494	15.63
11	1971	36,348	17.19
12	1961	34,700	18.75
13	1997	33,876	20.31
14	1963	33,559	21.88
15	1946	32,432	23.44
16	1947	31,953	25.00
17	1952	31,768	26.56
18	1956	31,298	28.13
19	1974	30,863	29.69
20	1968	29,566	31.25
21	1983	29,121	32.81
22	1943	28,950	34.38
23	1942	28,406	35.94
24	1975	28,306	37.50
25	1973	26,516	39.06
26	1962	26,224	40.63
27	1993	26,104	42.19
28	1980	25,657	43.75
29	1995	25,511	45.31
30	1964	25,388	46.88
31	1984	25,077	48.44
32	1972	24,163	50.00
33	1948	22,649	51.56
34	1978	22,369	53.13
35	2001	22,224	54.69
36	1945	22,045	56.25
37	1987	21,853	57.81
38	1953	21,684	59.38
39	1939	20,497	60.94
40	1944	20,031	62.50
41	1966	18,770	64.06
42	1992	18,299	65.63
43	1958	18,166	67.19
44	1981	18,132	68.75
45	1940	18,037	70.31
46	1951	17,907	71.88
47	1955	16,454	73.44
48	1989	16,047	75.00
49	1994	15,304	76.56
50	1991	14,900	78.13
51	1988	14,808	79.69
52	1967	14,279	81.25
53	2000	13,663	82.81
54	1960	13,400	84.38
55	1969	13,218	85.94
56	1959	12,738	87.50
57	1985	11,416	89.06
58	1965	11,218	90.63
59	1950	10,361	92.19
60	1954	8,313	93.75
61	1999	7,342	95.31
62	1941	7,130	96.88
63	1986	6,091	98.44

HARRIS - 3 DAY			
Rank	Yr	Flow (cfs)	Position
1	1979	133,820	1.56
2	1990	127,368	3.13
3	1977	125,178	4.69
4	1976	104,332	6.25
5	1949	98,355	7.81
6	1982	98,341	9.38
7	1970	94,317	10.94
8	1998	90,593	12.50
9	1961	85,805	14.06
10	1971	84,623	15.63
11	1957	80,381	17.19
12	1963	79,913	18.75
13	1956	79,759	20.31
14	1996	77,857	21.88
15	1997	76,283	23.44
16	1947	75,351	25.00
17	1974	70,370	26.56
18	1942	69,301	28.13
19	1968	69,089	29.69
20	1943	69,068	31.25
21	1946	68,833	32.81
22	1983	68,404	34.38
23	1952	67,042	35.94
24	1975	64,978	37.50
25	1972	61,517	39.06
26	1964	60,886	40.63
27	1962	59,930	42.19
28	1980	57,667	43.75
29	1953	57,340	45.31
30	1973	57,318	46.88
31	1984	56,732	48.44
32	1978	54,919	50.00
33	1995	53,545	51.56
34	2001	53,359	53.13
35	1987	51,792	54.69
36	1993	50,949	56.25
37	1992	49,010	57.81
38	1948	48,655	59.38
39	1939	48,229	60.94
40	1966	45,328	62.50
41	1951	44,181	64.06
42	1944	42,239	65.63
43	1981	41,805	67.19
44	1991	40,645	68.75
45	1958	39,495	70.31
46	1940	38,554	71.88
47	1945	38,197	73.44
48	2000	36,900	75.00
49	1989	36,741	76.56
50	1967	36,437	78.13
51	1959	35,748	79.69
52	1969	33,960	81.25
53	1994	32,802	82.81
54	1955	31,984	84.38
55	1960	31,651	85.94
56	1965	30,270	87.50
57	1985	29,778	89.06
58	1988	29,718	90.63
59	1954	22,555	92.19
60	1950	21,725	93.75
61	1999	17,637	95.31
62	1941	16,545	96.88
63	1986	13,795	98.44

HARRIS - 5 DAY			
Rank	Yr	Flow (cfs)	Position
1	1990	174,227	1.56
2	1979	173,229	3.13
3	1977	171,365	4.69
4	1949	154,798	6.25
5	1976	138,645	7.81
6	1982	136,324	9.38
7	1961	136,097	10.94
8	1970	120,839	12.50
9	1998	116,097	14.06
10	1971	108,436	15.63
11	1996	107,487	17.19
12	1957	103,266	18.75
13	1947	100,638	20.31
14	1997	98,869	21.88
15	1946	98,627	23.44
16	1956	97,581	25.00
17	1943	96,295	26.56
18	1963	94,802	28.13
19	1972	92,696	29.69
20	1975	91,826	31.25
21	1974	90,161	32.81
22	1984	87,988	34.38
23	1952	86,845	35.94
24	1983	86,551	37.50
25	1942	86,164	39.06
26	1968	85,101	40.63
27	1964	82,432	42.19
28	1980	78,263	43.75
29	1995	77,562	45.31
30	1962	75,183	46.88
31	1966	73,249	48.44
32	1973	73,238	50.00
33	1978	72,334	51.56
34	1953	70,198	53.13
35	1993	67,148	54.69
36	1948	66,331	56.25
37	1987	66,327	57.81
38	2001	64,007	59.38
39	1992	63,981	60.94
40	1939	63,487	62.50
41	1940	55,586	64.06
42	1991	55,560	65.63
43	1944	54,247	67.19
44	1951	52,844	68.75
45	1958	51,573	70.31
46	1945	51,217	71.88
47	1981	50,899	73.44
48	1967	50,854	75.00
49	1959	48,908	76.56
50	2000	48,860	78.13
51	1989	48,665	79.69
52	1969	47,043	81.25
53	1960	44,338	82.81
54	1955	43,949	84.38
55	1985	43,169	85.94
56	1965	42,217	87.50
57	1994	41,236	89.06
58	1988	36,182	90.63
59	1954	29,348	92.19
60	1950	29,066	93.75
61	1941	26,416	95.31
62	1999	23,168	96.88
63	1986	18,515	98.44

Table HAR-2: Summary of FFA Results for Harris

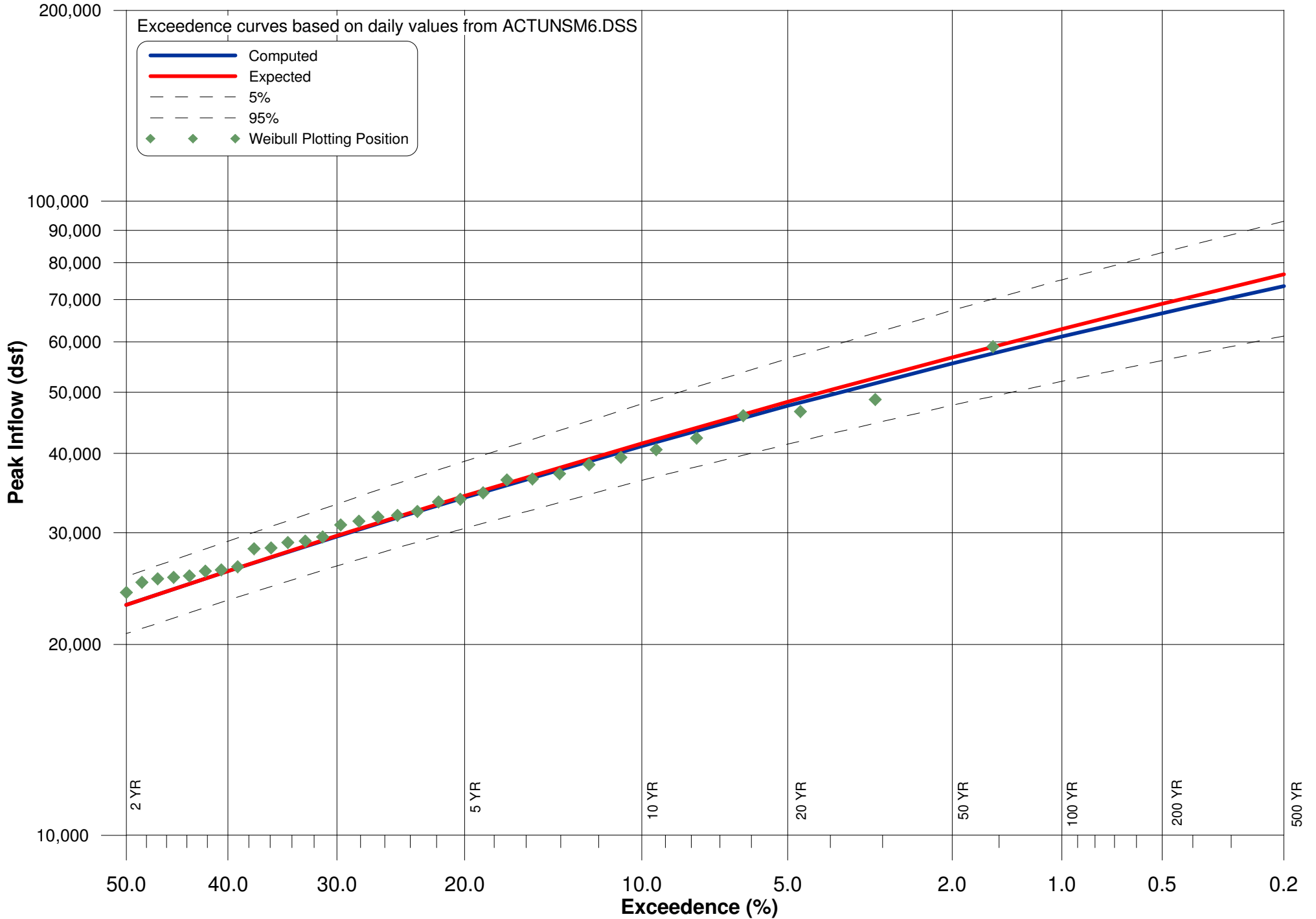
HARRIS DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
73,500	76,700	0.20	93,000	61,300
68,300	70,800	0.40	85,400	57,400
66,600	68,900	0.50	83,000	56,100
61,200	62,900	1.00	75,200	52,000
55,500	56,700	2.00	67,300	47,700
49,500	50,400	4.00	59,100	43,000
47,600	48,300	5.00	56,500	41,400
41,100	41,500	10.00	47,900	36,300
34,100	34,300	20.00	38,900	30,500
31,700	31,800	25.00	35,900	28,400
29,600	29,700	30.00	33,300	26,600
26,100	26,100	40.00	29,100	23,500
23,100	23,100	50.00	25,600	20,800
20,300	20,300	60.00	22,500	18,200
17,600	17,600	70.00	19,600	15,700
14,900	14,800	80.00	16,600	13,100
11,600	11,400	90.00	13,200	9,890
9,340	9,130	95.00	10,800	7,750
2,270	1,860	99.99	3,090	1,500
MEAN	4.3483		HISTORIC EVENTS	0
STANDARD DEV	0.2159		HIGH OUTLIERS	0
COMPUTED SKEW	-0.5585		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.4000		SYSTEM EVENTS	63

HARRIS 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
181,000	189,000	0.20	230,000	150,000
166,000	173,000	0.40	209,000	139,000
162,000	168,000	0.50	203,000	136,000
147,000	152,000	1.00	182,000	125,000
132,000	136,000	2.00	161,000	114,000
117,000	119,000	4.00	140,000	102,000
112,000	114,000	5.00	133,000	97,800
96,400	97,300	10.00	112,000	85,000
79,400	79,800	20.00	90,500	71,000
73,500	73,900	25.00	83,200	66,000
68,700	68,900	30.00	77,200	61,800
60,400	60,500	40.00	67,400	54,500
53,400	53,400	50.00	59,300	48,200
47,100	47,000	60.00	52,200	42,300
41,000	40,900	70.00	45,500	36,500
34,700	34,500	80.00	38,800	30,500
27,300	26,900	90.00	31,000	23,300
22,200	21,700	95.00	25,700	18,500
6,020	5,030	99.99	8,070	4,070
MEAN	4.7170		HISTORIC EVENTS	0
STANDARD DEV	0.2144		HIGH OUTLIERS	0
COMPUTED SKEW	-0.4644		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63

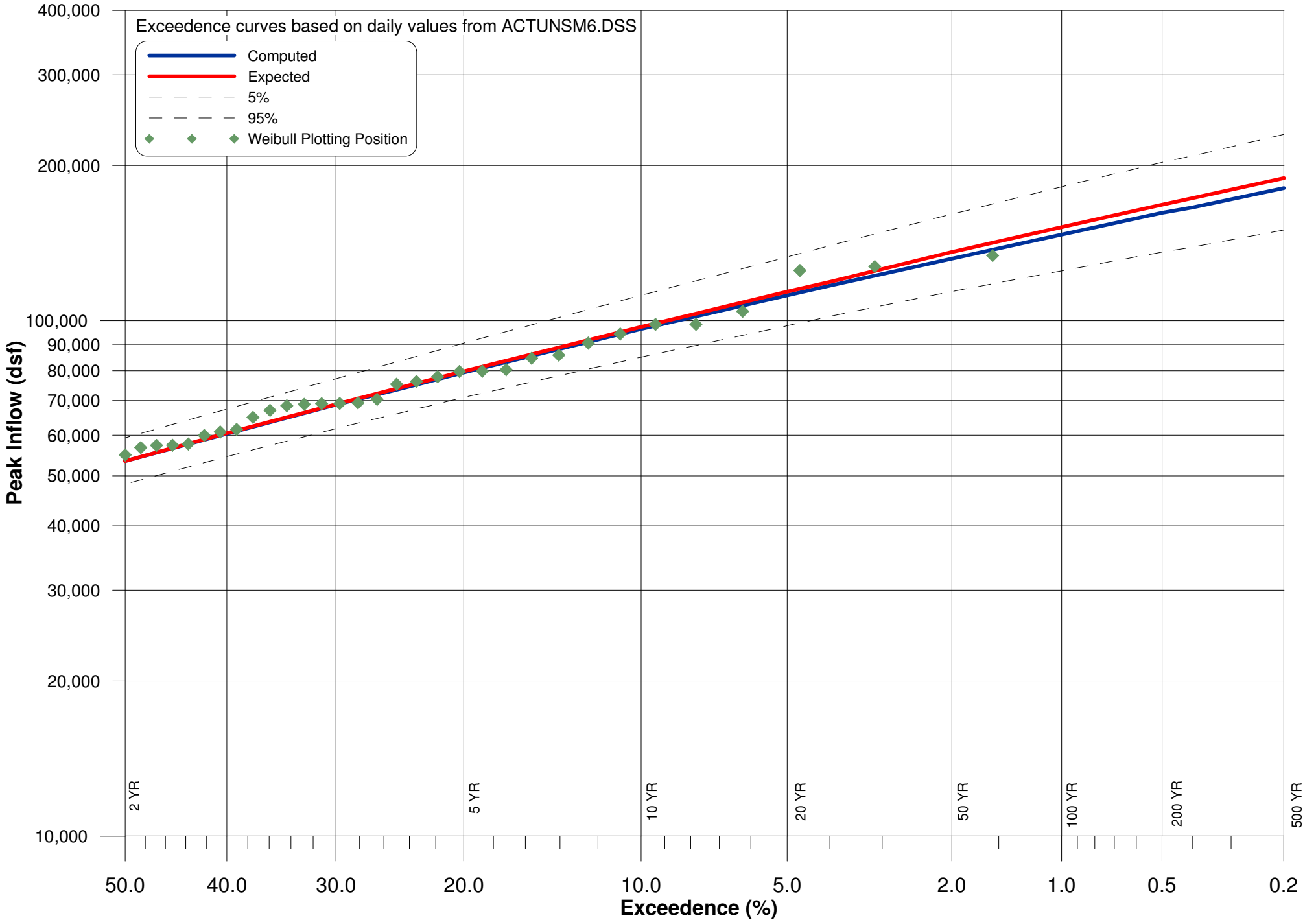
HARRIS 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
241,000	253,000	0.20	307,000	200,000
222,000	231,000	0.40	279,000	186,000
216,000	224,000	0.50	270,000	182,000
197,000	203,000	1.00	243,000	167,000
177,000	181,000	2.00	215,000	152,000
157,000	160,000	4.00	187,000	136,000
150,000	153,000	5.00	178,000	131,000
129,000	130,000	10.00	150,000	114,000
106,000	107,000	20.00	121,000	95,000
98,500	98,900	25.00	111,000	88,400
91,900	92,200	30.00	103,000	82,800
80,900	81,000	40.00	90,200	73,100
71,600	71,600	50.00	79,400	64,600
63,100	63,000	60.00	69,900	56,700
55,000	54,800	70.00	61,000	49,000
46,600	46,200	80.00	52,000	40,900
36,700	36,200	90.00	41,600	31,400
29,900	29,200	95.00	34,600	24,900
8,110	6,780	99.99	10,900	5,500
MEAN	4.8441		HISTORIC EVENTS	0
STANDARD DEV	0.2137		HIGH OUTLIERS	0
COMPUTED SKEW	-0.3700		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63



**Figure HEF- 4: Exceedence Curve for Unregulated 1 Day Volume at Heflin**  
(1939-2001)



**Figure HAR- 5: Exceedence Curve for Unregulated 3 Day Volume at Harris**  
*(1939-2001)*



**Figure HAR- 6: Exceedence Curve for Unregulated 5 Day Volume at Harris**  
(1939-2001)

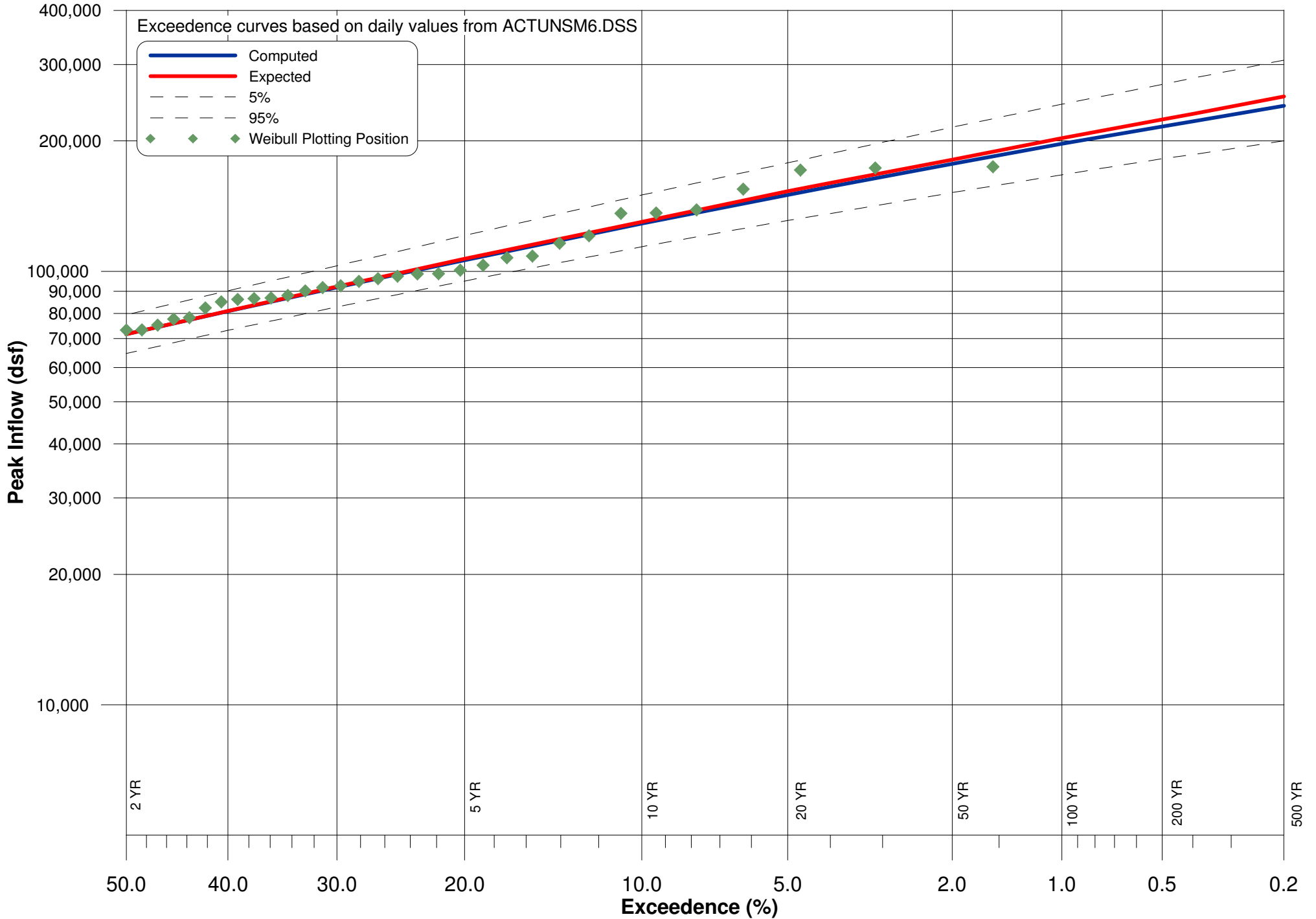


Table HAR-3: Regulation Impact on Flood Recurrences at Harris

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval	Regulated Discharge (cfs)	Recurrence Interval
1976		48,658	10	45,936	10
1977		45,917	10	46,110	10
1978		22,369	1	22,098	1
1979		59,002	50	59,073	50
1980		25,657	2	24,969	2
1981		18,132	1	17,574	1
1982		36,494	5	34,626	5
1983	12/7/83	29,121	2	28,790	2
1984	8/3/84	25,077	2	15,880	1
1985	2/6/85	11,416	1	11,780	1
1986	11/27/86	6,091	1	6,840	1
1987	3/2/87	21,853	1	14,060	1
1988	1/22/88	14,808	1	11,760	1
1989	6/22/89	16,047	1	14,270	1
1990	3/17/90	46,604	10	36,960	5
1991	2/21/91	14,900	1	12,940	1
1992	12/21/92	18,299	1	13,434	1
1993	3/28/93	26,104	2	13,095	1
1994	7/28/94	15,304	1	10,585	1
1995	10/6/95	25,511	2	18,306	1
1996	2/3/96	42,327	10	16,912	1
1997	3/2/97	33,876	2	24,634	2
1998	3/10/98	40,572	5	24,154	2
1999	6/28/99	7,342	1	7,198	1
2000	4/4/00	13,663	1	13,938	1
2001	3/24/01	22,224	1	12,445	1

Figure WAD-1: FFA Datafile WAD.DAT

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TT TALLAPOOSA RIVER AT WADLEY FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID WADLEY DSS 1939-2001
GS ALL 0.0
QR 1939 23147
QR 1940 20575
QR 1941 8214
QR 1942 31428
QR 1943 33162
QR 1944 22901
QR 1945 25120
QR 1946 37244
QR 1947 35906
QR 1948 25196
QR 1949 42807
QR 1950 11796
QR 1951 21140
QR 1952 35711
QR 1953 24527
QR 1954 9522
QR 1955 18647
QR 1956 35766
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QR 1959 14152
QR 1960 15307
QR 1961 39704
QR 1962 29729
QR 1963 39324
QR 1964 29171
QR 1965 12918
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QR 1968 33052
QR 1969 14927
QR 1970 44476
QR 1971 41640
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QR 1974 35125
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QR 1981 20618
QR 1982 40838
QR 1983 32792
QR 1984 26724
QR 1985 14943
QR 1986 7311
QR 1987 23485
QR 1988 26496
QR 1989 18163
QR 1990 75976
QR 1991 15493
QR 1992 22169
QR 1993 30366
QR 1994 20204
QR 1995 30621
QR 1996 46420
QR 1997 35080
QR 1998 47858
QR 1999 8683
QR 2000 16601
QR 2001 27550
ED

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Figure WAD-2: FFA Datafile WAD3.DAT

