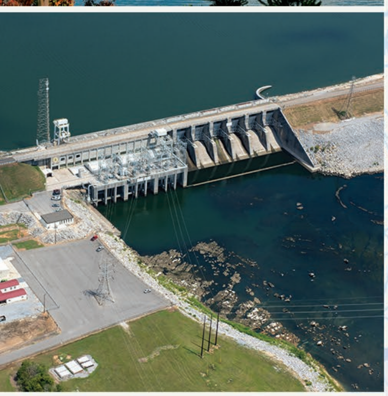
November 2019

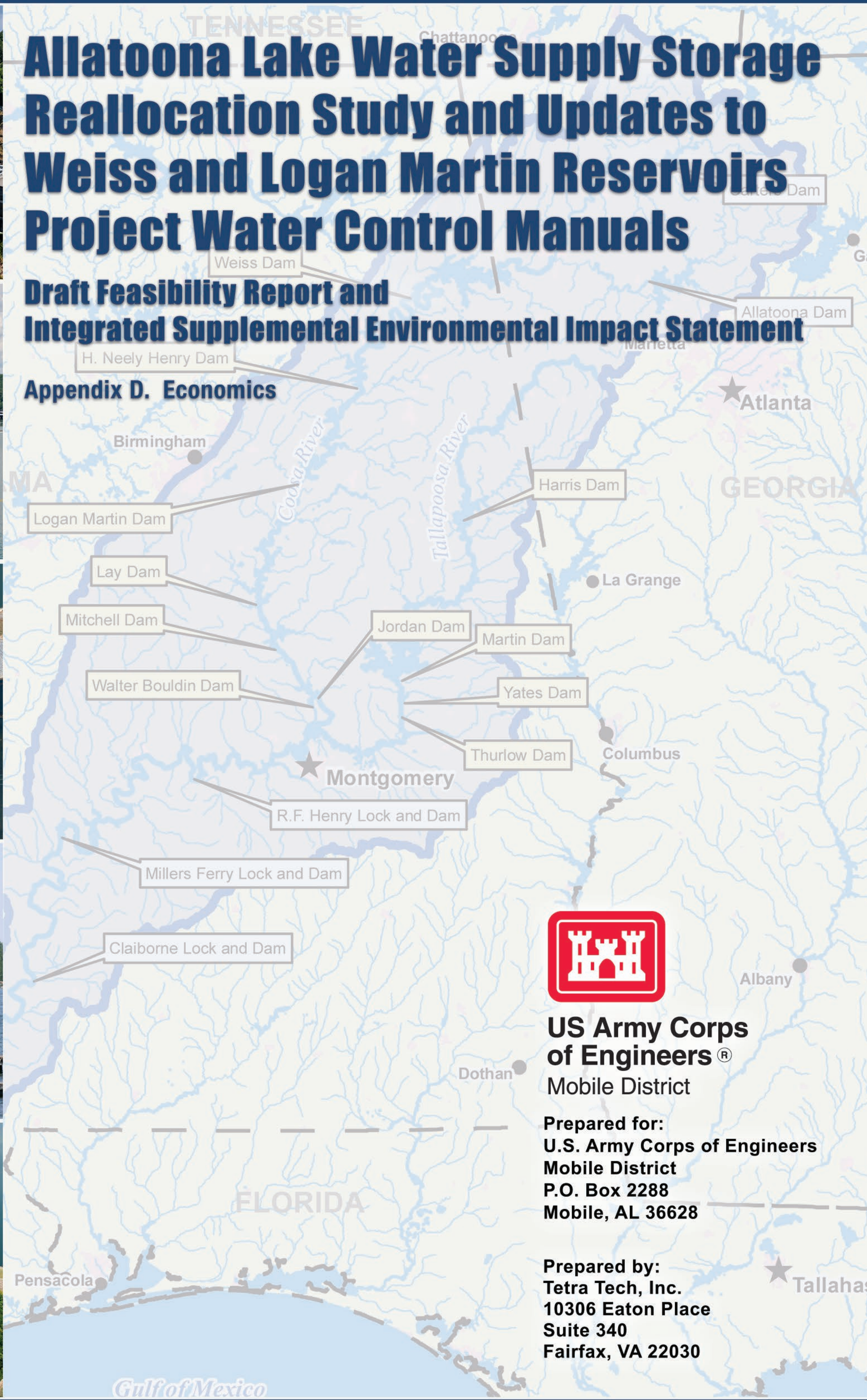




Allatoona Lake Water Supply Storage Reallocation Study and Updates to Weiss and Logan Martin Reservoirs Project Water Control Manuals

Draft Feasibility Report and Integrated Supplemental Environmental Impact Statement

Appendix D. Economics



US Army Corps of Engineers®
Mobile District

Prepared for:
U.S. Army Corps of Engineers
Mobile District
P.O. Box 2288
Mobile, AL 36628

Prepared by:
Tetra Tech, Inc.
10306 Eaton Place
Suite 340
Fairfax, VA 22030

APPENDIX D

ECONOMICS APPENDIX

Page intentionally blank

APPENDIX D. ECONOMICS APPENDIX

CONTENTS

FIGURES

TABLES

D.1 Purpose of Economic Evaluations in a Reallocation Study

As stated in the Institute for Water Resources (IWR) Water Supply Handbook (Revised IWR Report 96-PS-4):

> "U.S. Army Corps of Engineers and other Federal reservoirs represent a combination of large economic investments and commitments of valuable natural resources. These reservoirs can make important contributions to the nation's economy. Over time, as population shifts and growth and need changes, the purposes of some Federal reservoirs may no longer satisfy the original project priories. To meet these changing needs, the Corps is continually turning to reallocation. Reallocation of storage to municipal and industrial water supply has been considered in a number of different ways. However, any new reallocation agreement must provide the states or others with financial incentives not available elsewhere and the use of existing storage in Corps facilities must be cheaper for the potential user than the construction of new or additional facilities. Corps policy for reallocated storage is to charge the user the cost of the storage as if it were constructed today."

According to the same manual, there are three conditions that create an opportunity to reallocate flood control storage to water supply storage, which are:

- Where reallocated flood control storage volumes are small and do not affect flood protection. If the effect is large, Congressional action is required;
- Where the downstream floodplain has changed or supplemental protection has been provided; and
- Where reservoirs have been designed to a maximum site capacity that is larger than required by hydrologic analysis.

The purpose of this economic evaluation is to determine the impacts of reallocating water from the conservation pool and flood control pool at the USACE's Allatoona project, and changing the operations of the Alabama Power Company's (APC) Logan Martin, and Weiss hydropower projects on the Coosa River. The proposed changes to the base condition (alternatives) are then compared to the base condition in order to determine their affects and aid the planning effort. For the Allatoona project specifically, this evaluation compares the increasing municipal and industrial (M&I) .water supply needs, changes in downstream flood impacts, and hydropower benefits foregone to the next least costly and most likely alternative means of attaining the requested amount of water supply storage. USACE ER 1105-2-100 specifies the four pricing methods used to calculate the value of storage considered for reallocation (i.e., the price to be charged for the capital investment for the reallocated storage): benefits foregone, revenues foregone, replacement cost, and updated cost of storage. The value placed on the storage is the highest of the four methods, which in this case is the updated cost of storage ($870,000). Average annual dollars in this report are based on the FY 2020 price levels, FY 2020 discount rate of 2.75 percent and a period of analysis of 50 years.

D.2 Study Area

The study area is the Alabama-Coosa-Tallapoosa (ACT) River Basin. The ACT River Basin includes the Alabama, Coosa, and Tallapoosa rivers and all areas within the basin boundaries from the headwaters downstream to the mouth of the Alabama River, where it joins the Tombigbee River to form the Mobile River. The ACT River Basin at its confluence with the Tombigbee River has a drainage area of 22,739 square miles (sq mi) and covers portions of the states of Alabama, Georgia, and Tennessee. Further information regarding the study area can be found in Section 1.1 of the main report. For modeling purposes the study area is separated into two sections.

The Allatoona Lake section is composed of the following Georgia counties:

- Floyd

- Bartow
- Murray
- Gordon
- Carroll
- Catoosa
- Chattooga
- Cherokee
- Cobb
- Dade
- Dawson
- Fannin
- Forsyth
- Gilmer
- Haralson
- Heard
- Lumpkin
- Paulding
- Pickens
- Polk
- Walker
- Whitfield

The APC study area is composed of the following Alabama counties:

- Calhoun
- Cherokee
- Chilton
- Coosa
- Elmore
- Etowah
- Shelby
- St. Clair
- Talladega
- Autauga
- Baldwin
- Bibb
- Blount
- Bullock
- Butler
- Chambers
- Clarke
- Clay
- Cleburne
- Conecuh
- Crenshaw

- Dallas
- DeKalb
- Escambia
- Jefferson
- Lee
- Lowndes
- Macon
- Marengo
- Mobile
- Monroe
- Montgomery
- Perry
- Pike
- Randolph
- Russell
- Tallapoosa
- Tuscaloosa
- Washington
- Wilcox

D.3 Existing and Future Without Project Condition

D.3.1 Population

Due to the nature of reallocation, the existing and future without project (FWOP) conditions are assumed to be equal with the exception of population growth. The Allatoona section is composed of the study area's Georgia counties and has a total land area of 7,209 sq mi and a population of 2,121,165. The largest city within the Allatoona section is Rome, GA with a population of 36,340. Rome is in Floyd County at the confluence of the Oostanaula and Etowah Rivers, approximately 70 miles northwest of Atlanta.

The APC section is composed of the study area's Alabama counties and has a total land area of 31,501 sq mi and a population of 3,307,059. The largest city within the APC study area is Gadsden with a population of 36,235. Gadsden is in Etowah County on the Coosa River downstream of Weiss Lake, approximately 60 miles northeast of Birmingham.

The following tables display the basic population, population projections, demographic, and poverty statistics information for each portion of the study area as estimated by the Census Bureau 2016 American Community Survey 5 year estimates and Center for Disease Control 2016 Social Vulnerability Index.

Table D-1. ACT Population

Area	% of Basin	1960	1970	1980	1990	2000	2010	2016
ACT (AL)	60%	2,330,066	2,379,925	2,688,651	2,766,512	3,042,112	3,255,514	3,307,059
ACT (GA)	40%	484,100	636,681	854,126	1,153,046	1,594,408	2,019,492	2,200,123
ACT Basin		2,814,166	3,016,606	3,542,777	3,919,558	4,636,520	5,275,006	5,507,182

Table D-2. ACT Population Projections

	2030	2060
ACT (AL)	4,197,614	5,601,733
ACT (GA)	4,643,786	6,197,150
ACT Basin	8,841,400	11,798,883

Table D-3. ACT Demographics (2016)

Area	Minority (all persons except white, non-Hispanic)	Percentage minority (all persons except white, non-Hispanic)	Persons below poverty	Percentage of persons below poverty	Single parent household with children under 18	Percentage of single parent households with children	Percentage of persons aged 17 and younger
ACT (AL)	1,249,404	38.78	601,746	21.77	125,381	9.78	22.55
ACT (GA)	645,686	18.22	290,083	16.37	73,022	8.72	23.71
ACT Basin	1,895,090	28.50	891,829	19.07	198,403	9.25	23.13

D.3.2 Education

Table D-4 shows the percent of people over the age of 25 with no high school diploma. This is an important statistic due to its correlation with higher rates of unemployment and underemployment. Overall this percentage is greatest in the Alabama counties of the study area with 19% of people with no a high school diploma. The Georgia counties of the study area also have a higher percentage at 18.7% compared to the state overall at 14.2%. The overall study area percent of people with no high school diploma is 18.9%, which is higher than both the U.S. South Region, and the overall U.S. at 14.4% and 13% respectively.

Table D-4. ACT Persons with no High School Diploma (2016)

Area	Percentage of persons with no high school diploma (age 25+)
ACT (AL)	19.0
AL (Entire State)	16.2
ACT (GA)	18.7
GA (Entire State)	14.2
ACT Basin	18.9
US South Region	14.4
Entire US	13

D.3.3 Employment

As seen in Table D-5 below, the industry sector that accounts for the highest percentage of the labor force in the ACT Basin is educational services, and health care and social assistance (20.06%). The second largest is manufacturing with 18.35% followed by retail trade with 11.78%.

Table D-5. ACT Percent of Employees by Industry (2016)

Industry	Area		
	AL	GA	ACT Basin
Educational services, and health care and social assistance	21.32	18.80	20.06
Manufacturing	18.37	18.34	18.35
Retail trade	11.53	12.03	11.78
Arts, entertainment, and recreation, and accommodation and food services	7.41	8.13	7.77
Professional, scientific, and management, and administrative and waste management services	6.65	8.85	7.75
Construction	6.83	8.36	7.59
Transportation and warehousing, and utilities	5.75	5.23	5.49
Other services, except public administration	4.93	5.35	5.14
Finance and insurance, and real estate and rental and leasing	4.71	5.33	5.02
Public administration	6.07	3.83	4.95
Wholesale trade	2.21	2.73	2.47
Agriculture, forestry, fishing and hunting, and mining	2.94	1.24	2.09
Information	1.32	1.82	1.57

D.3.4 Income

Table D-6 and Table D-7 show income per capita and income growth rate for the study area. During the period from 2009 to 2016, the income growth rate for the study area has slowed compared to the previous 50 years. However, overall the areas income has grown at a rate of 3.11% since 1959.

Table D-6. ACT Income per Capita (1959-2016)

Income Per Capita							
Area	**1959**	**1969**	**1979**	**1989**	**1999**	**2009**	**2016**
ACT(AL)	$3,824	$6,046	$8,514	$9,779	$15,738	$19,895	$21,125
ACT(GA)	$4,362	$7,234	$9,544	$11,709	$18,841	$22,174	$24,850
ACT Basin	$4,009	$6,455	$8,868	$10,444	$16,806	$20,679	$22,988

Table D-7. ACT Income per Capita Growth Rate (1959-2016)

Income Per Capita Annual Growth Rate							
Area	**1959-1969**	**1969-1979**	**1979-1989**	**1989-1999**	**1999-2009**	**2009-2016**	**1959–2016**
ACT(AL)	4.69%	3.48%	1.40%	4.87%	2.37%	0.86%	3.04%
ACT(GA)	5.19%	2.81%	2.07%	4.87%	1.64%	1.64%	3.10%
ACT Basin	4.88%	3.23%	1.65%	4.87%	2.10%	1.52%	3.11%

D.3.5 Housing

The following tables display the number of housing units for the study area as well as annual growth rate for houses and mobile home. Overall, the number of housing units has grown at a rate of 1.90% since the 1940s to a total of 2,391,261 in 2016 of which 259,744 are mobile homes.

Table D-8. ACT Total Housing Units (1940-2016)

Total Housing Units									
Area	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2016**
ACT (AL)	487,000	598,041	691,644	773,949	1,010,899	1,141,341	1,336,384	1,530,108	1,510,687
ACT (GA)	86,556	112,995	144,153	204,074	318,845	471,315	627,987	819,161	880,574
ACT Basin	573,556	711,036	835,797	978,023	1,329,744	1,612,656	1,964,371	2,349,269	2,391,261

Table D-9. ACT Housing Annual Growth Rate (1940-2016)

Housing Annual Growth Rates									
Area	1940-1950	1950-1960	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2010-2016	1940-2016
ACT (AL)	2.08%	1.46%	1.13%	2.71%	1.22%	1.59%	1.36%	-0.21%	1.50%
ACT (GA)	2.70%	2.47%	3.54%	4.56%	3.99%	2.91%	2.69%	1.21%	3.10%
ACT Basin	2.17%	1.63%	1.58%	3.12%	1.95%	1.99%	1.81%	0.30%	1.90%

Table D-10. ACT Mobile Homes (2000-2016)

Housing units mobile homes			Annual growth rate
Area	2000	2016	2000–2016
ACT(AL)	199,445	190,445	-6.41%
ACT(GA)	68,950	69,141	0.02%
ACT Basin	268,395	268,395	-0.20%

D.4 Water Supply Demand

D.4.1 Summary of Water Supply Demand Forecast

The Metropolitan North Georgia Water Planning District provided a future water supply demand forecast for the demands at Allatoona Lake. The analysis forecasted future water supply demand through 2050 based on population and employment forecasts. The 2050 forecasts used the Demand Side Management Least Cost Planning Decision Support System (DSS) Model developed by Maddaus Water Management (Maddaus Water Management, Inc. and CH2M Hill 2011).In 2050, the demand forecast estimates that the Cobb County-Marietta Water Authority will require 57 million gallons per day (MGD), and the City of Cartersville will require 37 MGD for a total of 94 MGD. Further information regarding the water supply demand analysis can be found in Section B.2 of Appendix B.

Table D-11. Water Supply Demand

Water Provider	Average Annual Day – Million Gallons per Day (AAD-MGD)
Cobb County-Marietta Water Authority	57
City of Cartersville / Bartow County	37
Total Demand	**94**

D.5 Navigation

The federally authorized Alabama River navigation project in southwest Alabama stretches 289 miles from its confluence with the Mobile River upstream to Montgomery, AL. The authorization provides for a 9-ft by 200-ft navigation channel from its junction with the Mobile River upstream to Montgomery and includes three lock and dams: Claiborne, Millers Ferry, and Robert F. Henry. No alternatives resulted in a reduction in channel availability of 1%. Due to the nature of the proposed alternatives, and the low amount of navigation that takes place on the ACT below Claiborne lock and dam an in-depth analysis of navigation was not conducted. Additional information about navigation on the ACT system can be found in Section E.1.7.2 of the main report.

D.6 Recreation Analysis

D.6.1 Summary of Recreation Analysis

This section summarizes the objectives, methods, and results of the recreation analysis performed for the Allatoona Lake Water Supply Storage Reallocation Study and Updates to Weiss and Logan Martin Reservoirs Water Control Manuals Feasibility Report and Integrated Supplemental Environmental Impact Statement (FR/SEIS). The analysis estimates National Economic Development (NED) recreation benefits for the final array of alternatives using the Unit Day Value (UDV) methodology. The full recreation analysis can be found in Attachment 1 of this appendix.

Per the UDV methodology, project visitation was forecasted for each project over the period of analysis, and UDV scores were generated for each project and recreation impact zone. UDV scores were converted to value-per-visit in accordance with the FY19 guidance, and total annual recreation value was estimated by project and alternative.

Scores generated for the UDV analysis were a function of reservoir pool level. For each project, several recreation impact zones (pool level ranges) were defined in a way that is consistent with existing information regarding the effects of decreasing pool elevation on recreation. The results from the detailed engineering modeling of the alternatives in the FR/SEIS were queried to tabulate the amount of time during the year that the reservoirs would remain within recreation impact zone under each alternative. This allowed estimation of the proportion of annual visitation that would occur within the recreation impact zone and application of the UDV methodology for the FWOP and the alternatives.

Based on modeling of reservoir levels documented in the main FR/SEIS, alternatives were categorized into two recreation impact scenarios:

• No Change Scenario – Consisting of the alternatives that would have negligible effects on recreation relative to the FWOP.

• With Change Scenario – Consisting of the alternatives that would affect recreation at the projects.

As shown in Table D-12 below, alternatives included in the With Change Scenario would result in positive net benefits to recreation at all three of reservoirs ranging from about 1to 3% net gains compared to the FWOP.

Table D-12. Summary of Recreation Analysis

Project and Scenario	Annualized Recreation Value ($)	Present Value ($)	Annualized Change vs. Without Project	Percent Change
Allatoona				
No Change Scenario	$73,784,300	$1,944,349,000	$0	0%
With Change Scenario [1]	$74,481,000	$1,962,708,000	$696,700	0.9%
Weiss				
No Change Scenario	$15,881,400	$418,503,000	$0	0%
With Change Scenario [2]	$16,208,700	$427,127,000	$327,300	2.1%
Logan Martin				
No Change Scenario	$16,167,000	$426,030,000	$0	0%
With Change Scenario [2]	$16,666,000	$439,180,000	$499,000	3.1%

[1] Allatoona WCS alternatives: 5, 8, 11, 13
[2] Weiss and Logan Martin WCS alternatives: 9, 10, 11, 12, 13

D.7 Hydropower Analysis

This section presents an abbreviated report of the full analysis of the effects on hydropower and the monetary value hydropower that are expected to result from proposed changes to system water control operations within the Alabama-Coosa-Tallapoosa (ACT) River Basin. The system hydropower values for energy and capacity were computed for the baseline condition, representing current water control operations, and for alternative flow scenarios associated with these studies. The full detailed hydropower analysis is found in the attached addendum prepared by the USACE Hydropower Analysis Center (HAC).

D.7.1 General methodology Discussion

D.7.1.1 Calculation of Hydropower

The calculations of hydropower energy and capacity values are based on seventy-three years of historic hydrology (1939-2011) using the HEC-ResSim model.

To understand how system operations can effect hydropower generation we will first consider the mathematics used to approximate the amount of power produced from a hydropower facility. The power equation, seen below, shows that power is directly proportional to three variables; the efficiency of the plant turbines, the amount of flow going through the turbines, and the head, the height of the water in the reservoir relative to its height after discharge.

$$P = e * g * Q * H$$

Where; P=power (kW),
e=turbine efficiency,
g = gravitational constant (ft/sec2),
Q-flow (cfs),
H=head (ft).

Reservoir operations can affect all three of these variables. Higher or lower operational reservoir elevations change the head. Maximum or minimum flow requirements used for flood risk management and environmental purpose can affect the flow. Although power is linear in both head and flow, this relationship quickly becomes non-linear with the inclusion of efficiency which is a non-linear function of both head and flow.

D.7.2 Summary of Results

D.7.2.1 Value of Hydropower

The following tables present a summary of the total hydropower value for the alternatives of this study. Hydropower Value is the sum of energy value and capacity value. Information concerning each alternative can be found in Table 4-5 of the main report document.

Table D-13. Value of Individual Plant Dependable Capacity – Water Supply Alternatives

Alternatives > Projects V		Base2018	BaseCap	FWOP	A03_WS1	A04_WS2	A05_WS3	A06_WS4	A08_WS6
ALLATOONA	Federal	$12,171,439	$12,206,419	$12,155,913	$11,998,932	$11,987,283	$12,185,108	$12,586,275	$12,176,229
CARTERS	Federal	$91,676,016	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768
MILLERS FERRY	Federal	$18,809,672	$18,812,973	$18,809,672	$18,808,806	$18,807,783	$18,816,238	$18,845,439	$18,815,943
RF HENRY	Federal	$16,024,183	$16,027,212	$16,022,763	$16,020,930	$16,020,871	$16,027,176	$16,071,984	$16,027,451
Federal	**subtotal**	**$138,681,310**	**$138,722,373**	**$135,664,206**	**$135,777,856**	**$138,704,290**	**$139,179,466**	**$139,179,466**	**$138,695,392**
HARRIS	non-Federal	$20,324,064	$20,323,803	$20,325,451	$20,329,455	$20,329,697	$20,324,409	$20,315,354	$20,325,382
HN HENRY	non-Federal	$11,820,078	$11,825,270	$11,820,949	$11,809,549	$11,808,511	$11,818,184	$11,863,068	$11,817,345
JORDAN	non-Federal	$19,669,654	$19,670,394	$19,667,801	$19,664,794	$19,664,881	$19,666,843	$19,636,988	$19,667,658
LAY	non-Federal	$34,972,575	$34,985,298	$34,974,828	$34,950,076	$34,946,939	$34,973,044	$35,058,594	$34,970,786
LOGAN MARTIN	non-Federal	$25,835,264	$25,845,161	$25,833,023	$25,814,232	$25,810,682	$25,837,311	$25,928,163	$25,835,870
MARTIN	non-Federal	$32,741,963	$32,732,669	$32,741,963	$32,126,943	$32,748,252	$33,127,237	$32,731,473	$33,127,232
MITCHELL	non-Federal	$32,680,019	$32,689,890	$32,679,272	$32,659,957	$32,657,212	$32,681,377	$32,763,306	$32,679,888
THURLOW	non-Federal	$16,156,554	$16,154,635	$16,156,258	$16,161,523	$16,162,752	$16,161,276	$16,149,051	$16,161,748
WALTER-BOULDIN	non-Federal	$45,440,193	$45,463,270	$45,439,428	$45,400,221	$45,392,754	$45,459,869	$45,688,342	$45,454,638
WEISS	non-Federal	$13,758,229	$13,764,232	$13,755,613	$13,742,600	$13,741,164	$13,761,819	$13,841,666	$13,760,691
YATES	non-Federal	$9,549,558	$9,438,499	$9,438,999	$9,441,726	$9,442,529	$9,443,368	$9,437,432	$9,443,356
non-Federal	**subtotal**	**$262,948,149**	**$262,893,121**	**$262,833,585**	**$263,101,075**	**$262,705,373**	**$263,254,378**	**$263,413,437**	**$263,244,594**
System	**TOTAL**	**$401,629,460**	**$401,615,494**	**$401,497,791**	**$398,878,931**	**$401,197,078**	**$401,958,668**	**$402,592,903**	**$401,939,986**

Table D-14. Value of Individual Plant Dependable Capacity – Water Supply Alternatives

Alternatives > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS1MF	A13_WS3MF
ALLATOONA	Federal	$12,155,913	$11,987,283	$12,176,229	$11,998,932	$12,185,108
CARTERS	Federal	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768
MILLERS FERRY	Federal	$18,780,138	$18,774,159	$18,780,560	$18,777,111	$18,782,311
RF HENRY	Federal	$15,997,069	$15,990,752	$15,997,727	$15,991,748	$15,998,042
Federal	**subtotal**	**$138,608,889**	**$138,427,961**	**$138,630,285**	**$138,443,560**	**$138,641,230**
HARRIS	non-Federal	$20,329,762	$20,331,070	$20,327,674	$20,331,744	$20,324,186
HN HENRY	non-Federal	$11,787,264	$11,773,542	$11,781,911	$11,774,144	$11,783,182
JORDAN	non-Federal	$19,622,391	$19,618,577	$19,622,064	$19,618,146	$19,622,612
LAY	non-Federal	$34,880,515	$34,849,221	$34,851,512	$34,851,212	$34,871,529
LOGAN MARTIN	non-Federal	$25,857,129	$25,830,823	$25,833,682	$25,833,682	$25,855,324
MARTIN	non-Federal	$33,116,005	$33,115,689	$33,116,607	$33,115,919	$33,116,732
MITCHELL	non-Federal	32,597,640	$32,572,045	$32,593,482	$32,574,186	$32,594,708
THURLOW	non-Federal	$16,161,574	$16,155,558	$16,157,729	$16,155,637	$16,155,928
WALTER-BOULDIN	non-Federal	$45,277,945	$45,222,219	$45,280,651	$45,228,279	$45,283,958
WEISS	non-Federal	$13,771,923	$13,756,217	$13,777,245	$13,757,656	$13,779,024
YATES	non-Federal	$9,441,291	$9,437,603	$9,439,622	$9,437,605	$9,438,809
non-Federal	**subtotal**	**$262,843,439**	**$262,662,563**	**$262,782,180**	**$262,678,509**	**$262,825,991**
System	**TOTAL**	**$401,452,328**	**$401,090,524**	**$401,412,465**	**$401,122,069**	**$401,467,221**

D.7.3 Summary of Benefits Foregone

Benefits forgone are calculated for the Allatoona project in accordance with guidance in the ER 1105-2-100. No NED benefits of navigation were evaluated due to the lack of consistent commodity movements over the last decade. Benefits forgone are calculated for the hydropower project purpose, flood risk management (FRM) and for recreation. A full description of the methodology for NED hydropower impacts is contained in Attachment 4 of Appendix C. Hydropower, FRM, and recreation benefits forgone are summarized in Table D-15.

Table D-15. Benefits Foregone

Alternative	Total Benefits (Federal System)	Benefits Foregone compared to baseline (Without Project Future Condition)
FWOP	$218,773,749	-
Hydropower	$138,664,206	-
Flood Risk Management	$6,325,243	-
Recreation	$73,784,300	-
Reallocation	$219,588,166	$760,975
Hydropower	$138,695,392	$31,186
Flood Risk Management	$6,411,774	($86,530)
Recreation	$74,481,000	$696,700

D.8 Flood Damage Analysis

To determine the acceptability of a reallocation from the flood control pool at the Allatoona project, and a change in operations at the APC's Logan Martin and Weiss projects, a flood impacts analysis was conducted to show any possible areas of increased flood risk.

D.8.1 Methodology

The model used to evaluate the existing and proposed flood damages in the ACT basin is the USACE Hydrologic Engineering Center's (HEC) Flood Impact Analysis (HEC-FIA) model software which is a tool to help identify the consequences from a single event. HEC-FIA was developed by HEC in collaboration with the Risk Management Center (RMC) and the Engineering Research and Design Center (ERDC). HEC-FIA evaluates consequences from events defined by hydraulic model output such as gridded data (e.g., depth and arrival time Grids) or HEC's Data Storage System (HEC-DSS) Stage Hydrographs. The consequences HEC-FIA computes include economic losses (losses to structures and their contents), agricultural losses, and expected life loss from these hydraulic events.

D.8.1.1 HEC-FIA Inputs

HEC-FIA requires external inputs, which are developed by the USACE economics branch and by the USACE Hydrologic and Hydraulic (H&H) branch.

D.8.1.1.1 H&H Inputs:

- Watershed Boundary
  - A geospatial boundary that contains the entire area which is to be considered.
- Terrain Grid
  - LiDAR data which established the ground elevation in raster format.
- Depth Grids
  - A raster dataset grid that contains the water depth with reference to the terrain grid. A depth grid is developed through the HEC-RAS model for each event/scenario that is to be evaluated in HEC-FIA.

D.8.1.1.2 Economic Inputs:

- Impact Areas
  - A set of boundaries that differentiate regions within the watershed. Impact areas for this study are the counties within the Watershed Boundary.
- Structure Inventory

A GIS point shapefile that contains the location and information of each structure within the study area. The dataset used for the study structure inventory is the National Structure Inventory (NSI) version 2. The NSI version 1 was initially developed to simplify the workflow for the GIS pre-processing for the USACE Modeling Mapping and Consequence center. Within a given layer of the NSI data, each point is represented by a geospatial location, and a series of required attributes. These attributes can then be used to inform consequence calculations in modeling frameworks such as LifeSim, HEC-FIA, and HEC-FDA. The NSI version 2 improves upon the NSI version 1 with increased accuracy by incorporating additional layers of location and value precision at the parcel level. Examples of the increased accuracy of the NSI 2 are found in Figure D-2 and Figure D-3. The data within the structure inventory is based on Hazus census block data and increasing accuracy for the structure inventory is possible through acquiring individual parcel data from Tax Assessor's Offices.

- Depth Damage Functions
  - Depth Damage Functions are a component of the structure inventory and report the amount of damage that a specific category of structures can expect to receive at certain depths of flooding. This study incorporated the same damage functions that were used in a 2014 ACT watershed CWMS report. The CWMS report utilized Hazus depth damage functions which are designed to be applied across the nation. Additional accuracy can be achieved through development of area specific depth damage functions via conducting surveys and interviews of local home and business owners.