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TT TALLAPOOSA RIVER AT WADLEY FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 3 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID WADLEY 3 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 55284
QR 1940 44222
QR 1941 19039
QR 1942 79543
QR 1943 79286
QR 1944 48532
QR 1945 44064
QR 1946 79031
QR 1947 86765
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QR 1949 112169
QR 1950 25064
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QR 1956 91858
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QR 1960 36379
QR 1961 98965
QR 1962 68898
QR 1963 92407
QR 1964 69539
QR 1965 34658
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QR 1967 41965
QR 1968 79998
QR 1969 39150
QR 1970 108450
QR 1971 96964
QR 1972 70931
QR 1973 66317
QR 1974 81360
QR 1975 75036
QR 1976 120583
QR 1977 143963
QR 1978 62965
QR 1979 153693
QR 1980 66461
QR 1981 47969
QR 1982 112983
QR 1983 83466
QR 1984 69288
QR 1985 35866
QR 1986 15805
QR 1987 57963
QR 1988 38345
QR 1989 47391
QR 1990 175176
QR 1991 43034
QR 1992 55585
QR 1993 66210
QR 1994 40383
QR 1995 63959
QR 1996 100625
QR 1997 94338
QR 1998 115378
QR 1999 22011
QR 2000 44321
QR 2001 66811
ED

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Figure WAD-3: FFA Datafile WAD5.DAT

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TT TALLAPOOSA RIVER AT WADLEY FREQUENCY ANALYSIS PROGRAM
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TT 1939-2001 5 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID WADLEY 5 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 73072
QR 1940 63788
QR 1941 30264
QR 1942 99290
QR 1943 110816
QR 1944 62508
QR 1945 58834
QR 1946 113251
QR 1947 115504
QR 1948 76350
QR 1949 177598
QR 1950 33495
QR 1951 60809
QR 1952 99851
QR 1953 81011
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QR 1956 112626
QR 1957 118621
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QR 1959 56302
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QR 1961 156860
QR 1962 86555
QR 1963 109213
QR 1964 95072
QR 1965 48544
QR 1966 83784
QR 1967 58935
QR 1968 98103
QR 1969 54201
QR 1970 139430
QR 1971 124723
QR 1972 106824
QR 1973 84385
QR 1974 103981
QR 1975 105760
QR 1976 159534
QR 1977 197158
QR 1978 83191
QR 1979 199244
QR 1980 90000
QR 1981 58496
QR 1982 156913
QR 1983 110479
QR 1984 104056
QR 1985 50720
QR 1986 22167
QR 1987 77026
QR 1988 45019
QR 1989 70623
QR 1990 235281
QR 1991 61764
QR 1992 75221
QR 1993 86756
QR 1994 54912
QR 1995 86040
QR 1996 126167
QR 1997 123082
QR 1998 147314
QR 1999 29522
QR 2000 59080
QR 2001 85014
ED

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Table WAD-1: Rankings of Flood Events at Wadley

WADLEY				WADLEY - 3 DAY				WADLEY - 5 DAY			
Rank	Yr	Flow (cfs)	Position	Rank	Yr	Flow (cfs)	Position	Rank	Yr	Flow (cfs)	Position
1	1990	75,976	1.56	1	1990	175,176	1.56	1	1990	235,281	1.56
2	1979	68,567	3.13	2	1979	153,693	3.13	2	1979	199,244	3.13
3	1976	55,146	4.69	3	1977	143,963	4.69	3	1977	197,158	4.69
4	1977	53,273	6.25	4	1976	120,583	6.25	4	1949	177,598	6.25
5	1998	47,858	7.81	5	1998	115,378	7.81	5	1976	159,534	7.81
6	1996	46,420	9.38	6	1982	112,983	9.38	6	1982	156,913	9.38
7	1970	44,476	10.94	7	1949	112,169	10.94	7	1961	156,860	10.94
8	1957	43,657	12.50	8	1970	108,450	12.50	8	1998	147,314	12.50
9	1949	42,807	14.06	9	1996	100,625	14.06	9	1970	139,430	14.06
10	1971	41,640	15.63	10	1961	98,965	15.63	10	1996	126,167	15.63
11	1982	40,838	17.19	11	1971	96,964	17.19	11	1971	124,723	17.19
12	1961	39,704	18.75	12	1997	94,338	18.75	12	1997	123,082	18.75
13	1963	39,324	20.31	13	1957	92,681	20.31	13	1957	118,621	20.31
14	1946	37,244	21.88	14	1963	92,407	21.88	14	1947	115,504	21.88
15	1947	35,906	23.44	15	1956	91,858	23.44	15	1946	113,251	23.44
16	1956	35,766	25.00	16	1947	86,765	25.00	16	1956	112,626	25.00
17	1952	35,711	26.56	17	1983	83,466	26.56	17	1943	110,816	26.56
18	1974	35,125	28.13	18	1974	81,360	28.13	18	1983	110,479	28.13
19	1997	35,080	29.69	19	1968	79,998	29.69	19	1963	109,213	29.69
20	1943	33,162	31.25	20	1942	79,543	31.25	20	1972	106,824	31.25
21	1968	33,052	32.81	21	1943	79,286	32.81	21	1975	105,760	32.81
22	1983	32,792	34.38	22	1946	79,031	34.38	22	1984	104,056	34.38
23	1975	32,396	35.94	23	1952	77,157	35.94	23	1974	103,981	35.94
24	1942	31,428	37.50	24	1975	75,036	37.50	24	1952	99,851	37.50
25	1995	30,621	39.06	25	1972	70,931	39.06	25	1942	99,290	39.06
26	1993	30,366	40.63	26	1964	69,539	40.63	26	1968	98,103	40.63
27	1973	29,987	42.19	27	1984	69,288	42.19	27	1964	95,072	42.19
28	1962	29,729	43.75	28	1962	68,898	43.75	28	1980	90,000	43.75
29	1980	29,356	45.31	29	2001	66,811	45.31	29	1993	86,756	45.31
30	1964	29,171	46.88	30	1980	66,461	46.88	30	1962	86,555	46.88
31	1972	27,587	48.44	31	1973	66,317	48.44	31	1995	86,040	48.44
32	2001	27,550	50.00	32	1993	66,210	50.00	32	2001	85,014	50.00
33	1984	26,724	51.56	33	1953	65,963	51.56	33	1973	84,385	51.56
34	1988	26,496	53.13	34	1995	63,959	53.13	34	1966	83,784	53.13
35	1978	25,932	54.69	35	1978	62,965	54.69	35	1978	83,191	54.69
36	1948	25,196	56.25	36	1987	57,963	56.25	36	1953	81,011	56.25
37	1945	25,120	57.81	37	1948	55,899	57.81	37	1987	77,026	57.81
38	1953	24,527	59.38	38	1992	55,585	59.38	38	1948	76,350	59.38
39	1987	23,485	60.94	39	1939	55,284	60.94	39	1992	75,221	60.94
40	1939	23,147	62.50	40	1966	51,940	62.50	40	1939	73,072	62.50
41	1944	22,901	64.06	41	1951	50,801	64.06	41	1989	70,623	64.06
42	1992	22,169	65.63	42	1944	48,532	65.63	42	1940	63,788	65.63
43	1966	21,374	67.19	43	1981	47,969	67.19	43	1944	62,508	67.19
44	1951	21,140	68.75	44	1989	47,391	68.75	44	1991	61,764	68.75
45	1958	20,784	70.31	45	1958	45,291	70.31	45	1951	60,809	70.31
46	1981	20,618	71.88	46	2000	44,321	71.88	46	1958	59,287	71.88
47	1940	20,575	73.44	47	1940	44,222	73.44	47	2000	59,080	73.44
48	1994	20,204	75.00	48	1945	44,064	75.00	48	1967	58,935	75.00
49	1955	18,647	76.56	49	1991	43,034	76.56	49	1945	58,834	76.56
50	1989	18,163	78.13	50	1967	41,965	78.13	50	1981	58,496	78.13
51	2000	16,601	79.69	51	1959	40,922	79.69	51	1959	56,302	79.69
52	1967	16,328	81.25	52	1994	40,383	81.25	52	1994	54,912	81.25
53	1991	15,493	82.81	53	1969	39,150	82.81	53	1969	54,201	82.81
54	1960	15,307	84.38	54	1988	38,345	84.38	54	1960	51,078	84.38
55	1985	14,943	85.94	55	1955	36,813	85.94	55	1985	50,720	85.94
56	1969	14,927	87.50	56	1960	36,379	87.50	56	1955	50,519	87.50
57	1959	14,152	89.06	57	1985	35,866	89.06	57	1965	48,544	89.06
58	1965	12,918	90.63	58	1965	34,658	90.63	58	1988	45,019	90.63
59	1950	11,796	92.19	59	1954	26,701	92.19	59	1954	33,791	92.19
60	1954	9,522	93.75	60	1950	25,064	93.75	60	1950	33,495	93.75
61	1999	8,683	95.31	61	1999	22,011	95.31	61	1941	30,264	95.31
62	1941	8,214	96.88	62	1941	19,039	96.88	62	1999	29,522	96.88
63	1986	7,311	98.44	63	1986	15,805	98.44	63	1986	22,167	98.44



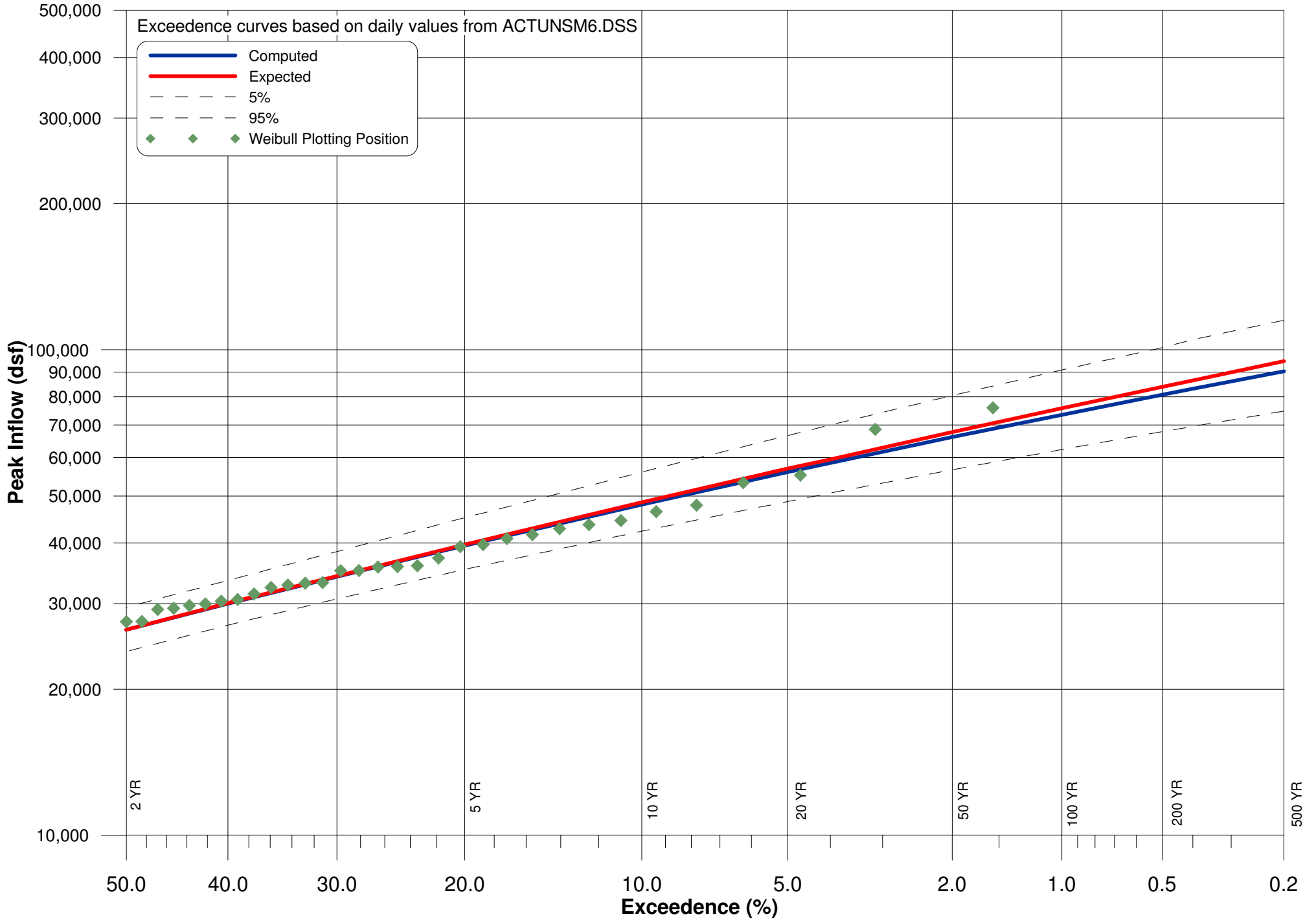
Table WAD-2: Summary of FFA Results for Wadley

WADLEY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
90,300	94,700	0.20	115,000	74,800
83,100	86,500	0.40	105,000	69,500
80,800	83,900	0.50	101,000	67,800
73,500	75,800	1.00	90,900	62,300
66,100	67,700	2.00	80,500	56,600
58,500	59,500	4.00	70,000	50,700
56,000	56,900	5.00	66,600	48,700
48,000	48,500	10.00	56,000	42,300
39,500	39,700	20.00	45,100	35,300
36,600	36,700	25.00	41,400	32,800
34,100	34,200	30.00	38,400	30,700
30,000	30,100	40.00	33,500	27,100
26,500	26,500	50.00	29,500	23,900
23,400	23,300	60.00	25,900	21,000
20,300	20,300	70.00	22,600	18,100
17,200	17,100	80.00	19,200	15,100
13,500	13,300	90.00	15,400	11,500
11,000	10,700	95.00	12,700	9,130
2,950	2,460	99.99	3,960	1,990
MEAN	4.4129		HISTORIC EVENTS	0
STANDARD DEV	0.2156		HIGH OUTLIERS	0
COMPUTED SKEW	-0.4531		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63

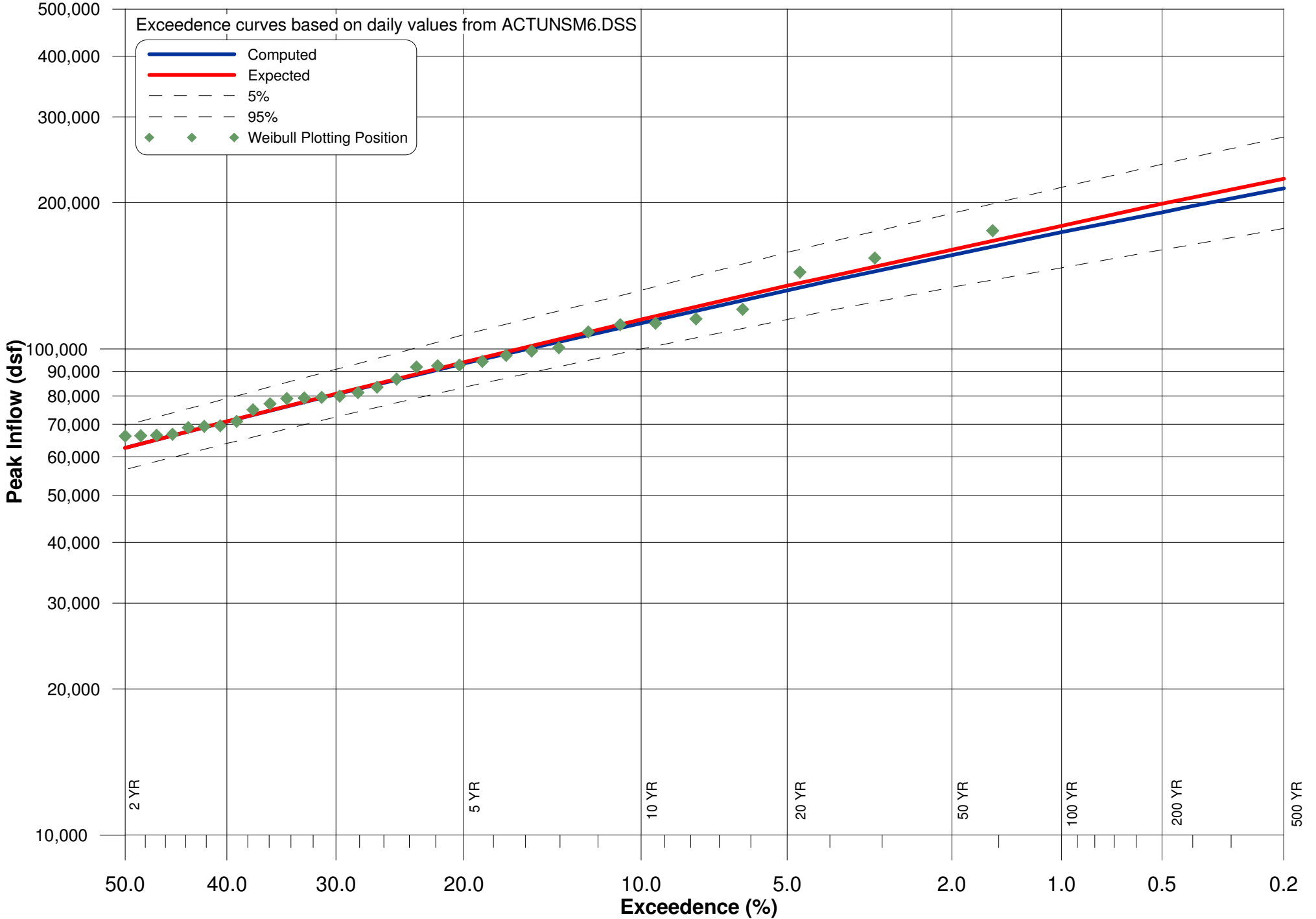
WADLEY 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
214,000	224,000	0.20	273,000	177,000
197,000	205,000	0.40	248,000	164,000
191,000	199,000	0.50	240,000	160,000
174,000	179,000	1.00	215,000	147,000
156,000	160,000	2.00	190,000	134,000
138,000	141,000	4.00	166,000	120,000
132,000	135,000	5.00	158,000	115,000
113,000	115,000	10.00	132,000	100,000
93,400	93,900	20.00	107,000	83,400
86,400	86,800	25.00	97,900	77,500
80,700	80,900	30.00	90,800	72,500
70,900	71,000	40.00	79,100	63,900
62,600	62,600	50.00	69,600	56,500
55,200	55,100	60.00	61,100	49,500
48,000	47,800	70.00	53,300	42,700
40,600	40,300	80.00	45,400	35,600
31,900	31,400	90.00	36,200	27,200
25,900	25,300	95.00	30,000	21,500
6,940	5,790	99.99	9,330	4,680
MEAN	4.7860		HISTORIC EVENTS	0
STANDARD DEV	0.2160		HIGH OUTLIERS	0
COMPUTED SKEW	-0.4024		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63

WADLEY 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
299,000	315,000	0.20	383,000	247,000
273,000	285,000	0.40	345,000	227,000
264,000	276,000	0.50	333,000	221,000
239,000	247,000	1.00	296,000	202,000
213,000	218,000	2.00	259,000	182,000
187,000	190,000	4.00	224,000	162,000
179,000	182,000	5.00	212,000	155,000
152,000	154,000	10.00	177,000	134,000
125,000	125,000	20.00	142,000	111,000
115,000	116,000	25.00	130,000	103,000
107,000	108,000	30.00	121,000	96,800
94,400	94,500	40.00	105,000	85,300
83,500	83,500	50.00	92,600	75,400
73,700	73,600	60.00	81,600	66,300
64,300	64,100	70.00	71,400	57,400
54,700	54,300	80.00	61,100	48,100
43,400	42,900	90.00	49,300	37,200
35,700	35,000	95.00	41,300	29,800
10,800	9,150	99.99	14,200	7,440
MEAN	4.9146		HISTORIC EVENTS	0
STANDARD DEV	0.2126		HIGH OUTLIERS	0
COMPUTED SKEW	-0.3123		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.2000		SYSTEM EVENTS	63

**Figure WAD-4: Exceedence Curve for Unregulated 1 Day Volume at Wadley**  
*(1939-2001)*



**Figure WAD- 5: Exceedence Curve for Unregulated 3 Day Volume at Wadley**  
*(1939-2001)*



**Figure WAD-6: Exceedence Curve for Unregulated 5 Day Volume at Wadley**  
 (1939-2001)

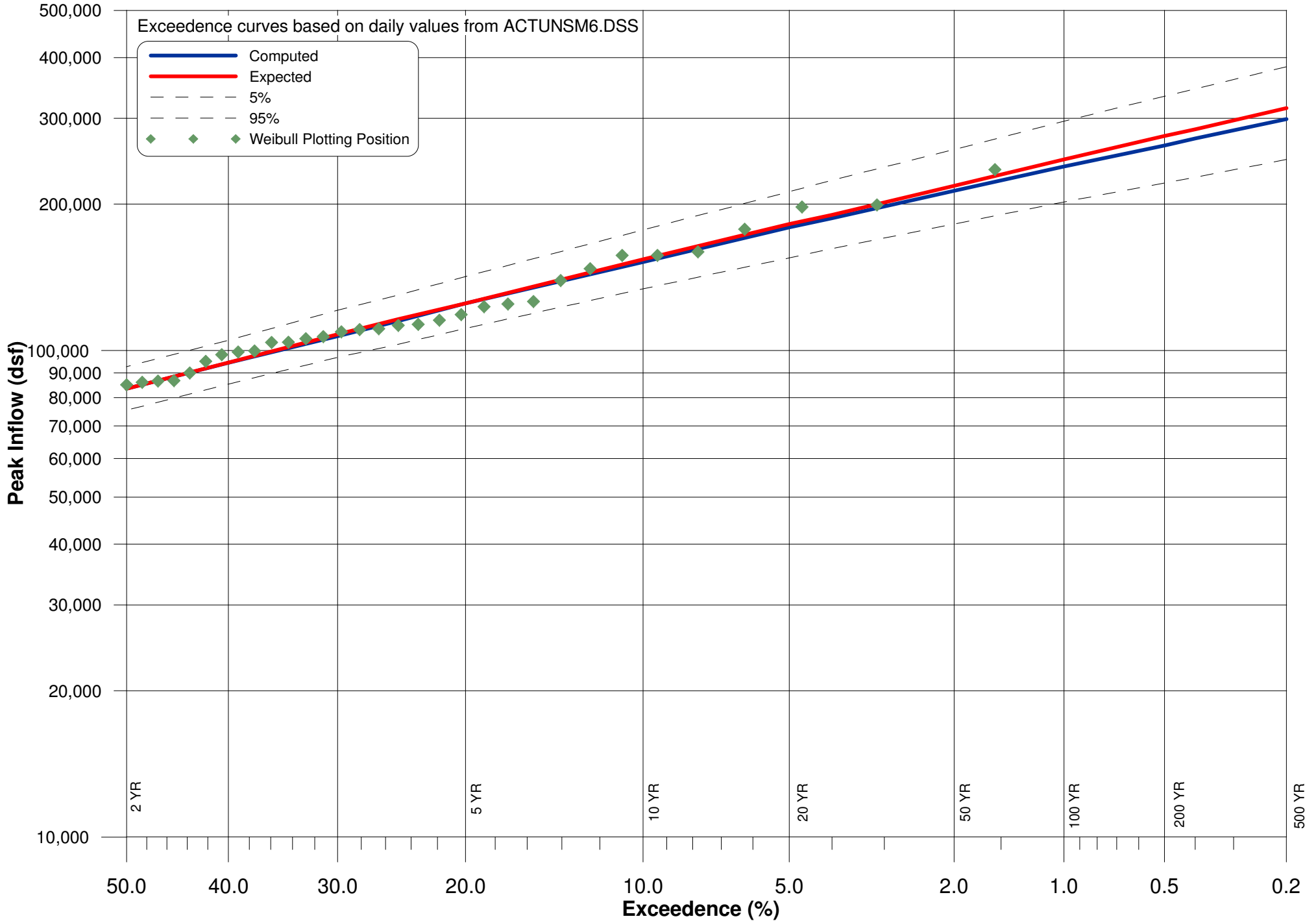


Table WAD-3: Regulation Impact on Flood Recurrences at Wadley

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval	Regulated Discharge (cfs)	Recurrence Interval
1976	3/16/76	55,146	10	52,800	10
1977	3/31/77	53,273	10	53,000	10
1978	1/26/78	25,932	1	25,400	1
1979	4/14/79	68,567	50	67,900	50
1980	4/14/80	29,356	2	28,700	2
1981	2/10/81	20,618	1	20,200	1
1982	2/4/82	40,838	5	39,800	5
1983	12/7/83	32,792	2	34,400	2
1984	8/3/84	26,724	2	20,900	1
1985	2/6/85	14,943	1	14,700	1
1986	3/14/86	7,311	1	8,610	1
1987	3/1/87	23,485	1	17,000	1
1988	9/17/88	26,496	1	20,700	1
1989	6/22/89	18,163	1	18,300	1
1990	3/17/90	75,976	100	60,300	25
1991	2/23/91	15,493	1	14,400	1
1992	12/21/92	22,169	1	15,700	1
1993	3/28/93	30,366	2	15,300	1
1994	7/28/94	20,204	1	14,200	1
1995	10/5/95	30,621	2	26,900	2
1996	2/3/96	46,420	5	23,700	1
1997	3/2/97	35,080	2	28,500	2
1998	3/10/98	47,858	5	28,700	2
1999	1/23/99	8,683	1	8,180	1
2000	4/4/00	16,601	1	16,500	1
2001	3/20/01	27,550	2	19,200	1