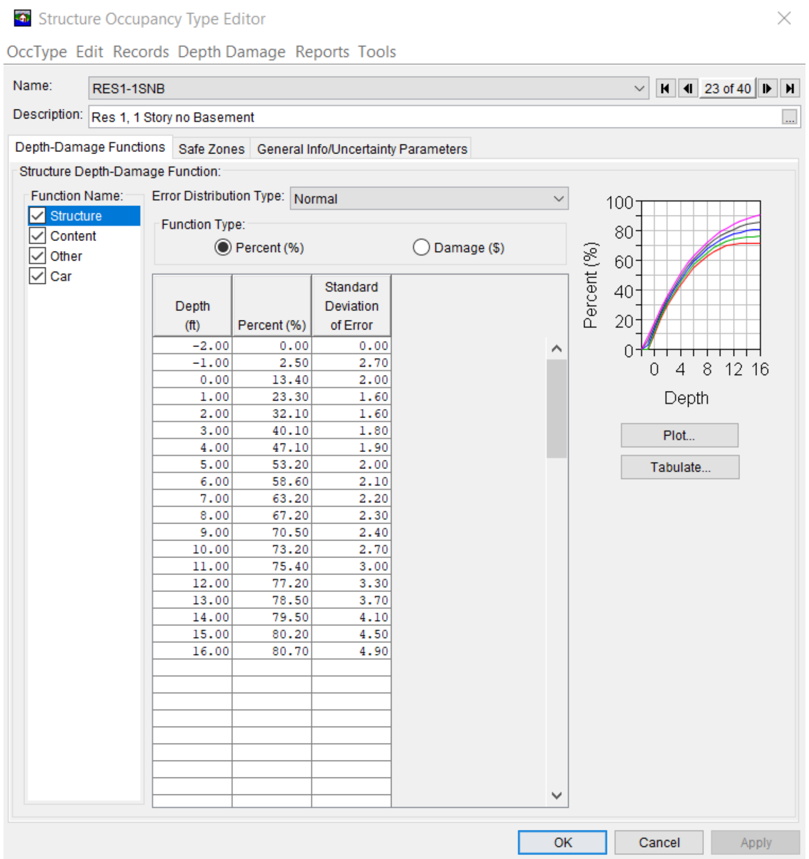


Figure D-1. Example of Depth Damage Function

Figure D-2. NSI 1 Structure locations example near Rainbow City, AL

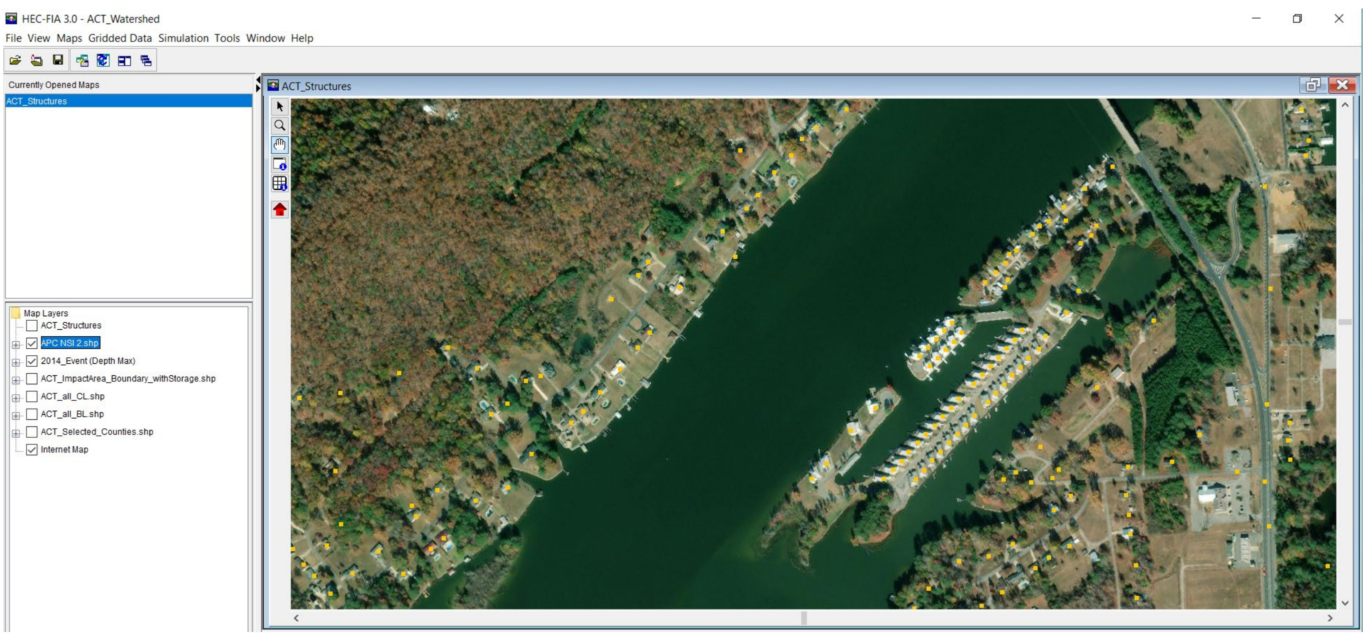


Figure D-3. NSI 2 Structure locations example near Rainbow City, AL

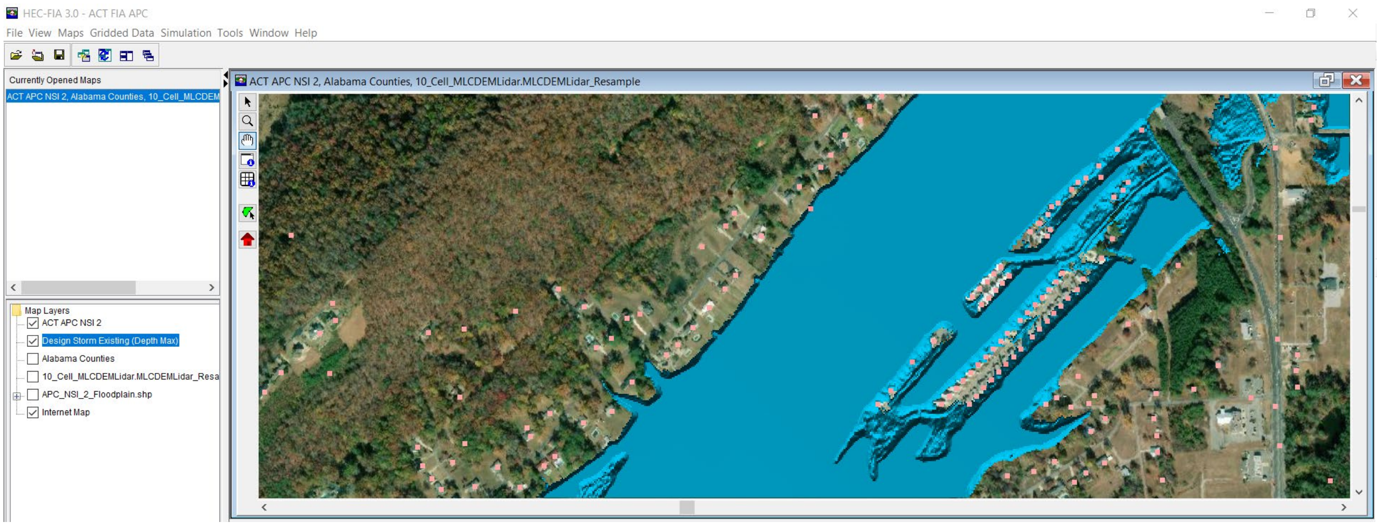


Figure D-4. NSI 2 Structure locations example near Rainbow City, AL with Existing Condition Design Storm Inundation

With all required data inputs, the HEC-FIA model then shows the depth of flooding and reported damages at each individual structure for a specific flood event. The results are then compared to show any flood impact increases or decreases across the modeled scenarios.

D.8.1.2 Assumptions

Assumptions for the HEC-FIA model development for this study include:

- Floodplain residents react to a floodplain management plan in a rational manner.
- Real property continues to be repaired to pre-flood conditions subsequent to each flood event.
- The NSI 2 is an accurate representation of the structure value and content.
- The depth damage functions developed by the FEMA Hazus program are applicable to structures within the floodplain.
- All values are equivalent to FY2020 dollars.
- Any new property development will occur outside of the modeled flood areas.
- The proposed operational changes are the only changes incorporated at each individual project over the analysis period.
- The inundation scenarios and data provided by APC and H&H accurately represent the extent and depth of flooding on the ground.

D.8.1.3 Risk and Uncertainty Factors

Risk and uncertainty are inherent in water resources planning and analysis. These factors arise due to errors in measurement and from the innate variability of complex physical, social, and economic situations. The measured or estimated values of key planning and design variables are rarely known with certainty and can take on a range of possible values. The model results depict the most accurate picture of the study area and the conditions which occur under the given scenarios. In order to further reduce uncertainty, additional time and resources would be needed that do not adhere to this studies mandated completion date.

D.8.2 Discussion of HEC-RAS Outputs

The HEC produces a suite of models and tools that USACE uses to conduct analysis. Many of these models have output data that feeds directly into another HEC model which requires a very specific data structure. The HEC-FIA model uses data produced by the HEC-HAS model to conduct a flood impacts analysis. Further information regarding the HEC-RAS model is discussed in Attachment 1 of Appendix C.

D.8.3 Event Selection and Descriptions

D.8.3.1 Allatoona Events

The USACE H&H branch provided HEC-RAS inputs for the Allatoona section analysis. A total of 3 Historical storms with 5 associated frequency based events each were analyzed to show any potential differences between the base operations of the Allatoona project and the operations due to the proposed reallocation from the conservation and flood control pools. These inputs translate to a total of 30 modeled flood scenarios, which include a base and proposed condition for 15 storm events. Table D-16 displays the events with the associated frequencies. Additional information concerning the methodology and descriptions of the modeled events is found in Attachment 1 of Appendix C.

Table D-16. Flood Frequencies for Allatoona Project Modeled Scenarios

Dam/Event	1961	1979	1990
Allatoona Base	0.20%	0.20%	0.20%
Allatoona Base	0.50%	0.50%	0.50%
Allatoona Base	1.00%	1.00%	1.00%
Allatoona Base	2.00%	2.00%	2.00%
Allatoona Base	5.00%	5.00%	5.00%
Allatoona Proposed	0.20%	0.20%	0.20%
Allatoona Proposed	0.50%	0.50%	0.50%
Allatoona Proposed	1.00%	1.00%	1.00%
Allatoona Proposed	2.00%	2.00%	2.00%
Allatoona Proposed	5.00%	5.00%	5.00%

D.8.3.2 APC Events

The USACE H&H branch provided HEC-FIA inputs for the APC Projects section analysis. A total of 5 Historical storms and 2 designed storms were analyzed to show any potential differences between the base operations of the APC projects and the operations due to the proposed change in operations. These inputs translate to a total of 14 modeled flood scenarios; a base and proposed condition for 7 storm events. Table D-17 describes the modeled flood scenarios. Additional information concerning the methodology and descriptions of the modeled events is found in Attachment 1 of Appendix C.

Table D-17. APC Projects Modeled Scenarios

Dam/City	Apr-79	Feb-90	Design Flood	Oct-95	May-03
Jordan	250-yr < X < 500-yr	25-yr	Unregulated 100-yr	5-yr	5-yr
Mitchell	250-yr < X < 500-yr	25-yr	Unregulated 100-yr	5-yr	8-yr
Childersburg, AL		33-yr		5-yr	16-yr
Lay	250-yr	33-yr	Unregulated 100-yr	5-yr	13-yr
Logan Martin	250-yr	25-yr < X < 50-yr	Unregulated 100-yr		20-yr
Gadsden, AL		90-yr		5-yr	10-yr
Henry	100-yr < X < 250-yr	75-yr	Unregulated 100-yr	5-yr	15-yr
Weiss	50-yr	100-yr	Unregulated 100-yr	5-yr	8-yr

D.8.4 Summary of Results

For organizational purposes, the watershed was separated into 2 individual areas, each with its own complete HEC-FIA model and analysis. The first modeled area was for the Allatoona portion of the study and contains the areas from Rome, GA upstream along the Oostanaula River to the Carters Reservoir and areas along the Etowah River to Allatoona Lake. The second modeled area was for the APC projects and follows the Coosa River from Weiss Lake in Cherokee County, AL to Lake Jordan in Elmore County, AL. Estimated FRM impacts for each are discussed below. Overall, under the proposed conditions, an acceptable level of flood risk is maintained, and the areas that may have never developed under an unregulated Oostanaula, Etowah, or Coosa river continue to receive flood risk management (FRM) benefits provided by the USACE project at Allatoona and the APC projects along the Coosa River. Any increases in water surface elevations seen downstream are in fractions of a foot and, except for in events above the 1.0% annual chance exceedance (ACE), do not appear to expand the extent of flooding to previously unaffected structures beyond marginal amounts. Attachment 4 of Appendix C.

D.8.4.1 Analysis of Allatoona

D.8.4.1.1 Proposed Changes to Water Supply Storage at Allatoona Lake

For detailed information regarding the proposed changes to water supply storage at Allatoona Lake, refer to Section 2.4 of the Main Report. In summary, the State of Georgia has requested that USACE enter into a storage contract to provide sufficient storage to sustain annual average withdrawals of 94 mgd in the year 2050. This section of the Economic Appendix provides analysis of the downstream impacts of the proposed reallocations to Allatoona Lake flood pool incorporated into study alternatives All permutations of alternatives with a flood pool reallocation would reduce the flood pool by the same amount.

D.8.4.1.2 Allatoona Flood Impact Analysis

From a total impacts perspective, the modeled events/frequencies that impacted the largest number of structures was the Base and Proposed 1979 0.2% ACE scenario (500 year event). These scenarios produced impacts to 509 structures at base conditions, and 514 structures at proposed conditions along the Etowah, Oostanaula, and Coosa Rivers. The majority of impacts occur in Rome, GA within Floyd County. Details of impacts are found in the following figures and descriptions.

Table D-18. Allatoona Project Summary of Impacts

Impacts								
Base				Proposed				
Storm	Frequency	Structures Impacted		Storm	Frequency	Structures Impacted		% Change from Base
1961	0.002	418		1961	0.002	418		0.00%
1961	0.005	350		1961	0.005	350		0.00%
1961	0.01	315		1961	0.01	315		0.00%
1961	0.02	271		1961	0.02	271		0.00%
1961	0.05	87		1961	0.05	87		0.00%
1979	0.002	509		1979	0.002	514		0.97%
1979	0.005	362		1979	0.005	369		1.88%
1979	0.01	251		1979	0.01	251		0.00%

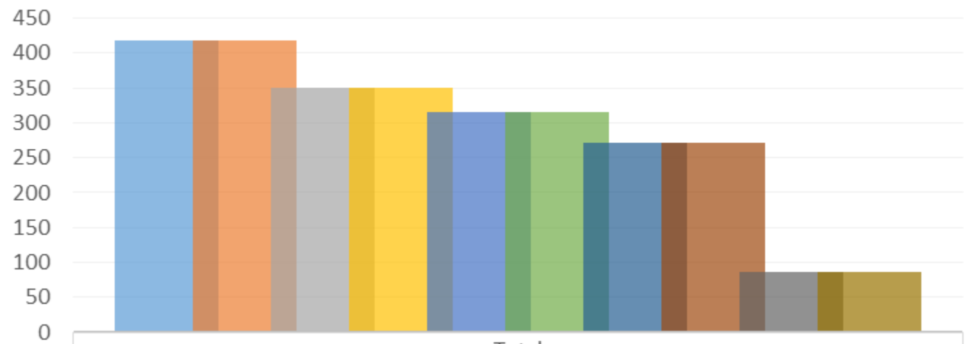
Impacts								
1979	0.02	184		1979	0.02	184		0.00%
1979	0.05	159		1979	0.05	159		0.00%
1990	0.002	328		1990	0.002	328		0.00%
1990	0.005	263		1990	0.005	263		0.00%
1990	0.01	203		1990	0.01	203		0.00%
1990	0.02	177		1990	0.02	177		0.00%
1990	0.05	158		1990	0.05	158		0.00%

Table D-19. Allatoona Project Summary of Damages

Damages								
Base				Proposed				
Storm	Frequency	Structure Damages		Storm	Frequency	Structure Damages		% Change from Base
1961	0.002	$180,208,187		1961	0.002	$180,280,028		0.04%
1961	0.005	$146,055,126		1961	0.005	$146,107,482		0.04%
1961	0.01	$133,697,579		1961	0.01	$133,697,426		0.00%
1961	0.02	$119,781,776		1961	0.02	$119,817,592		0.03%
1961	0.05	$14,675,209		1961	0.05	$14,756,926		0.55%
1979	0.002	$181,990,474		1979	0.002	$187,386,680		2.88%
1979	0.005	$131,256,139		1979	0.005	$136,189,406		3.62%
1979	0.01	$107,064,199		1979	0.01	$107,063,350		0.00%
1979	0.02	$86,293,757		1979	0.02	$86,270,710		-0.03%
1979	0.05	$65,859,888		1979	0.05	$67,069,335		1.80%
1990	0.002	$132,436,363		1990	0.002	$132,451,203		0.01%
1990	0.005	$118,366,005		1990	0.005	$118,392,483		0.02%
1990	0.01	$104,614,830		1990	0.01	$104,641,536		0.03%
1990	0.02	$93,619,544		1990	0.02	$93,656,391		0.04%
1990	0.05	$74,559,305		1990	0.05	$74,807,521		0.33%

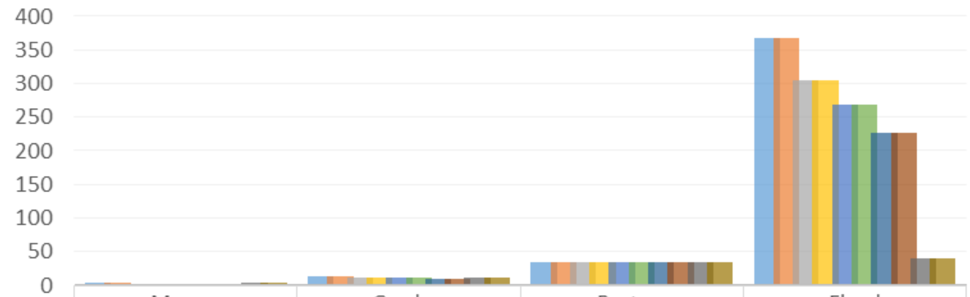
D.8.4.1.2.1 1961 Storm

Figure D-5 and Figure D-6 display the number of structures impacted downstream of Allatoona Lake under the base and proposed conditions for the 1961 Storm frequencies. This storm showed no additional impacts under the proposed condition.



	Total
1961 0.2% Base Allatoona	418
1961 0.2% Proposed Allatoona	418
1961 0.5% Base Allatoona	350
1961 0.5% Proposed Allatoona	350
1961 1.0% Base Allatoona	315
1961 1.0% Proposed Allatoona	315
1961 2.0% Base Allatoona	271
1961 2.0% Proposed Allatoona	271
1961 5.0% Base Allatoona	87
1961 5.0% Proposed Allatoona	87

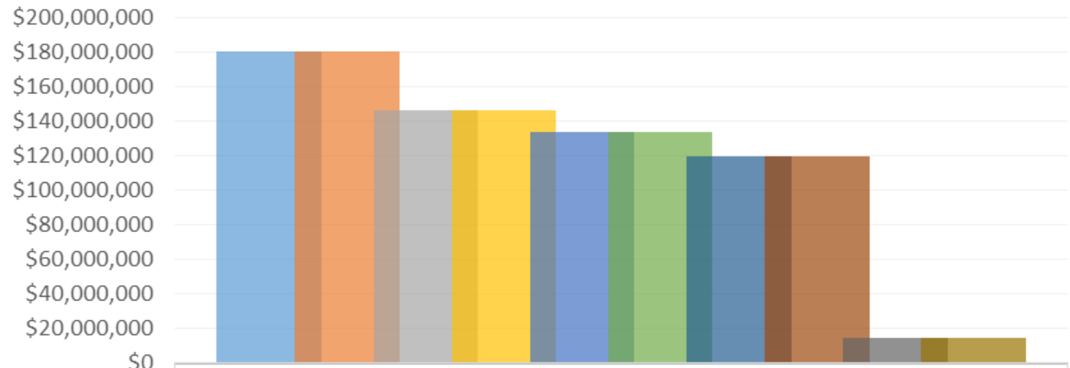
Figure D-5. 1961 Storm Allatoona Project Total of Downstream Structures Impacted (Count)



	Murray	Gordon	Bartow	Floyd
1961 0.2% Base Allatoona	3	14	35	368
1961 0.2% Proposed Allatoona	3	14	35	368
1961 0.5% Base Allatoona	2	11	35	304
1961 0.5% Proposed Allatoona	2	11	35	304
1961 1.0% Base Allatoona	2	11	35	269
1961 1.0% Proposed Allatoona	2	11	35	269
1961 2.0% Base Allatoona	2	10	35	226
1961 2.0% Proposed Allatoona	2	10	35	226
1961 5.0% Base Allatoona	3	11	35	40
1961 5.0% Proposed Allatoona	3	11	35	40

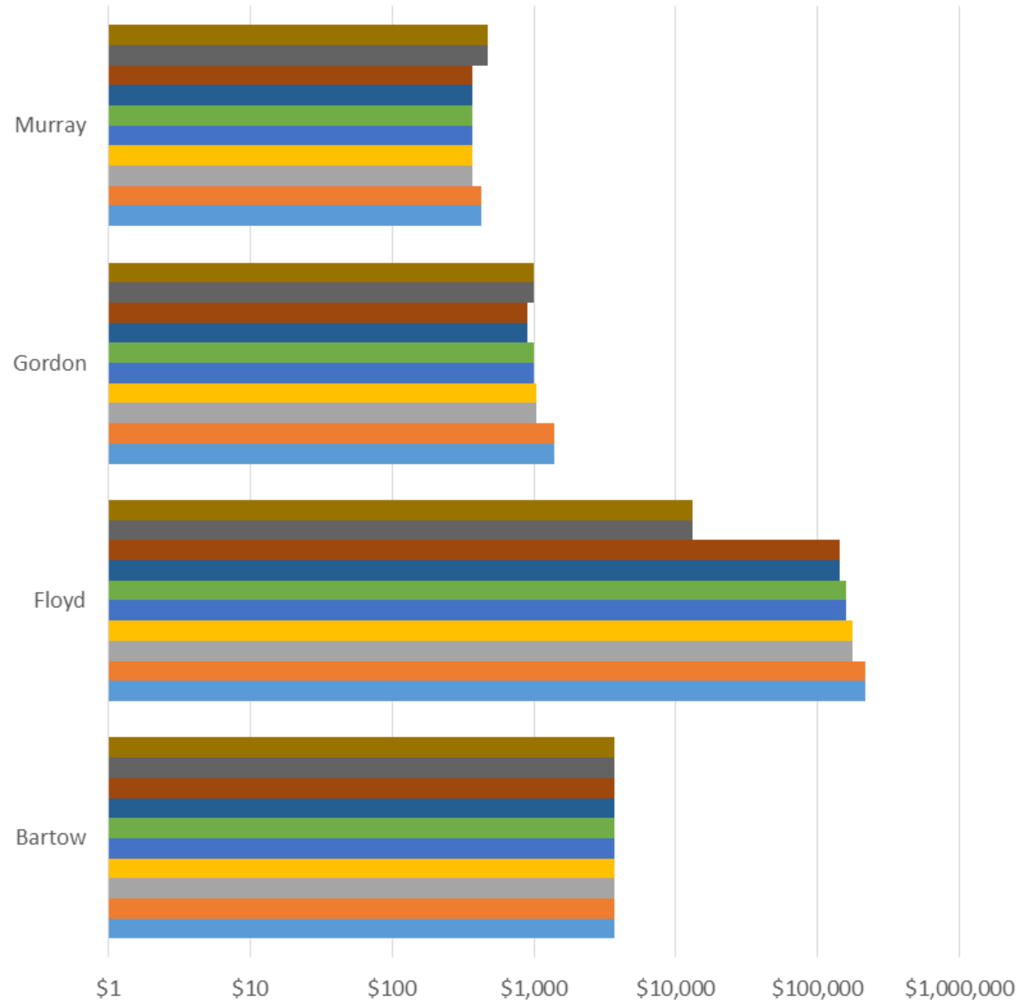
Figure D-6. 1961 Storm Allatoona Project Total of Downstream Structures Impacted by County (Count)

Figure D-7 and Figure D-8 display the amount of flood damages expected at each frequency of the 1961 modeled storm. Additional damages in the proposed events are less than a 1% increase from base conditions.



	All
1961 0.2% Base Allatoona	$180,208,187
1961 0.2% Proposed Allatoona	$180,280,027
1961 0.5% Base Allatoona	$146,055,126
1961 0.5% Proposed Allatoona	$146,107,483
1961 1.0% Base Allatoona	$133,697,579
1961 1.0% Proposed Allatoona	$133,697,425
1961 2.0% Base Allatoona	$119,781,776
1961 2.0% Proposed Allatoona	$119,817,591
1961 5.0% Base Allatoona	$14,675,209
1961 5.0% Proposed Allatoona	$14,756,926

Figure D-7. 1961 Storm Allatoona Project Total Downstream Flood Damages ($)



	Bartow	Floyd	Gordon	Murray
1961 5.0% Proposed Allatoona	$3,679	$13,166	$995	$473
1961 5.0% Base Allatoona	$3,677	$13,066	$995	$473
1961 2.0% Proposed Allatoona	$3,672	$143,730	$908	$368
1961 2.0% Base Allatoona	$3,672	$143,686	$908	$368
1961 1.0% Proposed Allatoona	$3,705	$160,819	$1,009	$368
1961 1.0% Base Allatoona	$3,705	$160,820	$1,009	$368
1961 0.5% Proposed Allatoona	$3,676	$176,206	$1,051	$368
1961 0.5% Base Allatoona	$3,676	$176,141	$1,051	$368
1961 0.2% Proposed Allatoona	$3,680	$218,220	$1,380	$424
1961 0.2% Base Allatoona	$3,680	$218,131	$1,380	$424

Figure D-8. 1961 Storm Allatoona Project Total Downstream Flood Damages by County ($1,000)

Table D-20. Allatoona Project 1961 Storm Base Average Annual Damages

Base Condition Damages 1961					
Frequency (Year Storm)	***Frequency***	***Incremental Probability***	***Incremental Damage***	***Average Damage***	***Incremental Average Annual***
		0.00200		$180,208,187	$360,416
500	0.002		$180,208,187		
		0.00300		$163,131,657	$489,395
200	0.005		$146,055,126		
		0.00500		$139,876,353	$699,382
100	0.010		$133,697,578		
		0.01000		$126,739,677	$1,267,397
50	0.020		$119,781,776		
		0.03000		$67,228,493	$2,016,855
20	0.050		$14,675,209		
		0.05000		$7,337,605	$366,880
10	0.100		-		
				Without Project Average Annual Damages	**$5,200,325**

Table D-20 displays the Average Annual Damages expected under the 1961 storm base conditions.

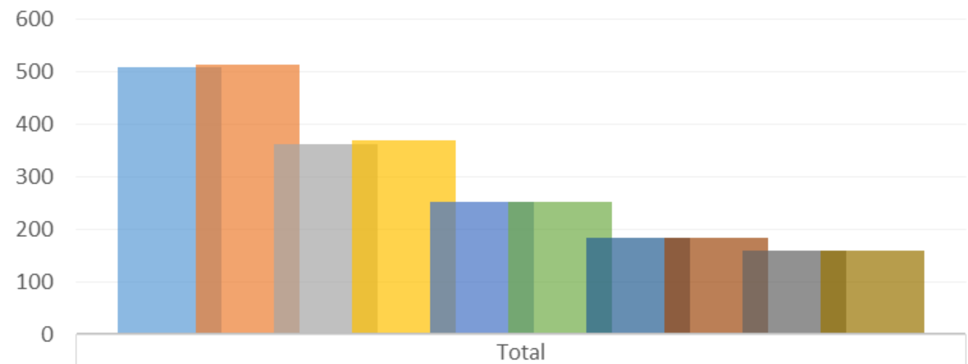
Table D-21 shows the 1961 storm proposed conditions average annual damages. The base conditions average annual damages are $5,200,325, and the proposed average annual damages are $5,204,770 with a difference of an additional $4,445 or 0.085% increase in damages under the proposed condition.

Table D-21. Allatoona Project 1961 Storm Proposed Average Annual Damages

Proposed Condition Damages 1961					
Frequency (Year Storm)	***Frequency***	***Incremental Probability***	***Incremental Damage***	***Average Damage***	***Incremental Average Annual***
		0.00200		$180,280,027	$360,560
500	0.002		$180,280,027		
		0.00300		$163,193,755	$489,581
200	0.005		$146,107,482		
		0.00500		$139,902,454	$699,512
100	0.010		$133,697,425		
		0.01000		$126,757,508	$1,267,575
50	0.020		$119,817,591		
		0.03000		$67,287,259	$2,018,618
20	0.050		$14,756,926		
		0.05000		$7,378,463	$368,923
10	0.100		-		
				With Project Average Annual Damages	**$ 5,204,770**
				Damage Reductions	**$ (4,445)**

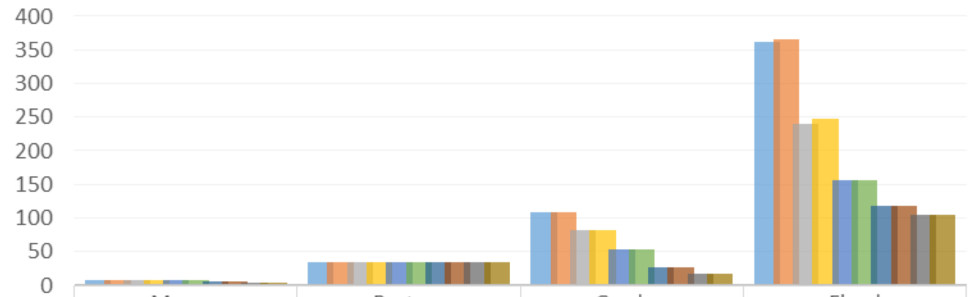
D.8.4.1.2.2 1979 Storm

Figure D-9 and Figure D-10 display the number of structures impacted downstream of Allatoona Lake under the base and proposed conditions for the 1979 Storm frequencies. The 0.5% ACE event showed an additional 7 structures impacted under the proposed condition and the 0.2% ACE event reported an additional 5 structures impacted under the proposed event. These increases represent a 1.88% increase at the 0.5% ACE and a 0.97% increase at the 0.2% ACE.



	Total
1979 0.2% Base Allatoona	509
1979 0.2% Proposed Allatoona	514
1979 0.5% Base Allatoona	362
1979 0.5% Proposed Allatoona	369
1979 1.0% Base Allatoona	251
1979 1.0% Proposed Allatoona	251
1979 2.0% Base Allatoona	184
1979 2.0% Proposed Allatoona	184
1979 5.0% Base Allatoona	159
1979 5.0% Proposed Allatoona	159

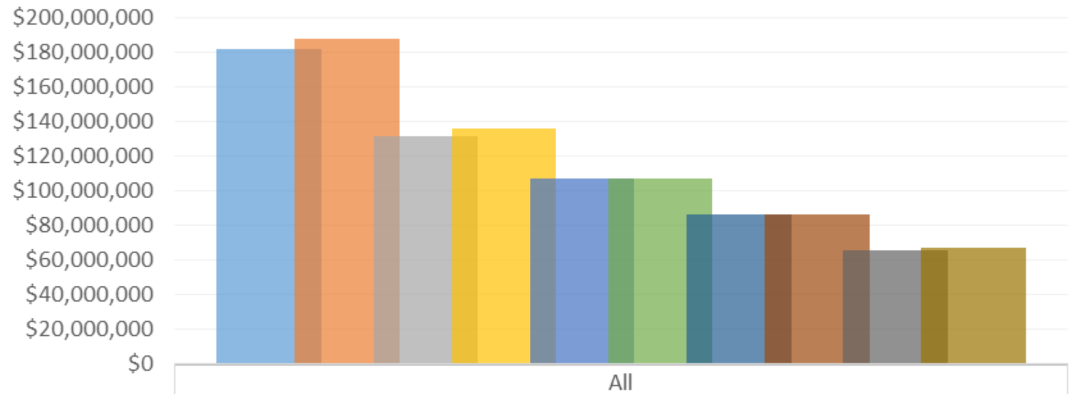
Figure D-9. 1979 Storm Allatoona Project Total of Downstream Structures Impacted (Count)



	Murray	Bartow	Gordon	Floyd
1979 0.2% Base Allatoona	8	35	108	361
1979 0.2% Proposed Allatoona	8	35	108	366
1979 0.5% Base Allatoona	8	35	82	240
1979 0.5% Proposed Allatoona	8	35	82	247
1979 1.0% Base Allatoona	7	35	54	157
1979 1.0% Proposed Allatoona	7	35	54	157
1979 2.0% Base Allatoona	5	35	27	119
1979 2.0% Proposed Allatoona	5	35	27	119
1979 5.0% Base Allatoona	3	35	18	105
1979 5.0% Proposed Allatoona	3	35	18	105

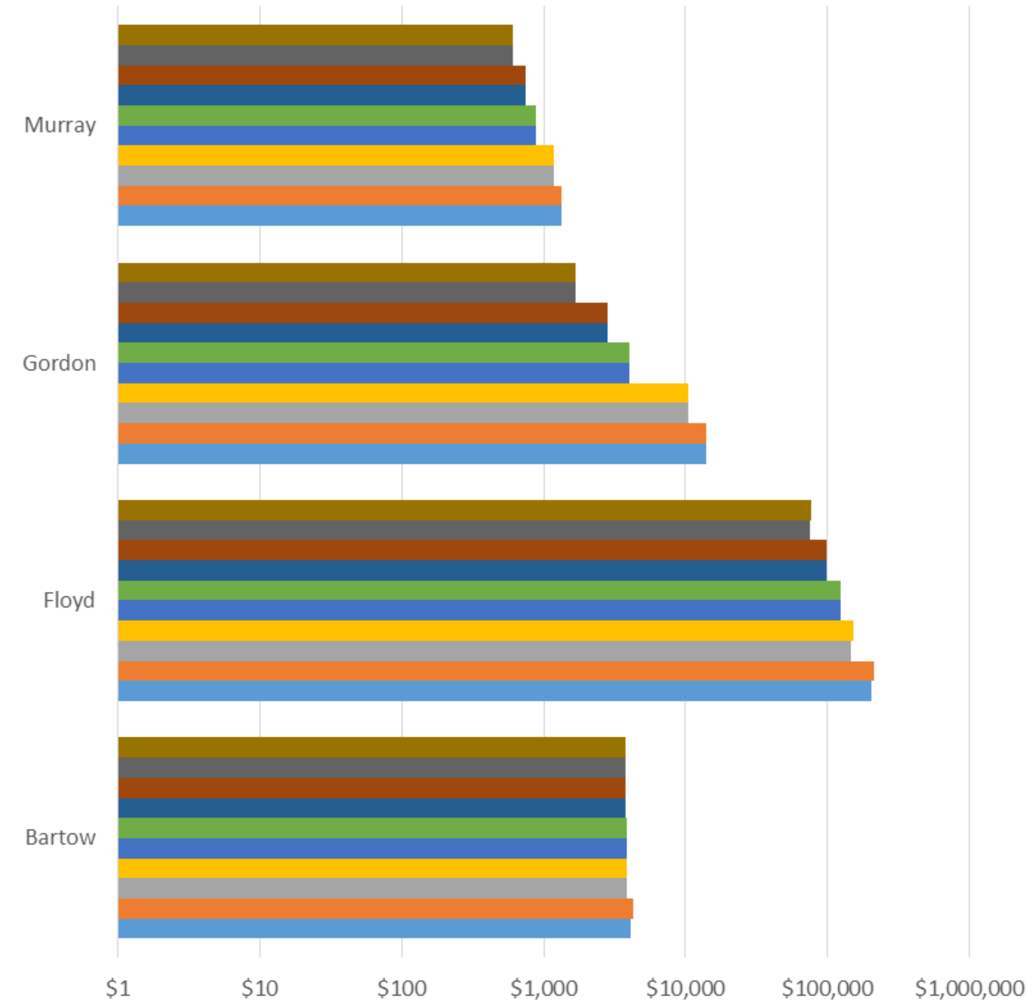
Figure D-10. 1979 Storm Allatoona Project Total of Downstream Structures Impacted by County (Count)

Figure D-11 and Figure D-12 display the amount of flood damages expected at each frequency of the 1979 modeled storm. All additional damages in the proposed events are less than a 4% increase from base conditions.



	All
1979 0.2% Base Allatoona	$181,990,474
1979 0.2% Proposed Allatoona	$187,386,681
1979 0.5% Base Allatoona	$131,256,140
1979 0.5% Proposed Allatoona	$136,189,406
1979 1.0% Base Allatoona	$107,064,199
1979 1.0% Proposed Allatoona	$107,063,350
1979 2.0% Base Allatoona	$86,293,758
1979 2.0% Proposed Allatoona	$86,270,710
1979 5.0% Base Allatoona	$65,859,888
1979 5.0% Proposed Allatoona	$67,069,335

Figure D-11. 1979 Storm Allatoona Project Total Downstream Flood Damages ($)



	Bartow	Floyd	Gordon	Murray
1979 5.0% Proposed Allatoona	$3,768	$77,173	$1,681	$603
1979 5.0% Base Allatoona	$3,759	$75,682	$1,681	$603
1979 2.0% Proposed Allatoona	$3,790	$99,687	$2,823	$752
1979 2.0% Base Allatoona	$3,790	$99,716	$2,823	$752
1979 1.0% Proposed Allatoona	$3,824	$124,152	$3,989	$888
1979 1.0% Base Allatoona	$3,824	$124,153	$3,989	$888
1979 0.5% Proposed Allatoona	$3,838	$153,599	$10,375	$1,183
1979 0.5% Base Allatoona	$3,838	$147,476	$10,376	$1,183
1979 0.2% Proposed Allatoona	$4,256	$212,851	$14,085	$1,332
1979 0.2% Base Allatoona	$4,136	$206,274	$14,085	$1,332

Figure D-12. 1979 Storm Allatoona Project Total Downstream Flood Damages by County ($1,000)

Table D-22 displays the Average Annual Damages expected under the base conditions of the 1979 storm.