Figure MAR-1: FFA Datafile MAR.DAT

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TT TALLAPOOSA RIVER AT MARTIN INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID MARTIN DSS 1939-2001
GS ALL 0.0
QR 1939 57332
QR 1940 51549
QR 1941 18165
QR 1942 67963
QR 1943 82080
QR 1944 60086
QR 1945 79747
QR 1946 63604
QR 1947 83142
QR 1948 33361
QR 1949 79682
QR 1950 24288
QR 1951 32404
QR 1952 48973
QR 1953 36073
QR 1954 41719
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QR 1957 71604
QR 1958 36531
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QR 1960 41874
QR 1961 101863
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QR 1963 37010
QR 1964 70381
QR 1965 41461
QR 1966 48003
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QR 1994 36506
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QR 1999 18100
QR 2000 20784
QR 2001 56160
ED

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Figure MAR-2: FFA Datafile MAR3.DAT

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TT TALLAPOOSA RIVER AT MARTIN INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 3 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID MARTIN 3 DAY VOLUME DSS 1939-2001
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QR 2001 111236
ED

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Figure MAR-3: FFA Datafile MAR5.DAT

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TT TALLAPOOSA RIVER AT MARTIN INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 5 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID MARTIN 5 DAY VOLUME DSS 1939-2001
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QR 1941 51113
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QR 1945 172547
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QR 1947 201981
QR 1948 130398
QR 1949 292626
QR 1950 64480
QR 1951 94022
QR 1952 146468
QR 1953 122227
QR 1954 72301
QR 1955 112091
QR 1956 204597
QR 1957 212591
QR 1958 123883
QR 1959 72187
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QR 1975 155843
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QR 1978 135076
QR 1979 341312
QR 1980 137771
QR 1981 113041
QR 1982 231952
QR 1983 187407
QR 1984 175414
QR 1985 86179
QR 1986 53488
QR 1987 112017
QR 1988 110740
QR 1989 202949
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QR 1991 76646
QR 1992 103116
QR 1993 154107
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ED

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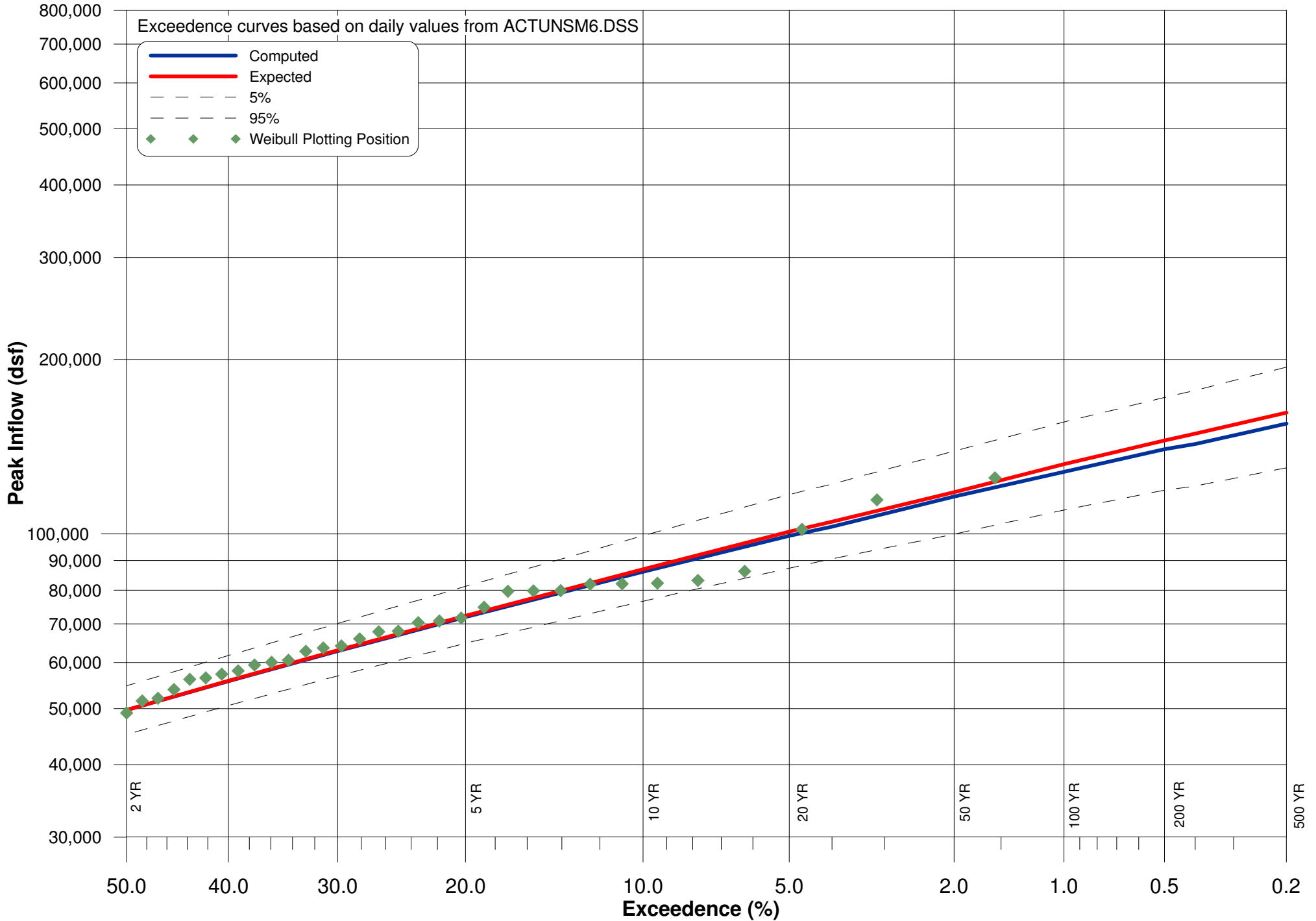
Table MAR-2: Summary of FFA Results for Martin

MARTIN DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
155,000	162,000	0.20	194,000	130,000
143,000	149,000	0.40	177,000	121,000
140,000	145,000	0.50	172,000	119,000
128,000	132,000	1.00	156,000	110,000
116,000	118,000	2.00	139,000	100,000
103,000	105,000	4.00	122,000	90,600
99,300	101,000	5.00	117,000	87,300
86,100	86,900	10.00	99,300	76,600
71,900	72,300	20.00	81,200	64,800
66,900	67,200	25.00	75,100	60,500
62,800	63,000	30.00	70,100	56,900
55,700	55,800	40.00	61,700	50,600
49,700	49,700	50.00	54,700	45,100
44,200	44,100	60.00	48,600	40,000
38,800	38,700	70.00	42,800	34,900
33,200	33,000	80.00	36,900	29,400
26,600	26,200	90.00	29,900	23,000
21,900	21,500	95.00	25,100	18,500
6,480	5,480	99.99	8,530	4,500
MEAN	4.6862		HISTORIC EVENTS	0
STANDARD DEV	0.1999		HIGH OUTLIERS	0
COMPUTED SKEW	-0.3896		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63

MARTIN 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
396,000	419,000	0.20	506,000	328,000
360,000	377,000	0.40	453,000	301,000
348,000	364,000	0.50	436,000	293,000
313,000	324,000	1.00	386,000	266,000
278,000	286,000	2.00	337,000	240,000
244,000	249,000	4.00	290,000	213,000
233,000	237,000	5.00	275,000	204,000
198,000	201,000	10.00	229,000	176,000
163,000	164,000	20.00	184,000	147,000
151,000	152,000	25.00	170,000	136,000
141,000	142,000	30.00	157,000	128,000
125,000	125,000	40.00	138,000	113,000
111,000	111,000	50.00	122,000	101,000
98,500	98,300	60.00	108,000	89,000
86,700	86,400	70.00	95,600	77,700
74,600	74,100	80.00	82,800	66,000
60,300	59,600	90.00	68,000	52,100
50,500	49,600	95.00	57,900	42,700
17,700	15,400	99.99	22,700	12,700
MEAN	5.0412		HISTORIC EVENTS	0
STANDARD DEV	0.2018		HIGH OUTLIERS	0
COMPUTED SKEW	-0.1683		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.1000		SYSTEM EVENTS	63

MARTIN 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
518,000	548,000	0.20	661,000	429,000
471,000	493,000	0.40	592,000	394,000
456,000	476,000	0.50	571,000	383,000
410,000	424,000	1.00	505,000	349,000
365,000	374,000	2.00	441,000	314,000
320,000	326,000	4.00	380,000	279,000
305,000	310,000	5.00	360,000	267,000
260,000	263,000	10.00	301,000	231,000
214,000	215,000	20.00	241,000	192,000
198,000	199,000	25.00	222,000	179,000
185,000	186,000	30.00	207,000	168,000
164,000	164,000	40.00	181,000	149,000
146,000	146,000	50.00	160,000	132,000
129,000	129,000	60.00	142,000	117,000
114,000	114,000	70.00	126,000	102,000
98,000	97,400	80.00	109,000	86,800
79,400	78,500	90.00	89,400	68,600
66,500	65,300	95.00	76,100	56,200
23,300	20,300	99.99	30,000	16,700
MEAN	5.1595		HISTORIC EVENTS	0
STANDARD DEV	0.2012		HIGH OUTLIERS	0
COMPUTED SKEW	-0.1806		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.1000		SYSTEM EVENTS	63

**Figure MAR- 4: Exceedence Curve for Unregulated 1 Day Volume at Martin**  
(1939-2001)



**Figure MAR- 5: Exceedence Curve for Unregulated 3 Day Volume at Martin**  
(1939-2001)

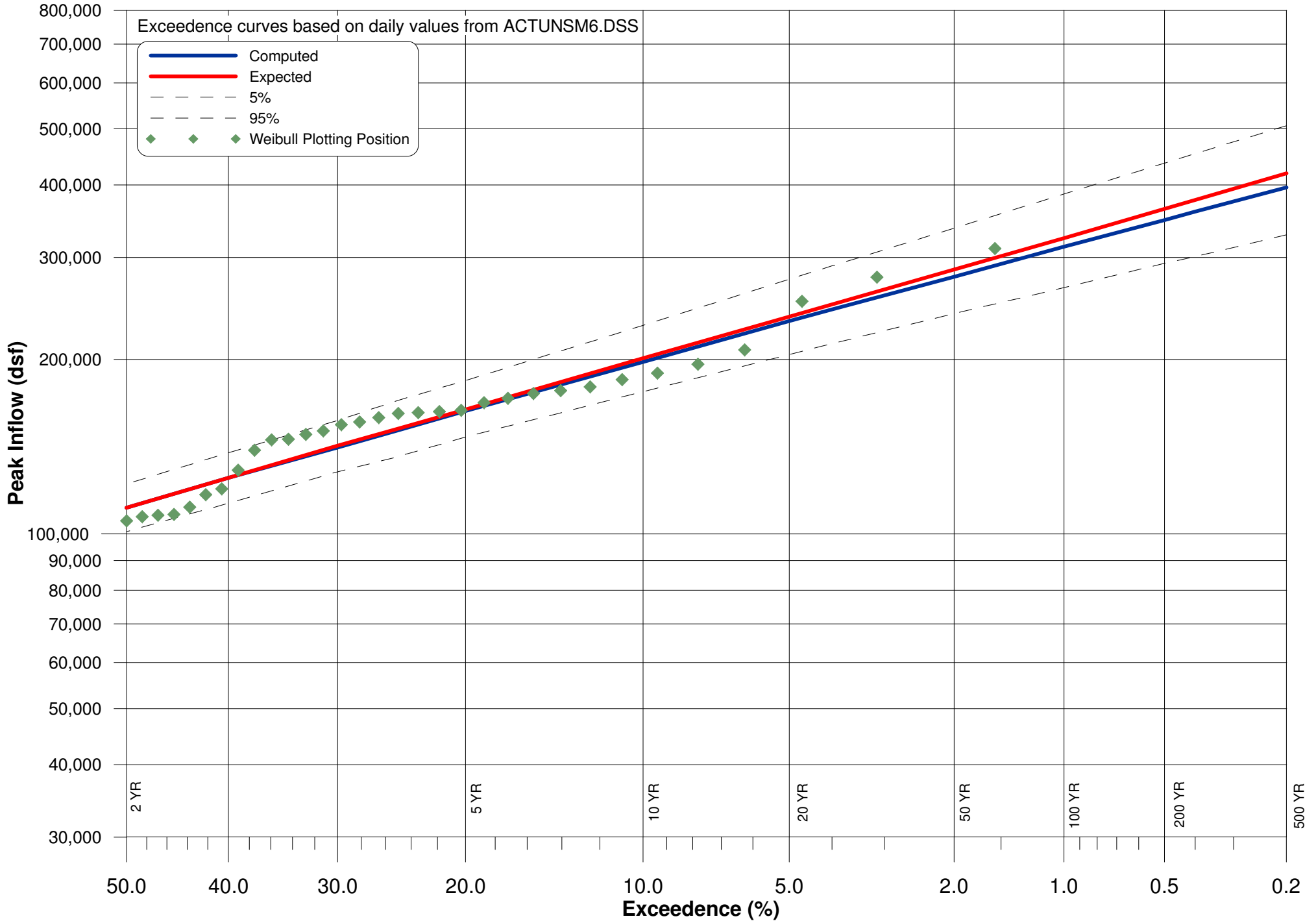


Table MAR-1: Rankings of Flood Events at Martin

MARTIN			
Rank	Yr	Flow (cfs)	Position
1	1990	125,019	1.56
2	1979	114,551	3.13
3	1961	101,863	4.69
4	1998	86,225	6.25
5	1947	83,142	7.81
6	1972	82,244	9.38
7	1943	82,080	10.94
8	1971	81,919	12.50
9	1982	79,903	14.06
10	1945	79,747	15.63
11	1949	79,682	17.19
12	1996	74,747	18.75
13	1957	71,604	20.31
14	1989	70,776	21.88
15	1964	70,381	23.44
16	1942	67,963	25.00
17	1977	67,838	26.56
18	1956	65,953	28.13
19	1962	64,107	29.69
20	1946	63,604	31.25
21	1976	62,770	32.81
22	1993	60,578	34.38
23	1944	60,086	35.94
24	1983	59,471	37.50
25	1970	58,060	39.06
26	1939	57,332	40.63
27	1988	56,474	42.19
28	2001	56,160	43.75
29	1997	53,919	45.31
30	1984	52,079	46.88
31	1940	51,549	48.44
32	1995	49,119	50.00
33	1952	48,973	51.56
34	1966	48,003	53.13
35	1975	46,422	54.69
36	1973	45,790	56.25
37	1981	45,182	57.81
38	1969	43,378	59.38
39	1980	43,314	60.94
40	1968	43,163	62.50
41	1960	41,874	64.06
42	1954	41,719	65.63
43	1965	41,461	67.19
44	1978	41,279	68.75
45	1987	39,327	70.31
46	1955	37,571	71.88
47	1963	37,010	73.44
48	1958	36,531	75.00
49	1994	36,506	76.56
50	1953	36,073	78.13
51	1974	34,444	79.69
52	1948	33,361	81.25
53	1951	32,404	82.81
54	1992	32,235	84.38
55	1967	27,577	85.94
56	1985	25,809	87.50
57	1991	24,378	89.06
58	1950	24,288	90.63
59	2000	20,784	92.19
60	1959	18,624	93.75
61	1986	18,419	95.31
62	1941	18,165	96.88
63	1999	18,100	98.44

MARTIN - 3 DAY			
Rank	Yr	Flow (cfs)	Position
1	1990	310,830	1.56
2	1979	277,337	3.13
3	1961	251,983	4.69
4	1949	207,857	6.25
5	1998	196,202	7.81
6	1971	189,380	9.38
7	1972	184,547	10.94
8	1964	179,414	12.50
9	1982	176,792	14.06
10	1977	174,722	15.63
11	1976	171,459	17.19
12	1943	168,418	18.75
13	1957	163,442	20.31
14	1947	162,624	21.88
15	1942	161,924	23.44
16	1956	161,399	25.00
17	1989	158,789	26.56
18	1996	156,030	28.13
19	1962	154,363	29.69
20	1970	150,661	31.25
21	1946	148,512	32.81
22	1983	145,718	34.38
23	1945	145,359	35.94
24	1997	139,450	37.50
25	1944	128,930	39.06
26	1939	119,664	40.63
27	1993	116,844	42.19
28	2001	111,236	43.75
29	1984	108,099	45.31
30	1952	107,733	46.88
31	1966	107,059	48.44
32	1978	105,379	50.00
33	1975	104,939	51.56
34	1995	103,762	53.13
35	1940	103,569	54.69
36	1965	100,445	56.25
37	1988	100,407	57.81
38	1980	99,584	59.38
39	1973	98,457	60.94
40	1963	97,811	62.50
41	1953	97,331	64.06
42	1974	93,956	65.63
43	1981	90,245	67.19
44	1968	90,194	68.75
45	1948	88,684	70.31
46	1960	84,750	71.88
47	1955	84,428	73.44
48	1969	83,664	75.00
49	1958	81,287	76.56
50	1987	79,922	78.13
51	1951	76,445	79.69
52	1992	75,381	81.25
53	1994	72,194	82.81
54	1954	65,523	84.38
55	1985	65,304	85.94
56	1967	61,047	87.50
57	1991	58,222	89.06
58	2000	55,027	90.63
59	1950	50,419	92.19
60	1959	50,079	93.75
61	1999	43,607	95.31
62	1986	42,427	96.88
63	1941	37,893	98.44

MARTIN - 5 DAY			
Rank	Yr	Flow (cfs)	Position
1	1990	392,413	1.56
2	1979	341,312	3.13
3	1961	339,012	4.69
4	1949	292,626	6.25
5	1998	247,526	7.81
6	1962	242,822	9.38
7	1977	241,688	10.94
8	1972	241,084	12.50
9	1964	236,297	14.06
10	1971	233,980	15.63
11	1982	231,952	17.19
12	1976	220,904	18.75
13	1943	215,119	20.31
14	1957	212,591	21.88
15	1946	205,578	23.44
16	1956	204,597	25.00
17	1989	202,949	26.56
18	1996	202,746	28.13
19	1947	201,981	29.69
20	1942	200,597	31.25
21	1970	197,952	32.81
22	1983	187,407	34.38
23	1997	181,977	35.94
24	1984	175,414	37.50
25	1945	172,547	39.06
26	1966	172,209	40.63
27	1944	162,153	42.19
28	1939	157,746	43.75
29	1975	155,843	45.31
30	1993	154,107	46.88
31	1952	146,468	48.44
32	2001	140,215	50.00
33	1980	137,771	51.56
34	1978	135,076	53.13
35	1995	134,405	54.69
36	1974	132,085	56.25
37	1948	130,398	57.81
38	1958	123,883	59.38
39	1940	122,653	60.94
40	1953	122,227	62.50
41	1973	120,300	64.06
42	1963	119,914	65.63
43	1965	119,375	67.19
44	1960	116,425	68.75
45	1981	113,041	70.31
46	1955	112,091	71.88
47	1987	112,017	73.44
48	1988	110,740	75.00
49	1968	108,982	76.56
50	1969	108,046	78.13
51	1992	103,116	79.69
52	1951	94,022	81.25
53	1994	92,370	82.81
54	1985	86,179	84.38
55	1967	79,289	85.94
56	1991	76,646	87.50
57	2000	73,354	89.06
58	1954	72,301	90.63
59	1959	72,187	92.19
60	1950	64,480	93.75
61	1999	63,760	95.31
62	1986	53,488	96.88
63	1941	51,113	98.44