Table D-22. Allatoona Project 1979 Storm Base Average Annual Damages

Base Condition Damages 1979					
Frequency (Year Storm)	***1/Frequency***	***Incremental Probability***	***Incremental Damage***	***Average Damage***	***Incremental Average Annual***
		0.00200		$181,990,474	$363,981
500	0.002		$181,990,473		
		0.00300		$156,623,307	$469,870
200	0.005		$131,256,139		
		0.00500		$119,160,169	$595,801
100	0.010		$107,064,198		
		0.01000		$96,678,978	$966,790
50	0.020		$86,293,757		
		0.03000		$76,076,823	$2,282,305
20	0.050		$65,859,888		
		0.05000		$32,929,944	$1,646,497
10	0.100		$ -		
				Without Project Average Annual Damages	**$ 6,325,243**

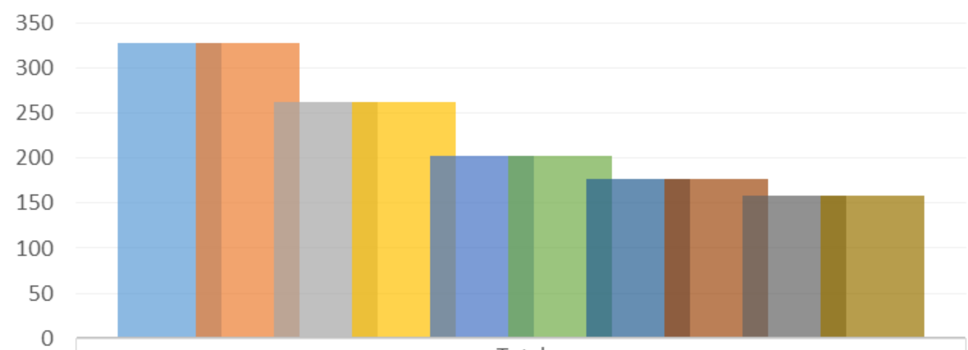
Table D-23 shows the 1979 storm proposed conditions average annual damages. The results reported the largest increase seen below Allatoona Lake. The base conditions average annual damages are $6,325,243, and the proposed average annual damages are $6,411,774 with a difference of an additional $86,530 or 1.35% increase in average annual damages under the proposed condition.

Table D-23. Allatoona Project 1979 Storm Proposed Average Annual Damages

Proposed Condition Damages 1979					
Frequency (Year Storm)	***1/Frequency***	***Incremental Probability***	***Incremental Damage***	***Average Damage***	***Incremental Average Annual***
		0.00200		$187,386,681	$374,773
500	0.002		$187,386,680		
		0.00300		$161,788,043	$485,364
200	0.005		$136,189,406		
		0.00500		$121,626,378	$608,132
100	0.010		$107,063,350		
		0.01000		$96,667,030	$966,670
50	0.020		$86,270,710		
		0.03000		$76,670,023	$2,300,101
20	0.050		$67,069,335		
		0.05000		$33,534,668	$1,676,733
10	0.100		$ -		
				With Project Average Annual Damages	**$ 6,411,774**
				Damage Reductions	**$ (86,530)**

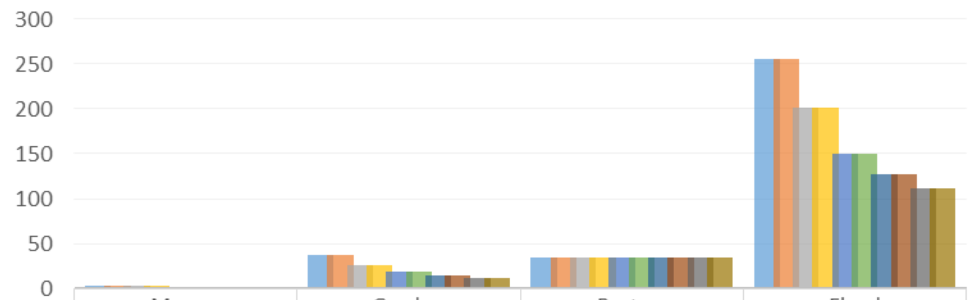
D.8.4.1.2.3 1990 Storm

Figure D-13 and Figure D-14 display the number of structures impacted downstream of Allatoona Lake under the base and proposed conditions for the 1990 Storm frequencies. This storm showed no additional impacts under the proposed condition.



	Total
1990 0.2% Base Allatoona	328
1990 0.2% Proposed Allatoona	328
1990 0.5% Base Allatoona	263
1990 0.5% Proposed Allatoona	263
1990 1.0% Base Allatoona	203
1990 1.0% Proposed Allatoona	203
1990 2.0% Base Allatoona	177
1990 2.0% Proposed Allatoona	177
1990 5.0% Base Allatoona	158
1990 5.0% Proposed Allatoona	158

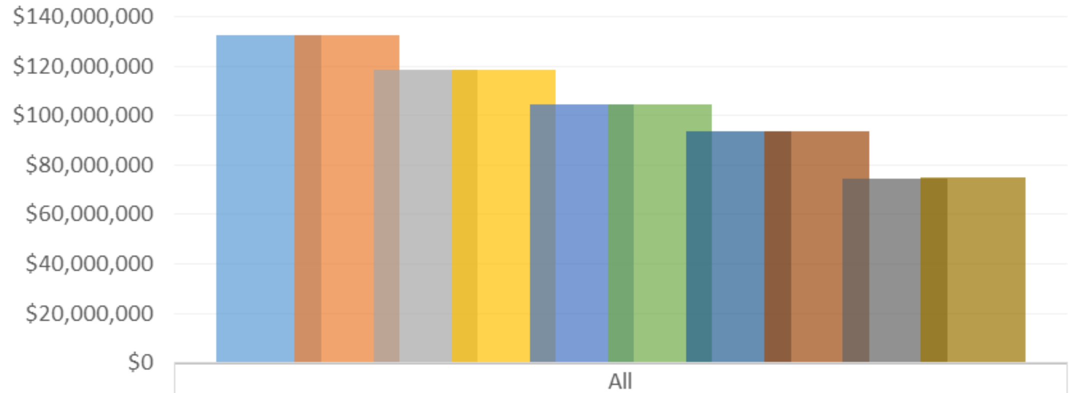
Figure D-13. 1990 Storm Allatoona Project Total of Downstream Structures Impacted (Count)



	Murray	Gordon	Bartow	Floyd
1990 0.2% Base Allatoona	3	37	35	255
1990 0.2% Proposed Allatoona	3	37	35	255
1990 0.5% Base Allatoona	3	26	35	201
1990 0.5% Proposed Allatoona	3	26	35	201
1990 1.0% Base Allatoona	2	18	35	150
1990 1.0% Proposed Allatoona	2	18	35	150
1990 2.0% Base Allatoona	2	15	35	127
1990 2.0% Proposed Allatoona	2	15	35	127
1990 5.0% Base Allatoona	2	12	35	111
1990 5.0% Proposed Allatoona	2	12	35	111

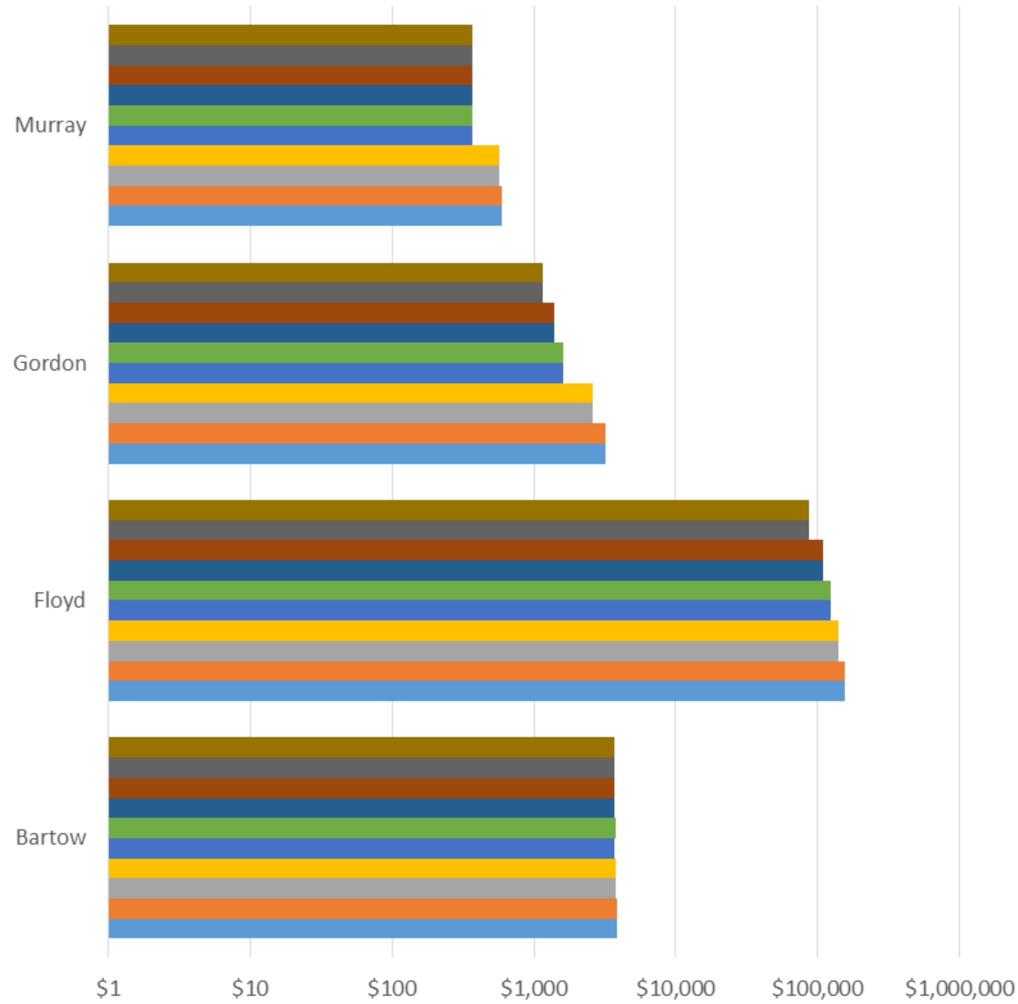
Figure D-14. 1990 Storm Allatoona Project Total of Downstream Structures Impacted by County (Count)

Figure D-15 and Figure D-16 display the amount of flood damages expected at each frequency of the 1990 modeled storm. All additional damages in the proposed events are less than a 1% increase from base conditions.



	All
1990 0.2% Base Allatoona	$132,436,363
1990 0.2% Proposed Allatoona	$132,451,203
1990 0.5% Base Allatoona	$118,366,005
1990 0.5% Proposed Allatoona	$118,392,483
1990 1.0% Base Allatoona	$104,614,830
1990 1.0% Proposed Allatoona	$104,641,536
1990 2.0% Base Allatoona	$93,619,543
1990 2.0% Proposed Allatoona	$93,656,390
1990 5.0% Base Allatoona	$74,559,304
1990 5.0% Proposed Allatoona	$74,807,521

Figure D-15. 1990 Storm Allatoona Project Total Downstream Flood Damages ($)



	Bartow	Floyd	Gordon	Murray
1990 5.0% Proposed Allatoona	$3,713	$87,578	$1,168	$368
1990 5.0% Base Allatoona	$3,704	$87,279	$1,167	$368
1990 2.0% Proposed Allatoona	$3,730	$110,730	$1,388	$368
1990 2.0% Base Allatoona	$3,726	$110,689	$1,387	$368
1990 1.0% Proposed Allatoona	$3,745	$124,124	$1,610	$368
1990 1.0% Base Allatoona	$3,741	$124,095	$1,610	$368
1990 0.5% Proposed Allatoona	$3,755	$139,962	$2,628	$566
1990 0.5% Base Allatoona	$3,752	$139,932	$2,628	$566
1990 0.2% Proposed Allatoona	$3,838	$156,681	$3,237	$600
1990 0.2% Base Allatoona	$3,837	$156,664	$3,237	$600

Figure D-16. 1990 Storm Allatoona Project Total Downstream Flood Damages by County ($1,000)

Table D-24 displays the Average Annual Damages expected under the base conditions of the 1990 storm.

Table D-24. Allatoona Project 1990 Storm Base Average Annual Damages

Base Condition Damages 1990					
Frequency (Year Storm)	***1/Frequency***	***Incremental Probability***	***Incremental Damage***	***Average Damage***	***Incremental Average Annual***
		0.002		$132,436,363	$264,873
500	0.002		$132,436,362		
		0.003		$125,401,184	$376,204
200	0.005		$118,366,004		
		0.005		$111,490,417	$557,452
100	0.010		$104,614,829		
		0.010		$99,117,187	$991,172
50	0.020		$93,619,543		
		0.030		$84,089,424	$2,522,683
20	0.050		$74,559,304		
		0.050		$37,279,652	$1,863,983
10	0.100				
Without Project Average Annual Damages					**$ 6,576,366**

Table D-25 shows the 1990 storm proposed conditions average annual damages. The base conditions average annual damages are $6,576,366, and the proposed average annual damages are $6,587,389 with a difference of an additional $11,024 or 0.17% increase in average damages under the proposed condition.

Table D-25. Allatoona Project 1990 Storm Proposed Average Annual Damages

Proposed Condition Damages 1990					
Frequency (Year Storm)	***1/Frequency***	***Incremental Probability***	***Incremental Damage***	***Average Damage***	***Incremental Average Annual***
		0.00200		$132,451,203	$264,902
500	0.002		$132,451,202		
		0.00300		$125,421,843	$376,266
200	0.005		$118,392,483		
		0.00500		$111,517,010	$557,585
100	0.010		$104,641,536		
		0.01000		$99,148,963	$991,490
50	0.020		$93,656,390		
		0.03000		$84,231,956	$2,526,959
20	0.050		$74,807,520		
		0.05000		$37,403,760	$1,870,188
10	0.100				
				With Project Average Annual Damages	**$ 6,587,389**
				Damage Reductions	**$ (11,024)**

D.8.4.2 Changes to Flood Risk Management

In all but 2 proposed scenarios, the total number of structures impacted was equal between the base case and with proposed reallocations from flood storage pools. The 2 scenarios in which very small increases occurred were at very low frequency flood events (0.2% chance exceedance and 0.5% chance exceedance) for the 1979 storm. In flood damages terms, the largest increase in flood damages under the proposed conditions cause an increase of 1.35% from the base average annual damages.

For the 1979 storm (0.2% chance exceedance) assuming reallocations , there were an additional 5 structures impacted in Floyd County, GA., of which 2 were residential along the Oostanaula River to the north of Rome, GA receiving -1.92 and -2.0 feet of flooding. Within the city of Rome, GA., one additional residential structure received -1.92 feet of flooding, and 2 commercial buildings received -0.95 and -0.94 feet of flooding. Negative depths of flooding result from flooding at the structure's foundation, below the elevation of the first finished floor. Using the assumption that residential structures are elevated 2 feet above the ground elevation and commercial structures are elevated 1 foot above the ground elevation, these results state that the structures are receiving less than 0.1 feet of flooding at the foundation. Details pertaining to the additional structures are found in Table D-26.

Table D-26. Allatoona Project 1979 Storm 0.2% Chance Exceedance Additional Structures

Structure Type	Foundation Height (FT)	Depth of Flooding (FT)	Notes
Residential	2.00	-2.00 (0.00)	Residential Structure near the Oostanaula River between Rome, GA and Carters Lake
Residential	2.00	-1.92 (+0.08)	Residential Structure in Rome, GA
Residential	2.00	-1.92 (+0.08)	Residential Structure near the Oostanaula River between Rome, GA and Carters Lake
Commercial	1.00	-0.95 (+0.05)	Commercial Structure in Rome, GA
Commercial	1.00	-0.94 (+0.06)	Commercial Structure in Rome, GA

Similarly, for the 1979 storm 0.5% chance exceedance proposed event there were and an additional 7 structures impacted in Floyd County. Details pertaining to these structures can be found in Table D-27.

Table D-27. Allatoona Project 1979 Storm 0.5% Chance Exceedance Additional Structures

Structure Type	Foundation Height (FT)	Depth of Flooding (FT)	Notes
Residential	2.00	-1.92 (+0.08)	Residential Structure in Rome, GA
Residential	2.00	-1.98 (+0.02)	Residential Structure in Rome, GA
Residential	2.00	-1.86 (+0.14)	Residential Structure in Rome, GA
Residential	2.00	-1.85 (+0.15)	Residential Structure in Rome, GA
Commercial	1.00	-0.78 (+0.22)	Commercial Structure in Rome, GA
Commercial	1.00	-0.73 (+0.27)	Commercial Structure in Rome, GA
Commercial	1.00	-0.99 (+0.01)	Commercial Structure in Rome, GA

D.8.5 Analysis of APC Projects

D.8.5.1 Proposed Changes to APC Projects

For detailed descriptions of the proposed reallocations to the APC projects, refer to section 2.6 of the main report. In summary, APC proposes revisions to flood operation plans for the Weiss and Logan Martin projects. At Weiss Lake and Dam the proposed changes include a 30% reduction in the flood storage during winter and a 24% reduction in flood storage during summer. At Logan Martin Dam and Lake the proposed changes include a 35% reduction in flood storage during the winter months as well as a 35% reduction in the summer months. To account for the reduction in flood storage, APC proposes to modify the current Flood Regulation Schedules for Weiss and Logan Martin Dams.

D.8.5.2 Model Results

Model results show that there is an overall decrease in flood impacts under the proposed operations of the Logan Martin and Weiss APC Projects. Flooding occurs in some areas; however, these increases in flooding extent are mostly in uninhabited rural areas directly downstream of the projects.

Table D-28. APC Projects Summary of Impacts

Impacts			
Storm	Existing	Proposed	% Change from Existing
	Structures Impacted		
Design	1,142	847	-34.83%
Back to Back	495	419	-18.14%
April 1979	796	757	-5.15%
February 1990	1,008	445	-126.52%
March 1990	457	424	-7.78%
May 2003	361	316	-14.24%
October 1995	393	383	-2.61%

Table D-29. APC Projects Summary of Damages

Damages			
Storm	Existing	Proposed	% Change from Existing
	Structure Damages		
Design	$60,355,624	$44,304,487	-36.23%
Back to Back	$28,283,180	$23,463,094	-20.54%
April 1979	$46,986,215	$44,567,294	-5.43%
February 1990	$51,480,801	$21,830,976	-135.82%
March 1990	$22,752,268	$21,529,299	-5.68%
May 2003	$19,382,372	$15,873,367	-22.11%
October 1995	$15,703,437	$18,653,614	15.82%

D.8.5.2.1 APC Projects Impacts Analysis

Across the basin, counties that benefited the most from the proposed operations are Etowah (Gadsden), Talladega (Childersburg), and St. Clair (Pell City, Ragland, Riverside).

D.8.5.2.1.1 Design Storm

Figure D-17 and Figure D-18 display the number of structures impacted along the Coosa River under the base and proposed conditions for the Design Storm scenario. This storm showed a net reduction of structures impacted under the proposed condition.

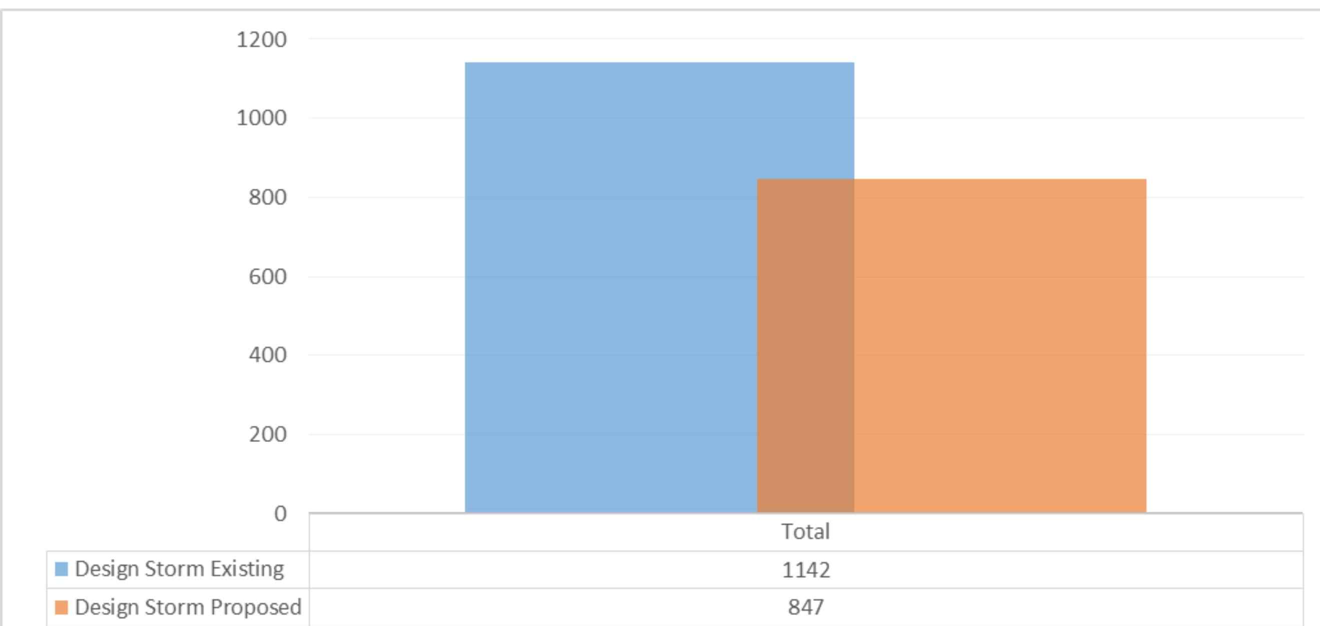
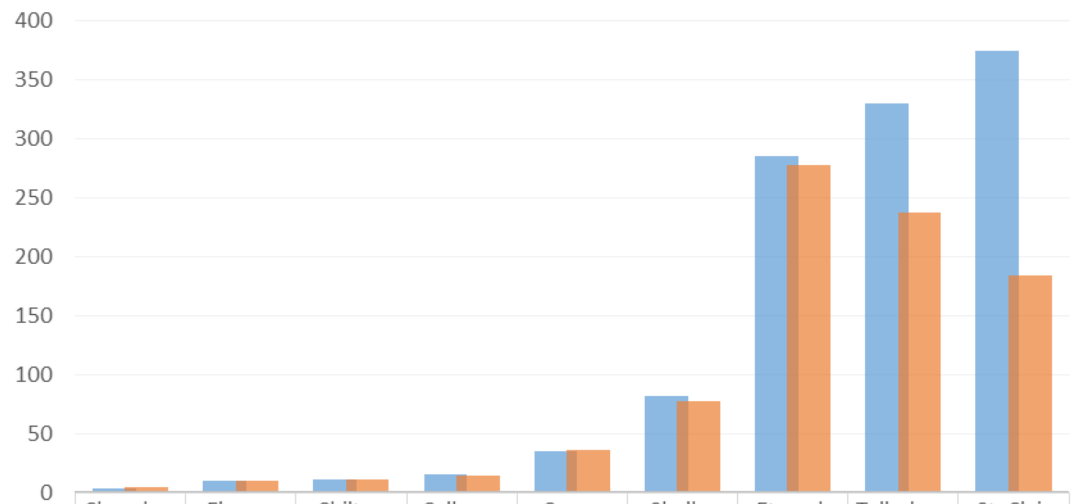


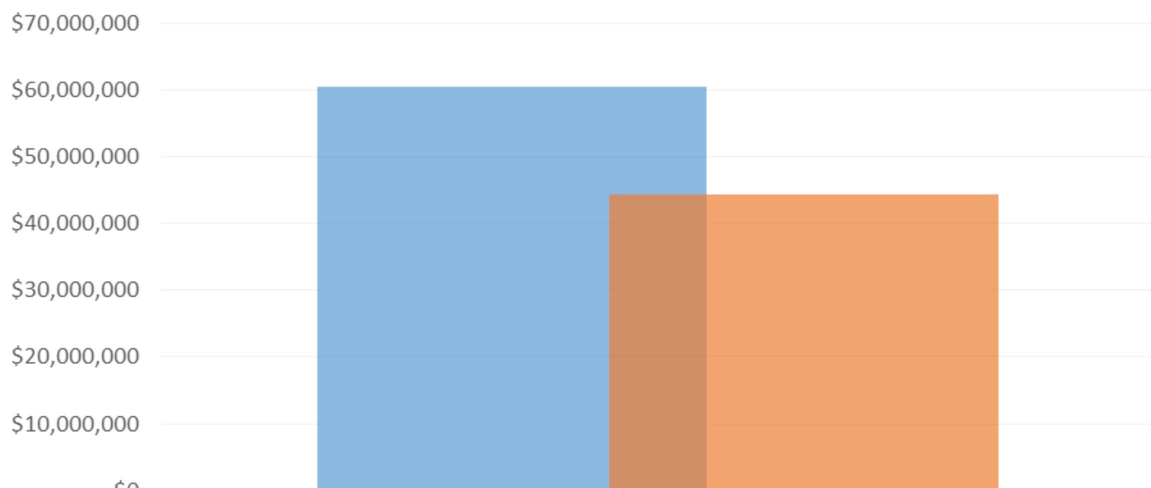
Figure D-17. Design Storm APC Area Total of Downstream Structures Impacted (Count)



	Cherokee	Elmore	Chilton	Calhoun	Coosa	Shelby	Etowah	Talladega	St. Clair
Design Storm Existing	3	10	11	15	35	82	285	330	375
Design Storm Proposed	4	10	11	14	36	77	278	237	184

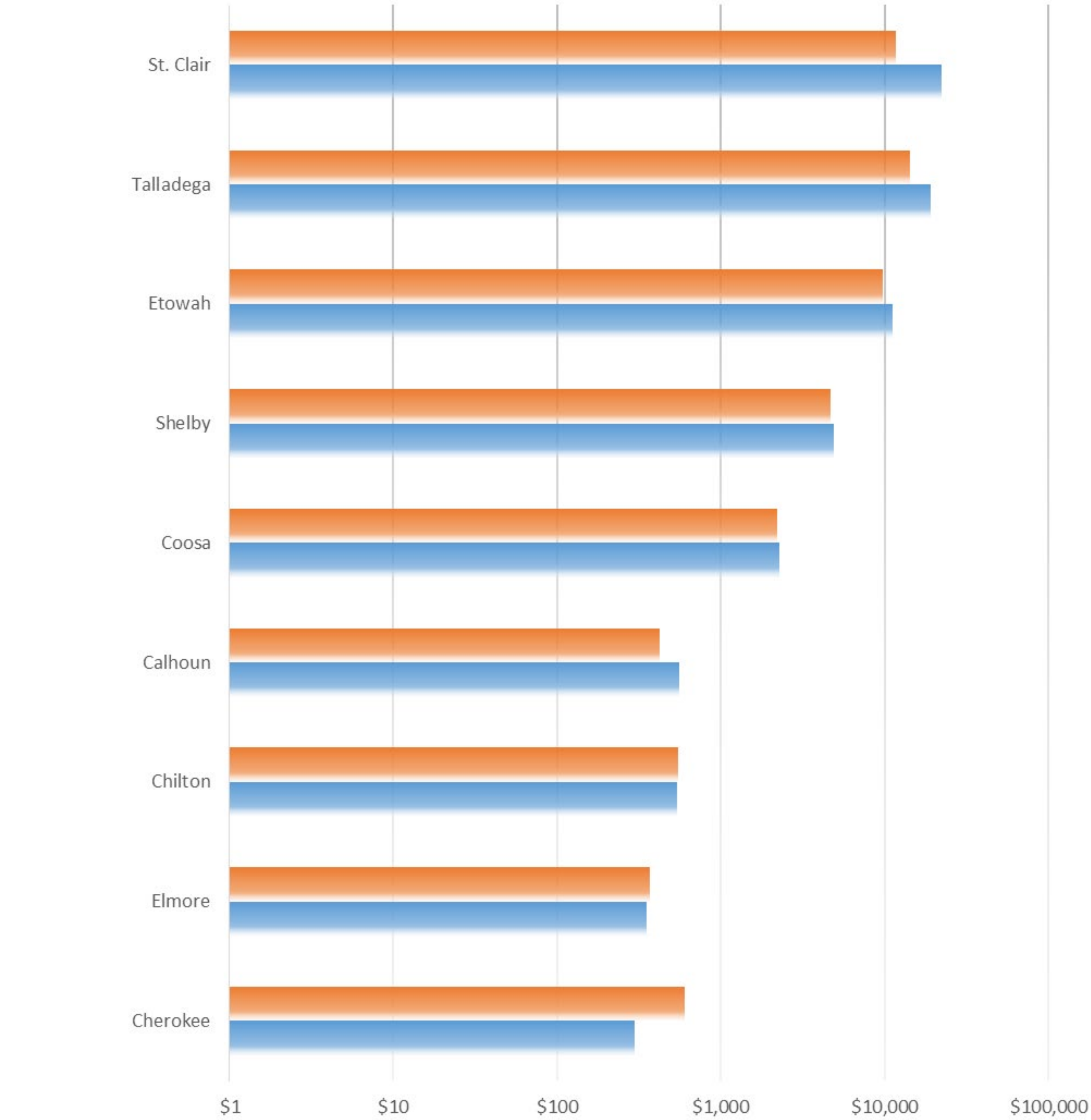
Figure D-18. Design Storm APC Area Total of Downstream Structures Impacted by County (Count)

Figure D-19 and Figure D-20 display the amount of flood damages expected at the Design Storm existing and proposed conditions. Overall, damages are reduced under the proposed condition.



	All
Design Storm Existing	$60,355,624
Design Storm Proposed	$44,304,487

Figure D-19. Design Storm APC Area Total Downstream Flood Damages ($)



	Cherokee	Elmore	Chilton	Calhoun	Coosa	Shelby	Etowah	Talladega	St. Clair
Design Storm Proposed	$599	$370	$544	$421	$2,193	$4,642	$9,779	$14,179	$11,631
Design Storm Existing	$298	$352	$538	$552	$2,265	$4,879	$11,090	$19,024	$22,192

Figure D-20. Design Storm APC Area Total Downstream Flood Damages by County ($)

D.8.5.2.1.2 Back to Back Storm

Figure D-21 and Figure D-22 display the number of structures impacted along the Coosa River under the base and proposed conditions for the Back to Back Storm scenario. This storm showed a net reduction of structures impacted under the proposed condition.

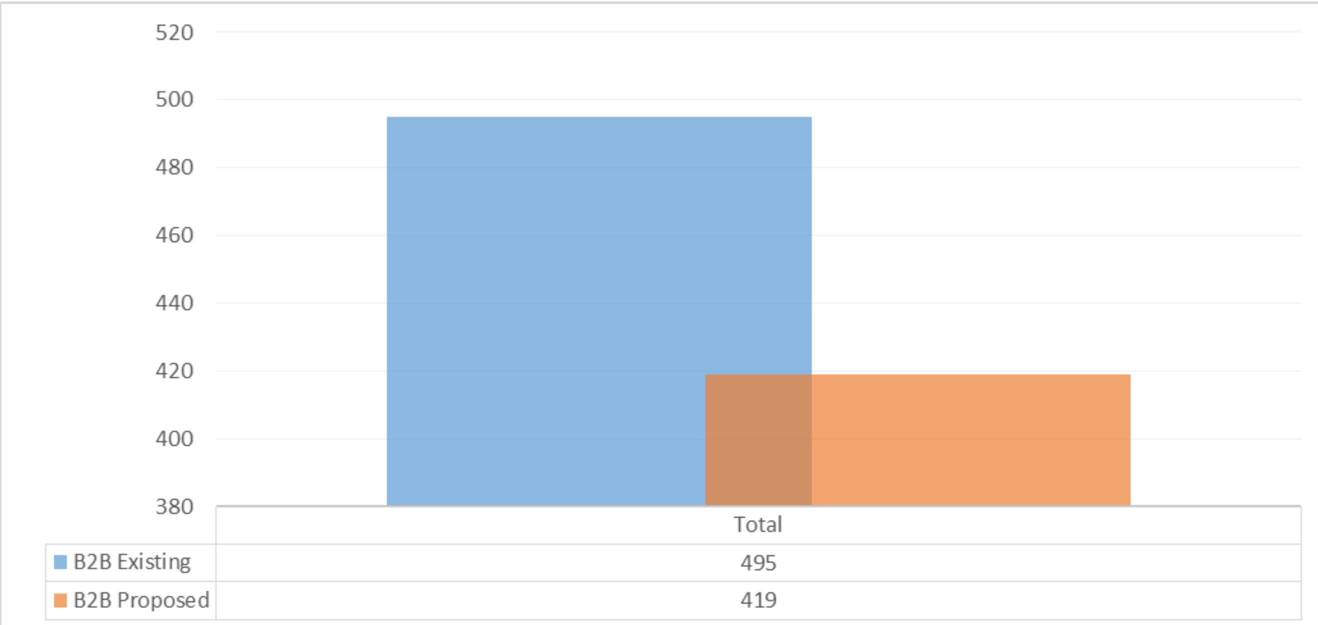


Figure D-21. APC Area Total of Downstream Structures Impacted (Count)

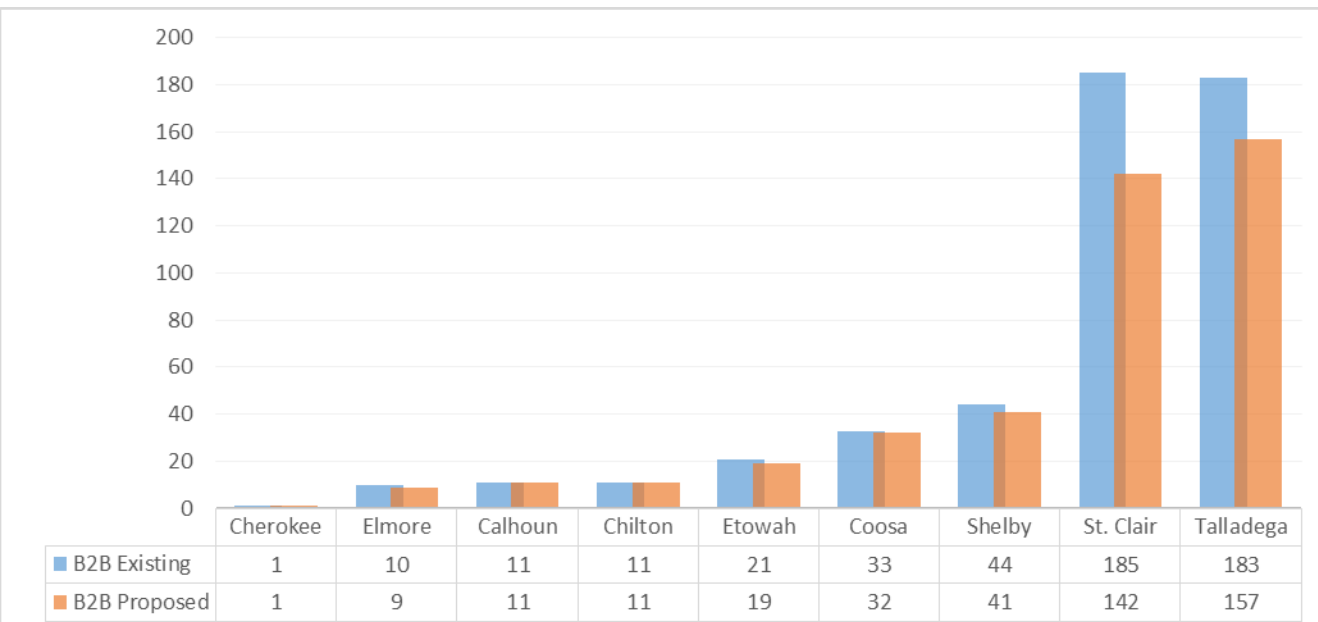


Figure D-22. APC Area Total of Downstream Structures Impacted by County (Count)

Figure D-23 and Figure D-24 display the amount of flood damages expected at the Back to Back Storm existing and proposed conditions. Overall, damages are reduced under the proposed condition.

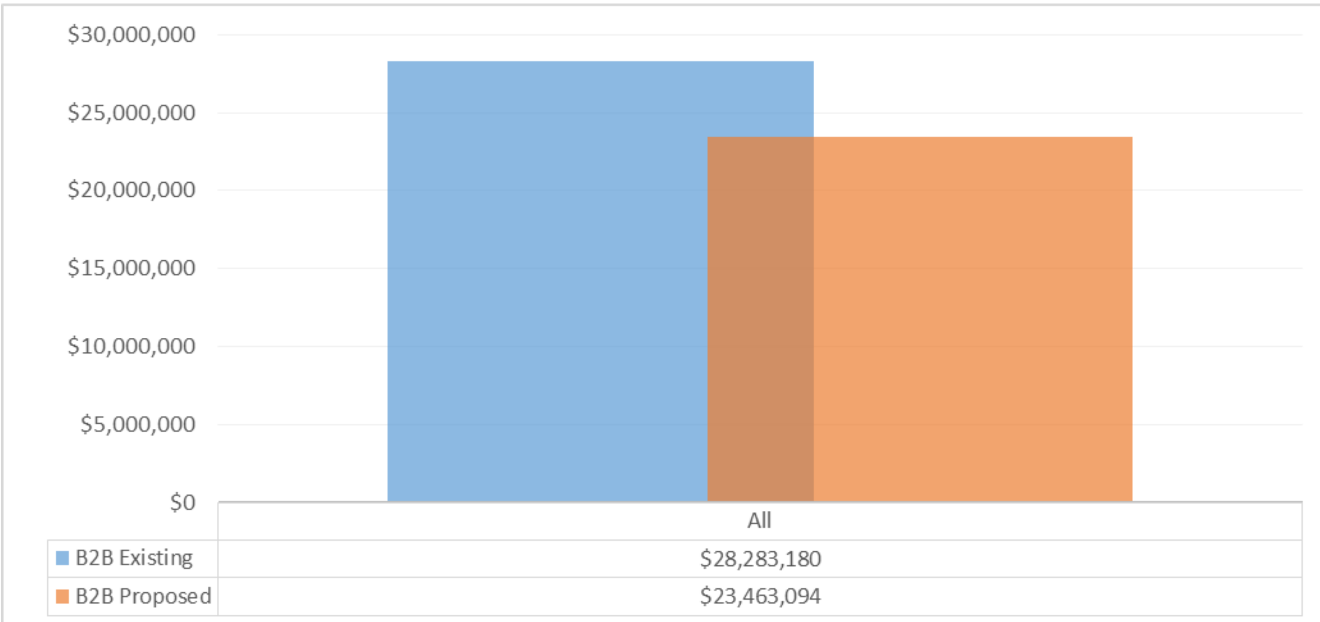
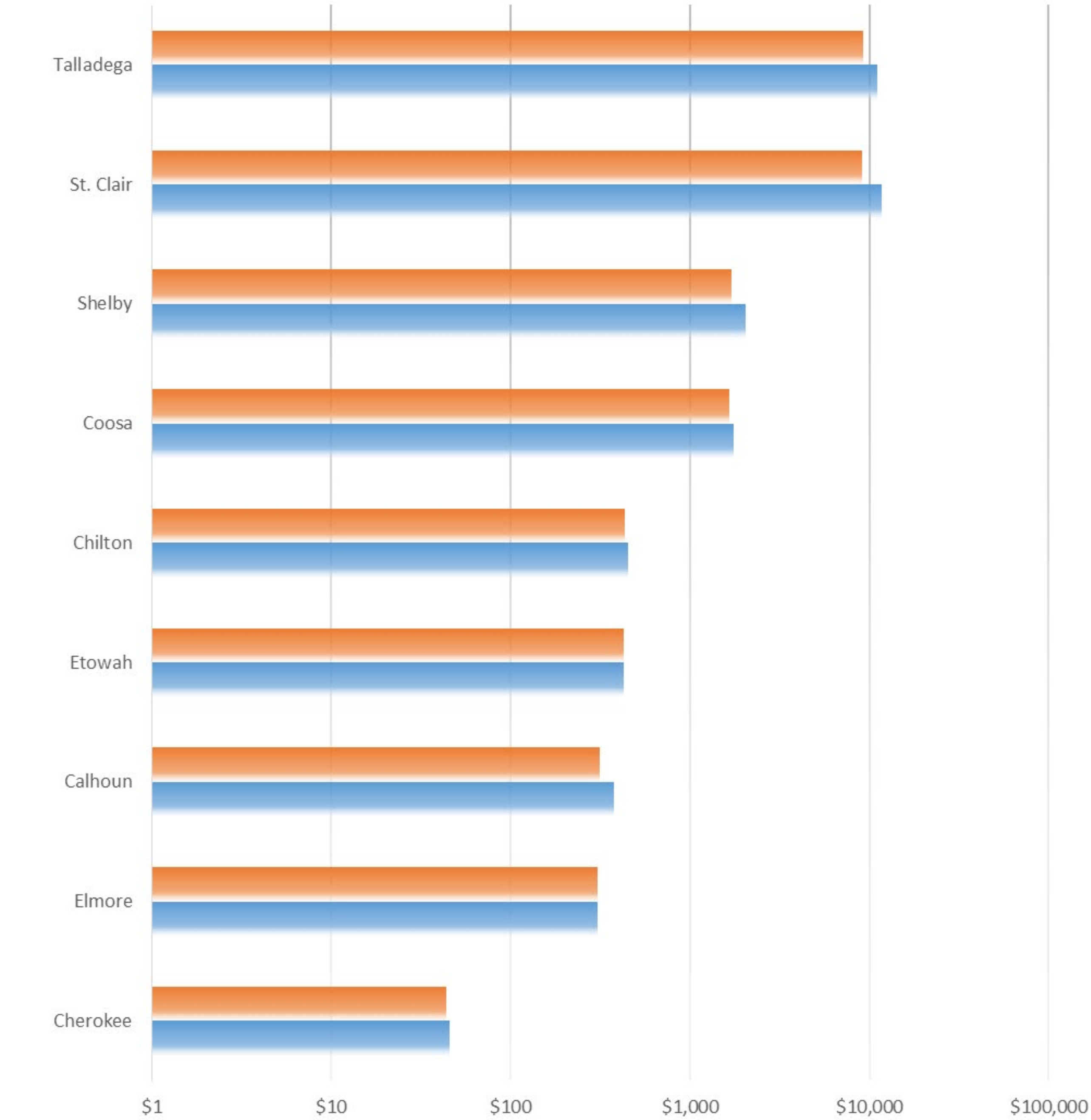


Figure D-23. APC Area Total Downstream Flood Damages ($)



	Cherokee	Elmore	Calhoun	Etowah	Chilton	Coosa	Shelby	St. Clair	Talladega
B2B Proposed	$44	$305	$315	$427	$432	$1,654	$1,715	$9,086	$9,250
B2B Existing	$46	$307	$378	$429	$450	$1,749	$2,055	$11,766	$11,029

Figure D-24. Back to Back Storms APC Area Total Downstream Flood Damages by County ($1,000)

D.8.5.2.1.3 April 1979 Storm

Figure D-25 and Figure D-26 display the number of structures impacted along the Coosa River under the base and proposed conditions for the April 1979 Storm scenario. This storm showed a net reduction of structures impacted under the proposed condition.

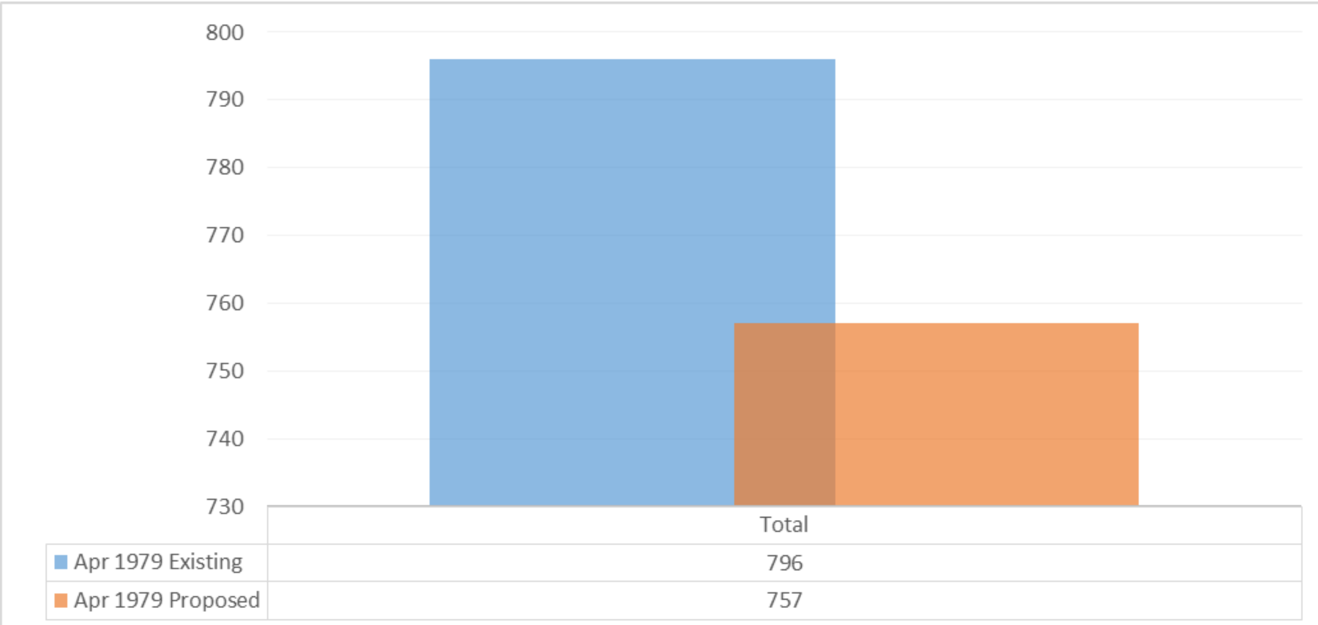


Figure D-25. April 1979 APC Area Total of Downstream Structures Impacted (Count)

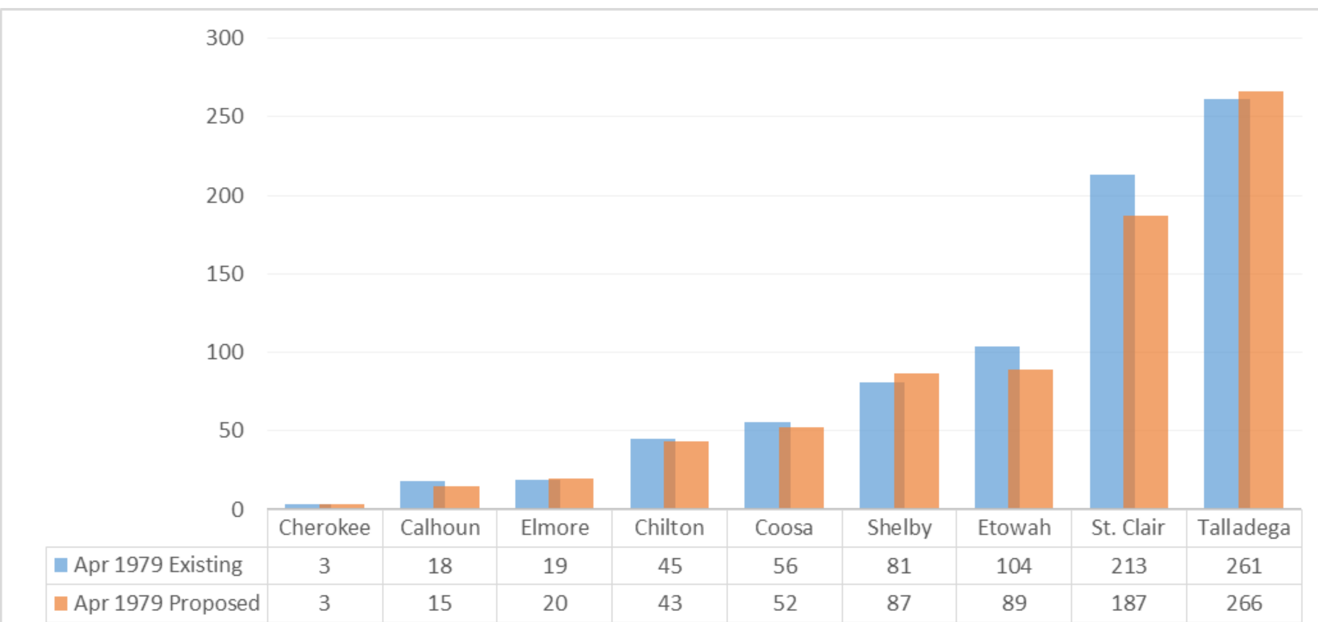


Figure D-26. April 1979 APC Area Total of Downstream Structures Impacted by County (Count)

Figure D-27 and Figure D-28 display the amount of flood damages expected at the April 1979 Storm existing and proposed conditions. Overall, damages are reduced under the proposed condition.

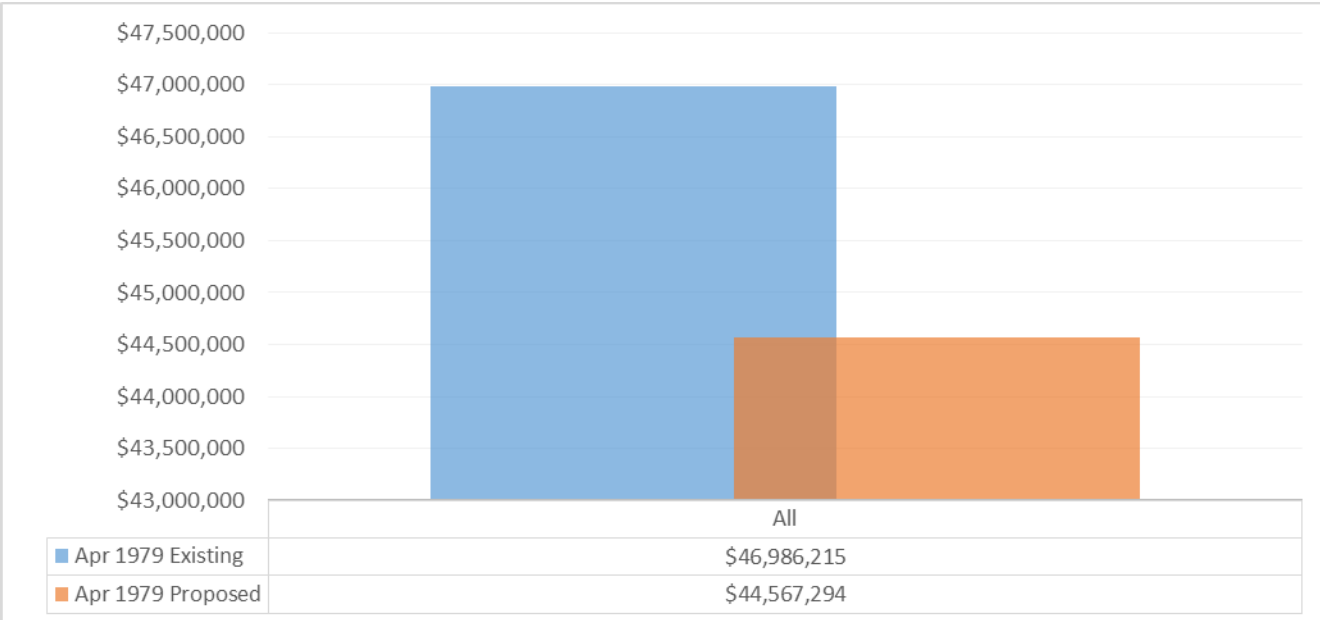
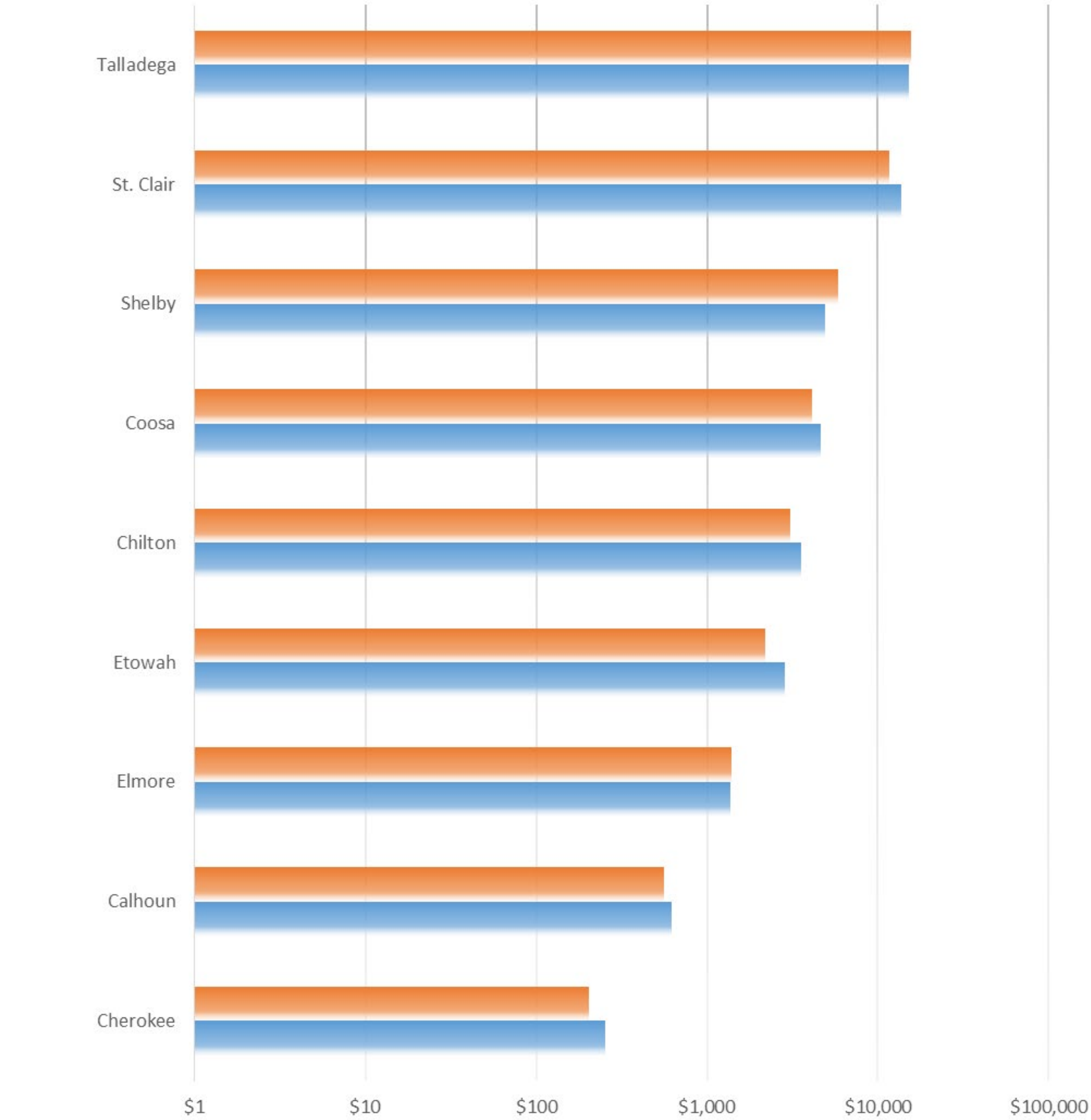


Figure D-27. April 1979 APC Area Total Downstream Flood Damages ($)

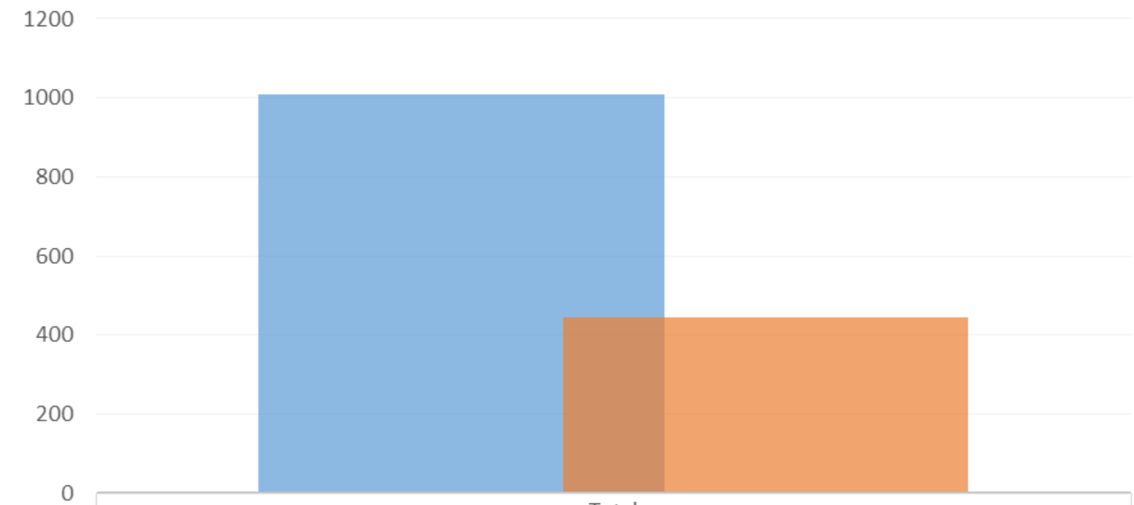


	Cherokee	Calhoun	Elmore	Etowah	Chilton	Coosa	Shelby	St. Clair	Talladega
Apr 1979 Proposed	$203	$559	$1,398	$2,175	$3,061	$4,143	$5,861	$11,669	$15,558
Apr 1979 Existing	$254	$618	$1,372	$2,864	$3,544	$4,625	$4,924	$13,688	$15,130

Figure D-28. April 1979 Storm APC Area Downstream Flood Damages by County ($1,000)

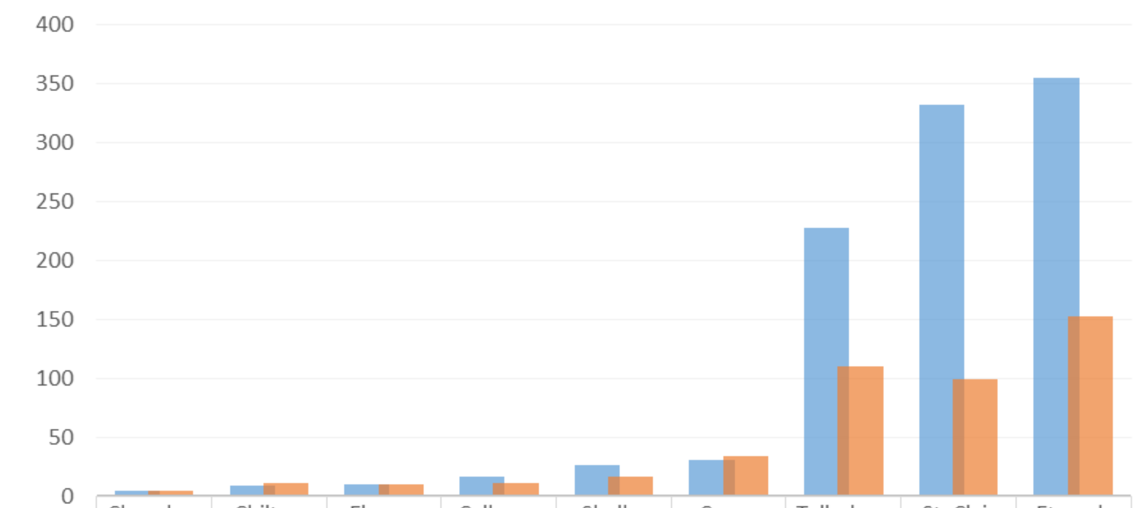
D.8.5.2.1.4 February 1990 Storm

Figure D-29 and Figure D-30 display the number of structures impacted along the Coosa River under the base and proposed conditions for the February 1990 Storm scenario. This storm showed a net reduction of structures impacted under the proposed condition.



	Total
Feb 1990 Existing	1008
Feb 1990 Proposed	445

Figure D-29. February 1990 APC Area Impacted Structures (Count)



	Cherokee	Chilton	Elmore	Calhoun	Shelby	Coosa	Talladega	St. Clair	Etowah
Feb 1990 Existing	4	9	10	17	26	31	228	332	355
Feb 1990 Proposed	4	11	10	11	17	34	110	99	153

Figure D-30. February 1990 APC Area Total of Downstream Structures Impacted by County (Count)

Figure D-31and Figure D-32 display the amount of flood damages expected at the February 1990 Storm existing and proposed conditions. Overall, damages are reduced under the proposed condition.

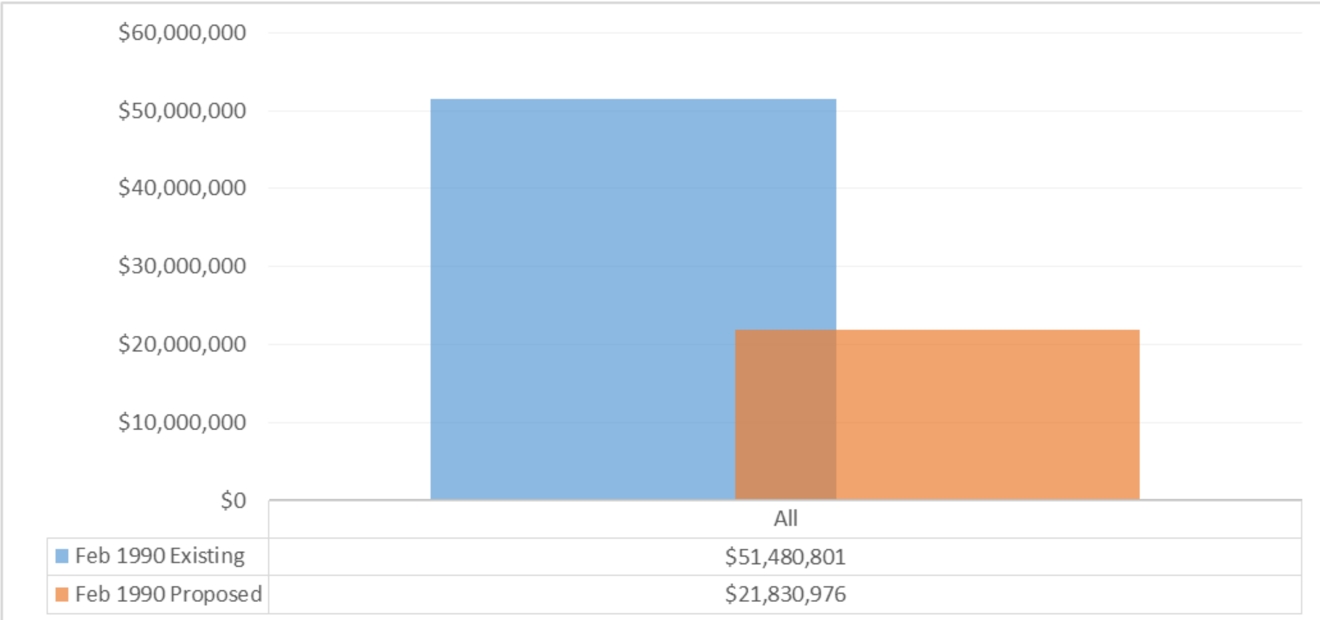
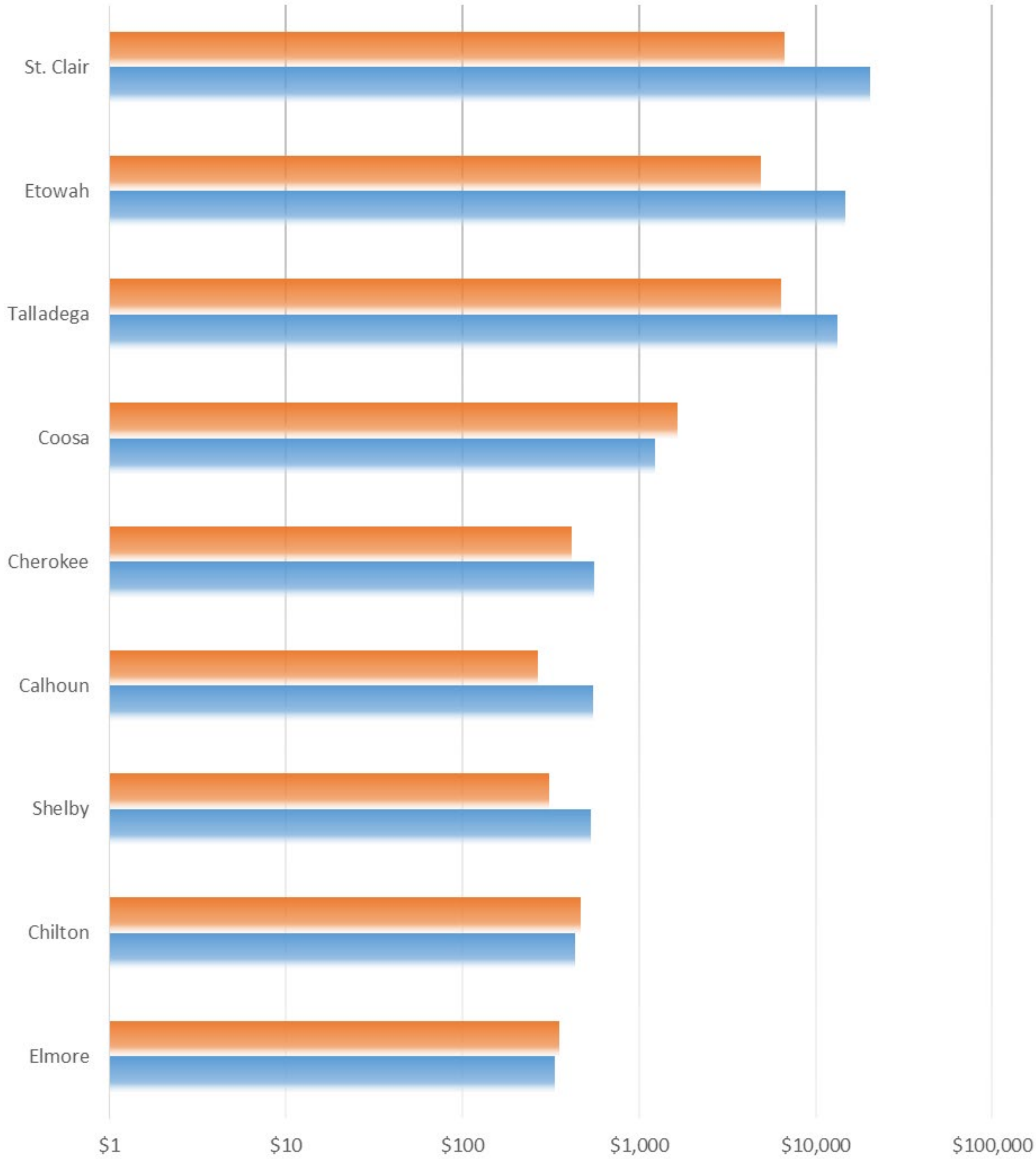


Figure D-31. February 1990 APC Area Total Downstream Flood Damages ($)

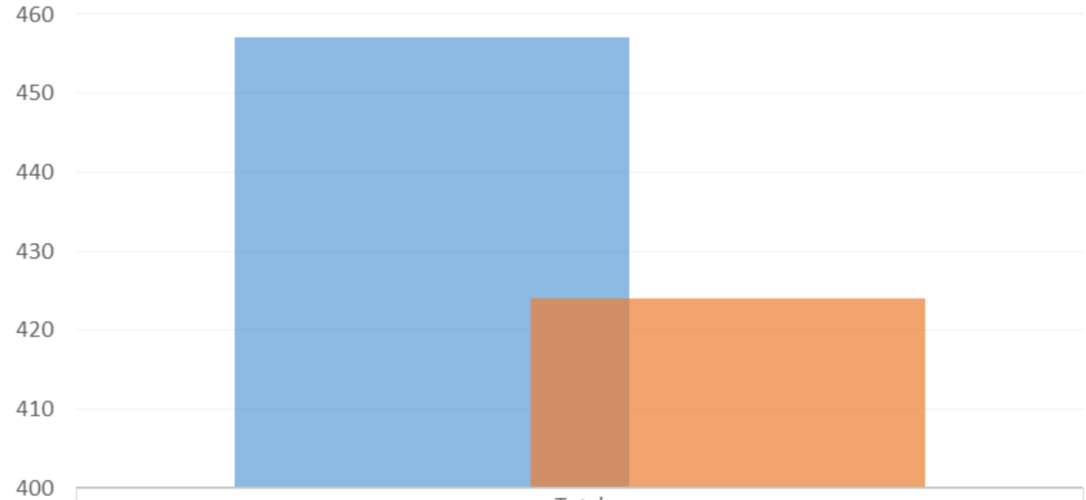


	Elmore	Chilton	Shelby	Calhoun	Cherokee	Coosa	Talladega	Etowah	St. Clair
Feb 1990 Proposed	$354	$466	$308	$266	$413	$1,652	$6,355	$4,905	$6,670
Feb 1990 Existing	$334	$434	$534	$551	$554	$1,234	$13,353	$14,738	$20,376

Figure D-32. February 1990 Storm APC Area Total Downstream Flood Damages by County ($1,000)

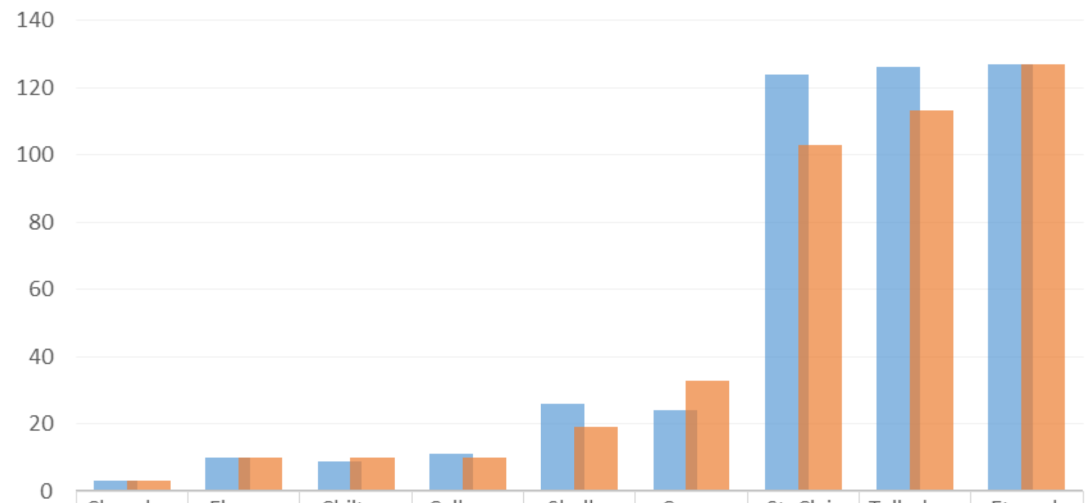
D.8.5.2.1.5 March 1990 Storm

Figure D-33 and Figure D-34 display the number of structures impacted along the Coosa River under the base and proposed conditions for the March 1990 Storm scenario. This storm showed a net reduction of structures impacted under the proposed condition.