**Figure MAR- 6: Exceedence Curve for Unregulated 5 Day Volume at Martin**  
(1939-2001)

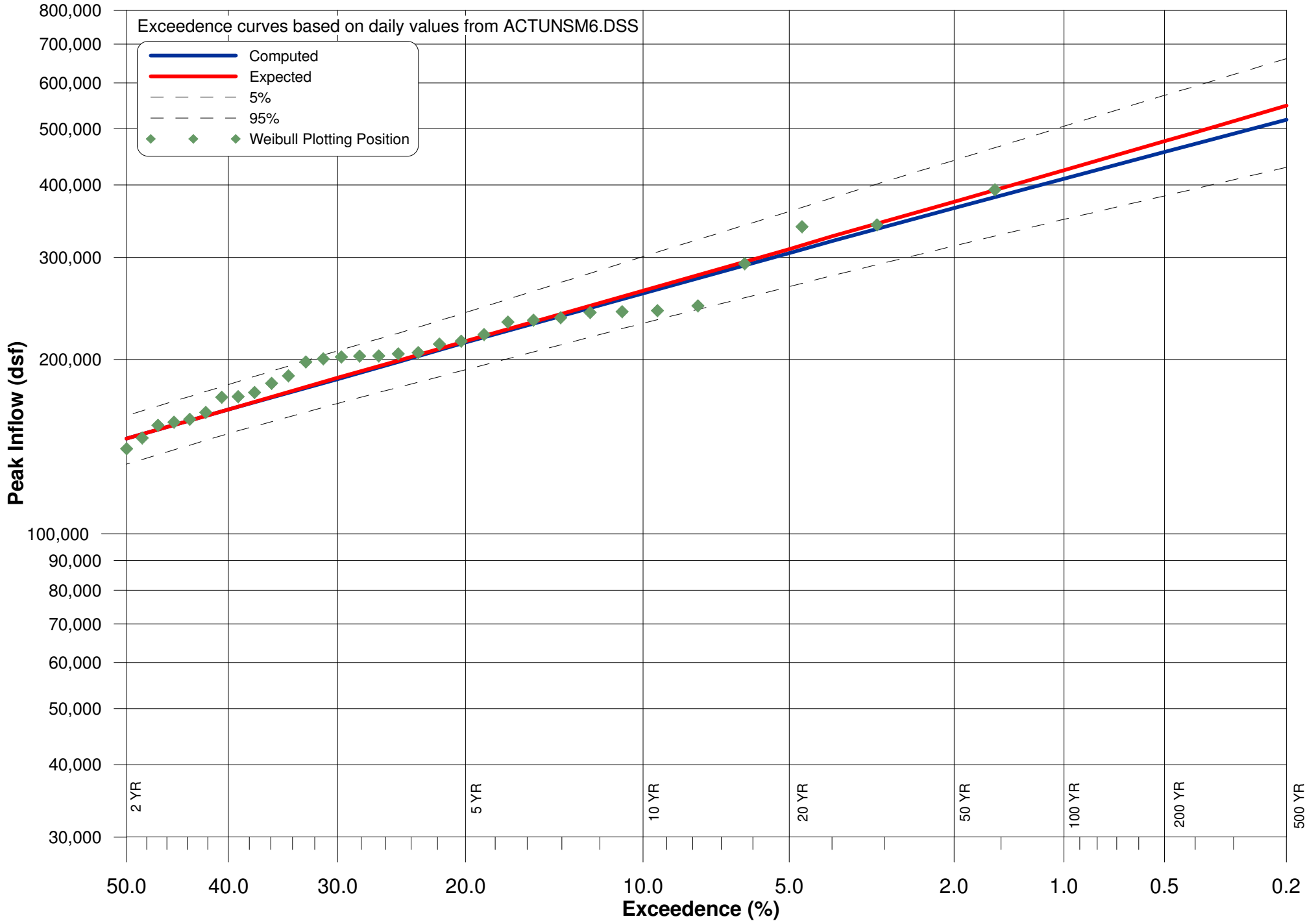


Table MAR-3: Regulation Impact on Flood Recurrences at Martin

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval	Regulated Discharge (cfs)	Recurrence Interval
1976	4/2/76	62,770	2	36,940	1
1977	3/31/77	67,838	2	63,290	2
1978	5/9/78	41,279	1	21,500	1
1979	4/15/79	114,551	25	119,410	50
1980	4/14/80	43,314	1	37,860	1
1981	2/14/81	45,182	1	9,660	1
1982	4/26/82	79,903	5	35,700	1
1983	4/9/83	59,471	2	34,250	1
1984	8/2/84	52,079	2	45,800	1
1985	2/16/85	25,809	1	9,680	1
1986	12/3/86	18,419	1	9,470	1
1987	3/6/87	39,327	1	10,880	1
1988	9/18/88	56,474	2	15,690	1
1989	6/20/89	70,776	2	63,940	2
1990	3/17/90	125,019	50	107,240	25
1991	5/14/91	24,378	1	14,210	1
1992	12/23/92	32,235	1	15,800	1
1993	3/30/93	60,578	2	11,081	1
1994	4/16/94	36,506	1	16,155	1
1995	10/6/95	49,119	1	32,783	1
1996	2/3/96	74,747	5	27,481	1
1997	6/17/97	53,919	2	20,179	1
1998	3/10/98	86,225	5	40,576	1
1999	7/1/99	18,100	1	13,493	1
2000	4/5/00	20,784	1	10,300	1
2001	4/4/01	56,160	2	34,852	1

Figure YAT-1: FFA Datafile YAT.DAT

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TT TALLAPOOSA RIVER AT YATES INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001
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FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
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GS ALL 0.0
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QR 1941 18166
QR 1942 67964
QR 1943 82081
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QR 1946 63605
QR 1947 83143
QR 1948 33362
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QR 1950 24289
QR 1951 32405
QR 1952 48974
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QR 1998 94109
QR 1999 21822
QR 2000 22223
QR 2001 56952
ED

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Figure YAT-2: FFA Datafile YAT3.DAT

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TT TALLAPOOSA RIVER AT YATES INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
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QR 1991 63941
QR 1992 80732
QR 1993 128317
QR 1994 73098
QR 1995 108451
QR 1996 163527
QR 1997 146023
QR 1998 205913
QR 1999 51023
QR 2000 58868
QR 2001 123852
ED

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Figure YAT-3: FFA Datafile YAT5.DAT

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TT TALLAPOOSA RIVER AT YATES INFLOW FREQUENCY ANALYSIS PROGRAM
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QR 1981 113041
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QR 1983 202350
QR 1984 183585
QR 1985 98567
QR 1986 62785
QR 1987 121101
QR 1988 114439
QR 1989 228100
QR 1990 433854
QR 1991 81406
QR 1992 110271
QR 1993 165923
QR 1994 93967
QR 1995 138800
QR 1996 207859
QR 1997 187455
QR 1998 251795
QR 1999 73400
QR 2000 79139
QR 2001 153192
ED

```

Table YAT-1: Rankings of Flood Events at Yates

YATES			
Rank	Yr	Flow (cfs)	Position
1	1990	141,920	1.56
2	1979	114,552	3.13
3	1961	101,865	4.69
4	1998	94,109	6.25
5	1982	90,386	7.81
6	1989	84,507	9.38
7	1947	83,143	10.94
8	1972	82,246	12.50
9	1996	82,099	14.06
10	1943	82,081	15.63
11	1971	81,920	17.19
12	1945	79,748	18.75
13	1949	79,683	20.31
14	1957	71,605	21.88
15	1964	70,382	23.44
16	1993	68,361	25.00
17	1942	67,964	26.56
18	1977	67,840	28.13
19	1983	66,643	29.69
20	1956	65,954	31.25
21	1962	64,109	32.81
22	1946	63,605	34.38
23	1976	62,772	35.94
24	1984	61,734	37.50
25	1944	60,087	39.06
26	1988	58,075	40.63
27	1970	58,061	42.19
28	1939	57,333	43.75
29	2001	56,952	45.31
30	1997	56,480	46.88
31	1995	53,588	48.44
32	1940	51,550	50.00
33	1952	48,974	51.56
34	1966	48,004	53.13
35	1975	46,423	54.69
36	1973	45,792	56.25
37	1981	45,181	57.81
38	1969	43,379	59.38
39	1980	43,313	60.94
40	1968	43,164	62.50
41	1987	42,660	64.06
42	1960	41,875	65.63
43	1954	41,720	67.19
44	1965	41,462	68.75
45	1978	41,281	70.31
46	1955	37,572	71.88
47	1963	37,011	73.44
48	1994	36,972	75.00
49	1958	36,532	76.56
50	1953	36,074	78.13
51	1992	34,751	79.69
52	1974	34,445	81.25
53	1948	33,362	82.81
54	1951	32,405	84.38
55	1985	31,926	85.94
56	1967	27,578	87.50
57	1991	26,500	89.06
58	1950	24,289	90.63
59	2000	22,223	92.19
60	1999	21,822	93.75
61	1986	20,614	95.31
62	1959	18,625	96.88
63	1941	18,166	98.44

YATES - 3 DAY			
Rank	Yr	Flow (cfs)	Position
1	1990	353,516	1.56
2	1979	277,340	3.13
3	1961	251,987	4.69
4	1949	207,860	6.25
5	1998	205,913	7.81
6	1982	191,333	9.38
7	1971	189,384	10.94
8	1972	184,552	12.50
9	1989	182,947	14.06
10	1964	179,417	15.63
11	1977	174,727	17.19
12	1976	171,464	18.75
13	1943	168,421	20.31
14	1996	163,527	21.88
15	1957	163,445	23.44
16	1947	162,627	25.00
17	1942	161,927	26.56
18	1956	161,402	28.13
19	1983	159,609	29.69
20	1962	154,368	31.25
21	1970	150,664	32.81
22	1946	148,515	34.38
23	1997	146,023	35.94
24	1945	145,362	37.50
25	1944	128,933	39.06
26	1993	128,317	40.63
27	2001	123,852	42.19
28	1939	119,667	43.75
29	1984	117,022	45.31
30	1995	108,451	46.88
31	1952	107,736	48.44
32	1966	107,063	50.00
33	1978	105,383	51.56
34	1975	104,943	53.13
35	1940	103,572	54.69
36	1988	103,305	56.25
37	1965	100,449	57.81
38	1980	99,580	59.38
39	1973	98,461	60.94
40	1963	97,814	62.50
41	1953	97,335	64.06
42	1974	93,961	65.63
43	1981	90,246	67.19
44	1968	90,197	68.75
45	1948	88,687	70.31
46	1987	86,590	71.88
47	1960	84,754	73.44
48	1955	84,431	75.00
49	1969	83,668	76.56
50	1958	81,290	78.13
51	1992	80,732	79.69
52	1985	76,938	81.25
53	1951	76,448	82.81
54	1994	73,098	84.38
55	1954	65,526	85.94
56	1991	63,941	87.50
57	1967	61,052	89.06
58	2000	58,868	90.63
59	1999	51,023	92.19
60	1950	50,422	93.75
61	1959	50,082	95.31
62	1986	49,579	96.88
63	1941	37,896	98.44

YATES - 5 DAY			
Rank	Yr	Flow (cfs)	Position
1	1990	433,854	1.56
2	1979	341,317	3.13
3	1961	339,018	4.69
4	1949	292,631	6.25
5	1998	251,795	7.81
6	1982	250,200	9.38
7	1962	242,829	10.94
8	1977	241,696	12.50
9	1972	241,092	14.06
10	1964	236,302	15.63
11	1971	233,986	17.19
12	1989	228,100	18.75
13	1976	220,912	20.31
14	1943	215,124	21.88
15	1957	212,596	23.44
16	1996	207,859	25.00
17	1946	205,583	26.56
18	1956	204,602	28.13
19	1983	202,350	29.69
20	1947	201,986	31.25
21	1942	200,602	32.81
22	1970	197,957	34.38
23	1997	187,455	35.94
24	1984	183,585	37.50
25	1945	172,552	39.06
26	1966	172,209	40.63
27	1993	165,923	42.19
28	1944	162,158	43.75
29	1939	157,751	45.31
30	1975	155,851	46.88
31	2001	153,192	48.44
32	1952	146,473	50.00
33	1995	138,800	51.56
34	1980	137,766	53.13
35	1978	135,083	54.69
36	1974	132,093	56.25
37	1948	130,403	57.81
38	1958	123,888	59.38
39	1940	122,658	60.94
40	1953	122,234	62.50
41	1987	121,101	64.06
42	1973	120,307	65.63
43	1963	119,919	67.19
44	1965	119,381	68.75
45	1960	116,431	70.31
46	1988	114,439	71.88
47	1981	113,041	73.44
48	1955	112,096	75.00
49	1992	110,271	76.56
50	1968	108,987	78.13
51	1969	108,052	79.69
52	1985	98,567	81.25
53	1951	94,028	82.81
54	1994	93,967	84.38
55	1991	81,406	85.94
56	1967	79,296	87.50
57	2000	79,139	89.06
58	1999	73,400	90.63
59	1954	72,306	92.19
60	1959	72,192	93.75
61	1950	64,485	95.31
62	1986	62,785	96.88
63	1941	51,118	98.44

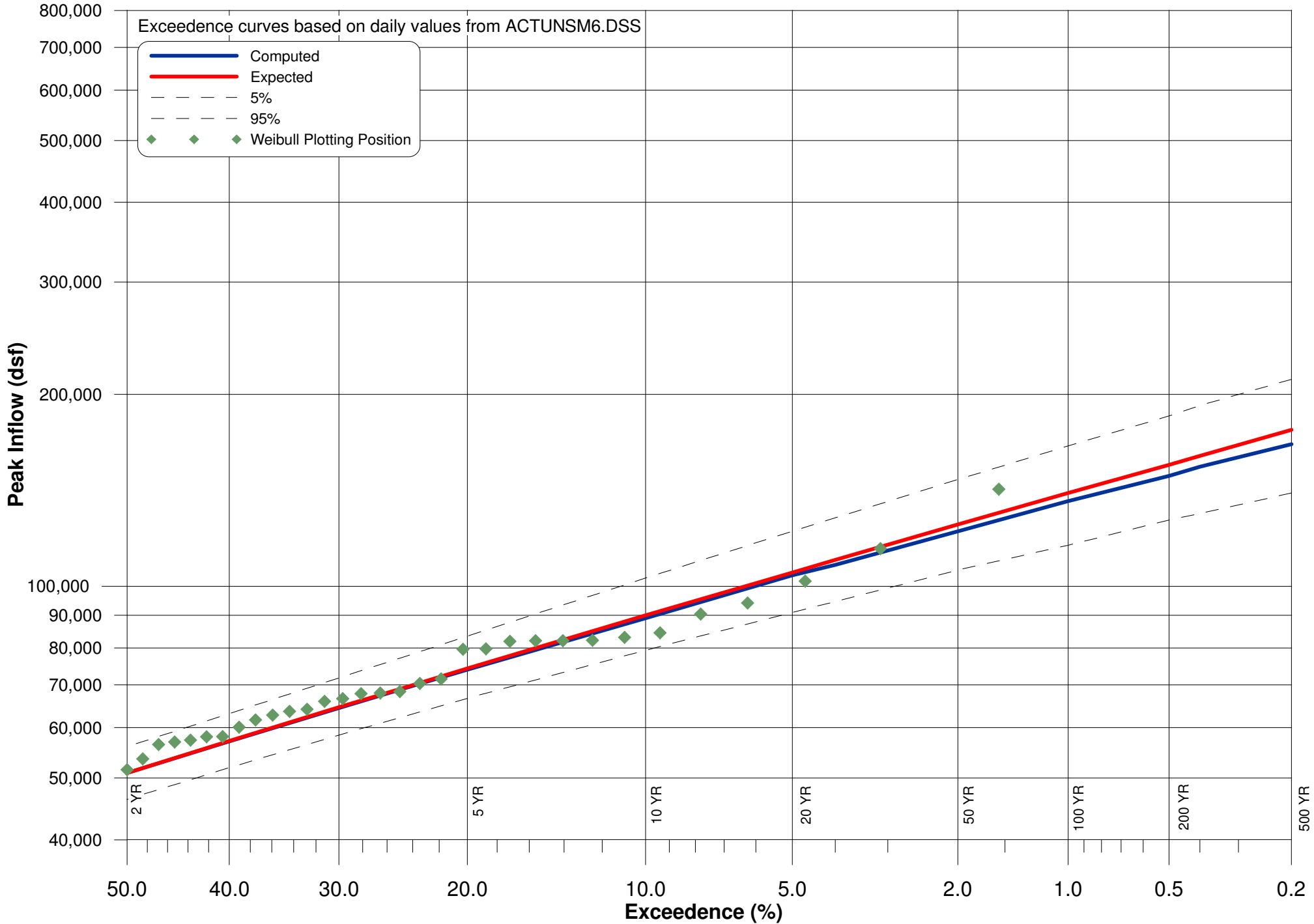
Table YAT-2: Summary of FFA Results for Yates

YATES DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
167,000	176,000	0.20	211,000	140,000
154,000	160,000	0.40	192,000	130,000
149,000	155,000	0.50	185,000	127,000
136,000	140,000	1.00	166,000	116,000
122,000	125,000	2.00	147,000	106,000
108,000	110,000	4.00	128,000	94,600
104,000	105,000	5.00	122,000	91,000
89,100	90,000	10.00	103,000	79,300
74,000	74,300	20.00	83,500	66,700
68,800	69,000	25.00	77,100	62,200
64,400	64,600	30.00	71,800	58,400
57,100	57,200	40.00	63,100	51,900
50,900	50,900	50.00	56,000	46,300
45,300	45,200	60.00	49,800	41,000
39,900	39,800	70.00	43,900	35,800
34,300	34,100	80.00	38,000	30,400
27,600	27,300	90.00	31,100	23,900
23,000	22,600	95.00	26,300	19,500
7,500	6,450	99.99	9,730	5,310
MEAN	4.7001		HISTORIC EVENTS	0
STANDARD DEV	0.1987		HIGH OUTLIERS	0
COMPUTED SKEW	-0.2581		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.2000		SYSTEM EVENTS	63

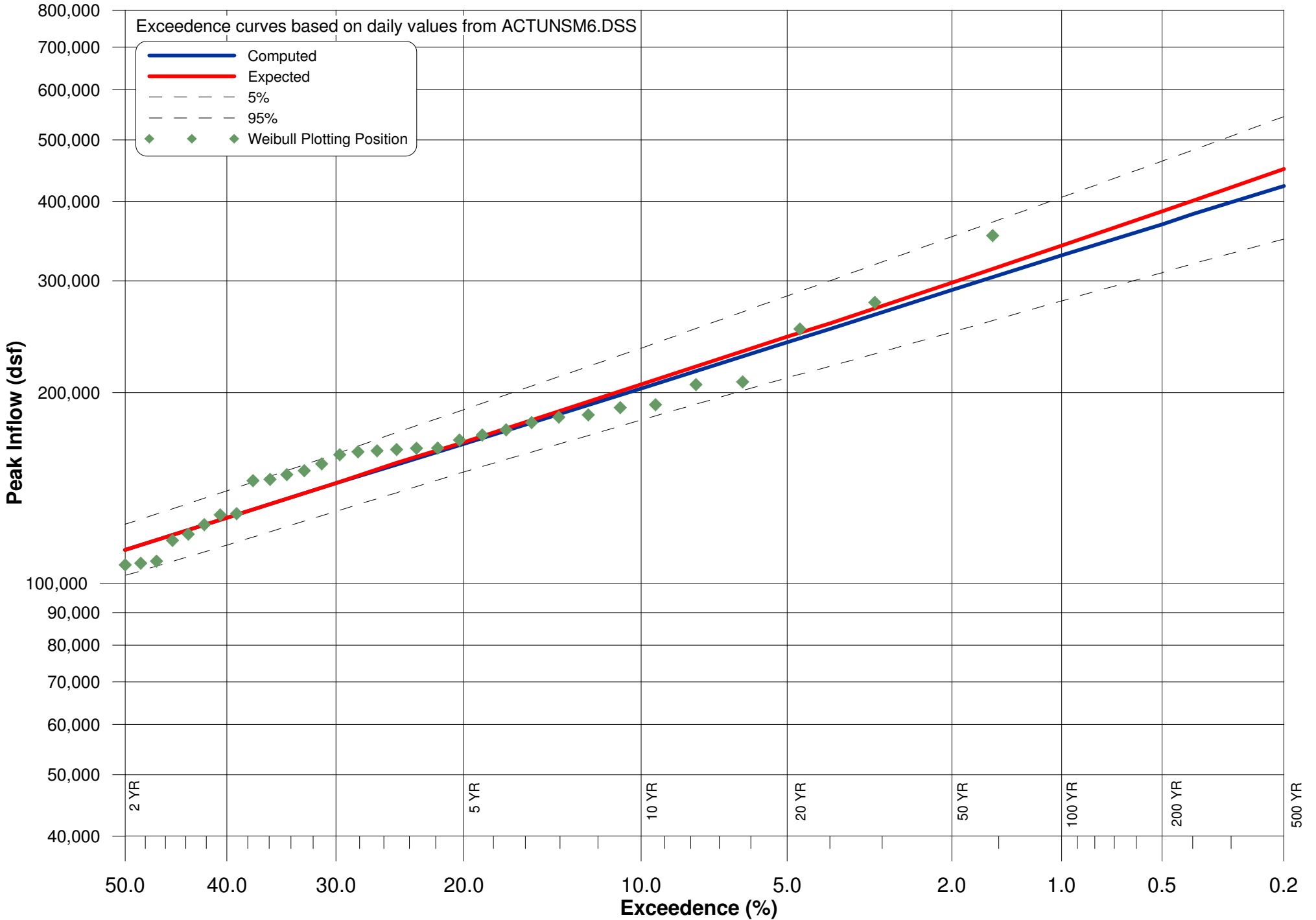
YATES 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
423,000	450,000	0.20	544,000	349,000
382,000	401,000	0.40	482,000	319,000
368,000	386,000	0.50	463,000	309,000
329,000	341,000	1.00	406,000	279,000
290,000	298,000	2.00	352,000	249,000
252,000	257,000	4.00	300,000	220,000
240,000	245,000	5.00	284,000	211,000
203,000	206,000	10.00	235,000	181,000
166,000	167,000	20.00	188,000	150,000
154,000	155,000	25.00	173,000	139,000
144,000	144,000	30.00	160,000	130,000
127,000	127,000	40.00	140,000	115,000
113,000	113,000	50.00	124,000	103,000
101,000	100,000	60.00	111,000	91,000
88,900	88,600	70.00	97,900	79,800
76,800	76,400	80.00	85,200	68,100
62,800	62,100	90.00	70,600	54,400
53,100	52,200	95.00	60,700	45,000
20,500	18,200	99.99	26,000	15,000
MEAN	5.0532		HISTORIC EVENTS	0
STANDARD DEV	0.1992		HIGH OUTLIERS	0
COMPUTED SKEW	-0.0571		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	0.0000		SYSTEM EVENTS	63

YATES 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
519,000	549,000	0.20	660,000	432,000
473,000	495,000	0.40	592,000	397,000
458,000	478,000	0.50	571,000	386,000
413,000	427,000	1.00	506,000	352,000
368,000	377,000	2.00	444,000	317,000
323,000	329,000	4.00	383,000	282,000
309,000	314,000	5.00	363,000	271,000
264,000	266,000	10.00	304,000	235,000
217,000	218,000	20.00	245,000	196,000
202,000	203,000	25.00	226,000	183,000
189,000	189,000	30.00	210,000	171,000
167,000	167,000	40.00	185,000	152,000
149,000	149,000	50.00	164,000	135,000
133,000	132,000	60.00	146,000	120,000
117,000	117,000	70.00	129,000	105,000
101,000	100,000	80.00	112,000	89,500
82,000	81,100	90.00	92,200	71,000
68,900	67,700	95.00	78,700	58,300
24,600	21,500	99.99	31,500	17,700
MEAN	5.1695		HISTORIC EVENTS	0
STANDARD DEV	0.1980		HIGH OUTLIERS	0
COMPUTED SKEW	-0.0939		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.1000		SYSTEM EVENTS	63

**Figure YAT- 4: Exceedence Curve for Unregulated 1 Day Volume at Yates**  
*(1939-2001)*



**Figure YAT- 5: Exceedence Curve for Unregulated 3 Day Volume at Yates**  
(1939-2001)



**Figure YAT- 6: Exceedence Curve for Unregulated 5 Day Volume at Yates**  
(1939-2001)

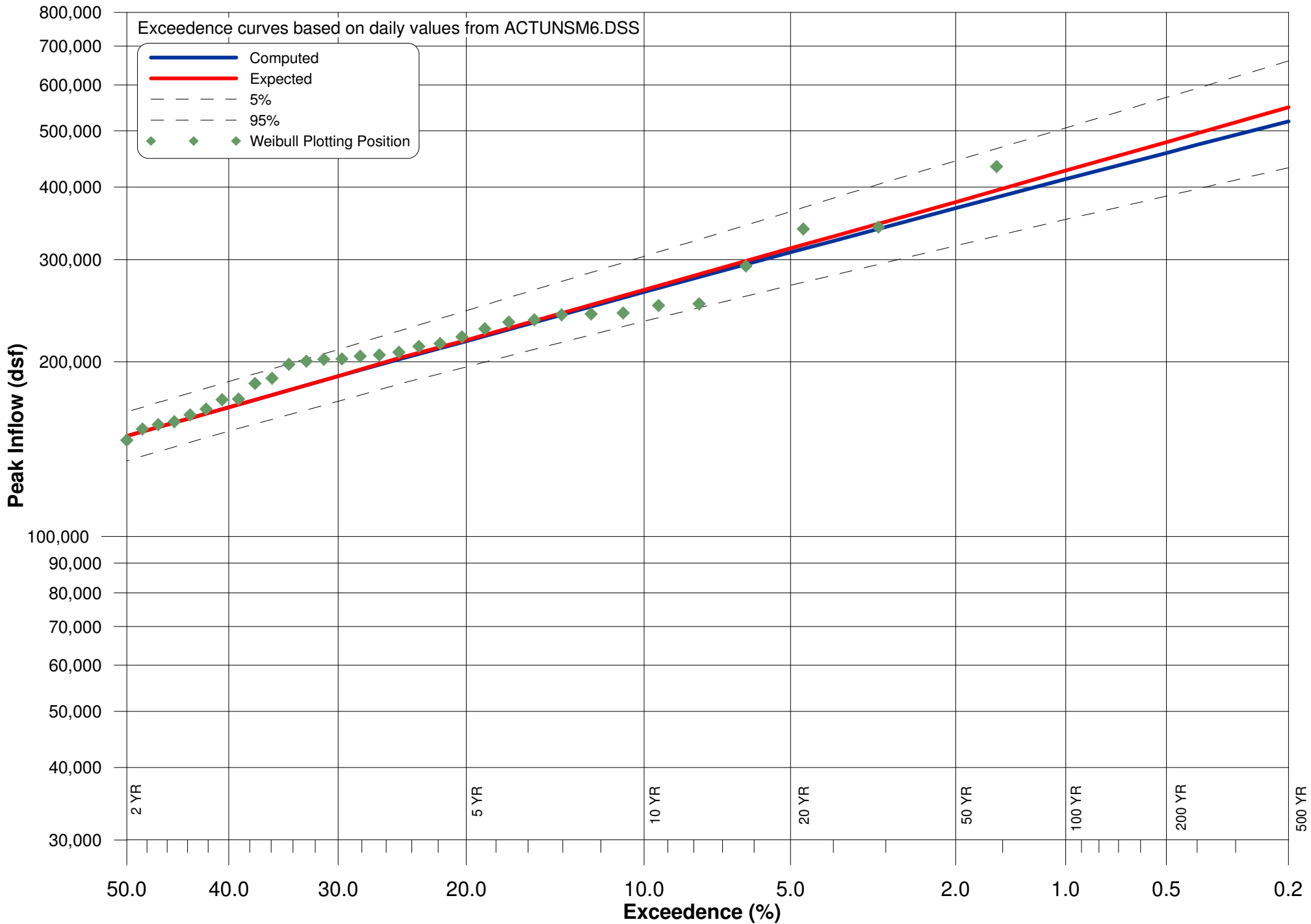


Table YAT-3: Regulation Impact on Flood Recurrences at Yates

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval	Regulated Discharge (cfs)	Recurrence Interval
1976		62,772	2	36,940	1
1977		67,840	2	63,290	2
1978		41,281	1	21,500	1
1979		114,552	25	119,410	25
1980		43,313	1	37,860	1
1981		45,181	1	9,660	1
1982	4/26/82	90,386	10	32,771	1
1983	5/21/83	66,643	2	38,796	1
1984	8/2/84	61,734	2	47,938	1
1985	2/6/85	31,926	1	9,588	1
1986	11/21/86	20,614	1	9,612	1
1987	3/6/87	42,660	1	10,670	1
1988	9/18/88	58,075	2	16,130	1
1989	6/20/89	84,507	5	74,420	5
1990	3/17/90	141,920	110	125,390	50
1991	6/27/91	26,500	1	16,530	1
1992	12/20/92	34,751	1	15,818	1
1993	1/23/93	68,361	2	10,273	1
1994	4/17/94	36,972	1	15,843	1
1995	10/6/95	53,588	2	34,401	1
1996	8/21/96	82,099	5	25,943	1
1997	6/18/97	56,480	2	17,573	1
1998	3/9/98	94,109	10	41,220	1
1999	6/29/99	21,822	1	18,473	1
2000	4/5/00	22,223	1	11,666	1
2001	4/5/01	56,952	2	33,354	1

Figure THU-1: FFA Datafile THU.DAT