	Total
March 1990 Existing	457
March 1990 Proposed	424

Figure D-33. March 1990 APC Area Impacted Structures (Count)



	Cherokee	Elmore	Chilton	Calhoun	Shelby	Coosa	St. Clair	Talladega	Etowah
March 1990 Existing	3	10	9	11	26	24	124	126	127
March 1990 Proposed	3	10	10	10	19	33	103	113	127

Figure D-34. March 1990 APC Area Total of Downstream Structures Impacted by County (Count)

Figure D-35 and Figure D-36 display the amount of flood damages expected at the March 1990 Storm existing and proposed conditions. Overall, damages are reduced under the proposed condition.

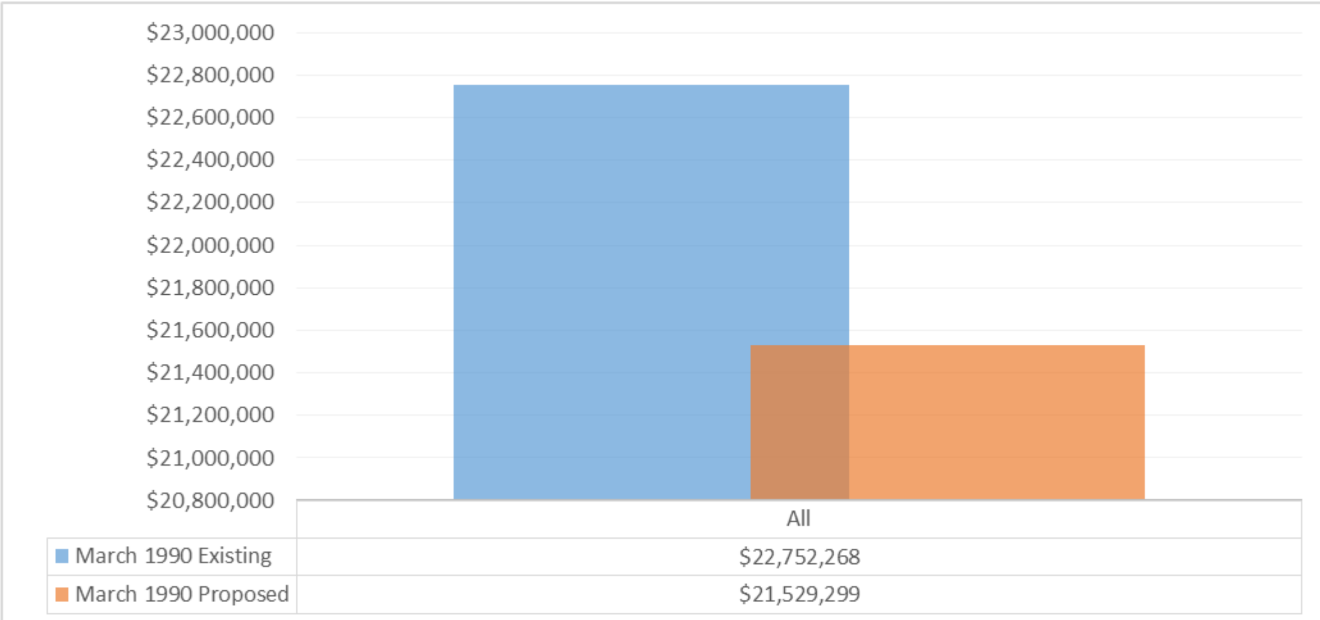
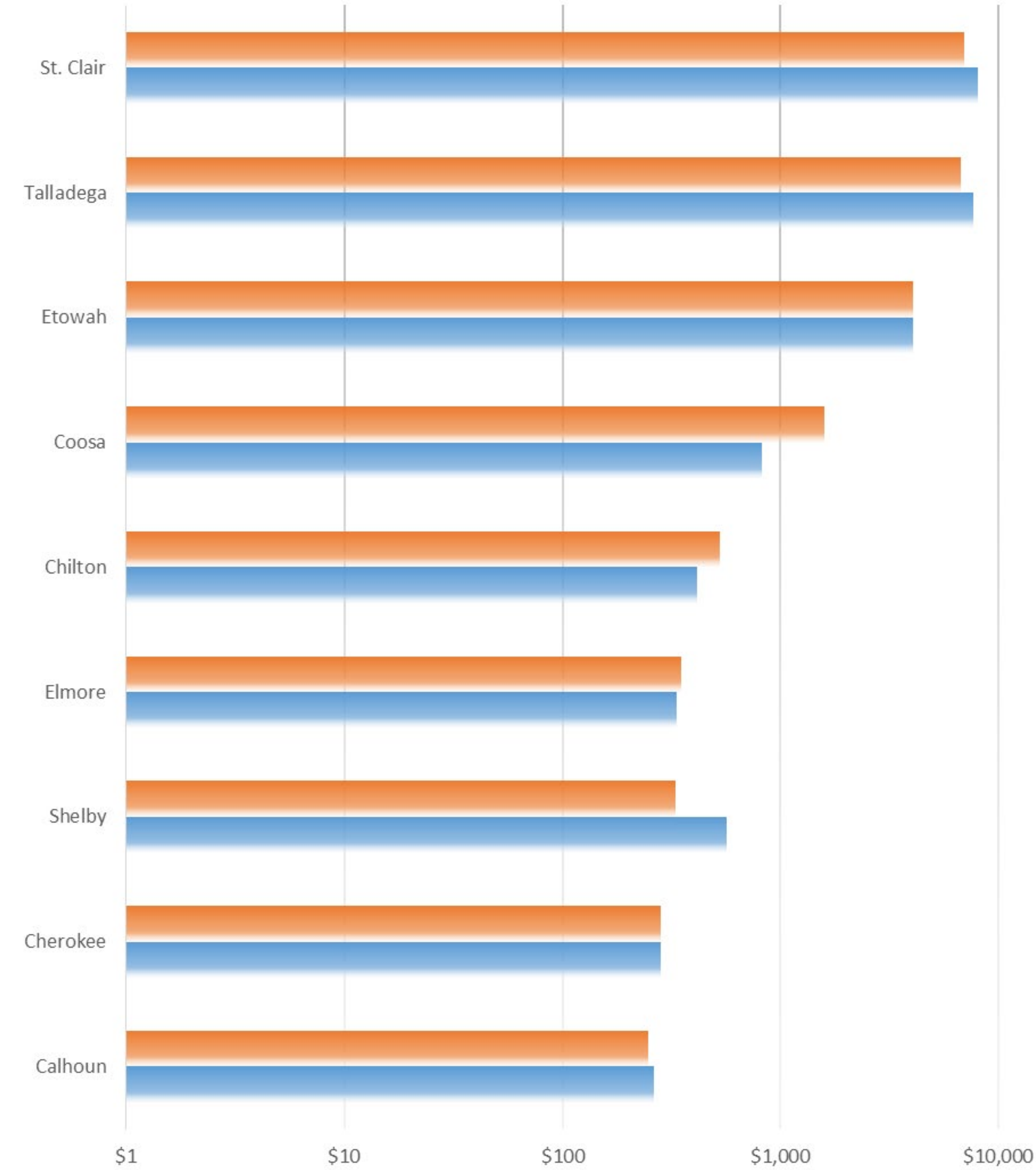


Figure D-35. March 1990 APC Area Total Downstream Flood Damages ($)

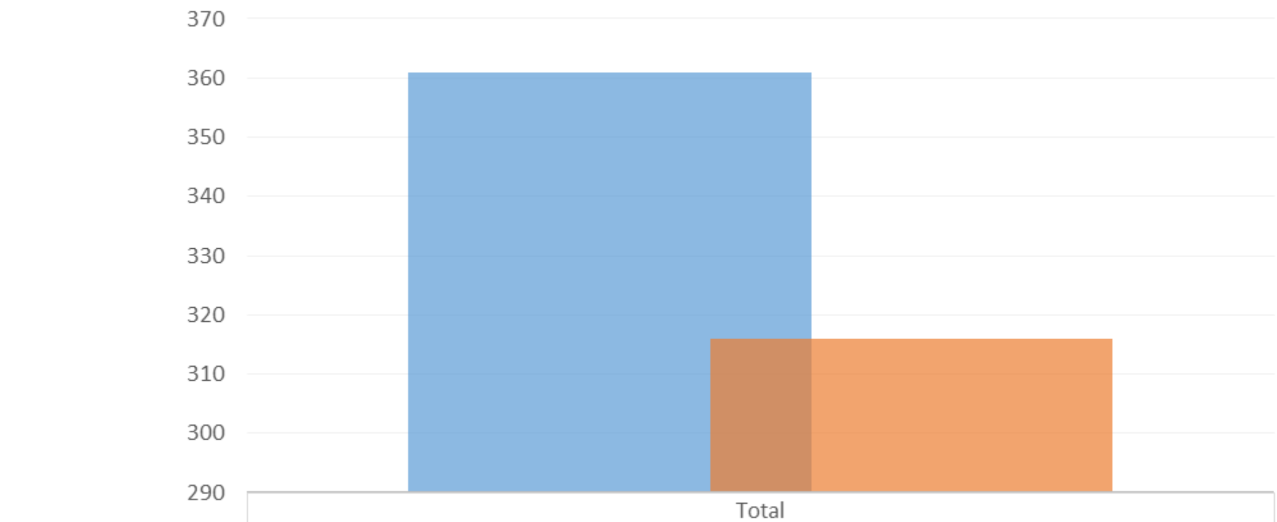


	Calhoun	Cherokee	Shelby	Elmore	Chilton	Coosa	Etowah	Talladega	St. Clair
March 1990 Proposed	$247	$283	$332	$352	$527	$1,595	$4,048	$6,712	$7,002
March 1990 Existing	$262	$283	$564	$335	$415	$818	$4,056	$7,628	$8,024

Figure D-36. March 1990 Storm APC Area Total Downstream Flood Damages by County ($1,000)

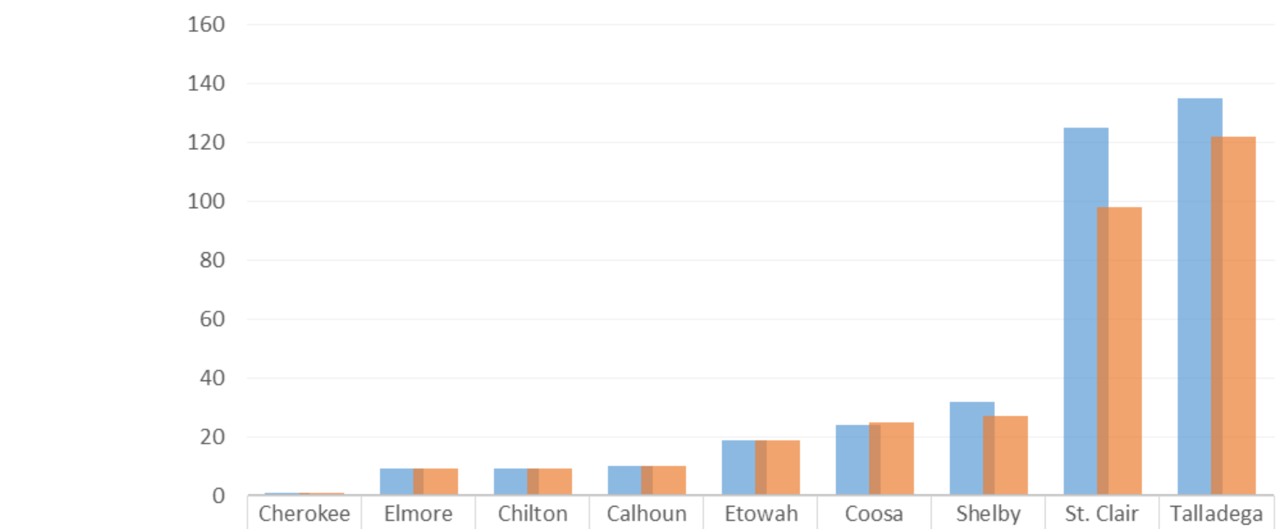
D.8.5.2.1.6 May 2003 Storm

Figure D-37 and Figure D-38 display the number of structures impacted along the Coosa River under the base and proposed conditions for the May 2003 Storm scenario. This storm showed a net reduction of structures impacted under the proposed condition.



	Total
May 2003 Existing	361
May 2003 Proposed	316

Figure D-37. May 2003 APC Area Impacted Structures (Count)



	Cherokee	Elmore	Chilton	Calhoun	Etowah	Coosa	Shelby	St. Clair	Talladega
May 2003 Existing	1	9	9	10	19	24	32	125	135
May 2003 Proposed	1	9	9	10	19	25	27	98	122

Figure D-38. May 2003 APC Area Total of Downstream Structures Impacted by County (Count)

Figure D-39 and Figure D-40 display the amount of flood damages expected at the May 2003 Storm existing and proposed conditions. Overall, damages are reduced under the proposed condition.

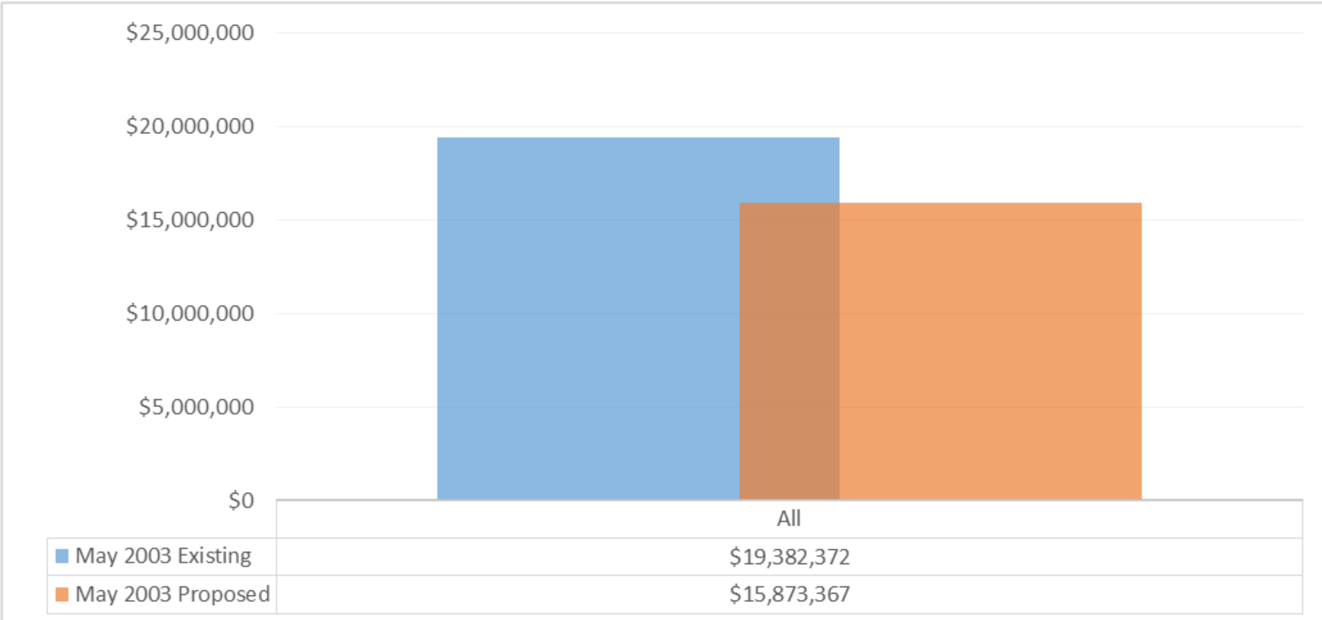
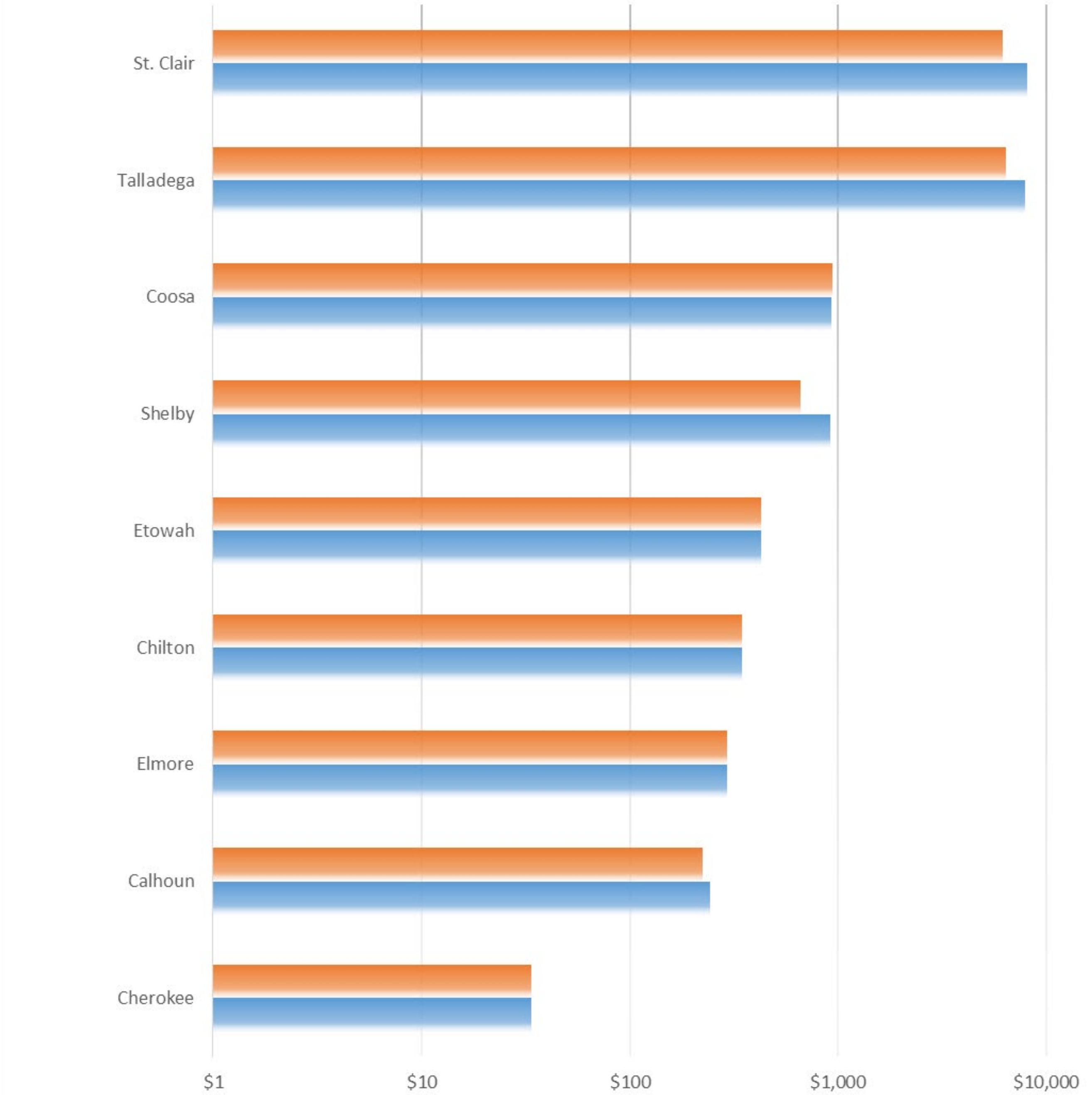


Figure D-39. May 2003 APC Area Total Downstream Flood Damages ($)



	Cherokee	Calhoun	Elmore	Chilton	Etowah	Shelby	Coosa	Talladega	St. Clair
May 2003 Proposed	$34	$225	$293	$347	$427	$663	$936	$6,379	$6,190
May 2003 Existing	$34	$242	$292	$345	$427	$922	$925	$7,852	$8,046

Figure D-40. May 2003 Storm APC Area Total Downstream Flood Damages by County ($1,000)

D.8.5.2.1.7 October 1995 Storm

Figure D-41 and Figure D-42 display the number of structures impacted along the Coosa River under the base and proposed conditions for the October 1995 Storm scenario. This storm showed a net reduction of structures impacted under the proposed condition.

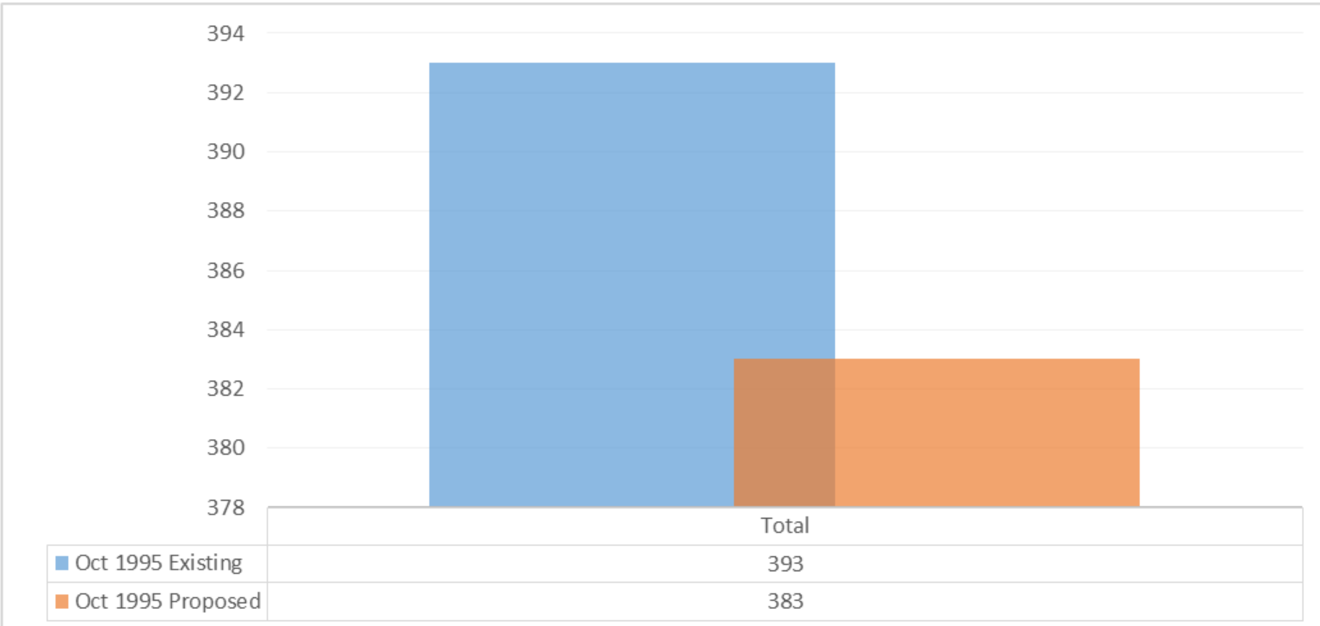


Figure D-41. October 1995 APC Area Impacted Structures (Count)

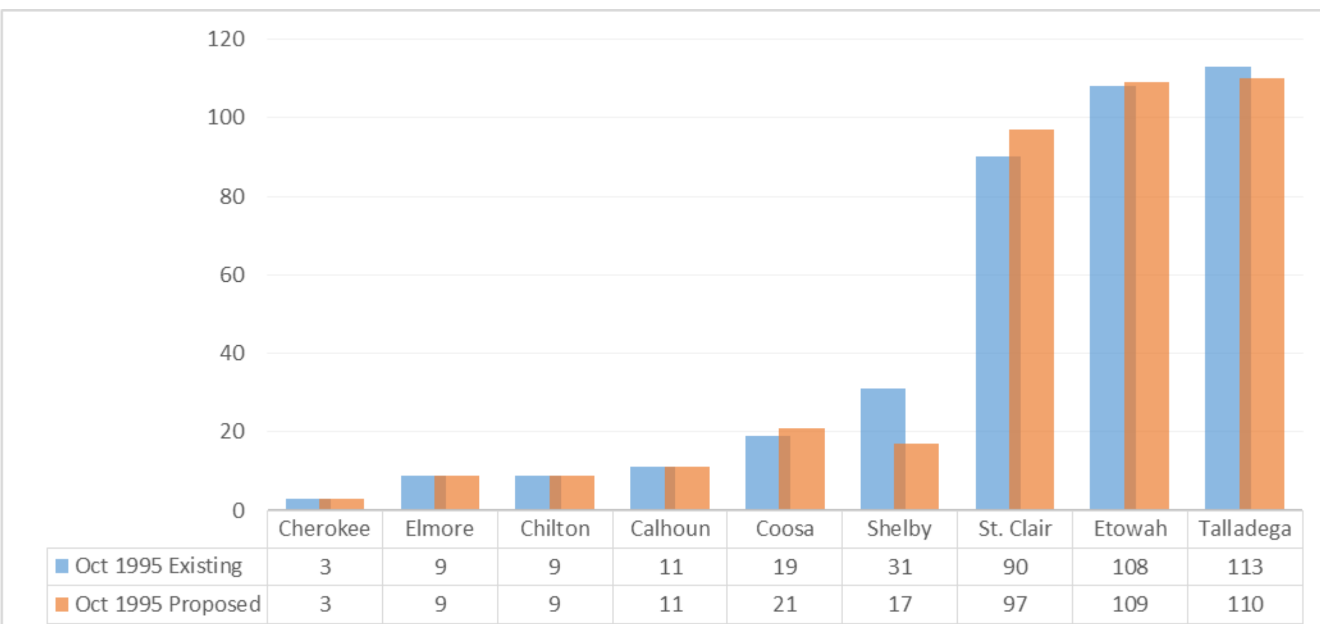
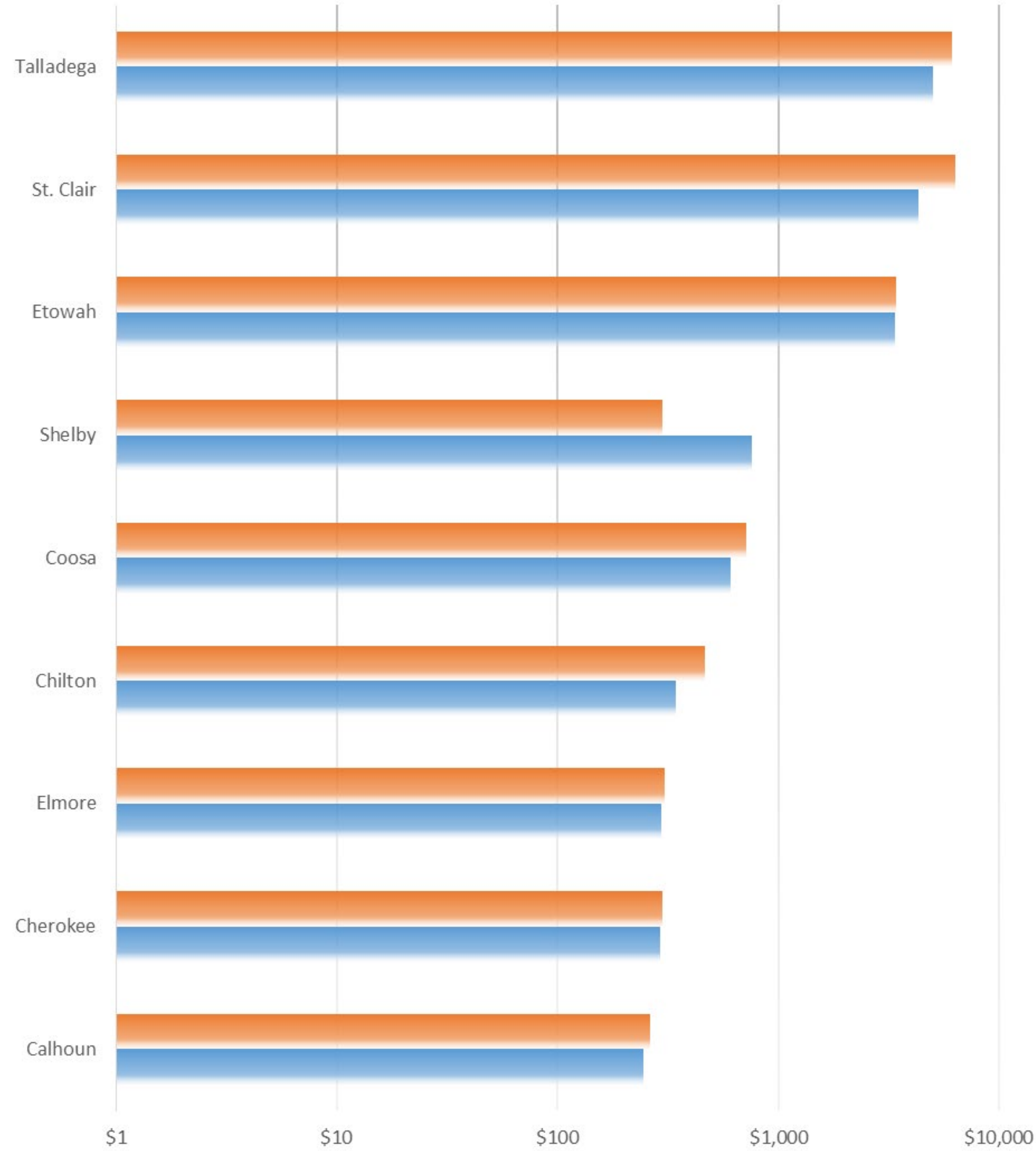


Figure D-42. October 1995 APC Area Total of Downstream Structures Impacted by County (Count)

Figure D-43 and Figure D-44 display the amount of flood damages expected at the October 1995 Storm existing and proposed conditions. Overall, damages are increased under the proposed condition.

Figure D-43. October 1995 APC Area Total Downstream Flood Damages ($)



	Calhoun	Cherokee	Elmore	Chilton	Coosa	Shelby	Etowah	St. Clair	Talladega
Oct 1995 Proposed	$262	$297	$305	$463	$713	$298	$3,415	$6,338	$6,125
Oct 1995 Existing	$244	$293	$296	$345	$607	$761	$3,357	$4,310	$4,993

Figure D-44. October 1995 APC Area Total Downstream Flood Damages by County ($1,000)

D.8.5.2.2 Changes to FRM

In all proposed scenarios there was a decrease in the total number of structures impacted, showing no net increase in overall flood risk at the structure level. However, there are increased levels of inundation under the proposed operations.

D.8.5.2.2.1 Changes to FRM at Gadsden and Childersburg, AL

The increased inundation is due to differences in the timed releases of water from the APC Weiss project and would mostly affect crop, pasture and forested land. The extent of flooding for the largest modeled events for the City of Gadsden (below Weiss Lake), and Childersburg (below Lake Logan Martin) are shown in Figure D-45 and Figure D-46 below. Grey and black display the extent of flooding under existing conditions, and blue displays the extent of flooding under the proposed changes. The largest modeled event that impacts Weiss Lake is the Feb 1990 scenario (100-yr event at Weiss Lake). Downstream of Weiss Lake is Gadsden, AL, which benefits from the proposed operations. Figure D-45 shows no change. The largest modeled event that impacts Logan Martin is the Apr 1979 scenario (200-yr storm at Logan Martin). Downstream of Logan Martin is Childersburg, AL, which receives slightly deeper flood waters under the proposed APC operations with cutback operations. When this storm is modeled without the cutback operations, the induced flooding does not occur at Childersburg.

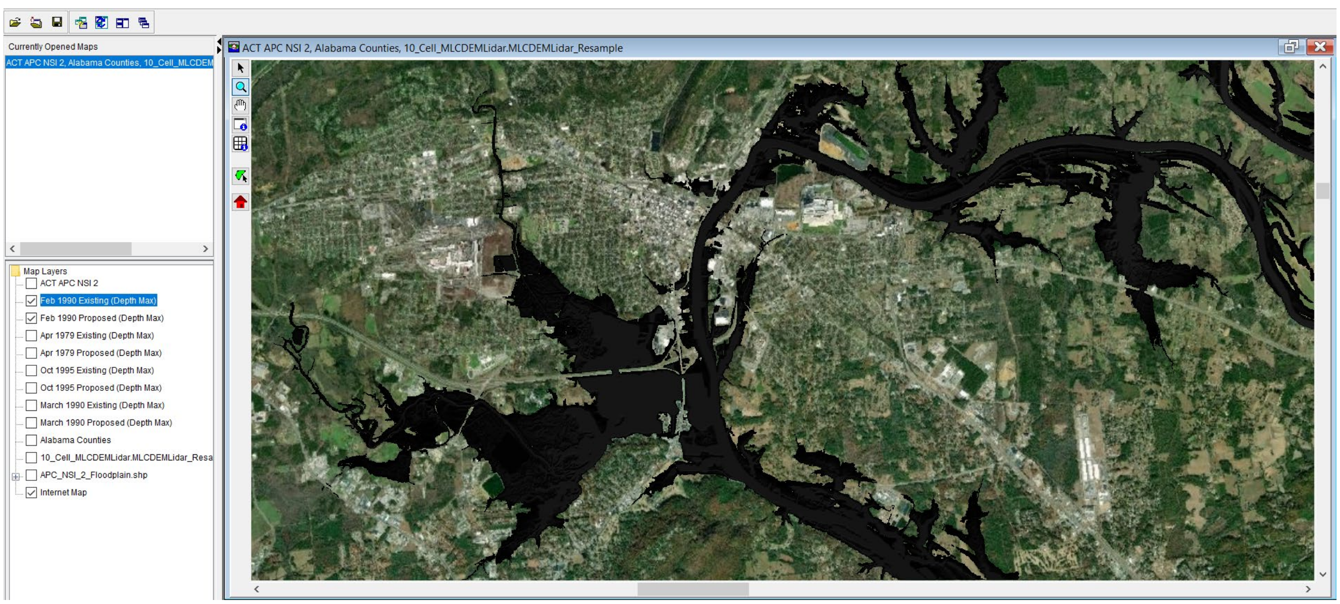


Figure D-45.Flooding Extents at Gadsden Alabama Weiss Feb 1990 Event (100-yr Storm)

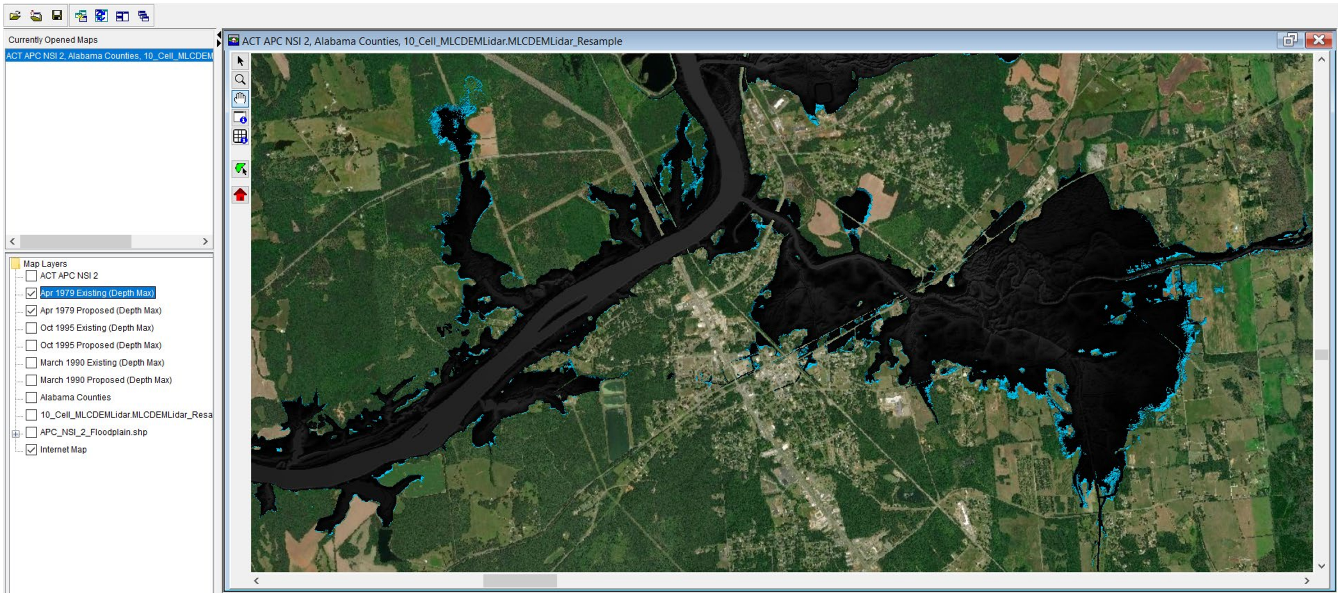


Figure D-46. Flooding Extents at Childersburg, Alabama Logan Martin Apr 1979 Event (250-yr Storm)

D.8.5.2.2.2 Changes to FRM Overall

The largest changes to FRM occurred during the design storm below Weiss Lake without cutback operations in areas composed mostly of uninhabited crop, pasture and forested land. Overall, populated areas, such as Gadsden and Childersburg, AL were not affected with appropriate cutback/without cutback operations at Weiss Lake and Lake Logan Martin.

Table D-30 below displays which modeled events receive changes to FRM under the respective with or without cutback operation. As seen below, some modeled scenarios undergo changes to FRM under with cutbacks, without cutbacks, or with and without cutback operations.

Table D-30. Changes to FRM by Operation and Location

Location	Modeled Scenario						
	Apr-79	Feb-90	Mar-90	May-03	Oct-95	Back to Back	Design
Below Lay Dam	0	YZ	YZ	YZ	YZ	0	0
Logan Martin to Childersburg	Z	0	0	0	0	0	0
Below Neely-Henry	0	0	0	0	YZ	0	0
Gadsden	0	0	0	0	YZ	0	Y
Weiss-Gadsden	0	0	YZ	0	YZ	0	YZ

Changes to FRM without Cutbacks (Y)
Changes to FRM with Cutbacks (Z)
Changes to FRM with and without Cutbacks (YZ)
No changes (0)

Figure D-47 shows the extent of the existing level of flooding (black), flooding under proposed operations without cutbacks (chartreuse), and extent of flooding under both with and without cutbacks (orange). This area, specifically, was the greatest increase in the extent of flooding under the design storm. The largest increase from existing was under the operations without cutbacks.

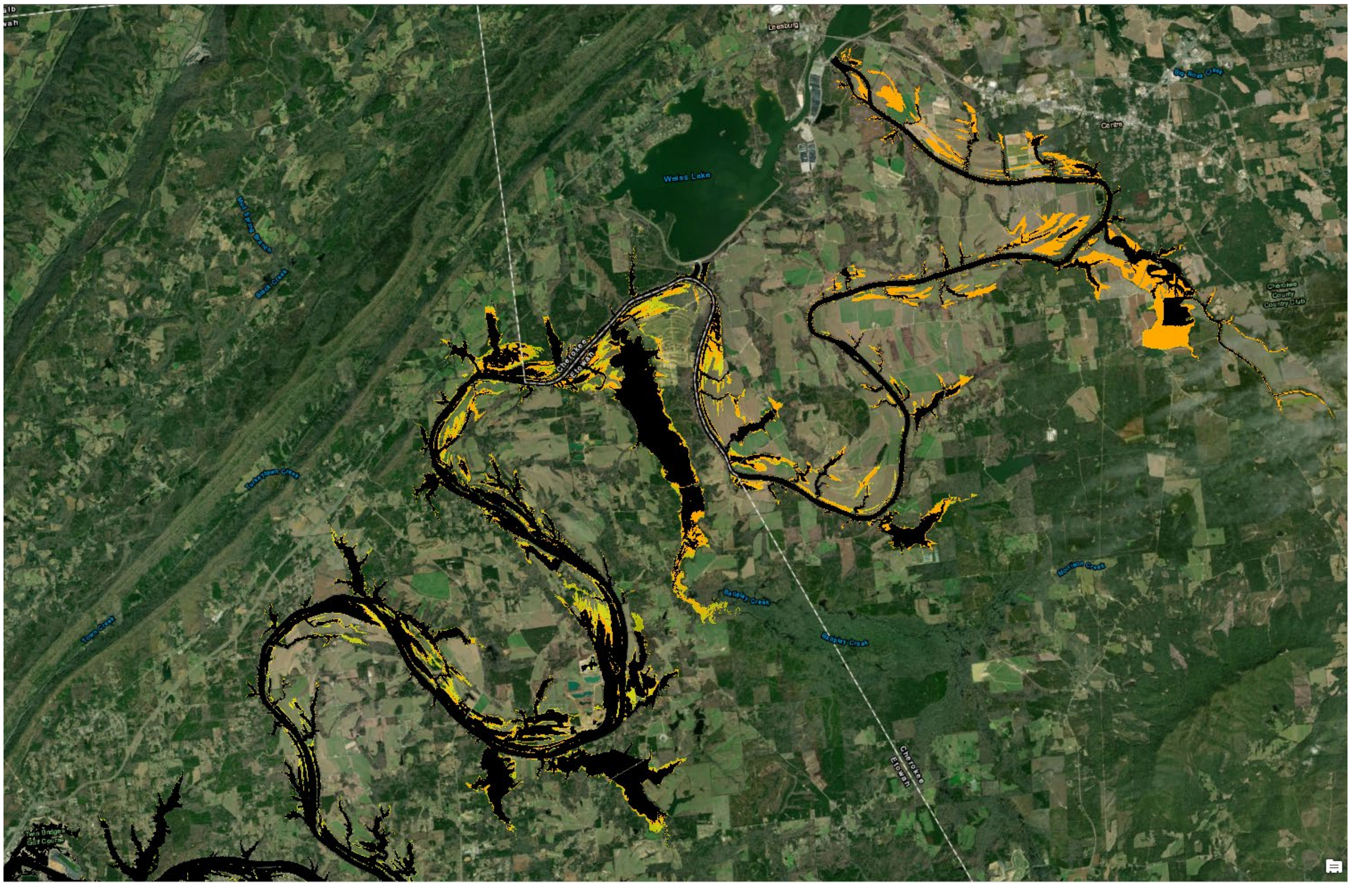


Figure D-47. Flooding Extents below Weiss Lake (Design Storm)

D.9 Regional Economic Impacts

Regional economic development benefits (RED) are more localized impacts that benefit the specific region in which they occur, and not the nation as a whole (NED). That is not to say that RED is not a benefits to the region, as it often represents a transfer of economic benefits, such as employment, from outside of the region to within it. However, due to the transfer nature of RED benefits, NED is the type of benefits used to select the TSP.

The U.S Army Corps of Engineers (USACE) Institute for Water Resources, the Louis Berger Group and Michigan State University has developed a regional economic impact modeling tool called RECONS (Regional ECONomic System) to provide estimates of regional and national job creation, and retention and other economic measures such as income, value added, and sales. This modeling tool automates calculations and generates estimates of jobs and other economic measures, such as income and sales associated with USACE's ARRA spending, annual Civil Work program spending and stem-from effects for Ports, Inland Water Way, FUSRAP and Recreation. This is done by extracting multipliers and other economic measures from more than 1,500 regional economic models that were built specifically for USACE's project locations. These multipliers were then imported to a database and the tool matches various spending profiles to the matching industry sectors by location to produce economic impact estimates. The tool will be used as a means to document the performance of direct investment spending of the USACE as directed by the American Recovery and Reinvestment Act (ARRA). The Tool will also allow the USACE to evaluate project and program expenditures associated with the annual expenditure by the USACE.

The following sections report the RECONS model results for the Allatoona regional economic impact (REI) area and the Coosa River System regional impact area as well as describing the local purchase coefficient (LPC) at the local state and national levels. The values reported are not reports of changes to operations under the TSP, but the stemming from effects of current expenditures. Operational changes due to the TSP are not expected to alter these results.

D.9.1 Allatoona REI

The following section describes the current FRM, recreation, hydropower, and environmental REI for the Allatoona study area which includes the following counties in Georgia: Barrow, Bartow, Butts, Carroll, Cherokee, Clayton, Cobb, Coweta, Dawson, De Kalb, Douglas, Fayette, Forsyth, Fulton, Gwinnet, Haralson, Heard, Henry, Jasper, Lamar, Meriwether, Newton, Paulding, Pickens, Pike, Rockdale, Spalding, and Walton.

D.9.1.1 Flood Risk Management REI

The following tables describe the current REI for the Allatoona study area with regards to FRM operations.

Table D-31. Allatoona RECONS FRM Input Assumptions

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Aggregate Materials	1%	$1,441	55%	81%	97%
Construction of Other New Nonresidential Structures	7%	$8,646	97%	97%	100%
Industrial and Machinery Equipment Rental and Leasing	2%	$3,144	64%	69%	100%
Architectural, Engineering, and Related Services	9%	$11,266	100%	100%	100%

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Planning, Environmental, Engineering and Design Studies and Services	3%	$4,323	97%	97%	100%
USACE Overhead	15%	$19,519	100%	100%	100%
Repair and Maintenance Construction Activities	28%	$36,287	100%	100%	100%
USACE Wages and Benefits	30%	$39,824	75%	99%	100%
Private Sector Labor or Staff Augmentation	5%	$6,550	100%	100%	100%
Total	**100%**	**$131,000**	**-**	**-**	**-**

The USACE is planning on expending $131,000 on the project for FRM functions. Of this total project expenditure $118,753 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table D-32 is the overall economic impacts for this analysis.

Table D-32. Allatoona RECONS Summary of FRM Economic Impacts

Impact Areas Impacts		Regional	State	National
Total Spending		$131,000	$131,000	$131,000
Direct Impact				
	Output	$118,753	$129,003	$130,942
	Job	1.15	1.24	1.25
	Labor Income	$76,678	$85,847	$86,718
	Gross Regional Product	$84,005	$94,029	$95,232
Total Impact				
	Output	$242,631	$264,984	$357,588
	Job	2.11	2.30	2.74
	Labor Income	$123,645	$136,578	$161,371
	Gross Regional Product	$163,845	$180,831	$224,552

Table D-33. Allatoona RECONS Recreation Input Assumptions

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Construction of Other New Nonresidential Structures	18%	$593,296	97%	97%	100%
USACE Overhead	14%	$465,198	100%	100%	100%
Repair and Maintenance Construction Activities	37%	$1,237,157	100%	100%	100%
USACE Wages and Benefits	28%	$943,880	75%	99%	100%
Private Sector Labor or Staff Augmentation	4%	$131,469	100%	100%	100%
Total	**100%**	**$3,371,000**	**-**	**-**	**-**

The USACE is planning on expending $3,371,000 on the project for recreation functions. Of this total project expenditure $3,112,958 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table D-34 is the overall economic impacts for this analysis.

Table D-34. Allatoona RECONS Summary of Recreation Economic Impacts

Impact Areas Impacts		Regional	State	National
Total Spending		$3,371,000	$3,371,000	$3,371,000
Direct Impact				
	Output	$3,112,958	$3,343,020	$3,370,647
	Job	29.88	31.79	32.02
	Labor Income	$1,835,194	$2,046,946	$2,060,877
	GRP	$2,055,744	$2,285,807	$2,301,830
Total Impact				
	Output	$6,240,942	$6,763,429	$9,267,409
	Job	54.31	58.75	70.78
	Labor Income	$3,027,243	$3,323,107	$3,986,528
	GRP	$4,063,588	$4,452,908	$5,624,671

D.9.1.2 Allatoona Hydropower REI

Table D-35. Allatoona RECONS Hydropower Input Assumptions

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Metals and Steel Materials	3%	$77,792	25%	25%	90%
Construction Machinery Manufacturing	3%	$68,640	20%	27%	79%
Turbine Equipment and Parts	1%	$32,032	3%	4%	68%
Switchgear and Switchboard Apparatus Equipment	2%	$45,760	31%	31%	80%
Planning, Environmental, Engineering and Design Studies and Services	2%	$54,912	97%	97%	100%
USACE Overhead	22%	$494,208	100%	100%	100%
Repair and Maintenance Construction Activities	10%	$226,512	100%	100%	100%
Industrial Machinery and Equipment Repair and Maintenance	5%	$112,112	73%	73%	100%
USACE Wages and Benefits	44%	$1,004,432	75%	99%	100%
Private Sector Labor or Staff Augmentation	8%	$171,600	100%	100%	100%
Total	**100%**	**$2,288,000**	**-**	**-**	**-**

The USACE is planning on expending $2,288,000 on the project for hydropower functions. Of this total project expenditure $1,829,199 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table D-36 is the overall economic impacts for this analysis.

Table D-36. Allatoona RECONS Summary of Hydropower Economic Impacts

Impact Areas Impacts		Regional	State	National
Total Spending		$2,288,000	$2,288,000	$2,288,000
Direct Impact				
	Output	$1,829,199	$2,079,082	$2,246,121

Impact Areas Impacts		Regional	State	National
	Job	20.75	22.80	23.50
	Labor Income	$1,405,252	$1,631,212	$1,682,684
	GRP	$1,503,942	$1,749,863	$1,822,656
Total Impact				
	Output	$3,724,627	$4,245,992	$5,957,602
	Job	35.76	40.15	48.65
	Labor Income	$2,109,711	$2,427,137	$2,896,666
	GRP	$2,725,590	$3,136,746	$3,944,577

D.9.1.3 Allatoona Environmental REI

Table D-37. Allatoona RECONS Environmental Input Assumptions

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Support Activities for Agriculture and Forestry	6%	$33,245	21%	48%	98%
Construction of Other New Nonresidential Structures	7%	$36,515	97%	97%	100%
Architectural, Engineering, and Related Services	4%	$20,710	100%	100%	100%
Planning, Environmental, Engineering and Design Studies and Services	22%	$117,175	97%	97%	100%
Scientific Research and Development Services	1%	$5,995	32%	32%	99%
USACE Overhead	16%	$89,380	100%	100%	100%
Repair and Maintenance Construction Activities	8%	$44,690	100%	100%	100%
Remediation Services	1%	$5,450	64%	67%	100%
Other Education Services	2%	$9,810	99%	99%	100%
USACE Wages and Benefits	33%	$182,030	75%	99%	100%
Total	**100%**	**$545,000**	**-**	**-**	**-**

The USACE is planning on expending $545,000 on the project for environmental functions. Of this total project expenditure $462,509 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table D-38 is the overall economic impacts for this analysis.

Table D-38. Allatoona RECONS Summary of Environmental Economic Impacts

Impact Areas Impacts		Regional	State	National
Total Spending		$545,000	$545,000	$545,000
Direct Impact				
	Output	$462,509	$515,878	$544,359
	Job	4.58	5.36	6.24
	Labor Income	$325,403	$373,127	$393,250
	GRP	$343,848	$395,003	$415,510
Total Impact				
	Output	$975,513	$1,085,362	$1,491,878
	Job	8.60	9.86	12.63
	Labor Income	$520,269	$586,913	$706,933
	GRP	$676,778	$762,378	$960,307

D.9.2 Coosa River Regional Economic Impacts

The following section describes the current water supply REI for the APC study area on the Coosa River.

Table D-39. APC RECONS Water Supply Input Assumptions

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Planning, Environmental, Engineering and Design Studies and Services	5%	$12,750	35%	50%	100%
USACE Overhead	31%	$78,250	77%	89%	100%

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
USACE Wages and Benefits	64%	$159,000	75%	100%	100%
Total	**100%**	**$250,000**	-	-	-

The USACE is planning on expending $250,000 on the project for all functions. Of this total project expenditure $184,212 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table D-40 is the overall economic impacts for this analysis.

Table D-40. APC RECONS Summary of FRM Economic Impacts

Impact Areas Impacts		Regional	State	National
Total Spending		$250,000	$250,000	$250,000
Direct Impact				
	Output	$184,212	$234,507	$249,974
	Job	2.38	2.94	3.19
	Labor Income	$144,167	$186,876	$197,408
	GRP	$156,390	$202,587	$213,142
Total Impact				
	Output	$338,185	$463,004	$659,274
	Job	3.81	4.89	6.00
	Labor Income	$199,321	$265,925	$332,774
	GRP	$251,926	$344,106	$450,768

D.9.3 ACR Study Area Economic Impacts

For the entire study area including both the Allatoona area and APC/Coosa River areas produces an annual REI of $7,881,727. State impacts are $8,876,969 annually, and National impacts are $11,204,875 annually. Together the entire study area produces $27,963,571 in economic outputs. These economic impacts highlight the benefits to the region, state, and nation, and make the case that continued existence of these projects is a vital asset to the communities that depend on them for economic productivity as well as general FRM, water supply, and hydropower benefits.

Table D-41. ACR RECONS Summary

Impact Areas Impacts		Regional	State	National
Total Spending		$6,585,000	$6,585,000	$6,585,000
Direct Impact				
	Output	$5,707,631	$6,301,490	$6,542,043
	Job	59	64	66
	Labor Income	$3,786,694	$4,324,008	$4,420,937
	GRP	$4,143,929	$4,727,289	$4,848,370
Total Impact				
	Output	$11,521,898	$12,822,771	$17,733,751
	Job	105	116	141
	Labor Income	$5,980,189	$6,739,660	$8,084,272
	GRP	$7,881,727	$8,876,969	$11,204,875

Attachment 1. Recreation Impact Analysis Report—Summary Memorandum

Page intentionally blank

Allatoona Lake Water Supply Storage Reallocation Study and Updates to Weiss and Logan Martin Reservoirs Water Control Manuals

Feasibility Report and Integrated Supplemental Environmental Impact Statement

Recreation Impact Analysis Summary Memorandum

May 2019

Page intentionally blank

Prepared for

U.S. Army Corps of Engineers
Mobile District

Prepared by

Tetra Tech, Inc.

EXECUTIVE SUMMARY

This memorandum summarizes the objectives, methods, and results of the recreation analysis performed for the Allatoona Lake Water Supply Storage Reallocation Study and Updates to Weiss And Logan Martin Reservoirs Water Control Manuals Feasibility Report And Integrated Supplemental Environmental Impact Statement (FR/SEIS). The analysis estimates National Economic Development (NED) recreation benefits for the final array of alternatives using the Unit Day Value (UDV) methodology.

Per the UDV methodology, project visitation was forecasted for each project over the period of analysis, and UDV scores were generated for each project and recreation impact zone. UDV scores were converted to value-per-visit in accordance with the FY19 guidance, and total annual recreation value was estimated by project and alternative.

Scores generated for the UDV analysis were a function of reservoir pool level. For each project, several recreation impact zones (pool level ranges) were defined consistent with existing information about the effects of decreasing pool on recreation. The results from the detailed engineering modeling of the alternatives in the FR/SEIS were queried to tabulate the amount of time during the year the reservoirs would remain within recreation impact zone under each alternative. This allowed estimation of the proportion of annual visitation that would occur within in recreation impact zone and application of the UDV methodology for the FWOP and the alternatives.

Based on modeling of reservoir levels documented in the main FR/SEIS, alternatives were categorized into two recreation impact scenarios:

- No Change Scenario – Consisting of the alternatives whose proposed changes would have negligible effects on recreation relative to the Future Without Project (FWOP).
- With Change Scenario – Consisting of the alternatives whose proposed changes would affect recreation at the projects.

As shown in the table below, the With Change Scenario would result in positive net benefits to recreation at all three of the projects, ranging from about 1-3% net gain compared to the FWOP.

Project and Scenario	Annualized Recreation Value ($)	Present Value ($)	Annualized Change vs. Without Project	Percent Change
Allatoona				
No Change Scenario	$73,784,300	$1,944,349,000	$0	0%
With Change Scenario [1]	$74,481,000	$1,962,708,000	$696,700	0.9%
Weiss				
No Change Scenario	$15,881,400	$418,503,000	$0	0%
With Change Scenario [2]	$16,208,700	$427,127,000	$327,300	2.1%
Logan Martin				
No Change Scenario	$16,167,000	$426,030,000	$0	0%
With Change Scenario [2]	$16,666,000	$439,180,000	$499,000	3.1%
[1] Allatoona WCS alternatives: 5, 8, 11, 13				
[2] Weiss and Logan Martin WCS alternatives: 9, 10, 11, 12, 13				

Page intentionally blank

Table of Contents

Tables

Figures

Page intentionally blank

1. INTRODUCTION

1.1. PURPOSE, SCOPE, AND OBJECTIVES

The purpose of this memorandum is to summarize the objectives, methods, and results of the recreation analysis performed for the Allatoona Lake Water Supply Storage Reallocation Study and Updates to Weiss And Logan Martin Reservoirs Water Control Manuals Feasibility Report And Integrated Supplemental Environmental Impact Statement (FR/SEIS). This evaluation is project-wide, inclusive of both federal and non-federal recreation use at the projects.

This analysis estimates National Economic Development (NED) recreation benefits under current water control operations and compares it to the estimated benefits under alternative operational scenarios to allow the calculation of net recreation benefits resulting from proposed operational changes.

1.2. STUDY AREA

The overall study area is the Alabama-Coosa-Tallapoosa (ACT) River Basin. The ACT River Basin includes the Alabama, Coosa, and Tallapoosa rivers and all areas in the basin boundaries from the headwaters downstream to the mouth of the Alabama River, where it joins the Tombigbee River to form the Mobile River. The ACT River Basin at its confluence with the Tombigbee River has a drainage area of 22,739 square miles and covers portions of the states of Alabama, Georgia, and Tennessee. The ACT River Basin is shown in **Figure 1** (following page).

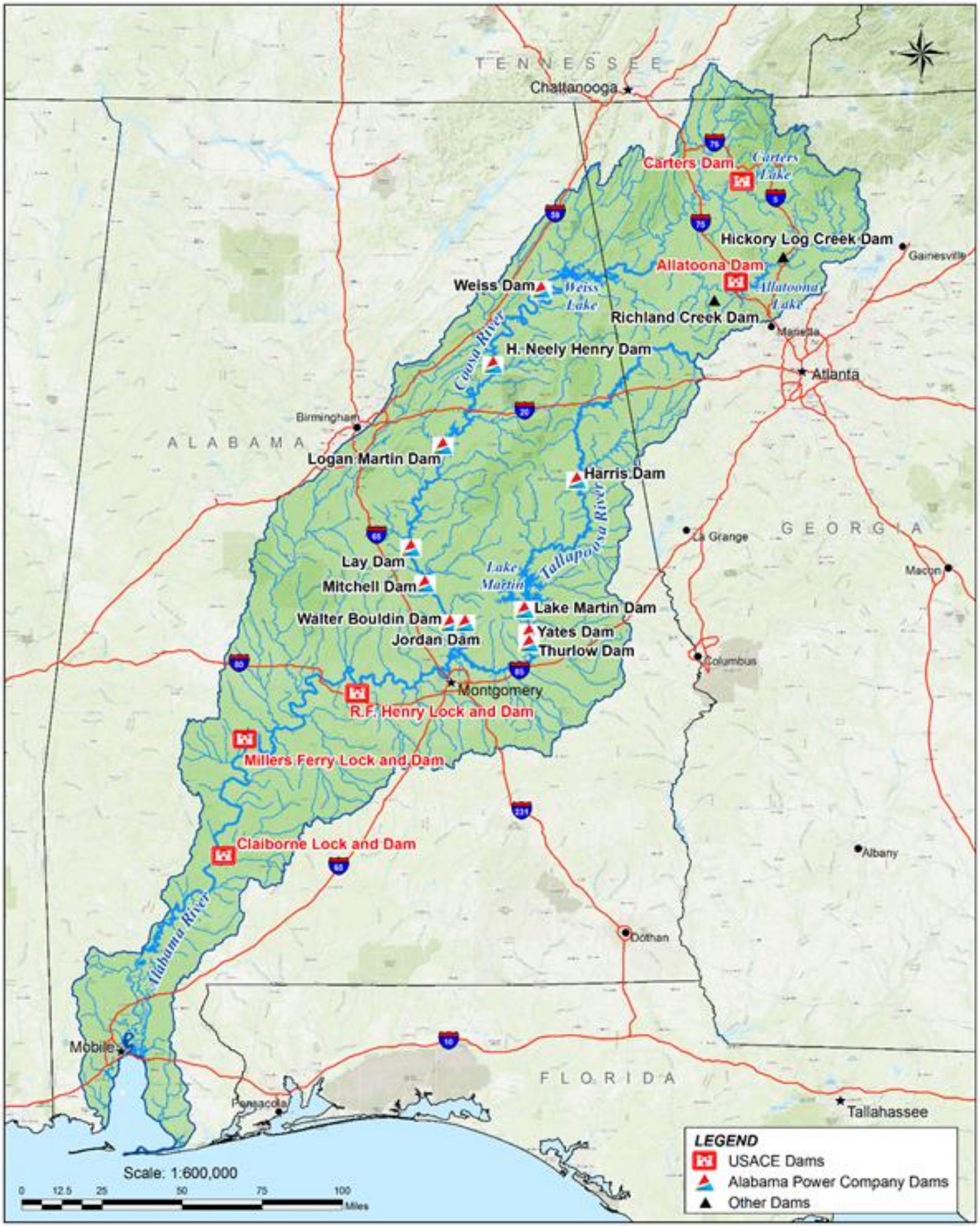
Based on review of engineering modeling results, the proposed operational changes among the alternatives resulted in potential recreational impacts at three projects, including Allatoona Lake (Allatoona), Weiss Lake (Weiss), and Logan Martin Lake (Logan Martin). For this recreation analysis, the study area is limited to these three projects. Allatoona is a USACE project, and Weiss and Logan Martin are both Alabama Power Company (APC) projects.

2. EVALUATION METHODOLOGY

2.1. NED RECREATION ANALYSIS

In this NED recreation analysis, the value of recreation refers to the value provided to recreation visitors and is estimated through approximation of visitors' *willingness to pay* for the recreation opportunity. In the case of a visitor to a Corps project, *willingness to pay* is the total value a visitor would be willing to pay to access the project, which would be the sum of any user fees actually paid, plus the additional amount they would be willing to pay but do not need to pay (referred to as the consumer surplus). The *willingness to pay* approach estimates the total economic value received by visitors to the project. Note that this NED approach to recreation value estimation does not include any payments made for other goods and services in the local economy (e.g. food, lodging, equipment rentals, etc.) associated with each recreation visit (USACE 2000, 1986).

Figure 1 – Study Area



2.2. Unit Day Value Method

The appropriate valuation methodology for estimating visitor *willingness to pay* was selected based on the guidelines in Appendix E, paragraph E-50b(4), in ER 1105-2-100 (USACE 2000). For this study, there is no regional model available for recreation; the project is not creating specialized recreation activities as defined in the ER; and there is no increase in Federal costs for recreation, since the water management alternatives do not include addition of recreation features to the project. As such, the Unit Day Value (UDV) methodology was selected as the appropriate valuation method.

When applying the UDV methodology, two categories of outdoor recreation visits, general and specialized, may be differentiated for evaluation purposes. "General" refers to a recreation visit involving primarily those activities that are attractive to the majority of outdoor users and that generally require the development and maintenance of convenient access and adequate facilities. "Specialized" refers to a recreation visit involving those activities for which opportunities in general are limited, intensity of use is low, and a high degree of skill, knowledge, and appreciation of the activity by the user may often be involved (USACE 2018a). All of the activities for this analysis were determined to fall into the general recreation category. Within the general category, separate values per visit were applied to general fishing & hunting and all other general activities.

The UDV method for estimating recreation benefits approximates the average willingness to pay of users. By applying a unit-day-value per visitor, an approximation of project recreation benefits is obtained. Per the guidance, this analysis does reflect that the proportion of visitation which is for fishing and hunting is assigned a different value per visit than the rest of the visitation.

The UDV process includes scoring of the project site using five guidance-defined criteria to yield a point score for the recreation opportunity at the project. The point score is converted to dollars-per-visit using tables provided in the UDV guidance (updated annually). The final dollars-per-visit value is the UDV. The UDV is then multiplied by the number of annual visitors to generate an estimate of the annual recreation value at the site. This annual value is then projected over the 50-year period of analysis based on visitation projections for the study area.

This method of estimating annual recreation value is completed twice. First, a valuation is completed for the No Action Alternative. Second, a valuation is completed for the "with" project alternatives. The difference between the two estimates is the net recreation value (net benefits) attributable to the alternative being evaluated.

2.3. Application for this Analysis

In this analysis, a separate UDV scoring evaluation is presented for each of the three reservoirs (Allatoona, Weiss, and Logan Martin). This approach required site-specific visitation data as well as separate UDV scorings for each of the three reservoirs. The recreation impact analysis was performed on the final array of alternatives (see main FR/SEIS for more detailed descriptions of each alternative). No recreation features are proposed for construction as part of the alternatives. The alternatives affect recreation by altering reservoir pool levels, which in turn affect recreation. The extent to which recreation is affected was accounted for as a function of the amount of time the pool is held at or below several pool levels. For Allatoona, there are four established USACE recreation impact levels which were utilized, as shown in **Table 1**.

Table 1. Allatoona Impact Levels

Name	Elevation Zone	Effects on Recreation
Full Pool	840 – 837 feet	No effect
Initial Impact Level	837 – 835 feet	Initial adverse effect
Recreation Impact Level	835 – 828 feet	Major adverse effects
Water Access Limited	Below 828 feet	Activities and access severely restricted

For the two APC projects, Weiss and Logan Martin, there are no such established impact levels. For the purpose of this analysis, three impact elevation zones were identified (**Table 2**). These zones were based on existing information from APC and public input which indicates that while summer pool levels are the most desirable for recreation, raising winter pool levels at Weiss and Logan Martin by 2-to-3 feet would alleviate the most severe recreation impacts the currently occur during low winter pools, leading to the identification of three impact zones for optimal conditions (summer pool), least-favorable conditions (existing winter pool), and a those elevations in between.

Table 2. Weiss and Logan Martin Impact Levels

Name	Elevation Zone		Effects on Recreation
	Weiss	Logan Martin	
Full Pool	564 – 561 feet	465 – 462 feet	No effect
Reduced Pool [1]	561 – 558 feet	462 – 460 feet	Initial adverse effects
Limited Pool [2]	Below 558 feet	Below 460 feet	Major adverse effects

Pool elevations under each the alternatives were obtained from results of detailed engineering modeling performed for the study (see the main FR/SEIS for more information about the engineering modeling). The engineering modeling considered 11 operational alternatives (see the main FR/SEIS for detailed description of the alternatives).

- #2 - FWOP: Future Without Project Condition
- #3 - WS1: Water Supply 1
- #4 - WS2: Water Supply 2
- #5 - WS3: Water Supply 3
- #8 - WS6: Water Supply 6
- #9 - MFO1: Modified Flood Operations 1
- #10 - WS2 + MFO1: Water Supply 2 + Modified Operations 1
- #11 - WS6 + MFO1: Water Supply 6 + Modified Operations 1
- #12 - WS1 + MFO1: Water Supply 1 + Modified Operations 1
- #13 - WS3 + MFO1: Water Supply 3 + Modified Operations 1

Using the results of the engineering modeling, the amount of time the pool level of each reservoir would remain within each recreation impact zone was extracted (see **Table 4**) and tallied for the entire year.

Next, UDV scores were developed for each reservoir. A UDV score was developed for each pool level at each reservoir (4 scores for Allatoona, and 3 each for Weiss and Logan Martin). In doing so, the effect on recreation for each alternative could be measured as a function of effect on pool level. This approach reflects that pool levels which are less than optimal for recreation would result in reduced value of the recreation opportunity (i.e., visitors have a lower willingness to pay for recreation at these reservoirs as pool levels drop below optimal levels and reduce the quality of the recreation experience).

These scores were converted to a dollar value per recreation visit (see Section 2.7) and then applied to estimates of annual visitation for each project. This step results in an estimate of recreation value at each reservoir for the time spent at each pool level. Adding up the value for each pool level based upon the amount of time at each level resulted in an estimate of recreation value across the 50-year period of analysis. This value was annualized using the Fiscal Year (FY) 2019 Federal discount rate of 2.875% percent to yield an estimate of the average annual recreation value for each alternative. These average annual values can be compared to the without project average annual value to assess the effect of each alternative on recreation value. This method estimates recreation value as a function of change in recreation quality. Based upon the nature of the alternatives, the same future without project visitation levels are applied in the with-project condition as well (see Section 5 for further discussion).