```

TT TALLAPOOSA RIVER AT THURLOW INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID THURLOW DSS 1939-2001
GS ALL 0.0
QR 1939 57872
QR 1940 52106
QR 1941 18183
QR 1942 68781
QR 1943 82835
QR 1944 65051
QR 1945 80408
QR 1946 64316
QR 1947 83747
QR 1948 36226
QR 1949 85892
QR 1950 24655
QR 1951 32649
QR 1952 50346
QR 1953 37862
QR 1954 42306
QR 1955 38038
QR 1956 66734
QR 1957 74080
QR 1958 37001
QR 1959 19412
QR 1960 43420
QR 1961 109523
QR 1962 64919
QR 1963 39801
QR 1964 76180
QR 1965 42143
QR 1966 48559
QR 1967 28192
QR 1968 43738
QR 1969 44519
QR 1970 63354
QR 1971 82569
QR 1972 88382
QR 1973 37965
QR 1974 36168
QR 1975 51568
QR 1976 61496
QR 1977 68373
QR 1978 49734
QR 1979 104491
QR 1980 40755
QR 1981 57217
QR 1982 90354
QR 1983 66556
QR 1984 61419
QR 1985 32686
QR 1986 20932
QR 1987 41662
QR 1988 57018
QR 1989 80063
QR 1990 140790
QR 1991 26571
QR 1992 35303
QR 1993 68746
QR 1994 37144
QR 1995 54694
QR 1996 81798
QR 1997 57921
QR 1998 94513
QR 1999 21303
QR 2000 22217
QR 2001 60638
ED

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Figure THU-2: FFA Datafile THU3.DAT

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TT TALLAPOOSA RIVER AT THURLOW INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 3 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID THURLOW 3 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 121506
QR 1940 104764
QR 1941 38591
QR 1942 163844
QR 1943 171452
QR 1944 139308
QR 1945 147091
QR 1946 150064
QR 1947 164540
QR 1948 90142
QR 1949 220988
QR 1950 51365
QR 1951 77022
QR 1952 111954
QR 1953 99112
QR 1954 66416
QR 1955 85626
QR 1956 163413
QR 1957 171248
QR 1958 83010
QR 1959 52348
QR 1960 88441
QR 1961 267574
QR 1962 156273
QR 1963 104235
QR 1964 192245
QR 1965 102465
QR 1966 108226
QR 1967 62769
QR 1968 92231
QR 1969 87328
QR 1970 154764
QR 1971 204555
QR 1972 190730
QR 1973 93054
QR 1974 99308
QR 1975 120547
QR 1976 160667
QR 1977 179639
QR 1978 126399
QR 1979 245692
QR 1980 99935
QR 1981 109317
QR 1982 191808
QR 1983 159213
QR 1984 116359
QR 1985 79068
QR 1986 49974
QR 1987 90368
QR 1988 102175
QR 1989 175042
QR 1990 351594
QR 1991 64264
QR 1992 82266
QR 1993 129946
QR 1994 73648
QR 1995 113051
QR 1996 165495
QR 1997 149823
QR 1998 205876
QR 1999 49524
QR 2000 58646
QR 2001 121494
ED

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Figure THU-3: FFA Datafile THU5.DAT

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TT TALLAPOOSA RIVER AT THURLOW INFLOW FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 5 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID THURLOW 5 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 160435
QR 1940 123930
QR 1941 52230
QR 1942 203164
QR 1943 222142
QR 1944 175546
QR 1945 175411
QR 1946 207887
QR 1947 204971
QR 1948 132704
QR 1949 309955
QR 1950 65807
QR 1951 94729
QR 1952 148590
QR 1953 129877
QR 1954 73698
QR 1955 113858
QR 1956 207597
QR 1957 224553
QR 1958 126336
QR 1959 76039
QR 1960 123618
QR 1961 355353
QR 1962 246209
QR 1963 128250
QR 1964 253885
QR 1965 122631
QR 1966 174160
QR 1967 82222
QR 1968 112493
QR 1969 112976
QR 1970 206089
QR 1971 252832
QR 1972 243909
QR 1973 124928
QR 1974 141068
QR 1975 160495
QR 1976 207644
QR 1977 249167
QR 1978 158866
QR 1979 307886
QR 1980 134734
QR 1981 138746
QR 1982 248563
QR 1983 201688
QR 1984 183674
QR 1985 100617
QR 1986 63341
QR 1987 125475
QR 1988 112773
QR 1989 224965
QR 1990 431496
QR 1991 81025
QR 1992 112718
QR 1993 168313
QR 1994 94878
QR 1995 145816
QR 1996 215385
QR 1997 194189
QR 1998 256048
QR 1999 71771
QR 2000 78734
QR 2001 150996
ED

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Table THU-1: Rankings of Flood Events at Thurlow

THURLLOW				THURLLOW - 3 DAY				THURLLOW - 5 DAY			
Rank	Yr	Flow (cfs)	Position	Rank	Yr	Flow (cfs)	Position	Rank	Yr	Flow (cfs)	Position
1	1990	140,790	1.56	1	1990	351,594	1.56	1	1990	431,496	1.56
2	1961	109,523	3.13	2	1961	267,574	3.13	2	1961	355,353	3.13
3	1979	104,491	4.69	3	1979	245,692	4.69	3	1949	309,955	4.69
4	1998	94,513	6.25	4	1949	220,988	6.25	4	1979	307,886	6.25
5	1982	90,354	7.81	5	1998	205,876	7.81	5	1998	256,048	7.81
6	1972	88,382	9.38	6	1971	204,555	9.38	6	1964	253,885	9.38
7	1949	85,892	10.94	7	1964	192,245	10.94	7	1971	252,832	10.94
8	1947	83,747	12.50	8	1982	191,808	12.50	8	1977	249,167	12.50
9	1943	82,835	14.06	9	1972	190,730	14.06	9	1982	248,563	14.06
10	1971	82,569	15.63	10	1977	179,639	15.63	10	1962	246,209	15.63
11	1996	81,798	17.19	11	1989	175,042	17.19	11	1972	243,909	17.19
12	1945	80,408	18.75	12	1943	171,452	18.75	12	1989	224,965	18.75
13	1989	80,063	20.31	13	1957	171,248	20.31	13	1957	224,553	20.31
14	1964	76,180	21.88	14	1996	165,495	21.88	14	1943	222,142	21.88
15	1957	74,080	23.44	15	1947	164,540	23.44	15	1996	215,385	23.44
16	1942	68,781	25.00	16	1942	163,844	25.00	16	1946	207,887	25.00
17	1993	68,746	26.56	17	1956	163,413	26.56	17	1976	207,644	26.56
18	1977	68,373	28.13	18	1976	160,667	28.13	18	1956	207,597	28.13
19	1956	66,734	29.69	19	1983	159,213	29.69	19	1970	206,089	29.69
20	1983	66,556	31.25	20	1962	156,273	31.25	20	1947	204,971	31.25
21	1944	65,051	32.81	21	1970	154,764	32.81	21	1942	203,164	32.81
22	1962	64,919	34.38	22	1946	150,064	34.38	22	1983	201,688	34.38
23	1946	64,316	35.94	23	1997	149,823	35.94	23	1997	194,189	35.94
24	1970	63,354	37.50	24	1945	147,091	37.50	24	1984	183,674	37.50
25	1976	61,496	39.06	25	1944	139,308	39.06	25	1944	175,546	39.06
26	1984	61,419	40.63	26	1993	129,946	40.63	26	1945	175,411	40.63
27	2001	60,638	42.19	27	1978	126,399	42.19	27	1966	174,160	42.19
28	1997	57,921	43.75	28	1939	121,506	43.75	28	1993	168,313	43.75
29	1939	57,872	45.31	29	2001	121,494	45.31	29	1975	160,495	45.31
30	1981	57,217	46.88	30	1975	120,547	46.88	30	1939	160,435	46.88
31	1988	57,018	48.44	31	1984	116,359	48.44	31	1978	158,866	48.44
32	1995	54,694	50.00	32	1995	113,051	50.00	32	2001	150,996	50.00
33	1940	52,106	51.56	33	1952	111,954	51.56	33	1952	148,590	51.56
34	1975	51,568	53.13	34	1981	109,317	53.13	34	1995	145,816	53.13
35	1952	50,346	54.69	35	1966	108,226	54.69	35	1974	141,068	54.69
36	1978	49,734	56.25	36	1940	104,764	56.25	36	1981	138,746	56.25
37	1966	48,559	57.81	37	1963	104,235	57.81	37	1980	134,734	57.81
38	1969	44,519	59.38	38	1965	102,465	59.38	38	1948	132,704	59.38
39	1968	43,738	60.94	39	1988	102,175	60.94	39	1953	129,877	60.94
40	1960	43,420	62.50	40	1980	99,935	62.50	40	1963	128,250	62.50
41	1954	42,306	64.06	41	1974	99,308	64.06	41	1958	126,336	64.06
42	1965	42,143	65.63	42	1953	99,112	65.63	42	1987	125,475	65.63
43	1987	41,662	67.19	43	1973	93,054	67.19	43	1973	124,928	67.19
44	1980	40,755	68.75	44	1968	92,231	68.75	44	1940	123,930	68.75
45	1963	39,801	70.31	45	1987	90,368	70.31	45	1960	123,618	70.31
46	1955	38,038	71.88	46	1948	90,142	71.88	46	1965	122,631	71.88
47	1973	37,965	73.44	47	1960	88,441	73.44	47	1955	113,858	73.44
48	1953	37,862	75.00	48	1969	87,328	75.00	48	1969	112,976	75.00
49	1994	37,144	76.56	49	1955	85,626	76.56	49	1988	112,773	76.56
50	1958	37,001	78.13	50	1958	83,010	78.13	50	1992	112,718	78.13
51	1948	36,226	79.69	51	1992	82,266	79.69	51	1968	112,493	79.69
52	1974	36,168	81.25	52	1985	79,068	81.25	52	1985	100,617	81.25
53	1992	35,303	82.81	53	1951	77,022	82.81	53	1994	94,878	82.81
54	1985	32,686	84.38	54	1994	73,648	84.38	54	1951	94,729	84.38
55	1951	32,649	85.94	55	1954	66,416	85.94	55	1967	82,222	85.94
56	1967	28,192	87.50	56	1991	64,264	87.50	56	1991	81,025	87.50
57	1991	26,571	89.06	57	1967	62,769	89.06	57	2000	78,734	89.06
58	1950	24,655	90.63	58	2000	58,646	90.63	58	1959	76,039	90.63
59	2000	22,217	92.19	59	1959	52,348	92.19	59	1954	73,698	92.19
60	1999	21,303	93.75	60	1950	51,365	93.75	60	1999	71,771	93.75
61	1986	20,932	95.31	61	1986	49,974	95.31	61	1950	65,807	95.31
62	1959	19,412	96.88	62	1999	49,524	96.88	62	1986	63,341	96.88
63	1941	18,183	98.44	63	1941	38,591	98.44	63	1941	52,230	98.44

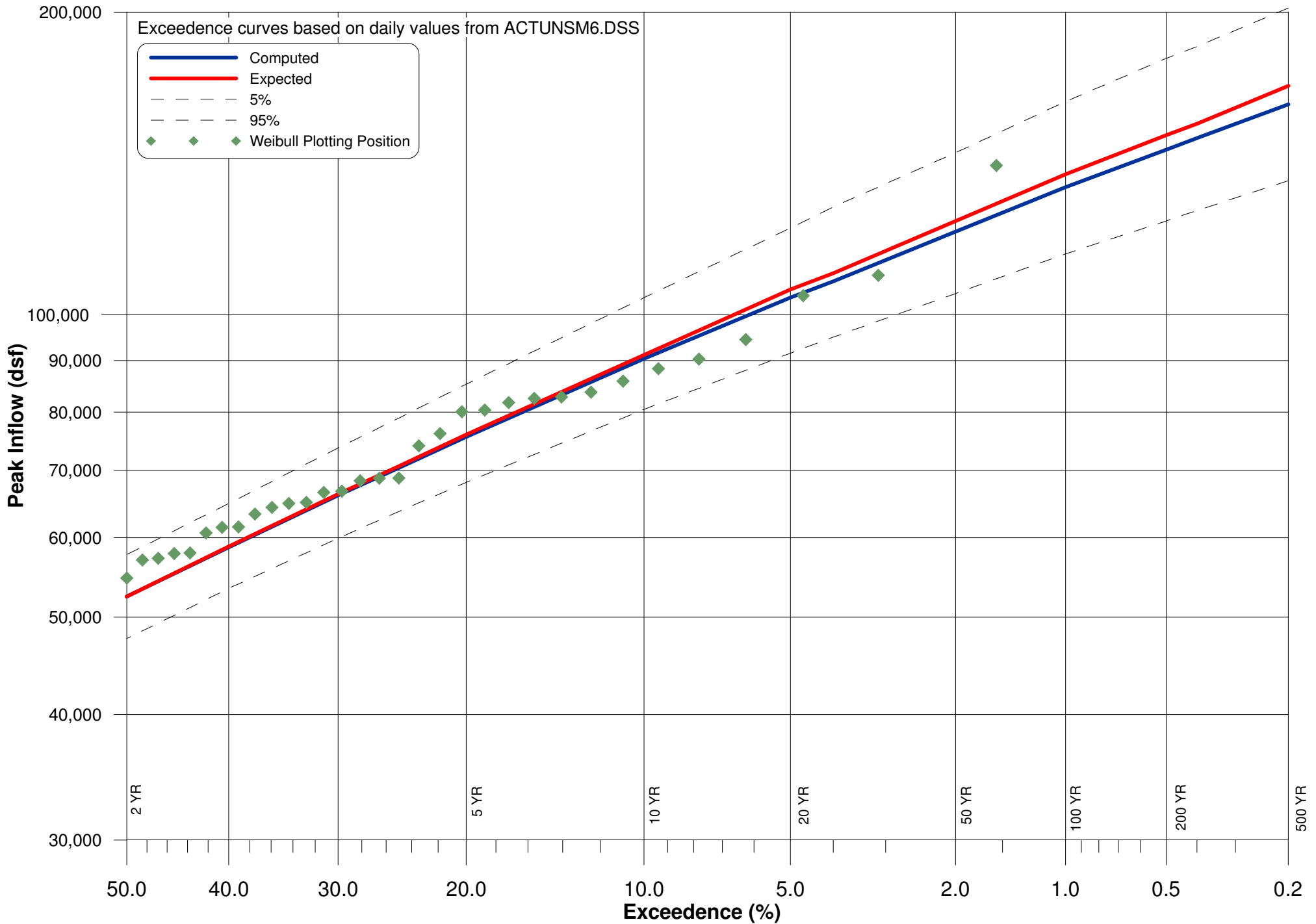
Table 8-2: Summary of FFA Results for Thurlow

THURLOW DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
162,000	169,000	0.20	202,000	136,000
150,000	155,000	0.40	185,000	127,000
146,000	151,000	0.50	180,000	124,000
134,000	138,000	1.00	163,000	115,000
121,000	124,000	2.00	145,000	105,000
108,000	110,000	4.00	128,000	95,000
104,000	106,000	5.00	122,000	91,600
90,400	91,200	10.00	104,000	80,500
75,600	76,000	20.00	85,300	68,100
70,400	70,700	25.00	78,900	63,700
66,100	66,300	30.00	73,700	59,900
58,700	58,800	40.00	64,900	53,400
52,400	52,400	50.00	57,700	47,600
46,600	46,500	60.00	51,200	42,200
41,000	40,900	70.00	45,200	36,900
35,100	34,900	80.00	39,000	31,200
28,200	27,800	90.00	31,700	24,400
23,300	22,800	95.00	26,700	19,600
6,950	5,890	99.99	9,120	4,840
MEAN	4.7092		HISTORIC EVENTS	0
STANDARD DEV	0.1983		HIGH OUTLIERS	0
COMPUTED SKEW	-0.3373		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63

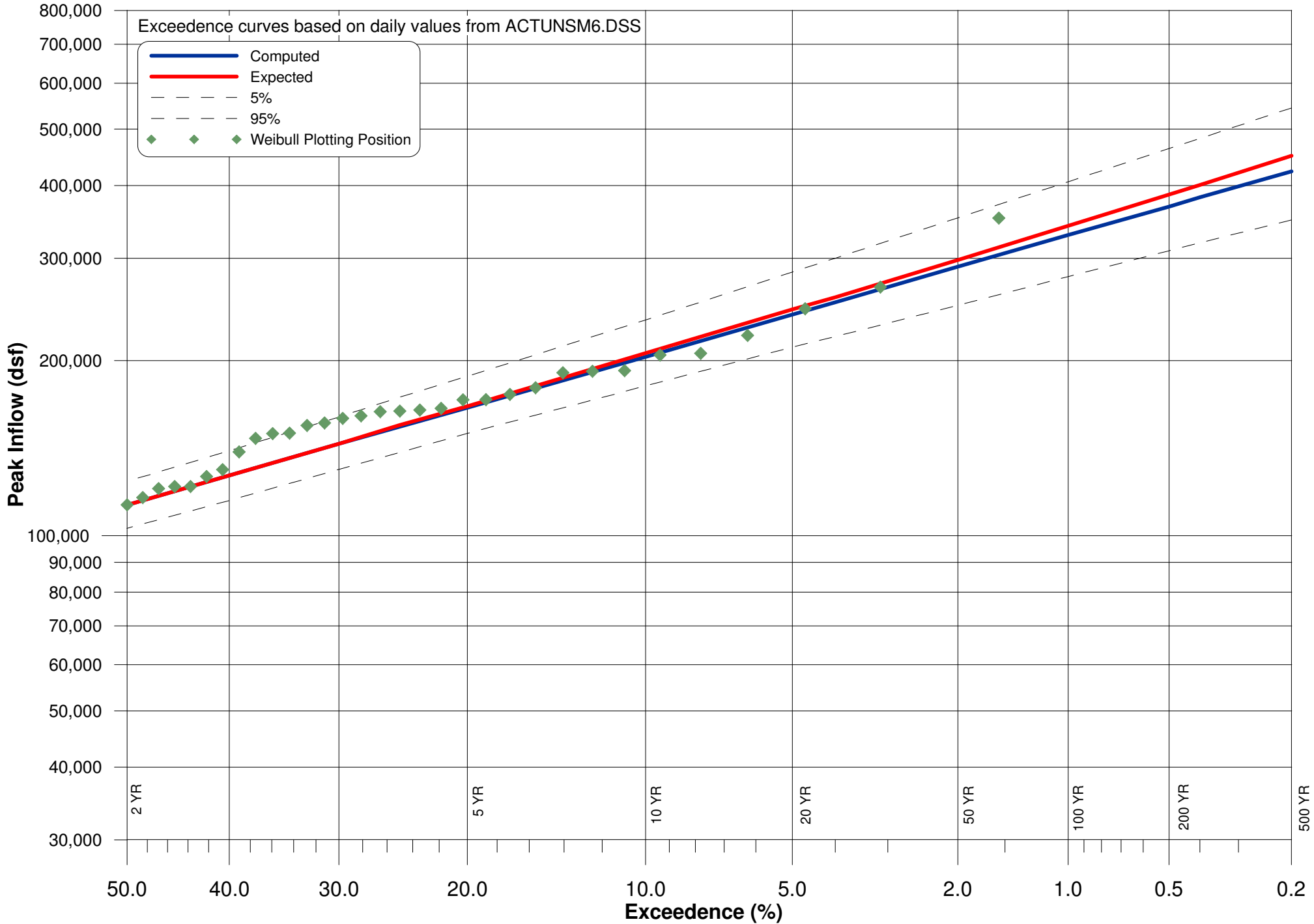
THURLOW 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
407,000	430,000	0.20	517,000	338,000
370,000	387,000	0.40	464,000	311,000
359,000	374,000	0.50	447,000	302,000
323,000	334,000	1.00	397,000	275,000
288,000	295,000	2.00	347,000	248,000
253,000	258,000	4.00	300,000	221,000
242,000	246,000	5.00	284,000	212,000
206,000	209,000	10.00	238,000	184,000
170,000	171,000	20.00	192,000	153,000
158,000	159,000	25.00	177,000	143,000
148,000	148,000	30.00	165,000	134,000
131,000	131,000	40.00	144,000	119,000
117,000	117,000	50.00	128,000	106,000
104,000	104,000	60.00	114,000	94,000
91,600	91,300	70.00	101,000	82,300
79,000	78,500	80.00	87,600	70,000
64,200	63,400	90.00	72,200	55,600
53,900	53,000	95.00	61,600	45,700
19,200	16,800	99.99	24,600	13,900
MEAN	5.0631		HISTORIC EVENTS	0
STANDARD DEV	0.1980		HIGH OUTLIERS	0
COMPUTED SKEW	-0.1476		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.1000		SYSTEM EVENTS	63