2.4. Summary of Operational Changes by Alternative

As noted in the summary, this recreation analysis estimates the recreation impacts associated with each of the alternatives as a function of proposed pool levels throughout the year.

Use of the year-round dataset was determined to be most appropriate based upon the nature of the operational changes proposed in the alternatives and the projects themselves. Changes proposed at Allatoona would affect the pool year-round, requiring a year-long lens to capture all potential effects on recreation. Additionally, the project's proximity to a large urban center, with numerous residential areas immediately adjacent to the lake, results in high potential for recreational use outside the peak season. At Weiss and Logan Martin, proposed changes would have no effect on peak recreation season (Jun – September). However, substantial changes are proposed for the winter pool. Stakeholders at the project have reiterated the importance of winter pool levels on recreation, warranting consideration of year-round effects.

Engineering modeling results were used to estimate the percent of time throughout the year the reservoir would remain within the pool elevations of each impact zone. At the back of this section, **Table 4** summarizes these pool levels for each alternative, and **Figure 2** though **Figure 4** illustrate the values in the tables graphically, showing how long the pool would remain in each zone under each alternative.

As shown in the figure and tables, the alternatives fall into two natural groupings: 1) alternatives exhibiting approximately the same pool level conditions as the FWOP, and 2) alternatives exhibiting increased duration at full pool and decreased duration at the lower pools.

At **Allatoona**:

- Alternatives 3, 4, 9, 10, and 12 exhibit relatively little change from the FWOP, approximately ±1.5% at each impact level.
- Alternatives 5, 8, 11, and 13 all result in an increase in the proportion of time spent at Full Pool, showing ≥4.5% increase over the entire year.

At **Weiss** and **Logan Martin**:

- Alternatives 3, 4, 5, and 8 exhibit negligible changes from the FWOP.
- Alternatives 9, 10, 11, 12, and 13 all show significant increase in the duration of time spent at Full Pool. Review of modeling results show this increase is due to a higher proposed winter pool. At Weiss, these alternatives exhibit a 25% increase in time spent in the Full Pool impact zone.

Similarly at Logan Martin, these alternatives exhibit a 33% increase in time spent in the Full Pool impact zone.

2.4.1. Two Recreation Impact Scenarios

Alternatives exhibiting little-to-no change in operations relative to the FWOP would not be expected to significantly affect recreation. Additionally, for alternatives that do include operational changes, those changes were the same across alternatives for a given project. As such, this analysis grouped the alternatives for the purpose of estimating recreation impacts. This grouping supports a simplified discussion of potential impacts, referring either to the group of alternatives under which recreation would be much the same as the FWOP (No Change Scenario), or the group of alternatives under which operational changes would be expected to affect recreation (With Change Scenario). **Table 3** illustrates the grouping of alternatives for the purpose of this analysis. Subsequent sections of the document will refer only to the No Change Scenario (NCS) and the With Change Scenario (WCS). Recreation impacts estimated for the WCS are applicable to all constituent alternatives.

Table 3. Grouping Alternatives for Analysis

Alternative	Allatoona	Weiss	Logan Martin
#2 - FWOP	No Change	No Change	No Change
#3 - WS1	No Change	No Change	No Change
#4 - WS2	No Change	No Change	No Change
#5 - WS3	With Changes	No Change	No Change
#8 - WS6	With Changes	No Change	No Change
#9 - MFO1	No Change	With Changes	With Changes
#10 - WS2 + MFO1	No Change	With Changes	With Changes
#11 - WS6 + MFO1	With Changes	With Changes	With Changes
#12 - WS1 + MFO1	No Change	With Changes	With Changes
#13 - WS3 + MFO1	With Changes	With Changes	With Changes

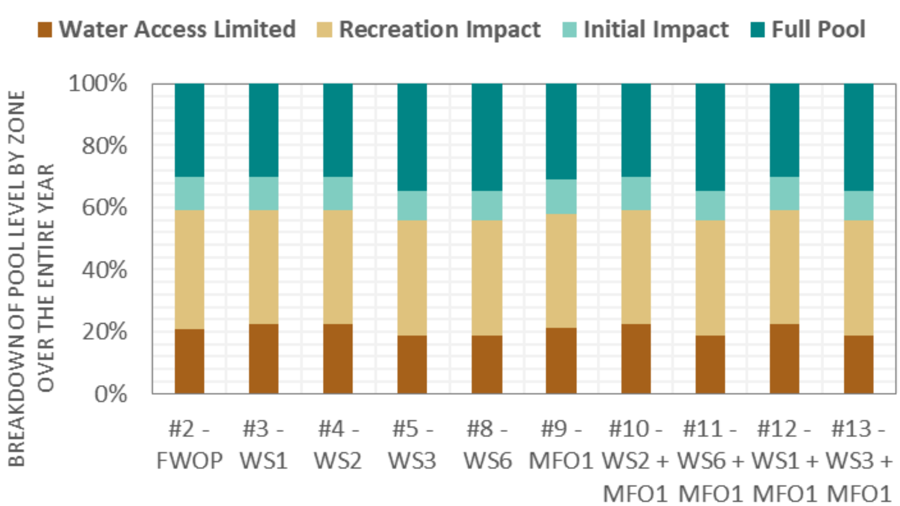


Figure 2 – Allatoona Pool and Recreation Impact Level by Alternative, Entire Year

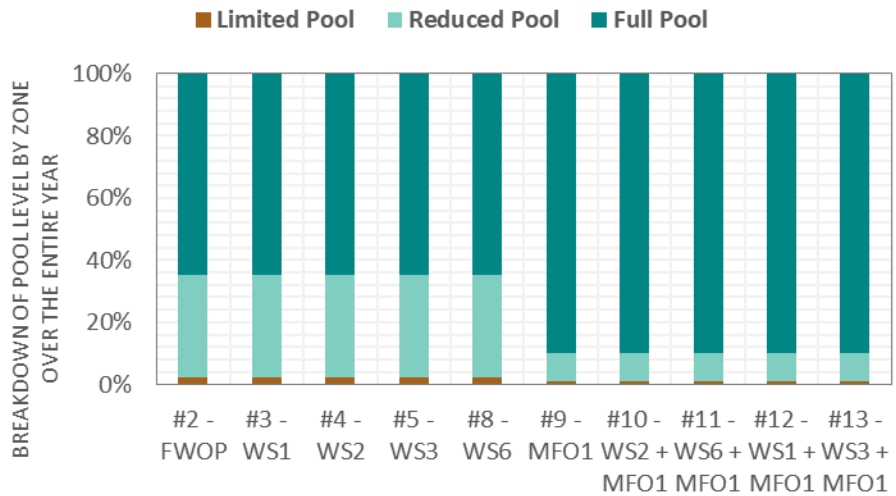


Figure 3 – Weiss Pool and Recreation Impact Level by Alternative, Entire Year

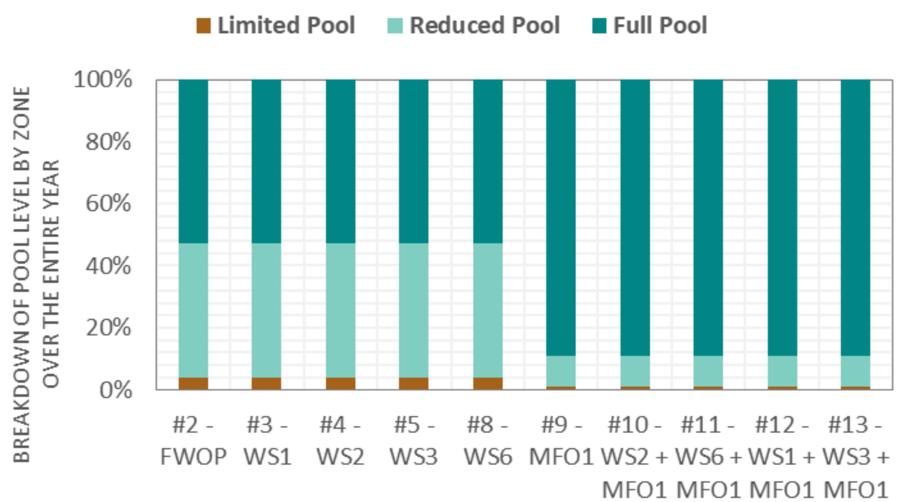


Figure 4 – Logan Martin Pool and Recreation Impact Level by Alternative, Entire Year

Table 4. Alternatives Summary, Pool and Recreation Impact Level by Alternative, Entire Year

Alternative	Allatoona				Weiss			Logan Martin		
	Full Pool	Initial Impact Level	Recreation Impact Level	Water Access Limited	Full Pool	Reduced Pool	Limited Pool	Full Pool	Reduced Pool	Limited Pool
#2 - FWOP	30.2%	10.8%	38.0%	21.0%	64.7%	33.3%	2.0%	53.0%	43.0%	4.0%
#3 - WS1	30.2%	10.8%	36.7%	22.3%	64.7%	33.3%	2.0%	53.0%	43.0%	4.0%
#4 - WS2	30.1%	10.9%	36.7%	22.3%	64.7%	33.3%	2.0%	53.0%	43.0%	4.0%
#5 - WS3	34.7%	9.3%	37.1%	18.9%	64.7%	33.3%	2.0%	53.0%	43.0%	4.0%
#8 - WS6	34.7%	9.3%	37.1%	18.9%	64.7%	33.3%	2.0%	53.0%	43.0%	4.0%
#9 - MFO1	30.8%	11.2%	36.9%	21.1%	90.0%	9.0%	1.0%	89.0%	10.0%	1.0%
#10 - WS2 + MFO1	30.1%	10.9%	36.7%	22.3%	90.0%	9.0%	1.0%	89.0%	10.0%	1.0%
#11 - WS6 + MFO1	34.7%	9.3%	37.1%	18.9%	90.0%	9.0%	1.0%	89.0%	10.0%	1.0%
#12 - WS1 + MFO1	30.2%	10.8%	36.7%	22.3%	90.0%	9.0%	1.0%	89.0%	10.0%	1.0%
#13 - WS3 + MFO1	34.7%	9.3%	37.1%	18.9%	90.0%	9.0%	1.0%	89.0%	10.0%	1.0%

2.5. VISITATION ESTIMATE

Visitation estimates were obtained from available published information. For Allatoona, visitation was obtained from the USACE through its Visitation Estimation and Reporting System (VERS) program (USACE 2019). For Weiss and Logan Martin, best available project-wide visitation was obtained from a recent EA prepared for the Coosa River Hydroelectric Project (FERC 2009). This report included a forecast of visitation by project to 2015 which was used as a baseline for further adjustment and forecast.

To forecast visitation growth during the period of analysis, growth rates applied in *FERC 2009* study were compared to recent regional and statewide general population growth rates available from the U.S. Census Bureau. While Atlanta continues to grow at upwards of 1.5% per year, much of the region surrounding the projects exhibits lower growth rates. For the purpose of conservatively estimating project visitation growth across the projects, a compound annual growth rate of 0.7% was applied to all projects for a period of 10 years. Visitation was held constant for the remainder of the period of analysis in acknowledgment of the uncertainty associated with long-range visitation growth forecasts and carrying capacity of the projects. **Table 5** presents the total visitation estimates for each project.

Table 5. Total Annual Visitation by Project

Year	Allatoona	Weiss	Logan Martin
2020	6,602,900	1,498,800	1,557,000
2030*	7,030,700	1,595,900	1,657,900
Avg. Ann.	**6,987,500**	**1,586,000**	**1,647,700**
** Held at this value for remainder of period of analysis*			

The proportion of visitation for fishing and hunting was also identified. **Table 6** presents these proportions by project. These factors were supported by the visitation source data referenced above and will be used in the analysis to allow application of a separate value per visit for fishing and hunting visits.

Table 6. Proportion of Visitation for Hunting and Fishing

	Allatoona	Weiss	Logan Martin
% Fishing and Hunting	15%	44%	40%

2.6. UDV SCORING / POINT ASSIGNMENT

UDV scoring was developed based upon the expected recreation impact levels described in Section 2.3. For each project, scores were developed for each pool impact level at each reservoir (4 scores at Allatoona, 3 each at Weiss and Logan Martin). In doing so, the recreation value for the NCS and for the WCS could be measured as a function of effect on pool impact level. The five UDV criteria for which points are assigned were:

- Recreation Experience: Score increases in proportion to the number of available activities at the site.

- Availability of Opportunity: Score is based on availability of substitute sites; the fewer the sites in the region that offer comparable recreation experience, the higher the score. In the case of fishing and hunting, reflects effects on likelihood of success.
- Carrying Capacity: Score rates level of facilities at the site to support the activities.
- Accessibility: Score rates ease of access to the site.
- Environmental: Rates the aesthetic/environmental quality of the recreation site/activities.

Scoring was based on the consideration of general recreation activities that would be affected at each project, with the same scores being applied for fishing as all other general recreation activities. **Attachment A** provides a copy of the USACE guidance which contains the scoring rubric. **Table 7** shows the scores developed for each project and pool impact level. In the sections following the table, the rationale is provided for the point assignments according to the five UDV criteria. In Section 2.7, these scores are converted to dollar value equivalents.

Table 7. UDV Score Summary

	Criteria					
	Recreation Experience	**Avail. of Opportunity**	**Carrying Capacity**	**Accessibility**	**Environ-mental**	**Total**
Allatoona						
Full Pool	30	14	14	18	18	**94**
Initial Impact	26	14	14	18	16	**88**
Recreation Impact	26	10	8	14	12	**70**
Water Access Limited	16	6	5	8	10	**45**
Weiss						
Full Pool	27	6	7	13	18	**71**
Reduced Pool	23	6	4	11	14	**58**
Limited Pool	19	6	3	9	10	**47**
Logan Martin						
Full Pool	26	6	7	13	18	**70**
Reduced Pool	22	6	4	11	14	**57**
Limited Pool	18	6	3	9	10	**46**

2.6.1. Recreation Experience

2.6.1.1. Allatoona

Full Pool

This criterion was scored 30 out of 30 points. All high quality and general activities would be available at the lake. Allatoona is one of the nation's most-visited Corps reservoir projects and offers a wide range of activities.

Initial Impact

This criterion scored 26 out of 30 points. At this level, it would be expected that swim areas would be impacted and there may be some minor navigation hazards, but that most facilities remain available, including boat ramps and docks.

Recreation Impact

This criterion scored 26 out of 30 points, reflecting that even as some effects are increased at swimming areas and beaches, the project would still offer many opportunities for recreation.

Water Access Limited

This criterion scored 16 out of 30 points. At this pool level, land-based activities are still minimally affected but numerous water-based activates are significantly affected. It'd be expected that boating access would be significant hindered, and that navigation hazard would be present in shallower regions of the reservoir, significantly affecting the quality of water-based activities.

2.6.1.2. Weiss

Full Pool

This criterion was scored 27 out of 30 points. All high quality and general activities would be available at the lake. Weiss is a known high-quality fishing resource and scores highly accordingly.

Reduced Pool

This criterion was scored 23 out of 30 points. At this level, recreation impact begins to be noticeable, but most activities are still available. Swimming areas become affected usable, and ramps and docks are usable but may need to accommodate the pool level. Some private docks may be unusable. There may be some navigation hazards for boaters.

Limited Pool

This criterion was scored 19 out of 30 points. At this impact level significant impacts to recreation are noticeable. Some beaches will become marginally usable, and many public and private boat launches and docks will be unusable. Boaters would need to be on alert for unmarked navigation hazards and may not be able to access all areas of the lake, especially small and shallow coves. Still, land-based activities remain available and most water activities are of reduced quality but still available.

2.6.1.3. Logan Martin

Full Pool

This criterion was scored 26 out of 30 points. All high quality and general activities would be available at the lake. Logan Martin is popular regional resource that offers a wide range of activities.

Reduced Pool

This criterion was scored 22 out of 30 points. At this level, recreation impact begins to be noticeable, but most activities are still available. Swimming areas become affected usable, and ramps and docks are usable but may need to accommodate the pool level. Some private docks may be unusable. There may be some navigation hazards for boaters.

Limited Pool

This criterion was scored 18 out of 30 points. At this impact level significant impacts to recreation are noticeable. Some beaches will become marginally usable, and many public and private boat launches and docks will be unusable. Boaters would need to be on alert for unmarked navigation hazards and may not be able to access all areas of the lake, especially small and shallow coves. Still, land-based activities remain available and most water activities are of reduced quality but still available.

2.6.2. Availability of Opportunity

2.6.2.1. Allatoona

Full Pool

This criterion was scored 14 out of 18 points. This score reflects that other high-quality value activities and general activities are available in the region within a one-hour travel time.

Initial Impact

This criterion was scored 14 out of 18 points. This impact level would have minimal additional effect on land-based activities and water-based activities may begin to be affected but would largely be available.

Recreation Impact

This criterion was scored 10 out of 18 points as well. At this level of impact, other regional projects might be attractive substitutes, especially for water-based activities. Land based activities would still be minimally affected.

Water Access Limited

This criterion was scored 6 out of 14 points. This additional reduction reflects that, in general, water-based activities would be severely restricted and of reduced quality at this level, likely making additional projects attractive substitutes.

2.6.2.2. Weiss

All Impact Levels

This criterion was scored 6 out of 18 points. This score reflects that there are several locations within one-hour drive time that provide similar recreational opportunities to the public. This score was held constant across all impact levels.

2.6.2.1. Logan Martin

All Impact Levels

This criterion was scored 6 out of 18 points. This score reflects that there are several locations within one-hour drive time that provide similar recreational opportunities to the public. This score was held constant across all impact levels.

2.6.3. Carrying Capacity

2.6.3.1. Allatoona

Full Pool

This criterion was scored 14 out of 14 points, reflecting that Allatoona is one of the most developed lake recreation projects in the region.

Initial Impact

This criterion was scored 14 out of 14 points, reflecting that the impacts here would not substantially affect carrying capacity.

Recreation Impact

This criterion was scored 8 out of 14 points. This reduced score reflects that at this pool level, the project may have a reduced functional capacity as beaches, boat ramps, and docks begin to become unusable. Land based facilities would still not be affected significantly.

Water Access Limited
This criterion was scored 5 out of 14 points. Further reduction in the score reflects that the number of accessible boat ramps and other water access points would be further reduced at this pool level.

2.6.3.2. Weiss

Full Pool
This criterion was scored 7 out of 14 points. The score reflects that the project consists of favorable and commonly requested facilities/amenities that support the most popular activities at the project, and past reports (FERC and USACE 2009) found that there are no major carrying capacity concerns.

Reduced Pool
This criterion was scored 4 out of 14 points. This score reflects that there would be deterioration of water access conditions would warrant dropping the score by one level.

Limited Pool
This criterion was scored 3 out of 14 points. This score reflects that at this lower reservoir level, inaccessibility of boat ramps and docks would affect functional capacity of the project.

2.6.3.1. Logan Martin

Full Pool
This criterion was scored 7 out of 14 points. The score reflects that the project consists of favorable and commonly requested facilities/amenities that support the most popular activities at the project, and past reports (FERC and USACE 2009) found that there are no major carrying capacity concerns.

Reduced Pool
This criterion was scored 4 out of 14 points. This score reflects that there would be deterioration of water access conditions would warrant dropping the score by one level.

Limited Pool
This criterion was scored 3 out of 14 points. This score reflects that at this lower reservoir level, inaccessibility of boat ramps and docks would affect functional capacity of the project.

2.6.4. Accessibility

2.6.4.1. Allatoona

Full Pool
This criterion was scored 18 out of 18 points, reflecting that Allatoona has very well-developed access to the site and within the site, including access to water-based activities.

Initial Impact
This criterion was scored 18 out of 18 points, reflecting that the impacts at this level would not substantially alter access via road, boat ramp, and dock.

Recreation Impact
This criterion was scored 14 out of 18 points. This reduced score reflects that at this pool level, access to water-based activities may be affected at some boat ramps and docks, though access to the project and for land-based activities remains good.

Water Access Limited

This criterion was scored 8 out of 18 points. Further reduction in the score reflects that the availability of many boat ramps, docks, and other water access points would be adversely affected at this pool level.

2.6.4.2. Weiss

Full Pool

This criterion was scored 13 out of 18 points, reflecting that Weiss has good access to and within the site.

Reduced Pool

This criterion was scored 11 out of 18 points. This score reflects that docks and boat ramps may begin to be affected in this elevation zone which may reduce the quality of access for water-based activities.

Limited Pool

This criterion was scored 9 out of 18 points. This score reflects that at this lower reservoir level, inaccessibility of boat ramps and docks would substantially affect access for water-based activities.

2.6.4.1. Logan Martin

Full Pool

This criterion was scored 13 out of 18 points, reflecting that Logan Martin has good access to and within the site.

Reduced Pool

This criterion was scored 11 out of 18 points. This score reflects that docks and boat ramps may begin to be affected in this elevation zone which may reduce the quality of access for water-based activities.

Limited Pool

This criterion was scored 9 out of 18 points. This score reflects that at this lower reservoir level, inaccessibility of boat ramps and docks would substantially affect access for water-based activities.

2.6.5. Environmental

2.6.5.1. Allatoona

Full Pool

This criterion was scored 18 out of 20 points. The score reflects that the project is one of the most popular outdoor recreation areas in the Atlanta region, offering visitors recreation opportunities in a high-quality natural setting while being near a major urban center.

Initial Impact

This criterion was scored 16 out of 20 points. Factors such as aesthetic quality may be marginally affected by a lowering pool, such as exposure of beaches and shoreline.

Recreation Impact

This criterion was scored 12 out of 20 points. At this pool level, additional bank exposure would be expected that would reduce aesthetic quality.

Water Access Limited

This criterion was scored 10 out of 20 points, reflecting still further reduction of aesthetic quality due to the exposed banks.

2.6.5.2. Weiss

Full Pool

This criterion was scored 18 out of 20 points. The score reflects that the project offers high quality natural aesthetics that complement popular water-based recreation activities at the project.

Reduced Pool

This criterion was scored 14 out of 20 points. Factors such as aesthetic quality may be marginally affected by a lowering pool, such as exposure of beaches and shoreline.

Limited Pool

This criterion was scored 10 out of 20 points. At this pool level, additional bank exposure would be expected that would reduce aesthetic quality.

2.6.5.1. Logan Martin

Full Pool

This criterion was scored 18 out of 20 points. The score reflects that the project offers high quality natural aesthetics that complement popular water-based recreation activities at the project.

Reduced Pool

This criterion was scored 14 out of 20 points. Factors such as aesthetic quality may be marginally affected by a lowering pool, such as exposure of beaches and shoreline.

Limited Pool

This criterion was scored 10 out of 20 points. At this pool level, additional bank exposure would be expected that would reduce aesthetic quality.

2.7. Unit Day Value Conversion

The points described above were converted to a dollar value based on the FY2019 UDV conversion table in EGM 19-03 (USACE 2018a). The scores were interpolated linearly as necessary. **Table 8** shows the point conversion table from the guidance, and **Table 9** summarizes the converted values.

Table 8. FY19 UDV Conversion, Value per Visit

General Recreation		
Point Values	**Fishing & Hunting ($)**	**Other General Activities ($)**
0	$5.95	$4.14
10	$6.73	$4.92
20	$7.25	$5.44
30	$8.03	$6.21
40	$8.80	$7.77
50	$9.58	$8.80
60	$10.62	$9.58
70	$11.13	$10.10
80	$11.91	$11.13
90	$12.17	$11.91
100	$12.43	$12.43

Table 9. Assigned Scores Converted

	Total Points	Value per Visit ($)	
		Hunting & Fishing	All General Activities
Allatoona			
Full Pool	94	$12.27	$12.12
Initial Impact	88	$12.12	$11.75
Recreation Impact	70	$11.13	$10.10
Water Access Limited	45	$9.19	$8.29
Weiss			
Full Pool	71	$11.21	$10.20
Reduced Pool	58	$10.41	$9.42
Limited Pool	47	$9.35	$8.49
Logan Martin			
Full Pool	70	$11.13	$10.10
Reduced Pool	57	$10.31	$9.35
Limited Pool	46	$9.27	$8.39

3. Recreation Value Calculations

Having completed estimates of visitation for each of the three projects and the UDV scoring, the two are combined to estimate recreation value. Recreation value was estimated for both the NCS and the WCS, and for each of the three projects.

To estimate recreation value, annual visits in each year of the period of analysis were proportionally applied to each pool level/ recreation impact level. Then visits for each pool level are multiplied by the corresponding UDV value in **Table 9** to estimate recreation value by pool level. Adding up these values gives the estimate of total recreation value in that year. The total value for each year is then discounted using the FY 2019 discount rate of 2.875 percent, then summed across each year of the period of analysis, yielding the total present value of recreation for that scenario. This value is amortized to give average annual recreation value over the period of analysis.

This same calculation was completed for the NCS and the WCS at each of the projects. **Table 10** summarizes the results of the recreation valuation calculations.

Table 10. Recreation Value by Project and Scenario

Project and Scenario	Annualized Recreation Value ($)	Present Value ($)	Annualized Change vs. Without Project	Percent Change
Allatoona				
No Change Scenario	$73,784,300	$1,944,349,000	$0	0%
With Change Scenario [1]	$74,481,000	$1,962,708,000	$696,700	0.9%
Weiss				
No Change Scenario	$15,881,400	$418,503,000	$0	0%
With Change Scenario [2]	$16,208,700	$427,127,000	$327,300	2.1%
Logan Martin				
No Change Scenario	$16,167,000	$426,030,000	$0	0%
With Change Scenario [2]	$16,666,000	$439,180,000	$499,000	3.1%

[1] Allatoona WCS alternatives: 5, 8, 11, 13

[2] Weiss and Logan Martin WCS alternatives: 9, 10, 11, 12, 13

4. Summary Conclusions

As described in Section 2.1, this analysis considers effects on NED recreation value by estimating change in visitor willingness to pay for the recreation opportunity as a function of recreation quality, resulting in an estimate of total economic value received by visitors to the project. It does not estimate any payments made for other goods and services in the local economy (e.g. food, lodging, equipment rentals, etc.) associated with each recreation visit. However, it may be reasonable to expect that higher quality recreation resources would be correlated with higher spending per visit.

As shown in **Table 10**, the With Change Scenario would result in a net increase in total recreation value at the projects. This increase reflects that the alternatives in the With Change Scenario all include operational modifications that would increase the duration of time the reservoirs spend at full pool, which would serve to increase the number of days of optimal recreation conditions with regard to pool elevation. As such, the estimated change in total recreation value is a function of the change in quality of experience for project visitors, not a change in the number of visitors. The analysis estimates that under any of the WPC alternatives, Allatoona would experience an approximate 1% increase in total recreation value, Weiss would experience an approximate 2% increase in recreation value, and Logan Martin would experience an approximate 3% increase in recreation value.

Review of operational changes by alternative in the main FR/SEIS provides an indication of seasonal trends in how these benefits may accrue.

At Allatoona, the WPC alternatives include changes in flood pool and conservation pool which affect reservoir elevation throughout the year, implying that the benefits to recreation estimated in this analysis would accrue to users throughout the year.

In contrast at the APC projects, the WPC alternatives do not substantially affect summer pools. For these alternatives, operational changes focus on the specification of a new winter pool which would raise the reservoir above existing levels during fall and winter seasons. As such, it’s expected that benefits to recreation estimated in this analysis would accrue to visitors during the fall and winter seasons, rather than the spring and summer.

In summary, it is expected that the WPC alternatives would result in net beneficial effects on recreation at each of the projects. Because the WPC alternatives would all have a net reduction in the proportion of time spent below full pool, there appears to be low risk that any of the WPC alternatives would have adverse effects on recreation.

5. Uncertainty Considerations

This analysis applies the UDV methodology to estimate project-scale changes in recreation value based on total annual visitation and aggregate scoring of the projects' recreation opportunities. Key sources of uncertainty in the UDV analysis include the total estimate of visitation and the scores assigned to each project and pool impact zone.

To address uncertainty in visitation, forecasted growth was limited to 10 years and capped. This approach results in visitation over the period of analysis which is likely conservative, minimizing the risk that overestimation of future visitation levels contributes to overestimation of benefits. The extent to which the alternatives would drive changes in visitation level was also considered. Because none of the alternatives include major pool level changes during peak season, when the majority of visits occur, it was judged that the with-project alternatives would not drive significant changes in project-wide annual visitation over the without-project condition. As such, both the No Change Scenario and the With Change Scenario to utilize the same visitation estimates. Any marginal increases in visitation as a result of the proposed operational changes would only serve to further increase the total recreation value.

To address uncertainty associated with the scoring, score reductions associated with adverse pool conditions were moderate. In general, scores in any rubric category did not drop more than two categories between the optimal and worst pool levels. Such an approach was determined to be appropriate given the project-scale lens of the analysis, which estimates average change in value for all users and activities.

6. References

(USACE) U.S. Army Corps of Engineers. October 2018a. EGM 19-03 Unit Day Values for Recreation for Fiscal Year 2019. CECW-CP Memorandum for Planning Community of Practice. Retrieved online via http://planning.usace.army.mil/toolbox/library/EGMs/EGM19-03.pdf.

(USACE) U.S. Army Corps of Engineers. October 2018b. EGM 19-01 Federal Interest Rates for Corps of Engineers Project for Fiscal Year 2019. CECW-P Memorandum for Planning Community of Practice. Retrieved online via http://planning.usace.army.mil/toolbox/library/EGMs/EGM19-01.pdf.

(USACE) U.S. Army Corps of Engineers. April 2000. ER 1105-2-100 Planning Guidance Notebook. CECW-P Engineering Regulation. Retrieved online via https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf.

(USACE) U.S. Army Corps of Engineers. March 1986. IWR Report 86-R-4 National Economic Development Procedures Manual – Recreation, Volume I, Recreation Use and Benefit Estimation Techniques. Retrieved online via https://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/86-R-4.pdf.

(USACE) U.S. Army Corps of Engineers. 2019. Value to the Nation Fast Facts – Allatoona Lake. Retrieved online via https://fastfacts.corpsresults.us/recreation/fastfacts/lake.cfml?LakeID=9.

(FERC) Federal Energy Regulatory Commission. December 2009. Final Environmental Assessment for Hydropower License, Coosa River Hydroelectric Project, FERC Project No. 2146-111, Alabama and Georgia. Provided electronically by Mobile District U.S. Army Corps of Engineers.

Attachment A – UDV Scoring Rubric

Criteria	Judgment Factors				
Recreation Experience (1) Points Possible: 30	Two general activities (2) 0-4	Several general activities 5-10	Several general activities: one high quality value activity (3) 11-16	Several general activities: more than one high quality value activity 17-23	Numerous high-quality value activities; some general activities 24-30
Availability of Opportunity (4) Points Possible: 18	Several within 1 hr. travel time; a few within 30 min travel time 0-3	Several within 1 hr. travel time; none within 30 min travel time 4-6	One or two within 1 hr. travel time; none within 45 min travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying Capacity (5) Points Possible: 14	Minimum facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
Accessibility Points Possible: 18	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental Quality Points Possible: 20	Low aesthetic factors (6) that significantly lower quality (7) 0-2	Average aesthetic quality; factors exist that lower quality to a minor degree 3-6	Above average aesthetic quality; any limiting factors can be reasonably rectified 7-10	High aesthetic quality; no factors exist that lower quality 11-15	Outstanding aesthetic quality; no factors exist that lower quality 16-20

Guidance Notes:
(1) Value for water-oriented activities should be adjusted if significant seasonal water level
(2) General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
(3) High quality value activities include those that are not common to the region and/or Nation, and that are usually of high quality.
(4) Likelihood of success at fishing and hunting.
(5) Value should be adjusted for overuse.
(6) Major esthetic qualities to be considered include geology and topography, water, and vegetation.
(7) Factors to be considered to lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

Attachment 2. Allatoona-Coosa Reallocation Study—Project Impacts to Hydropower Report

Page intentionally blank

US Army Corps
of Engineers
Portland District

Allatoona Dam and Lake

HYDROELECTRIC DESIGN CENTER

Allatoona Lake

Water Supply Storage Reallocation Study

&

Weiss and Logan Martin Reservoirs

Updates to Project Water Control Manuals

Project Impacts to Hydropower

PREPARED BY: Hydropower Analysis Center

Prepared By: Hydropower Analysis Center

Hydroelectric Design Center

U.S. Army Corps of Engineers

June 2019

ABSTRACT

This is an analysis of impacts to hydropower at both Federal and non-Federal plants in the ACT River Basin resulting from allocating additional reservoir storage at Allatoona Lake for increased municipal water supply and simultaneously implementing a modified Flood Risk Management strategy at Weiss and Logan Martin Reservoirs.

Table of Contents

Tables

Figures

Allatoona-Coosa Reallocation (ACR)

Water Supply Reallocation (WSR)

Hydropower Analysis Draft

1 Introduction:

The U.S. Army Corps of Engineers (USACE), Mobile District is conducting a combined study of Allatoona Lake Water Supply Storage Reallocation and Updates to the Weiss and Logan Martin Reservoirs Project Water Control Manuals. The water supply study will evaluate an updated March 30, 2018 request by the State of Georgia for a water supply storage reallocation out of Allatoona Lake. The flood storage analysis will evaluate APC's proposal for revised operations at the Weiss and Logan Martin projects for which USACE has navigation and flood risk management oversight.

This report presents an analysis of the effects on hydropower and the monetary value hydropower that are expected to result from proposed changes to system water control operations within the Alabama-Coosa-Tallapoosa (ACT) River Basin. The system hydropower valuess for energy and capacity were computed for the baseline condition, representing current water control operations, and for alternative flow scenarios associated with these studies.

1.1 Calculation of Hydropower

The calculations of hydropower energy and capacity values are based on seventy-three years of historic hydrology (1939-2011) using the HEC-ResSim model.

To understand how system operations can effect hydropower generation we will first consider the mathematics used to approximate the amount of power produced from a hydropower facility, the power equation (Eq. 1). This equation shows that power is directly proportional to three variables; the efficiency of the plant turbines, the amount of flow going through the turbines, and the head, the height of the water in the reservoir relative to its height after discharge.

$$P = e * g * Q * H$$

Where; P=power (kW),
e=turbine efficiency,
g = gravitational constant (ft/sec^2),
Q-flow (cfs),
H=head (ft).

Reservoir operations can affect all three of these variables. Higher or lower operational reservoir elevations change the head. Maximum or minimum flow requirements used for flood risk management and environmental purpose can affect the flow. Although power is linear in both head and flow, this relationship quickly becomes non-linear with the inclusion of efficiency which is a non-linear function of both head and flow.