THURLOW 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
528,000	558,000	0.20	671,000	440,000
481,000	504,000	0.40	602,000	405,000
466,000	487,000	0.50	581,000	394,000
420,000	435,000	1.00	515,000	359,000
375,000	385,000	2.00	452,000	324,000
330,000	336,000	4.00	390,000	288,000
315,000	320,000	5.00	371,000	277,000
269,000	272,000	10.00	310,000	240,000
222,000	224,000	20.00	251,000	201,000
207,000	207,000	25.00	231,000	187,000
193,000	194,000	30.00	215,000	175,000
171,000	171,000	40.00	189,000	156,000
153,000	153,000	50.00	168,000	139,000
136,000	136,000	60.00	150,000	123,000
120,000	120,000	70.00	132,000	108,000
104,000	103,000	80.00	115,000	92,100
84,400	83,500	90.00	94,900	73,200
71,100	69,800	95.00	81,100	60,200
25,500	22,300	99.99	32,600	18,400
MEAN	5.1817		HISTORIC EVENTS	0
STANDARD DEV	0.1969		HIGH OUTLIERS	0
COMPUTED SKEW	-0.1730		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.1000		SYSTEM EVENTS	63

**Figure THU- 4: Exceedence Curve for Unregulated 1 Day Volume at Thurlow**  
(1939-2001)



**Figure THU- 5: Exceedence Curve for Unregulated 3 Day Volume at Thurlow**  
*(1939-2001)*



**Figure THU - 6: Exceedence Curve for Unregulated 5 Day Volume at Thurlow**  
(1939-2001)

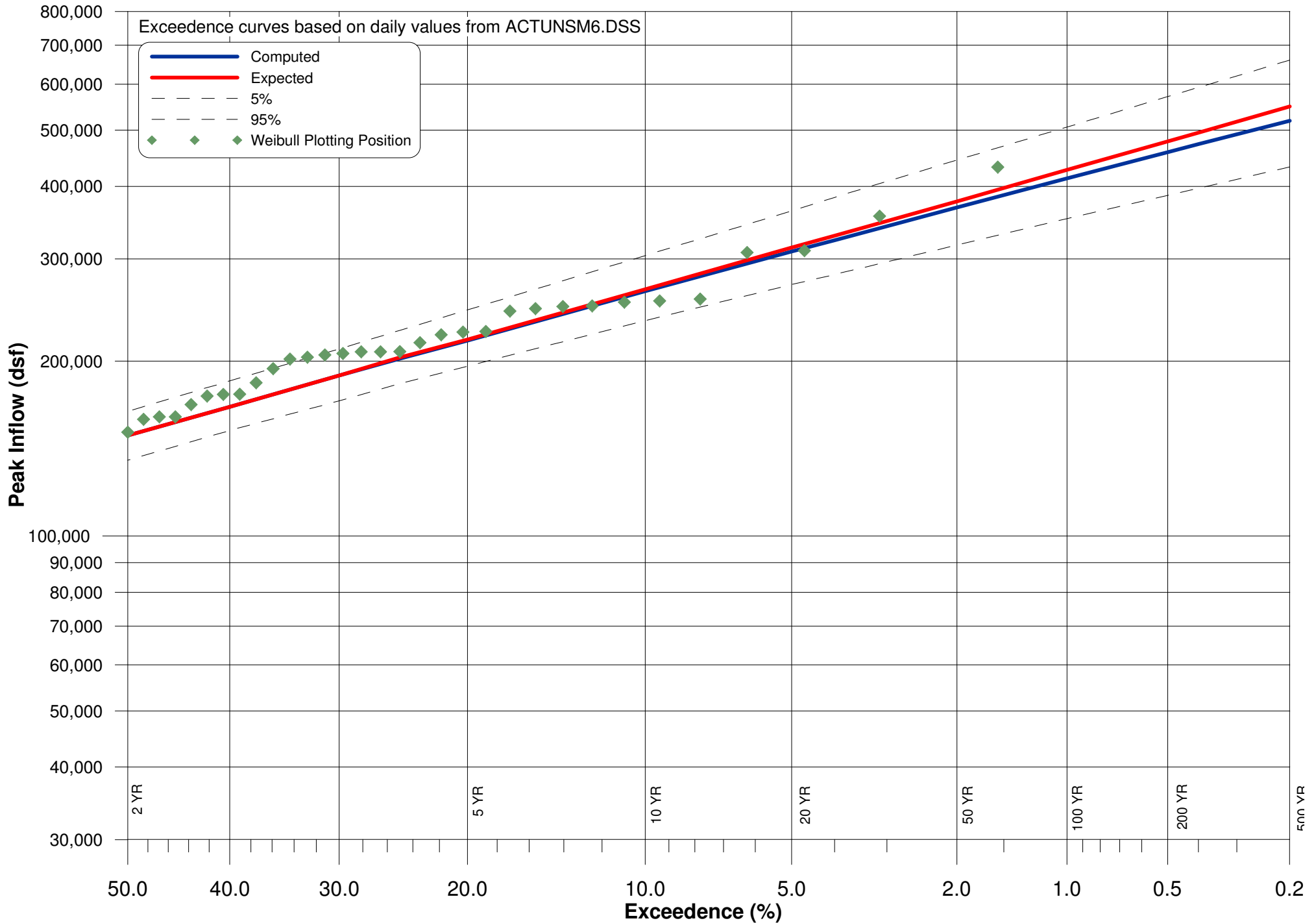


Table THU-3: Regulation Impact on Flood Recurrences at Thurlow

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval	Regulated Discharge (cfs)	Recurrence Interval
1976		61,496	2	36,182	1
1977		68,373	2	63,815	2
1978		49,734	1	21,769	1
1979		104,491	10	109,340	10
1980		40,755	1	35,188	1
1981		57,217	2	13,121	1
1982	4/26/82	90,354	5	32,603	1
1983	4/9/83	66,556	2	38,269	1
1984	8/2/84	61,419	2	47,613	1
1985	2/6/85	32,686	1	10,338	1
1986	12/1/86	20,932	1	10,139	1
1987	1/22/87	41,662	1	10,238	1
1988	9/18/88	57,018	2	16,003	1
1989	6/20/89	80,063	5	69,978	2
1990	3/18/90	140,790	120	124,250	50
1991	6/27/91	26,571	1	17,494	1
1992	12/22/92	35,303	1	17,097	1
1993	3/31/93	68,746	2	10,934	1
1994	7/7/94	37,144	1	16,250	1
1995	10/6/95	54,694	2	36,229	1
1996	2/3/96	81,798	5	25,854	1
1997	6/18/97	57,921	2	21,249	1
1998	3/10/98	94,513	10	40,842	1
1999	6/29/99	21,303	1	20,923	1
2000	4/5/00	22,217	1	11,411	1
2001	4/5/01	60,638	2	36,057	1



Figure TAL-1: FFA Datafile TAL.DAT

```

TT TALLAPOOSA RIVER AT WADLEY FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001
J1      1
FR      19      0.20      0.40      0.50      1.00      2.00      4.00      5.00      10.00      20.00
FR 25.00  30.00  40.00  50.00  60.00  70.00  80.00  90.00  95.00  99.99
ID WADLEY DSS 1939-2001
GS ALL      0.0
QR      1939      57914
QR      1940      52149
QR      1941      18183
QR      1942      68845
QR      1943      82894
QR      1944      65447
QR      1945      80460
QR      1946      64372
QR      1947      83795
QR      1948      36454
QR      1949      86388
QR      1950      24683
QR      1951      32668
QR      1952      50454
QR      1953      38070
QR      1954      42352
QR      1955      38074
QR      1956      66795
QR      1957      74277
QR      1958      37050
QR      1959      19474
QR      1960      43543
QR      1961      110134
QR      1962      64983
QR      1963      40024
QR      1964      76642
QR      1965      42196
QR      1966      48602
QR      1967      28240
QR      1968      43783
QR      1969      44609
QR      1970      63390
QR      1971      82819
QR      1972      88444
QR      1973      38130
QR      1974      36224
QR      1975      51901
QR      1976      61570
QR      1977      68758
QR      1978      49799
QR      1979      105151
QR      1980      40861
QR      1981      57289
QR      1982      90444
QR      1983      66675
QR      1984      61706
QR      1985      32747
QR      1986      20949
QR      1987      41707
QR      1988      57066
QR      1989      80397
QR      1990      141539
QR      1991      26611
QR      1992      35362
QR      1993      68811
QR      1994      37181
QR      1995      54693
QR      1996      81797
QR      1997      57896
QR      1998      94503
QR      1999      21282
QR      2000      22225
QR      2001      60689
ED

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Figure TAL-2: FFA Datafile TAL3.DAT

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TT TALLAPOOSA RIVER AT WADLEY FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 3 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID WADLEY 3 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 121652
QR 1940 104857
QR 1941 38644
QR 1942 163994
QR 1943 171692
QR 1944 140136
QR 1945 147227
QR 1946 150185
QR 1947 164691
QR 1948 90255
QR 1949 222036
QR 1950 51437
QR 1951 77066
QR 1952 112288
QR 1953 99250
QR 1954 66485
QR 1955 85719
QR 1956 163571
QR 1957 171870
QR 1958 83145
QR 1959 52527
QR 1960 88733
QR 1961 268816
QR 1962 156423
QR 1963 104746
QR 1964 193267
QR 1965 102622
QR 1966 108316
QR 1967 62903
QR 1968 92390
QR 1969 87656
QR 1970 154930
QR 1971 205210
QR 1972 190917
QR 1973 93586
QR 1974 99466
QR 1975 121158
QR 1976 160919
QR 1977 180492
QR 1978 126589
QR 1979 247067
QR 1980 100091
QR 1981 109476
QR 1982 192039
QR 1983 159689
QR 1984 117044
QR 1985 79248
QR 1986 50013
QR 1987 90523
QR 1988 102337
QR 1989 176046
QR 1990 353133
QR 1991 64394
QR 1992 82435
QR 1993 130151
QR 1994 73701
QR 1995 113135
QR 1996 165489
QR 1997 149838
QR 1998 205805
QR 1999 49570
QR 2000 58653
QR 2001 121481
ED

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Figure TAL-3: FFA Datafile TAL5.DAT

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TT TALLAPOOSA RIVER AT TALLASSEE FREQUENCY ANALYSIS PROGRAM
TT LOG-PEARSON TYPE III DIST
TT 1939-2001 5 DAY VOLUME
J1 1
FR 19 0.20 0.40 0.50 1.00 2.00 4.00 5.00 10.00 20.00
FR 25.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 95.00 99.99
ID TALLASSEE 5 DAY VOLUME DSS 1939-2001
GS ALL 0.0
QR 1939 160646
QR 1940 124027
QR 1941 52314
QR 1942 203364
QR 1943 222699
QR 1944 176613
QR 1945 175636
QR 1946 208066
QR 1947 205206
QR 1948 132883
QR 1949 311337
QR 1950 65907
QR 1951 94780
QR 1952 148754
QR 1953 130645
QR 1954 73805
QR 1955 113995
QR 1956 207832
QR 1957 225506
QR 1958 126527
QR 1959 76343
QR 1960 124187
QR 1961 356654
QR 1962 246475
QR 1963 128912
QR 1964 255286
QR 1965 122885
QR 1966 174311
QR 1967 82451
QR 1968 112768
QR 1969 113363
QR 1970 206450
QR 1971 253800
QR 1972 244294
QR 1973 125629
QR 1974 141334
QR 1975 161092
QR 1976 208231
QR 1977 250458
QR 1978 159166
QR 1979 309661
QR 1980 135426
QR 1981 138967
QR 1982 248914
QR 1983 202420
QR 1984 184044
QR 1985 100874
QR 1986 63393
QR 1987 125726
QR 1988 113065
QR 1989 226269
QR 1990 433501
QR 1991 81225
QR 1992 113003
QR 1993 168705
QR 1994 94952
QR 1995 145931
QR 1996 215362
QR 1997 194287
QR 1998 256019
QR 1999 71885
QR 2000 78748
QR 2001 150975
ED

```

Table TAL-1: Rankings of Flood Events at Tallassee

TALLASSEE			
Rank	Yr	Flow (cfs)	Position
1	1990	141,539	1.56
2	1961	110,134	3.13
3	1979	105,151	4.69
4	1998	94,503	6.25
5	1982	90,444	7.81
6	1972	88,444	9.38
7	1949	86,388	10.94
8	1947	83,795	12.50
9	1943	82,894	14.06
10	1971	82,819	15.63
11	1996	81,797	17.19
12	1945	80,460	18.75
13	1989	80,397	20.31
14	1964	76,642	21.88
15	1957	74,277	23.44
16	1942	68,845	25.00
17	1993	68,811	26.56
18	1977	68,758	28.13
19	1956	66,795	29.69
20	1983	66,675	31.25
21	1944	65,447	32.81
22	1962	64,983	34.38
23	1946	64,372	35.94
24	1970	63,390	37.50
25	1984	61,706	39.06
26	1976	61,570	40.63
27	2001	60,689	42.19
28	1939	57,914	43.75
29	1997	57,896	45.31
30	1981	57,289	46.88
31	1988	57,066	48.44
32	1995	54,693	50.00
33	1940	52,149	51.56
34	1975	51,901	53.13
35	1952	50,454	54.69
36	1978	49,799	56.25
37	1966	48,602	57.81
38	1969	44,609	59.38
39	1968	43,783	60.94
40	1960	43,543	62.50
41	1954	42,352	64.06
42	1965	42,196	65.63
43	1987	41,707	67.19
44	1980	40,861	68.75
45	1963	40,024	70.31
46	1973	38,130	71.88
47	1955	38,074	73.44
48	1953	38,070	75.00
49	1994	37,181	76.56
50	1958	37,050	78.13
51	1948	36,454	79.69
52	1974	36,224	81.25
53	1992	35,362	82.81
54	1985	32,747	84.38
55	1951	32,668	85.94
56	1967	28,240	87.50
57	1991	26,611	89.06
58	1950	24,683	90.63
59	2000	22,225	92.19
60	1999	21,282	93.75
61	1986	20,949	95.31
62	1959	19,474	96.88
63	1941	18,183	98.44

TALLASSEE - 3 DAY			
Rank	Yr	Flow (cfs)	Position
1	1990	351,594	1.56
2	1961	267,574	3.13
3	1979	245,692	4.69
4	1949	220,988	6.25
5	1998	205,876	7.81
6	1971	204,555	9.38
7	1964	192,245	10.94
8	1982	191,808	12.50
9	1972	190,730	14.06
10	1977	179,639	15.63
11	1989	175,042	17.19
12	1943	171,452	18.75
13	1957	171,248	20.31
14	1996	165,495	21.88
15	1947	164,540	23.44
16	1942	163,844	25.00
17	1956	163,413	26.56
18	1976	160,667	28.13
19	1983	159,213	29.69
20	1962	156,273	31.25
21	1970	154,764	32.81
22	1946	150,064	34.38
23	1997	149,823	35.94
24	1945	147,091	37.50
25	1944	139,308	39.06
26	1993	129,946	40.63
27	1978	126,399	42.19
28	1939	121,506	43.75
29	2001	121,494	45.31
30	1975	120,547	46.88
31	1984	116,359	48.44
32	1995	113,051	50.00
33	1952	111,954	51.56
34	1981	109,317	53.13
35	1966	108,226	54.69
36	1940	104,764	56.25
37	1963	104,235	57.81
38	1965	102,465	59.38
39	1988	102,175	60.94
40	1980	99,935	62.50
41	1974	99,308	64.06
42	1953	99,112	65.63
43	1973	93,054	67.19
44	1968	92,231	68.75
45	1987	90,368	70.31
46	1948	90,142	71.88
47	1960	88,441	73.44
48	1969	87,328	75.00
49	1955	85,626	76.56
50	1958	83,010	78.13
51	1992	82,266	79.69
52	1985	79,068	81.25
53	1951	77,022	82.81
54	1994	73,648	84.38
55	1954	66,416	85.94
56	1991	64,264	87.50
57	1967	62,769	89.06
58	2000	58,646	90.63
59	1959	52,348	92.19
60	1950	51,365	93.75
61	1986	49,974	95.31
62	1999	49,524	96.88
63	1941	38,591	98.44

TALLASSEE - 5 DAY			
Rank	Yr	Flow (cfs)	Position
1	1990	431,496	1.56
2	1961	355,353	3.13
3	1949	309,955	4.69
4	1979	307,886	6.25
5	1998	256,048	7.81
6	1964	253,885	9.38
7	1971	252,832	10.94
8	1977	249,167	12.50
9	1982	248,563	14.06
10	1962	246,209	15.63
11	1972	243,909	17.19
12	1989	224,965	18.75
13	1957	224,553	20.31
14	1943	222,142	21.88
15	1996	215,385	23.44
16	1946	207,887	25.00
17	1976	207,644	26.56
18	1956	207,597	28.13
19	1970	206,089	29.69
20	1947	204,971	31.25
21	1942	203,164	32.81
22	1983	201,688	34.38
23	1997	194,189	35.94
24	1984	183,674	37.50
25	1944	175,546	39.06
26	1945	175,411	40.63
27	1966	174,160	42.19
28	1993	168,313	43.75
29	1975	160,495	45.31
30	1939	160,435	46.88
31	1978	158,866	48.44
32	2001	150,996	50.00
33	1952	148,590	51.56
34	1995	145,816	53.13
35	1974	141,068	54.69
36	1981	138,746	56.25
37	1980	134,734	57.81
38	1948	132,704	59.38
39	1953	129,877	60.94
40	1963	128,250	62.50
41	1958	126,336	64.06
42	1987	125,475	65.63
43	1973	124,928	67.19
44	1940	123,930	68.75
45	1960	123,618	70.31
46	1965	122,631	71.88
47	1955	113,858	73.44
48	1969	112,976	75.00
49	1988	112,773	76.56
50	1992	112,718	78.13
51	1968	112,493	79.69
52	1985	100,617	81.25
53	1994	94,878	82.81
54	1951	94,729	84.38
55	1967	82,222	85.94
56	1991	81,025	87.50
57	2000	78,734	89.06
58	1959	76,039	90.63
59	1954	73,698	92.19
60	1999	71,771	93.75
61	1950	65,807	95.31
62	1986	63,341	96.88
63	1941	52,230	98.44

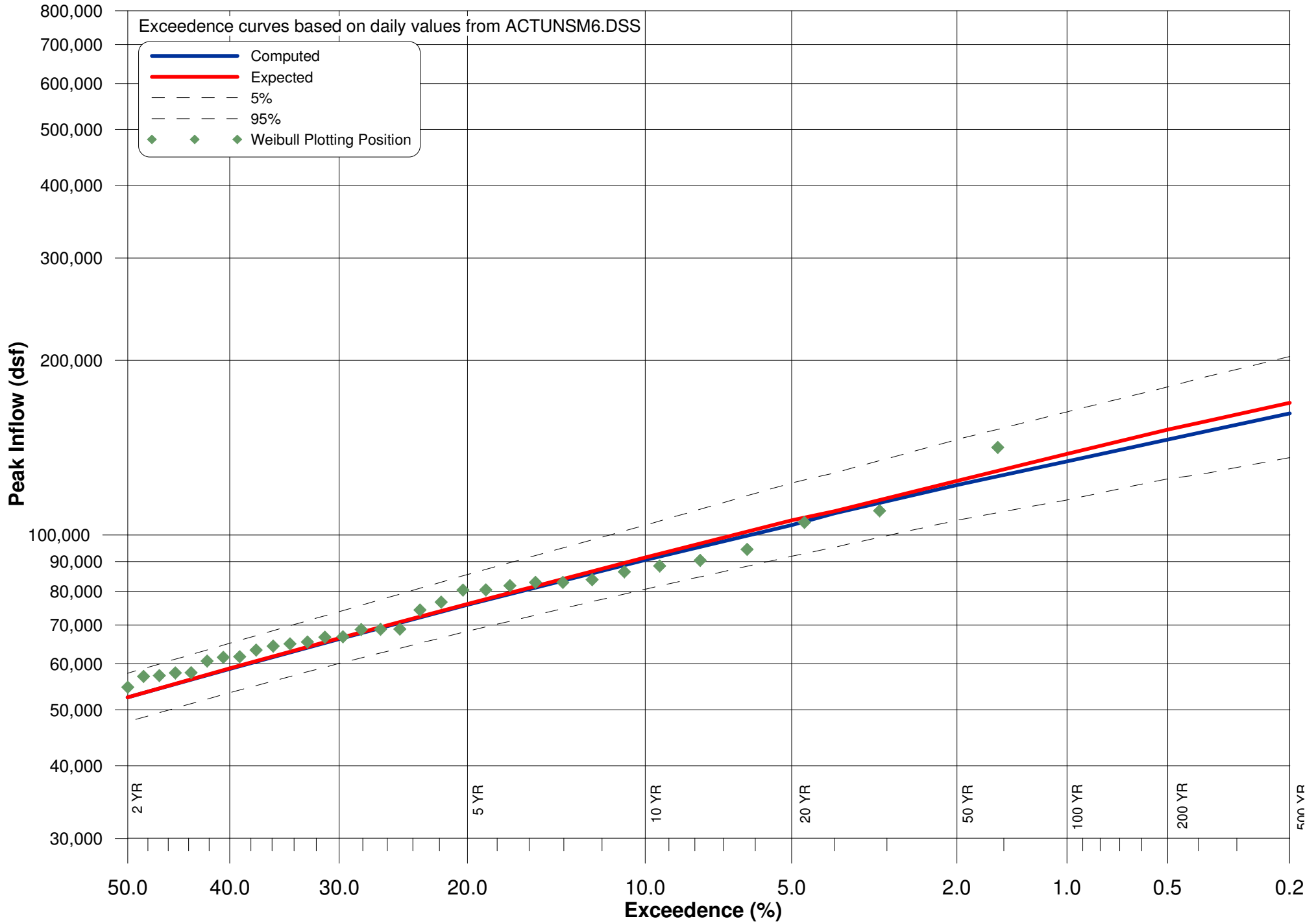
Table TAL-2: Summary of FFA Results for Tallassee

TALLASSEE DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
162,000	169,000	0.20	203,000	136,000
150,000	156,000	0.40	186,000	127,000
146,000	152,000	0.50	180,000	125,000
134,000	138,000	1.00	163,000	115,000
122,000	124,000	2.00	146,000	106,000
109,000	110,000	4.00	128,000	95,300
104,000	106,000	5.00	123,000	91,900
90,600	91,500	10.00	104,000	80,700
75,800	76,100	20.00	85,500	68,300
70,600	70,800	25.00	79,100	63,800
66,200	66,400	30.00	73,800	60,100
58,800	58,900	40.00	65,100	53,500
52,500	52,500	50.00	57,800	47,700
46,700	46,600	60.00	51,300	42,300
41,100	40,900	70.00	45,200	36,900
35,200	35,000	80.00	39,000	31,200
28,200	27,800	90.00	31,700	24,400
23,300	22,800	95.00	26,700	19,700
6,950	5,890	99.99	9,120	4,840
MEAN	4.7101		HISTORIC EVENTS	0
STANDARD DEV	0.1985		HIGH OUTLIERS	0
COMPUTED SKEW	-0.3361		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.3000		SYSTEM EVENTS	63

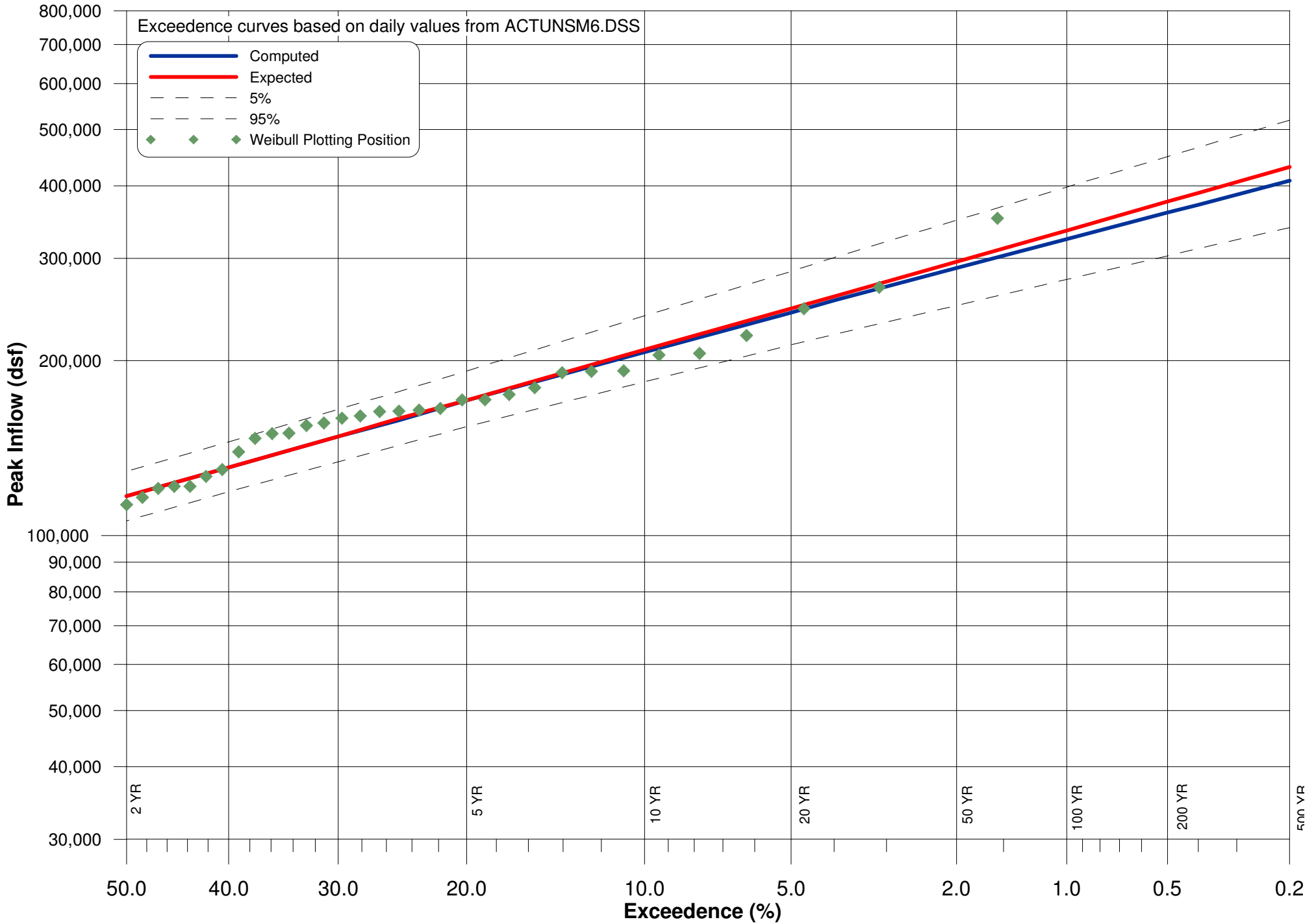
TALLASSEE 3-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
408,000	431,000	0.20	519,000	339,000
371,000	389,000	0.40	466,000	312,000
360,000	376,000	0.50	449,000	303,000
324,000	335,000	1.00	398,000	276,000
289,000	296,000	2.00	349,000	249,000
254,000	258,000	4.00	301,000	222,000
242,000	246,000	5.00	285,000	213,000
207,000	209,000	10.00	239,000	184,000
171,000	171,000	20.00	192,000	154,000
158,000	159,000	25.00	177,000	143,000
148,000	148,000	30.00	165,000	134,000
131,000	131,000	40.00	145,000	119,000
117,000	117,000	50.00	129,000	106,000
104,000	104,000	60.00	114,000	94,100
91,700	91,400	70.00	101,000	82,400
79,100	78,600	80.00	87,700	70,200
64,300	63,500	90.00	72,300	55,700
54,000	53,000	95.00	61,700	45,700
19,200	16,800	99.99	24,600	13,900
MEAN	5.0641		HISTORIC EVENTS	0
STANDARD DEV	0.1982		HIGH OUTLIERS	0
COMPUTED SKEW	-0.1454		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.1000		SYSTEM EVENTS	63

TALLASSEE 5-DAY DSS DATA 1939-2001				
Computed Curve (cfs)	Expected Probability (cfs)	% Chance Exceedance	Confidence Limits	
			5% (cfs)	95% (cfs)
530,000	560,000	0.20	673,000	441,000
483,000	505,000	0.40	605,000	406,000
468,000	488,000	0.50	583,000	395,000
422,000	436,000	1.00	517,000	360,000
376,000	386,000	2.00	453,000	325,000
331,000	337,000	4.00	391,000	289,000
316,000	321,000	5.00	372,000	278,000
270,000	273,000	10.00	311,000	241,000
223,000	224,000	20.00	251,000	201,000
207,000	208,000	25.00	232,000	188,000
194,000	194,000	30.00	216,000	176,000
172,000	172,000	40.00	190,000	156,000
153,000	153,000	50.00	168,000	139,000
136,000	136,000	60.00	150,000	124,000
120,000	120,000	70.00	133,000	108,000
104,000	103,000	80.00	115,000	92,300
84,600	83,600	90.00	95,100	73,300
71,200	69,900	95.00	81,200	60,300
25,500	22,300	99.99	32,600	18,400
MEAN	5.1817		HISTORIC EVENTS	0
STANDARD DEV	0.1969		HIGH OUTLIERS	0
COMPUTED SKEW	-0.1730		LOW OUTLIERS	0
REGIONAL SKEW	0.0000		ZERO OR MISSING	0
ADOPTED SKEW	-0.1000		SYSTEM EVENTS	63

**Figure TAL-4: Exceedence Curve for Unregulated 1 Day Volume at Tallasee**  
(1939-2001)



**Figure TAL-5: Exceedence Curve for Unregulated 3 Day Volume at Tallassee**  
(1939-2001)



**Figure TAL- 6: Exceedence Curve for Unregulated 5 Day Volume at Tallassee**  
*(1939-2001)*

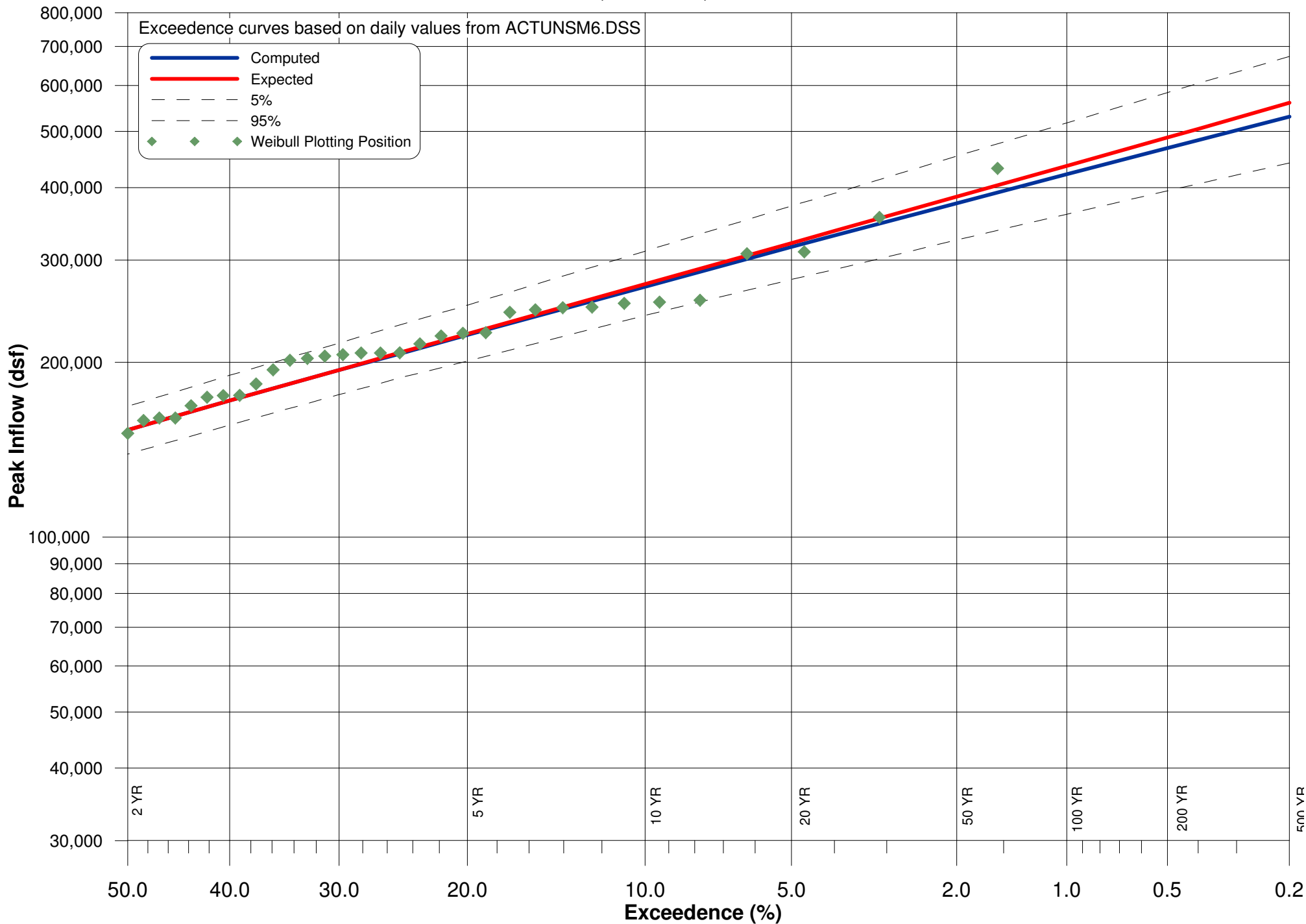




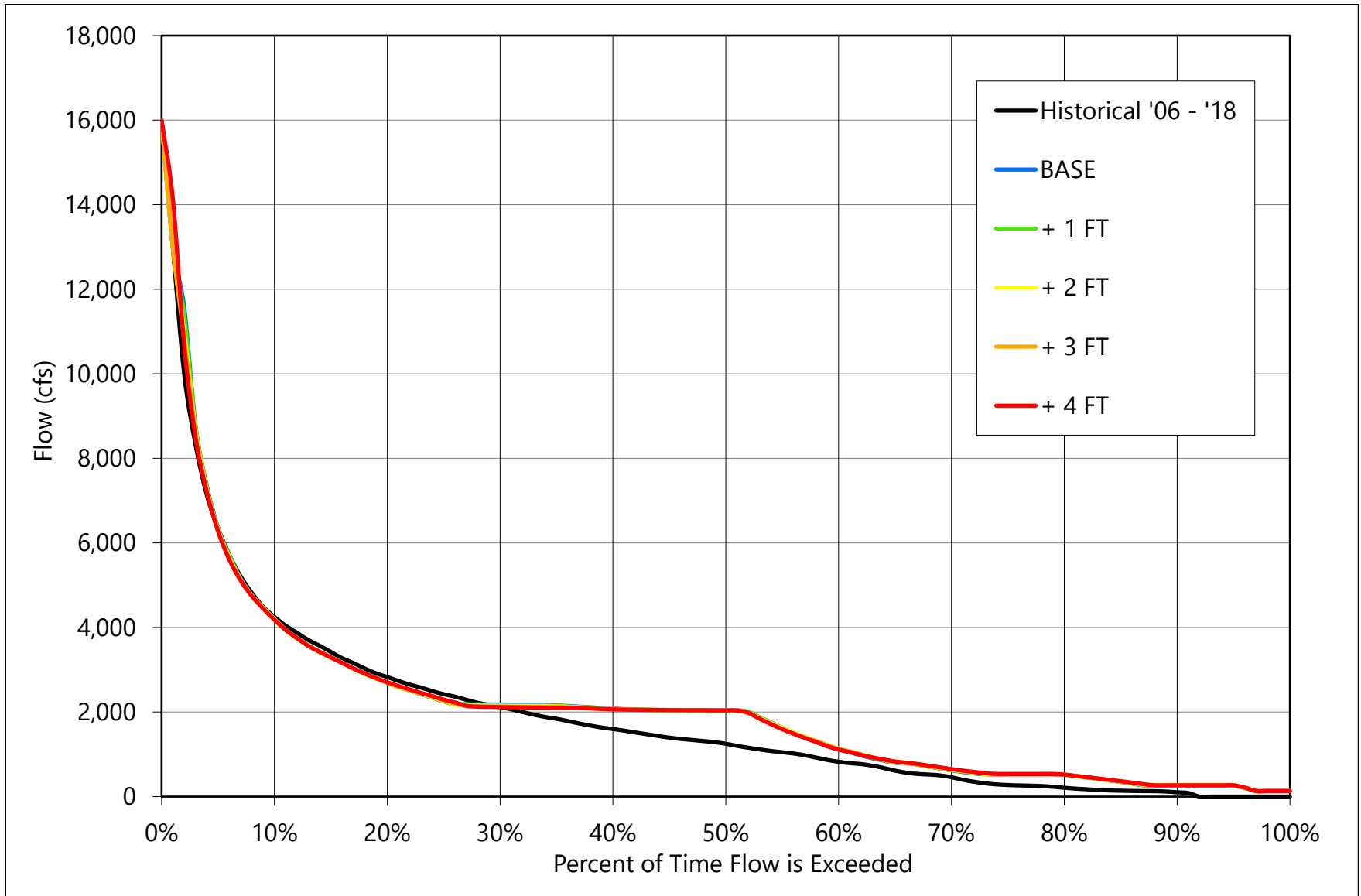
Table TAL-3: Regulation Impact on Flood Recurrences at Tallasse

Water Yr	Date of Event	Unregulated Flow (cfs)	Recurrence Interval	Regulated Discharge (cfs)	Recurrence Interval
1976		61,496	2	36182	1
1977		68,373	2	63815	2
1978		49,734	1	21769	1
1979		104,491	10	109340	10
1980		40,755	1	35188	1
1981		57,217	2	13121	1
1982	4/26/82	90,354	5	32603	1
1983	4/9/83	66,556	2	38269	1
1984	8/2/84	61,419	2	47613	1
1985	2/6/85	32,686	1	10338	1
1986	12/1/86	20,932	1	10139	1
1987	1/22/87	41,662	1	10238	1
1988	9/18/88	57,018	2	16003	1
1989	6/20/89	80,063	5	69978	2
1990	3/18/90	140,790	110	124250	50
1991	6/27/91	26,571	1	17494	1
1992	12/22/92	35,303	1	17097	1
1993	3/31/93	68,746	2	10934	1
1994	7/7/94	37,144	1	16250	1
1995	10/6/95	54,694	2	36229	1
1996	2/3/96	81,798	5	25854	1
1997	6/18/97	57,921	2	21249	1
1998	3/10/98	94,513	10	40842	1
1999	6/29/99	21,303	1	20923	1
2000	4/5/00	22,217	1	11411	1
2001	4/5/01	60,638	2	36057	1

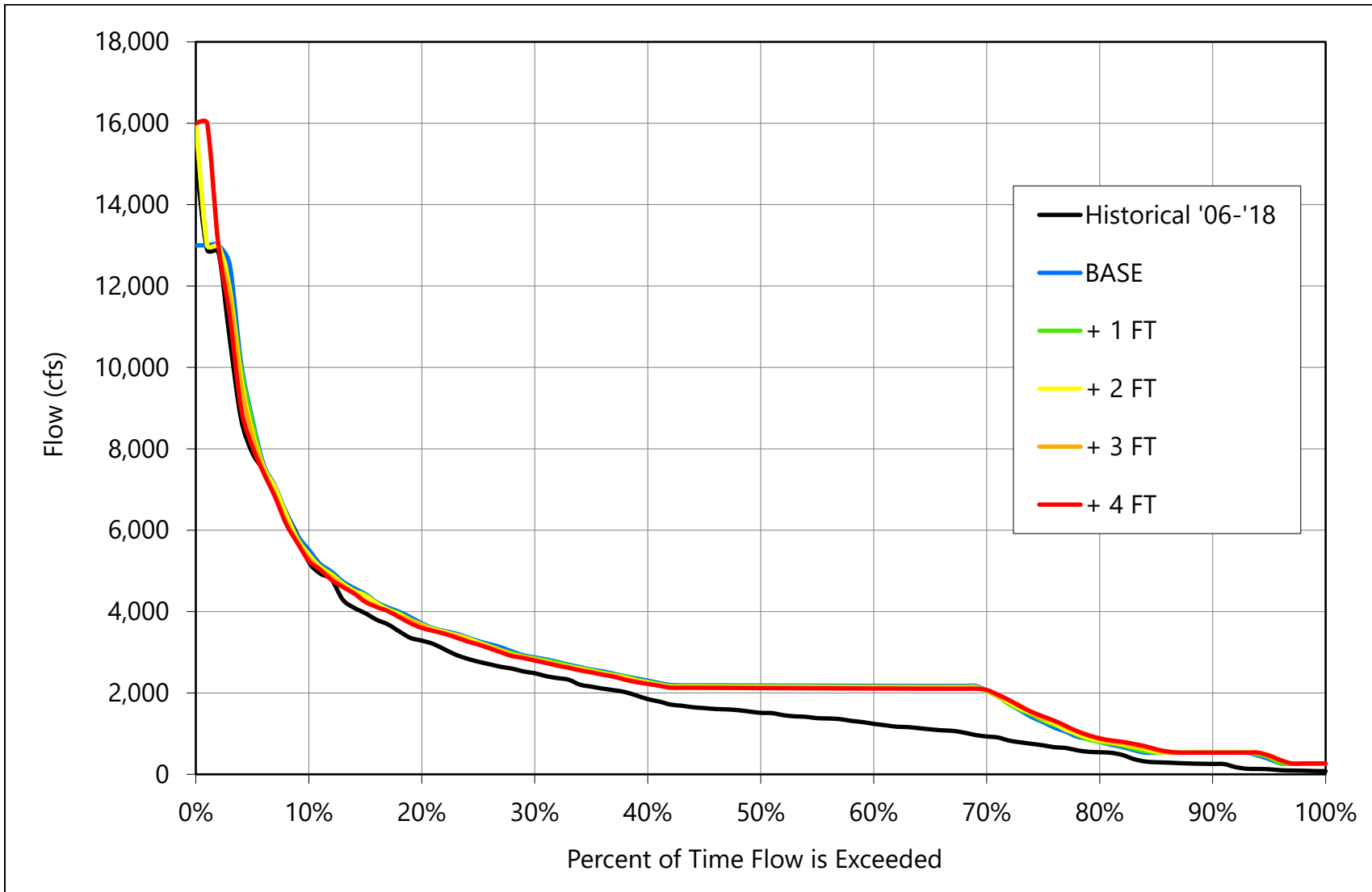
## **APPENDIX C**

### **FLOW DURATION CURVES**

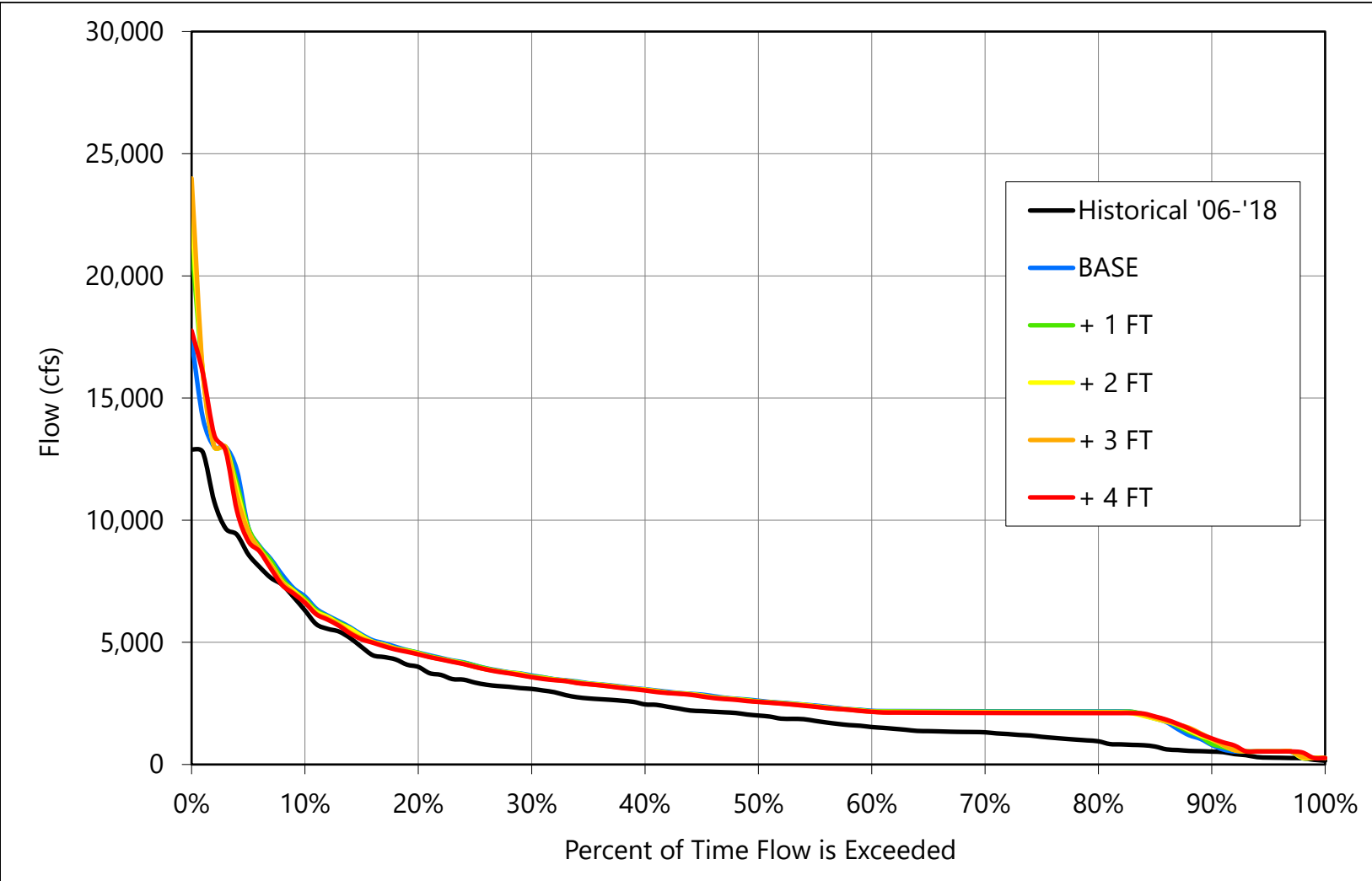
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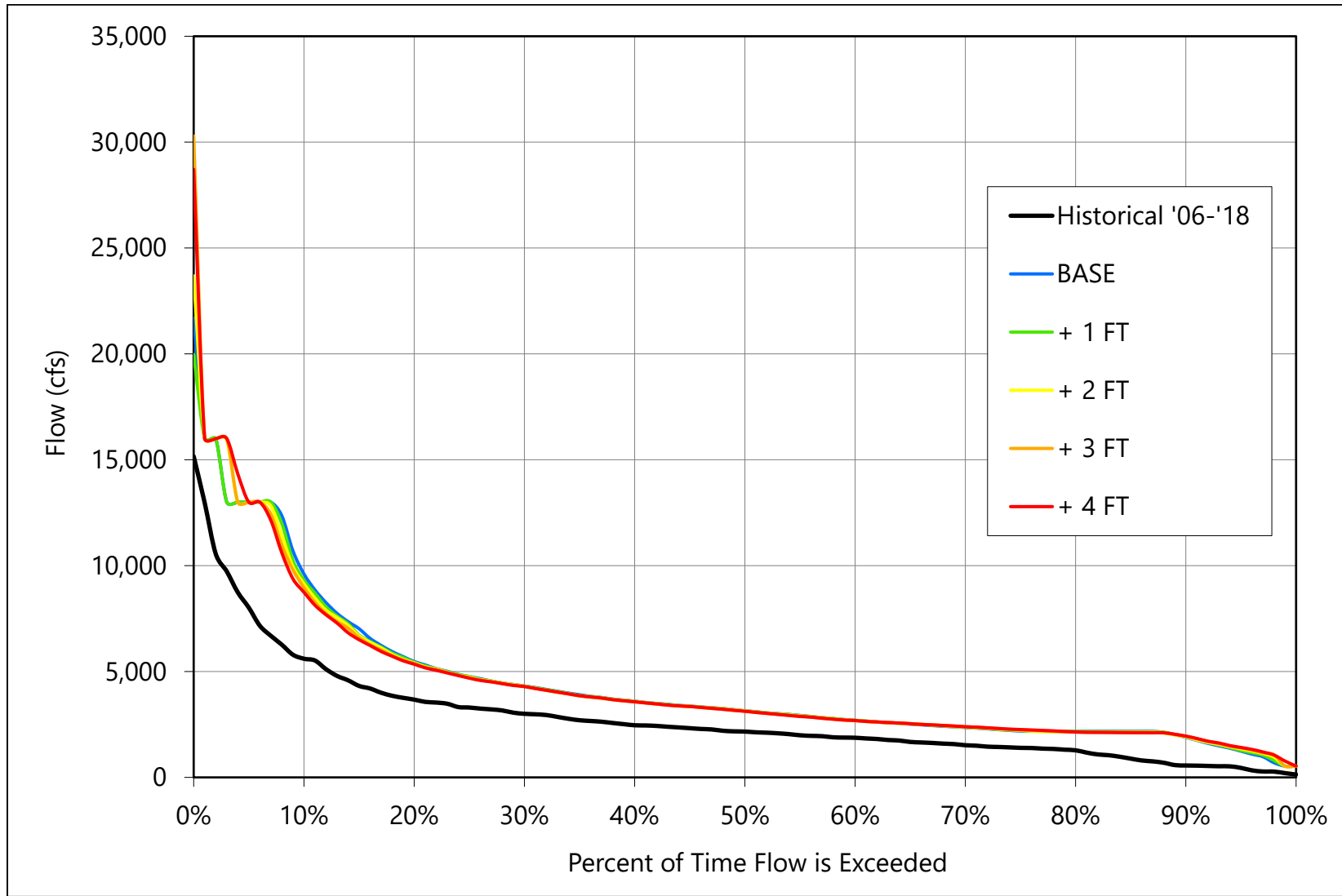
**Figure C-1 Harris Reservoir Annual Flow Duration Curve**



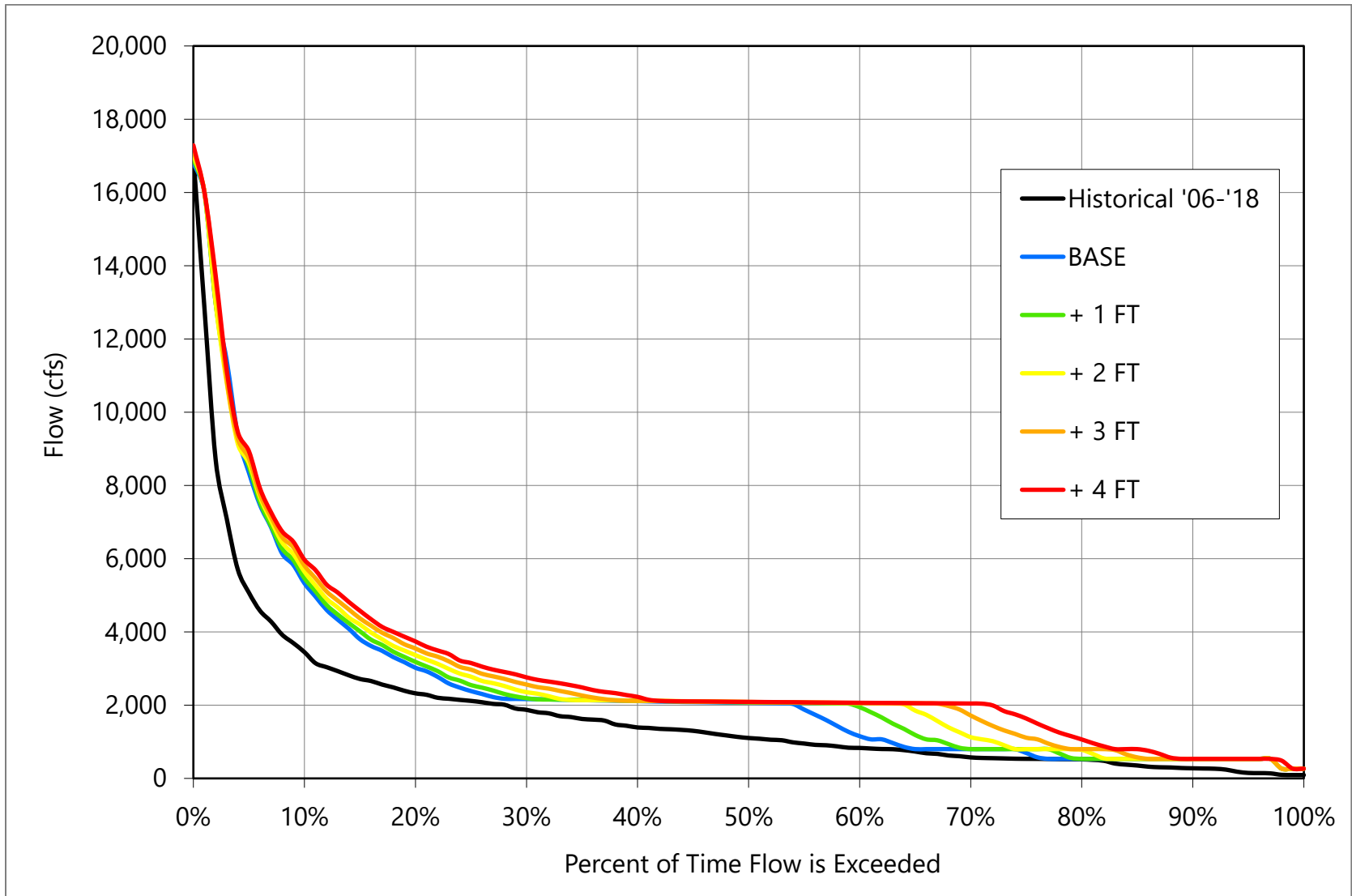
**Figure C-2 Harris Reservoir - January Flow Duration Curve**



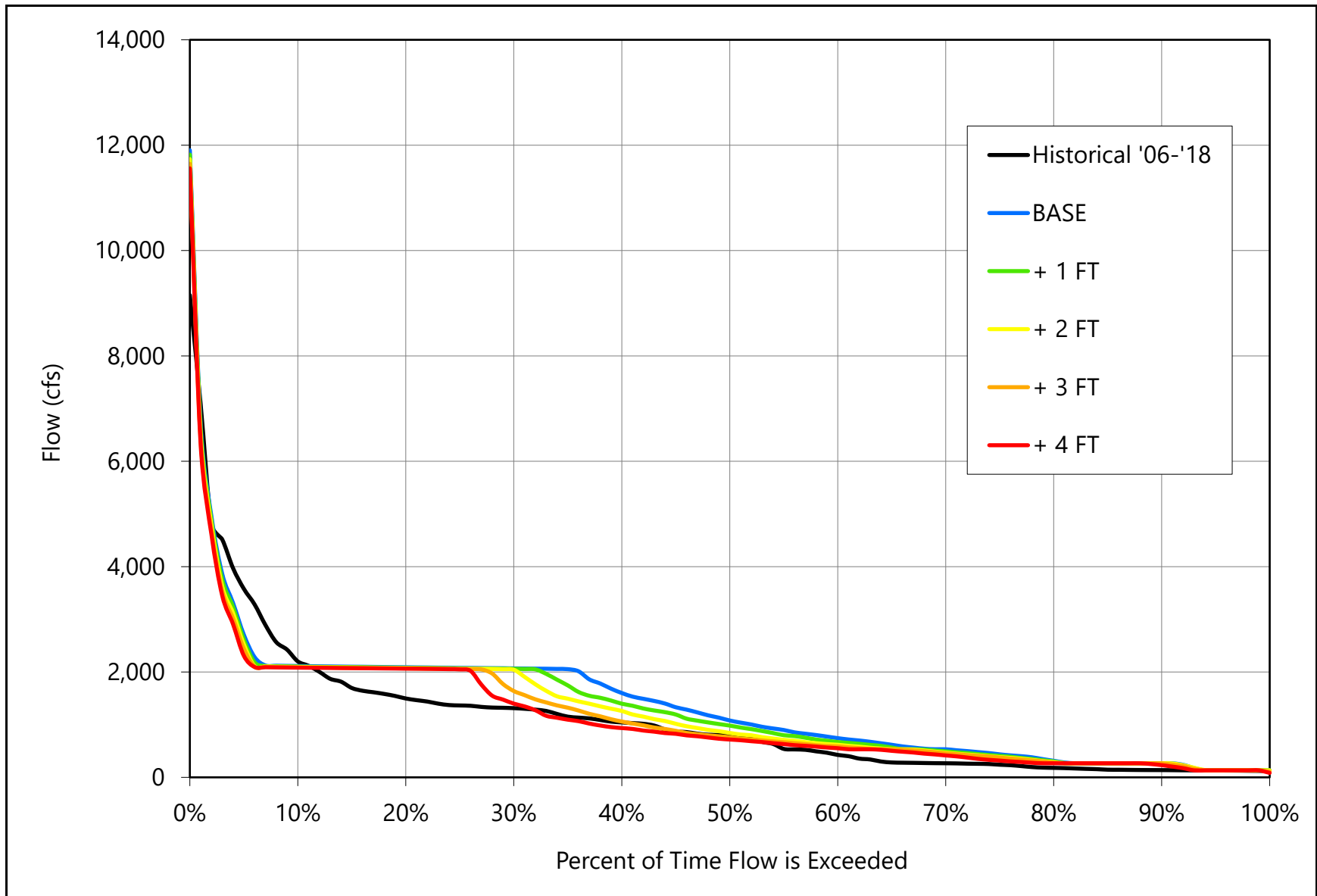
**Figure C-3 Harris Reservoir - February Flow Duration Curve**



**Figure C-4 Harris Reservoir - March Flow Duration Curve**

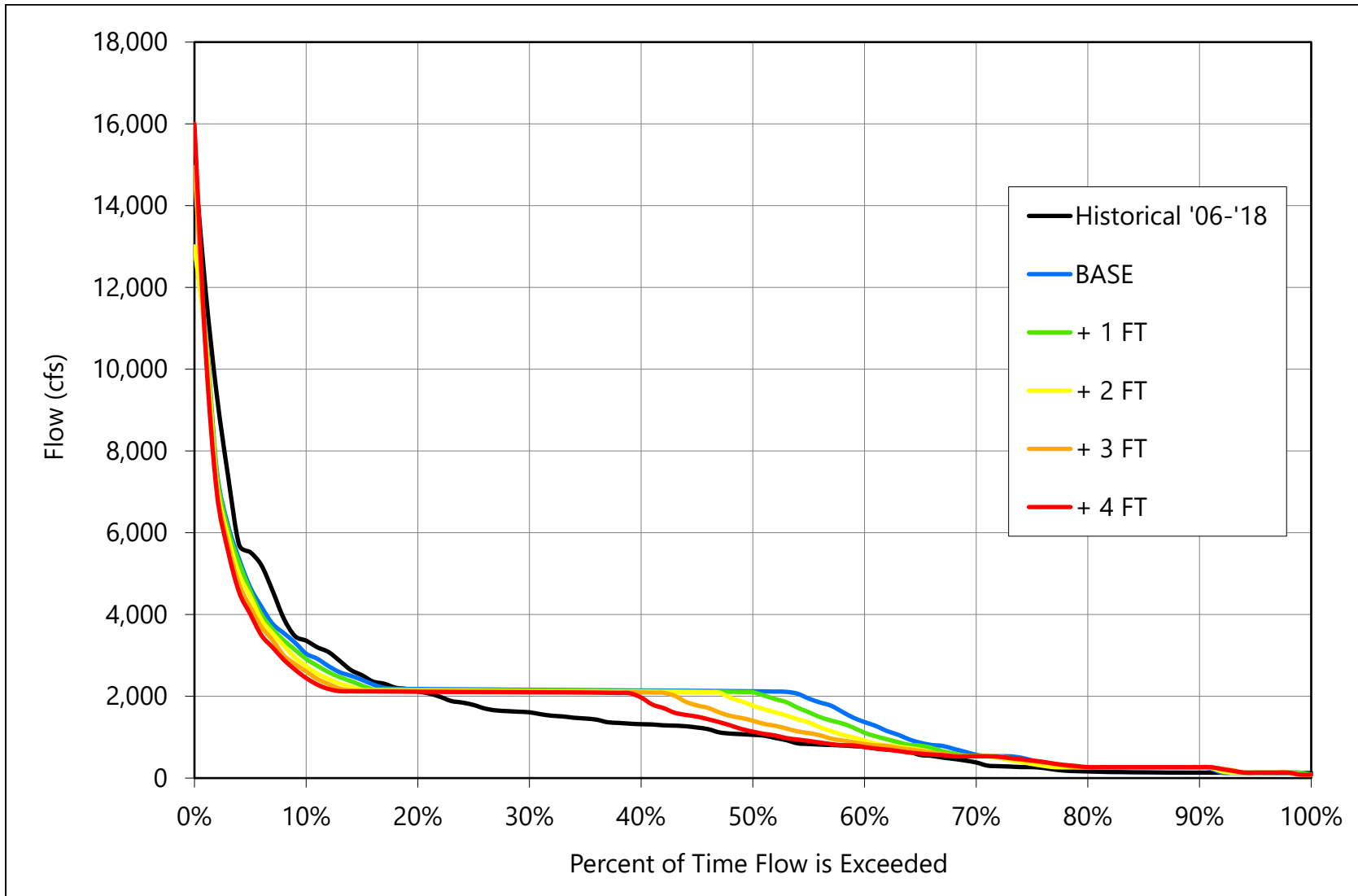


**Figure C-5 Harris Reservoir - April Flow Duration Curve**

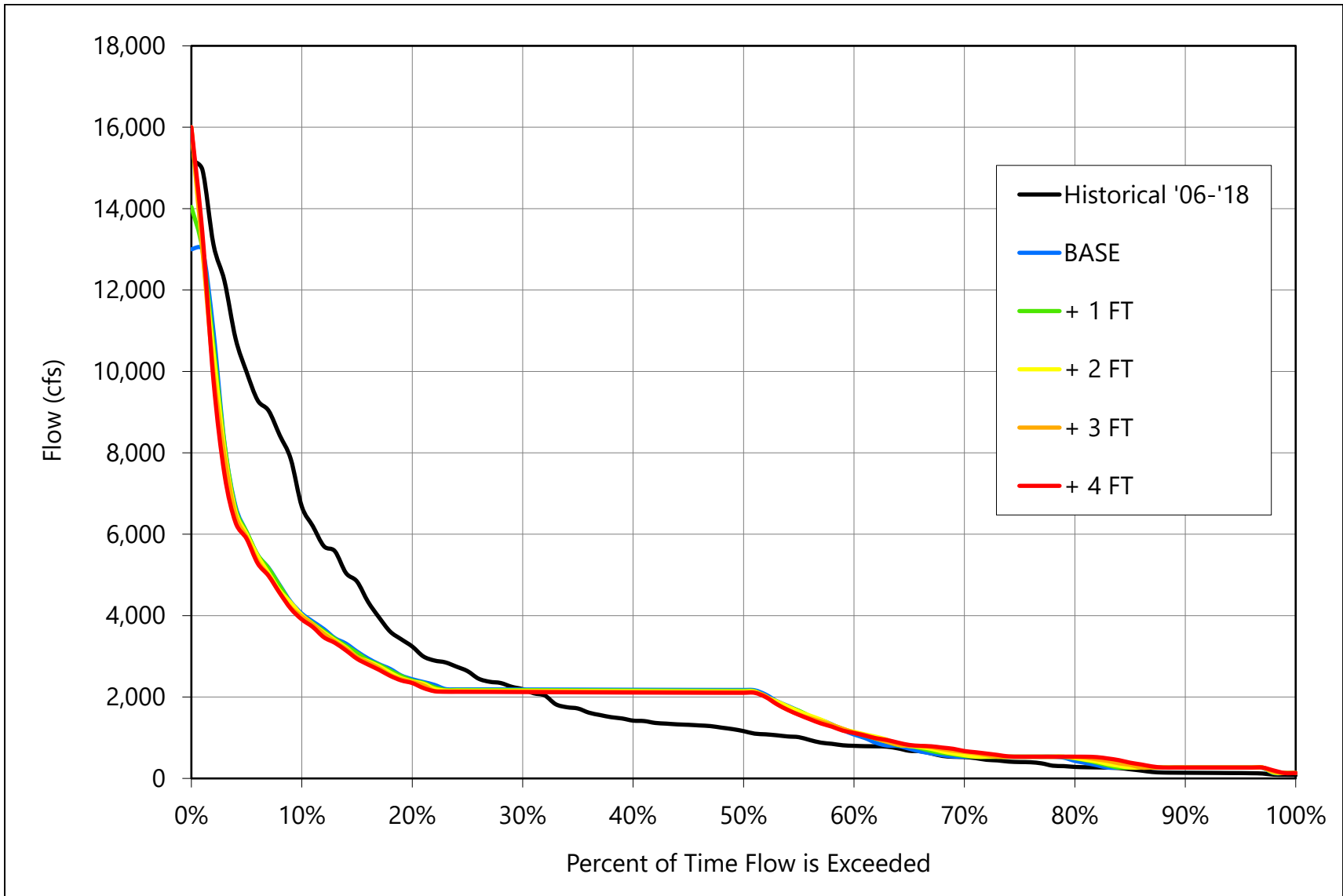


**Figure C-6 Harris Reservoir - October Flow Duration Curve**





**Figure C-7 Harris Reservoir - November Flow Duration Curve**



**Figure C-8 Harris Reservoir - December Flow Duration Curve**

## **APPENDIX D**

### **STAKEHOLDER COMMENT TABLE**

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<b>Commenting Entity</b>	<b><u>Date of Comment &amp; FERC Accession Number</u></b>	<b><u>Comment on Draft Operating Curve Change Feasibility Analysis Phase 1 Study Report</u></b>	<b><u>Alabama Power Response</u></b>
<b>Federal Energy Regulatory Commission (FERC)</b> Note: footnotes included in the original letter have been omitted from this table	6/10/2020  20200610-3059	Figure 5-3, on page 39 of the Draft Operating Curve Change Feasibility Analysis (Phase 1) Study Report, shows how changing the winter pool elevation from the current project operating curve to the +1, +2, +3, and +4-foot winter operating curves could affect reservoir elevations in Lake Harris throughout the year. Moreover, the figure documents the interaction between higher winter pool levels and low-inflow periods. During the period between 2006 and 2008, which encompasses two low-flow periods, the model showed that increasing the winter pool elevation can result in higher reservoir elevations during low-flow years, compared to the existing operating curve. However, Figure 5-3 shows that from about July 2007 through mid-February 2008, modeled reservoir levels for the +2 and +3-foot winter pool curve alternatives were lower than that of the other operating curve alternatives for the same operating period. Please explain what appears to be an anomaly in the modeling result in the final report.	Alabama Power has been in contact with the USACE Hydrologic Engineering Center regarding the HEC-ResSim model since the draft report was distributed. Based on its guidance, Alabama Power updated the HEC-ResSim model and in doing so resolved the apparent anomaly in the modeling result. Figure 5-3 has been updated in the final report and now demonstrates that +2 and +3-foot winter operating curve alternatives could have kept the reservoir slightly higher from July 2007 through mid-February 2008 due to the reservoir starting with a higher elevation.
<b>Alabama Department of Conservation and Natural Resources (ADCNR)</b> Note: footnotes included in the original letter have been omitted from this table	6/11/2020  20200611-5152	On page 6, section 2.1.1.5 Lower Tallapoosa River of the Operation Curve Change Feasibility Analysis Study discusses downstream gages. Include years of discharge and stage data for these gages, similar to previous gages years of discharge and stage data discussed and included in the document.	This change has been made in the final report.
<b>ADCNR</b>		On pages 45-50, Figures 5-7 through 5-12 of the Operation Curve Change Feasibility Analysis Study visually indicate inundation boundaries for the baseline of four winter pool alternatives. Include a Table with calculated totals of inundated acreages for the baseline and four winter pool increase alternatives to assist with the quantitative evaluation of inundation effects downstream of the dam.	A table with the calculated totals of inundated acreages for the baseline and four winter pool alternatives has been included in the final report.

<b>Commenting Entity</b>	<b><u>Date of Comment &amp; FERC Accession Number</u></b>	<b><u>Comment on Draft Operating Curve Change Feasibility Analysis Phase 1 Study Report</u></b>	<b><u>Alabama Power Response</u></b>
<b>Chuck Denman</b>	6/11/2020  20200611-5174	<p>Harris Dam additional studies suggested</p> <p>A general review of historical materials ie newspapers, and other records dealing with the proposals for constructing the Dam. Including comments and conditions provided in initial permitting. With the goal being to determine if the dam has achieved the original benefits expected. Perhaps a score card.</p> <p>A pre vs post Dam analysis of down stream impacts. Including flooding, erosion and habitat changes to flora and fauna.</p> <ol style="list-style-type: none"> <li>1. Flooding: storm runoff model comparing 25,50 and 100 year 24 hour storm events.</li> <li>2. Erosion: utilizing available remote sensing materials to compare river channel and islands size and shape today and pre dam.</li> <li>3. Plants: utilize remote sensing materials to map flag grass and invasive plant communities to compare changes from pre Dam.</li> <li>4. Fisheries: review available materials from locals in the community, fish and game and other resources to determine what effect the Dam has had on down stream fish types and numbers.</li> </ol>	See Alabama Power's response filed July 10, 2020 (Accession No. 20200710-5122) and FERC's Determination on Requests for Study Modifications (Accession No. 20200810-3007).
<b>Donna Matthews</b>	6/11/2020  20200612-5018	<p>For studies using 100 year climate data to model outcomes,</p> <p><b>(d) I propose additional modelling based on predictive data from the studies of climate change.</b> It is my understanding Federal Dams do additional modelling to take effects of climate change into account when undergoing licensing. This would include climate change considerations of Operating Curve Rules among others.</p> <p>This idea was previously presented to FERC in 2019 comments by Maria Clark from the EPA.</p> <p>Given the long life of the permit, the measurable manifestations of climate change and the Southern Company's goal to shift power generation away from fossil fuels, it seems prudent to take advantage of modelling in preparation to be best able to deal with unexpected situations such as greater reliance on hydro power by APC.</p> <ol style="list-style-type: none"> <li>1. To my knowledge climate alternative data has not been modelled</li> <li>2. Modelling is a very cost effective way to prepare for future events.</li> </ol>	See Alabama Power's response filed July 10, 2020 (Accession No. 20200710-5122) and FERC's Determination on Requests for Study Modifications (Accession No. 20200810-3007).