1.1 Hydropower Impact Components

In general the hydropower values resulting from generation can be divided into two components: energy values and capacity values. A change in energy value is the result of a change in the amount of water that is available to pass through the turbines. The values changes both daily and seasonally as a function of the systems electrical load. For example energy may be more valuable during the height of the summer heat while businesses and residents are attempting to cool their environments as opposed to the fall or winter when air conditioners maybe turned off. The capacity value is a measure of the amount of capacity that the project can reliably contribute towards meeting system peak power demands.

1.1.1 Energy

Energy (generation) summarized and value of energy (generation) calculated in Chapter 3 is based upon the cost of utilizing the most likely alternative source for power. For example, if an operational strategy reduces hydropower storage or flow, the loss in energy value is equivalent to the cost of replacing the lost power with the most likely alternative source of power.

1.1.2 Capacity

There may be a decrease the amount of capacity that the hydropower plant can contribute to the peak system load making it necessary to replace this lost capacity with an alternative source of power made up of a combination of thermal generating plants. Capacity and its value are the subject of Chapter 4.

2 ACT Watershed Bulk Power System Overview

This chapter contains the following: an overview of the power generation system for the ACT River Basin with an emphasis on hydropower, a descriptive analysis of the potential annual and seasonal changes in hydropower production due to water control management decisions, and a description of the process of calculating the changes in the energy and capacity value of the ACT system resulting from the study alternatives.

2.1 Location of ACT River Basin and USACE Projects

The Alabama-Coosa-Tallapoosa (ACT) River Basin watershed lies primarily in the States of Alabama and Georgia.

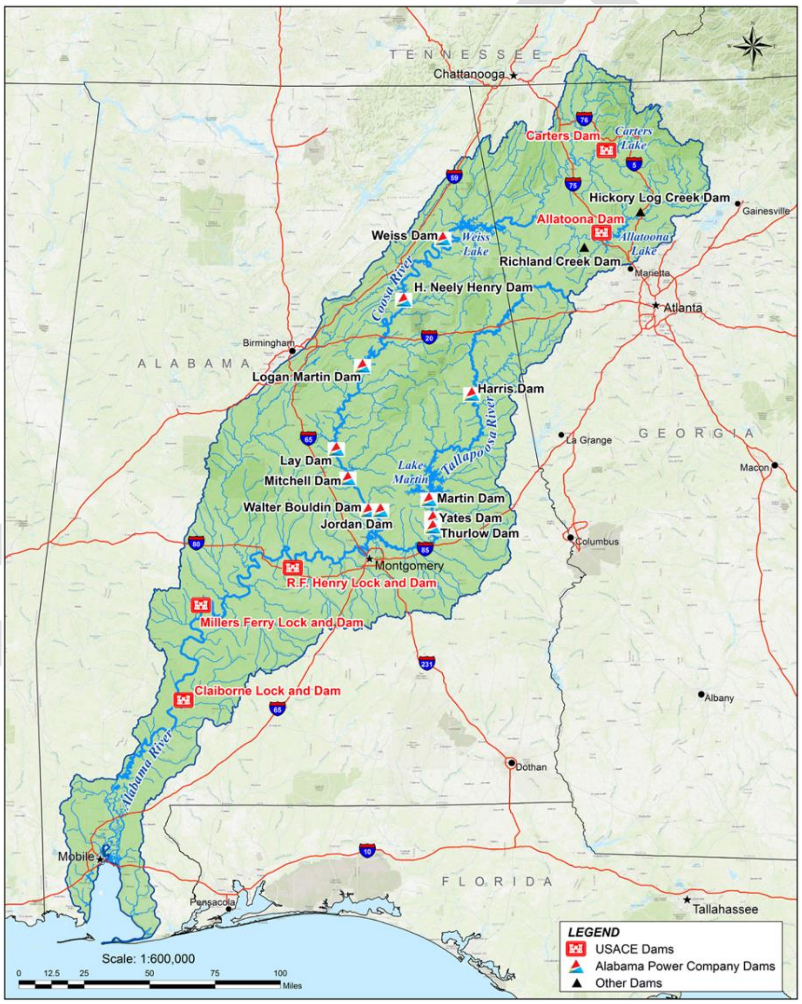


Figure 2-1. ACT watershed hydropower system map

2.2 SERC/Southeastern System Capacity & Power

SERC/Southeastern is responsible for improving the electric power generating system critical infrastructure in the region.

Since 2000, the Southeastern sub-region has undergone a significant increase in natural gas-fired generating plant capacity. Natural gas currently exceeds Coal and Nuclear in percentage of total system capacity at around 38%. Nuclear and Hydroelectric energy make up the remaining generating plant capacity accounting for 30% and 7% of total system capacity respectively (Figure 1).

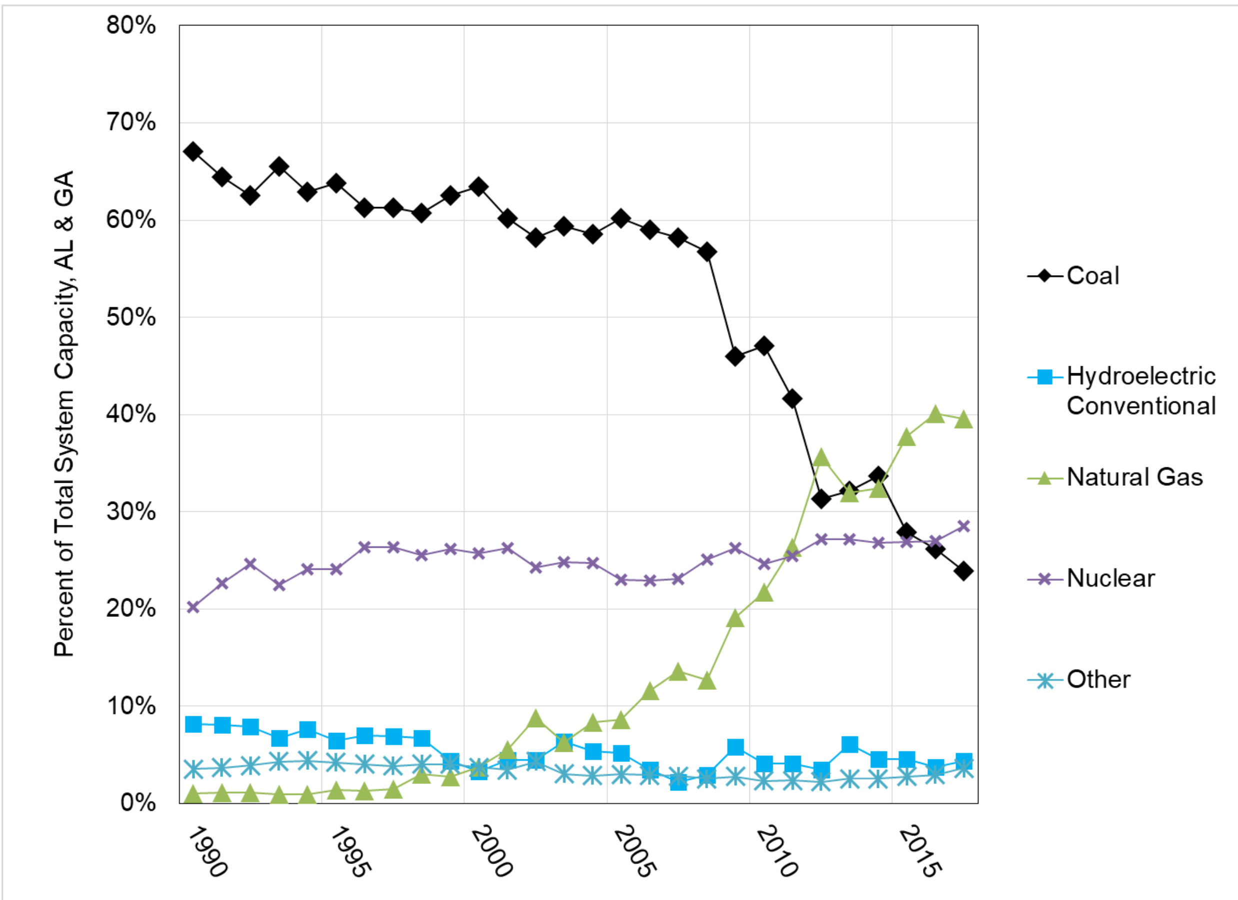


Figure 2-2. Historical trends for the percent of total system capacity for the State of Alabama & Georgia

Coal and nuclear power are predominately run as baseload plants, facilities that produce constant rates of generation to meet the systems continuous regional demands. Recently, a larger number of coal plant in this region have been modified to use natural gas and maintain their baseload function. Natural gas and hydropower plants on the other hand are generally run as peaking plants, meeting the daily and seasonal peak loads throughout the system. This is important, conceptually, to identify which alternative thermal plants might be used to replace hydropower if changes in operations dictated such a need. As an illustrative example consider the 2019 generation pattern reported by the (EIA) for the Southern sub-region (Figure 3). Increases (decreases) in percent of total generation for hydropower are matched by decreases (increases) in percent generation for natural gas. The same coupling of energy sources can be seen in the relationship between coal and nuclear power.

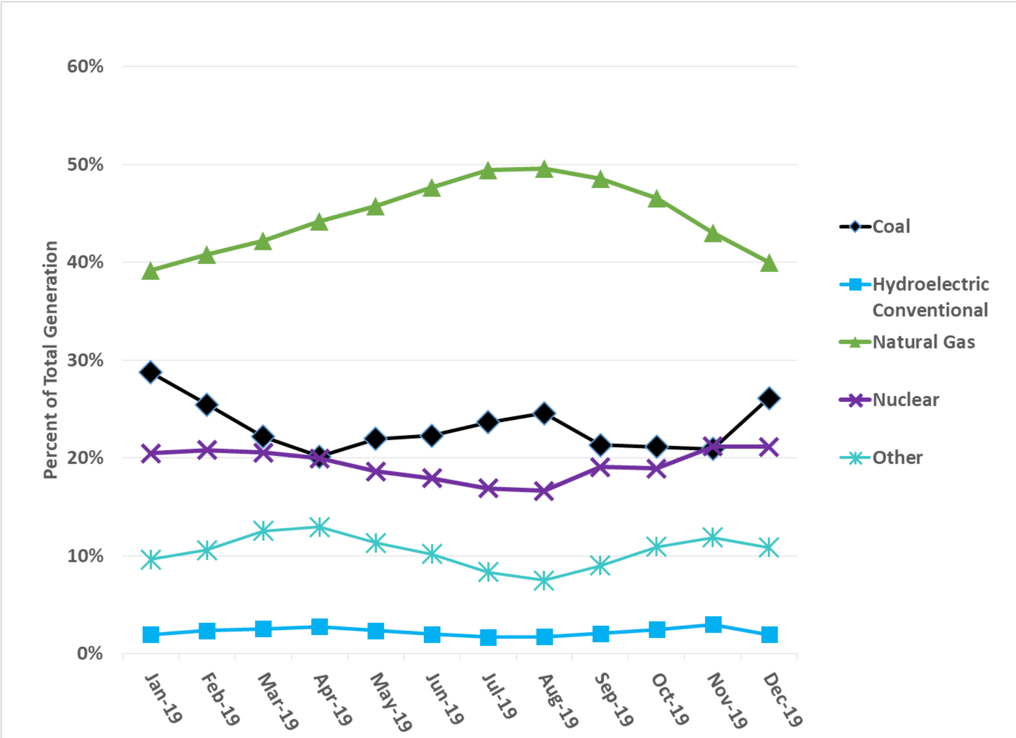


Figure 2-3. Percent of Total Generation by Fuel Type for Southern sub-region

2.3 ACT Hydropower System

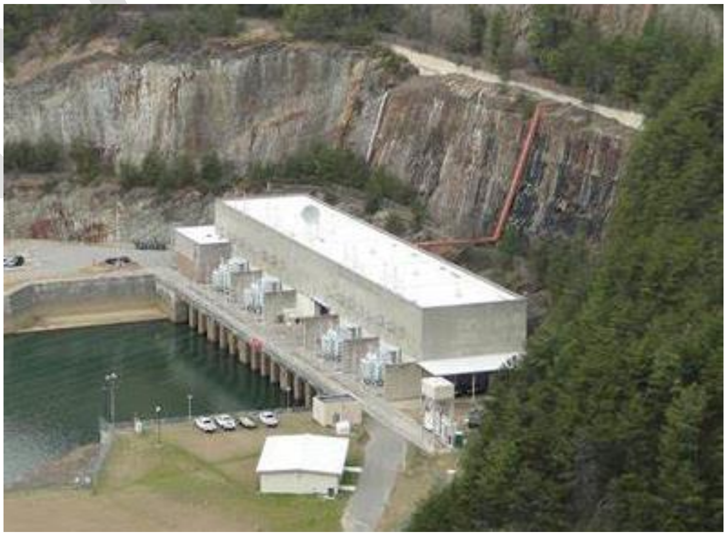
2.3.1 USACE Hydropower Projects

The USACE operates four dams with hydropower capabilities in the ACT River Basin. The RF Henry Dam and Millers Ferry Lock and Dam are both located on the Alabama River around 200 miles upstream of Mobile Bay. These two dams work together with a combined generating capacity of 172 MW in supporting multiple purposes other than hydropower including navigation and waste assimilation. Allatoona Dam is located northwest of Atlanta on the Etowah River in Georgia. It is operated as a peaking plant with an installed generating capacity of 82 MW. The final plant, Carters Dam is located on the Coosawattee River in Georgia and is operated as a pump storage plant. This plant consists of two pools, Carters Lake and Carters Reregulation Pool. During peak loading hours, water is released from Carters Lake to the re-regulation pool generating energy. When demand is low, energy is purchased to pump water back into the Carters Lake from the re-regulation pool. This plant has a total generating capacity of 600 MW.

2.3.1.1 Allatoona Dam

Located in Bartow County on the Etowah River near Cartersville, Ga., the Allatoona Dam and Powerhouse is the oldest multipurpose project in the U.S. Army Corps of Engineer's South Atlantic Division. Construction of Allatoona Dam was authorized under the Flood Control Acts of 1941 and 1944 and built to retain the Etowah River, a tributary of the Coosa River. Originally delayed because of World War II, construction of the dam began in 1946 and was completed in late 1949. Allatoona Dam is a concrete gravity dam and was the first of its kind, eventually becoming the model for all future Corps of Engineers-built dams. The filling of the reservoir was completed in May 1950, and the power plant came online the same year. Authorized federal purposes for the dam include power, flood control, water supply, and recreation. The current plant capacity is 82 MW and the dam impounds Lake Allatoona, a popular recreation facility that is also managed by the Corps of Engineers.

2.3.1.2 Carters Dam



Carters Dam impounds about 3,200 surface acres of water with more than 60 miles of shoreline. At 445 feet, it is the highest earth-filled dam east of the Mississippi River. Carters Dam is one of the few pump storage facility dams in the nation. Water flows through the turbines to generate power during peak demand periods. During off-peak periods, two units can be reversed to pump water back to the upper pool and stored for later use. Located 26.8 miles above the mouth of the Coosawattee River in northwest Georgia, the Carters Dam and Powerhouse were authorized by the Rivers and Harbors Act of 1945. Construction began in 1962 and was completed in 1977. The project came online in 1975. The current plant capacity is 600 MW.

2.3.1.3 Robert F. Henry Lock and Dam

R. E. "Bob" Woodruff Lake impounds the Alabama River between Montgomery and Selma in central Alabama. The U. S. Army Corps of Engineers built the Robert F. Henry Lock and Dam to create a 12,510 acre reservoir that provides navigation, hydroelectric power generation, and recreation. The low retention time and water storage capacity often result in frequent winter and spring flooding. Locals still refer to it as the Alabama River; however, numerous creeks have been flooded, providing a wide variety of fishing opportunities. The powerhouse at the Robert F. Henry Lock and Dam came online in 1975. The project's current capacity is 82 MW.

2.3.1.4 Millers Ferry Lock and Dam

Millers Ferry Lock and Dam is a lock and hydro-electric dam on the Alabama River, near the community of Millers Ferry, Alabama. It was built by and continues to be operated by the United States Army Corps of Engineers. Construction of the complex began in 1963 and was completed in 1970. The Millers Ferry Powerhouse came online in 1970 and has a generating capacity of 90 megawatts. The dam impounds a 17,200-acre reservoir on the Alabama River, the William (Bill) Dannelly Reservoir is better known locally as "Millers Ferry." The reservoir covers 27 square miles and has approximately 500 miles of shoreline

2.3.2 Alabama Power Company Hydropower Projects

Eleven non-Corps plants owned by Alabama Power Company are also considered in this analysis. As a whole, Alabama Power Company owns a total of 14 peaking power plants making up 6% of the company's power generation. The 1,400 MW of installed generating capacity from the 11 plants in this analysis are located on the Tallapoosa and Coosa Rivers.

Table 2-1. Plant characteristics of hydropower projects for ACT Basin

Plant	Owner	Number of Units	Installed Capacity (MW)
Weiss Dam	Alabama Power Company	3	81
H. Neely Henry	Alabama Power Company	3	70
Logan Martin	Alabama Power Company	3	135
Martin	Alabama Power Company	4	186
Lay	Alabama Power Company	6	180
Mitchell	Alabama Power Company	4	166
Jordan	Alabama Power Company	4	100
Walter Boudin	Alabama Power Company	3	225
Harris	Alabama Power Company	2	132
Yates	Alabama Power Company	2	47
Thurlow	Alabama Power Company	3	78
RF Henry	USACE	4	82
Millers Ferry	USACE	3	90
Allatoona	USACE	3	72
Carters	USACE	4	575
Total		51	2,219

2.4 Study Alternatives

- **Base2018:** This is the Current Condition (which includes reservoir storage allocations for water supply to 2 entities (CCMWA-12,485 AF and Cartersville-6,054 AF) without capping withdrawals.

- **BaseCap** This is the Current Condition (which includes reservoir storage allocations for water supply to 2 entities (CCMWA-12,485 AF and Cartersville-6,054 AF) with capped withdrawals.

- **FWOP:** Future WithOut Project (without additional reallocation for (94 MGD or 32,809 AF). This the base case for water supply reallocation alternatives.

- **A03_WS1:** Reallocation of 32,809 AF from Conservation Pool using State of Georgia's water accounting method

- **A04_WS2:** Reallocation of 32,809 AF from Conservation Pool using USACE water accounting method

- **A05_WS3:** Reallocation of 32,809 AF from both Flood Pool and Conservation Pool using State of Georgia's water accounting method

- **A06_WS4:** Reallocation of 32,809 AF from both Flood Pool and Conservation Pool using State of Georgia's water accounting method

- **A08_WS6:** Reallocation of 32,809 AF from both Flood Pool and Conservation Pool using USACE water accounting method

- **A09_FWOPMF**: Modified Flood Operation 1 including Future WithOut Project (without additional reallocation for (94 MGD or 32,809 AF). This the base case for APC requested modified flood operations with water supply reallocation alternatives.

- **A10_WS2MF:** Modified Flood Operation 1 including (A04_WS2) Reallocation of 32,809 AF from Conservation Pool using USACE water accounting method

- **A11_WS6MF:** Modified Flood Operation 1 including (A08_WS6) Reallocation of 32,809 AF from both Flood Pool and Conservation Pool using USACE water accounting method

- **A12_WS1MF:** Modified Flood Operation 1 including (A03_WS1) Reallocation of 32,809 AF from Conservation Pool using State of Georgia's water accounting method

- **A13_WS3MF:** Modified Flood Operation 1 including (A05_WS3) Reallocation of 32,809 AF from both Flood Pool and Conservation Pool using State of Georgia's water accounting method.

Table 2-2. Characteristics of hydropower projects for ACT Basin

ALTERNATIVE	Description	Attributes						
		Meets GA 2050 Demands 94MGD	Storage: USACE	Storage: GA	Reallocation: Inactive Pool	Reallocation: Conservation Pool	Reallocation: Flood Pool	APC Requested Changes
Base2018	No Action		✓					
BaseCap								
FWOP	Future Without Project		✓					
A03_WS1	Water Supply 1	✓		✓		✓		
A04_WS2	Water Supply 2	✓	✓			✓		
A05_WS3	Water Supply 3	✓		✓		✓	✓	
A06_WS4	Water Supply 4	✓	✓				✓	
	Water Supply 5				✓			
A08_WS6	Water Supply 6	✓	✓			✓	✓	
A09_FWOPMF	Modified Flood Operation 1		✓					✓
A10_WS2MF	Water Supply 2 + Modified Flood Operation 1	✓	✓			✓		✓
A11_WS6MF	Water Supply 6 + Modified Flood Operation 1	✓	✓			✓	✓	✓
A12_WS1MF	Water Supply 1 + Modified Flood Operation 1	✓		✓		✓		✓
A13_WS3MF	Water Supply 3 + Modified Flood Operation 1	✓		✓		✓	✓	✓

2.5 Hydropower Generation

To determine the change in energy generation resulting from the Studies' Alternative Plans, an analysis was performed to determine the average annual energy generated in the BaseCase, current condition, using the seventy-three year ResSim Model simulation period. As shown in Figure 4 there is a less than a one percent change in average annual energy for each alternative when compared to the baseline condition.

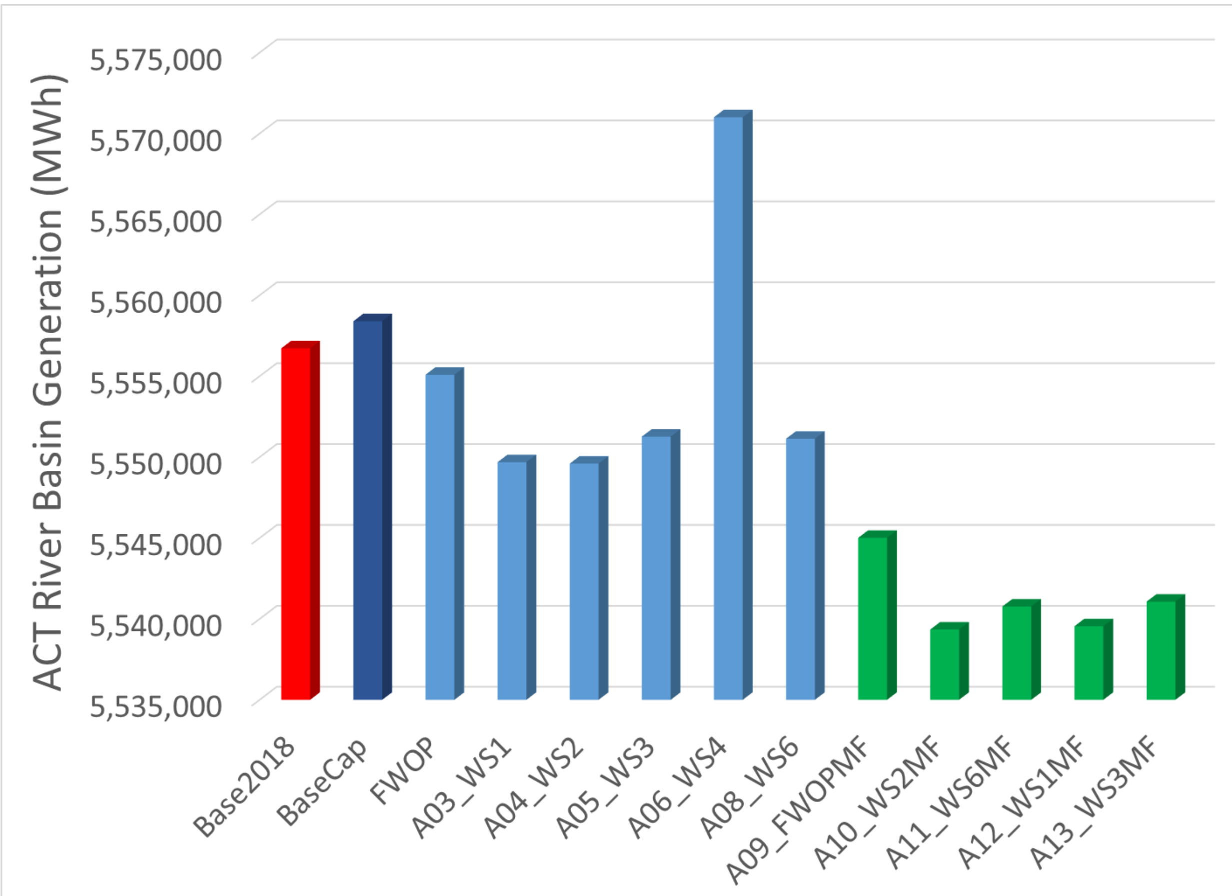


Figure 2-4. Average Annual Hydropower System Generation by Alternatives

The value of the replacement energy has a seasonal trend following the demand and generating resource availability through the year. Therefore, in calculating annual value, it is necessary to look at how the generated energy is distributed on a monthly basis. Figure 2-5 shows both the average monthly energy generated for Base2018 and other alternatives as well. Alternative scenario FWOP shows an increase in power generation from June through November and losses December through May compared to the baseline condition. The other alternative scenarios show similar losses. For alternative scenario A06_WS4 there are power generation losses October through March.

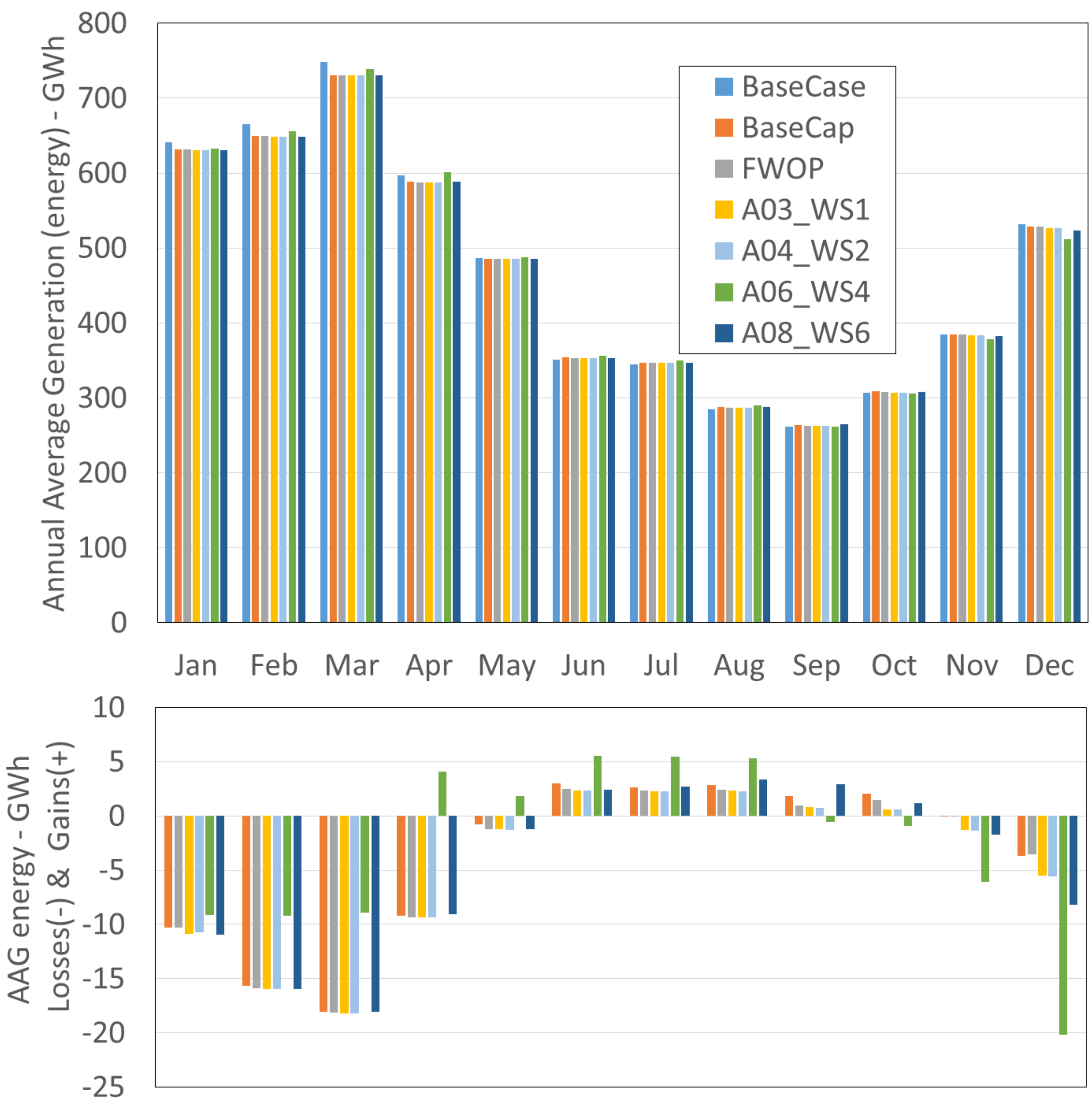


Figure 2-5. Monthly Generation for Alternative Flow Scenarios compared to Base2018

3 Energy & Energy Value

Energy value is computed as the product of the energy loss in megawatt-hours and a block energy price ($/MWh). The block energy price is based on the cost of energy from regional combination of electricity generating plants that would replace the lost energy from the hydropower plant due to operational and/or structural changes.

3.1 Energy Blocks

3.1.1 Energy Blocks Defined

The energy prices used for this analysis reflect the daily differences in peak and off peak operations, the seasonal dynamics related to demand and availability, and the annual forecasted changes due to modifications in capacity and overall demand. The following paragraphs describe the process of obtaining these values.

The regional definition of on-peak hours of generation is 6am to 10pm on weekdays. The off-peak hours of generation are the remaining hours on weekdays and all hours on weekends. However, because generation by USACE hydropower plants in the ACT Basin is concentrated in a subset of the highest-value weekday peak hours to fulfill power contracts, these hours were evaluated separately as contract on-peak hours in order not to understate the their value. Table 3-1 presents the distribution of hours into generation blocks for contract-peak hours, non-contract peak hours, and off-peak hours for each month of the year, and also for weekends. The schedule of generation blocks was provided by the Southeastern Power Administration (SEPA), an agency of the U.S. Department of Energy.

Table 3-1. Generation Block Schedule for SEPA/USACE Hydropower Plants

	On-Peak Hours (contract)	On-Peak Hours (non-contract)	Off-Peak Hours
Weekdays			
January	11	5	8
February	11	5	8
March	11	5	8
April	6	10	8
May	6	10	8
June	6	10	8
July	6	10	8
August	6	10	8
September	6	10	8
October	11	5	8
November	11	5	8
December	11	5	8
Weekends (All Year)			
All Months	0	0	24

3.1.2 Energy Allocation to Blocks

As an example of how daily energy production is allocated between on-peak and off-peak designations, Table 4-2 below shows the simulated daily energy production for Allatoona Lake for the week of April 1, 1946, under No Action (baseline conditions). The capability varies with the rise and fall of the lake level. The average capability on Tuesday was 93.48 MW and the Generation was 1,758.5 MWh. On-Peak generation for 16 hours could be 1,495.68 MWh, of which 6 hours would be SEPA contract generation (560.9 MWh) and the remaining 10 hours of On-Peak would be non-contract generation (934.8 MWh). Generation in excess of 16 hours on weekdays is off-peak energy (262.8 MWh). All power generated on the weekend is off-peak energy.

Table 3-2. On-Peak & Off-Peak Daily Blocks Energy Allocation for Allatoona Lake – April 1 through 7, 1946

DATE	Day	Capability	Energy Production	Weekday			Weekend
				On-Peak Energy (contract)	On-Peak Energy (non-contract)	Off-Peak Energy	Off-Peak Energy
		(MW)	(MWh)	(MWh)	(MWh)	(MWh)	(MWh)
1-Apr-46	Monday	94.29	1,367.9	565.8	802.1	0.0	0.0
2-Apr-46	Tuesday	93.48	1,758.5	560.9	934.8	262.8	0.0
3-Apr-46	Wednesday	91.90	1,789.3	551.4	919.0	318.9	0.0
4-Apr-46	Thursday	90.44	1,773.3	542.6	904.4	326.3	0.0
5-Apr-46	Friday	89.40	1,761.3	536.4	894.0	330.9	0.0
6-Apr-46	Saturday	88.40	1,749.5	0.0	0.0	0.0	1749.5
7-Apr-46	Sunday	91.89	1,231.3	0.0	0.0	0.0	1231.3

This energy block allocation procedure was applied to the RESSIM model output to transform daily energy production into energy blocks. Table 3-3 are the average annual energy blocks for the Base Case.

Table 3-3. Annual Average Monthly Energy Blocks for Allatoona Lake under the Base2018

	On-Peak Hours (contract)	On-Peak Hours (non-contract)	Off-Peak Hours	Off-Peak Hours
	Weekday	Weekday	Weekday	Weekday
	MWH	MWH	MWH	MWH
Jan	6,814	712	643	2,691
Feb	6,162	640	566	2,513
Mar	7,548	941	806	3,385
Apr	5,631	2,179	830	2,868
May	6,780	1,423	388	2,635
Jun	6,001	322	39	1,051
Jul	6,356	355	84	563
Aug	5,788	165	58	156
Sep	3,658	301	106	665
Oct	3,935	170	195	459
Nov	5,487	221	118	1,259
Dec	9,445	605	444	3,356

3.2 Study Alternative's Annual Energy

Table 3-4. Individual Plant and ACT System Energy – Water Supply Alternatives

Alternatives > Projects V		Base2018	BaseCap	FWOP	A03_WS1	A04_WS2	A05_WS3	A06_WS4	A08_WS6
ALLATOONA	Federal	107,554	107,910	106,508	104,764	104,756	105,693	112,221	105,686
CARTERS	Federal	659,603	659,601	659,601	659,601	659,601	659,601	659,601	659,601
MILLERS FERRY	Federal	327,871	327,955	327,864	327,771	327,751	327,951	328,723	327,932
RF HENRY	Federal	267,636	267,693	267,580	267,467	267,478	267,526	268,927	267,537
Federal	**subtotal**	**1,362,664**	**1,363,160**	**1,361,553**	**1,359,595**	**1,360,523**	**1,367,299**	**1,369,471**	**1,360,756**
HARRIS	non-Federal	191,251	191,250	191,249	191,252	191,251	191,253	191,253	191,253
HN HENRY	non-Federal	200,935	201,036	200,892	200,607	200,601	200,641	201,952	200,627
JORDAN	non-Federal	277,597	277,621	277,514	277,443	277,448	277,374	276,206	277,384
LAY	non-Federal	650,366	650,615	650,304	649,570	649,555	649,691	652,439	649,666
LOGAN MARTIN	non-Federal	425,101	425,278	424,993	424,444	424,435	424,501	426,116	424,487
MARTIN	non-Federal	417,220	417,217	417,220	417,227	417,225	417,221	417,197	417,212
MITCHELL	non-Federal	550,016	550,193	549,942	549,401	549,393	549,405	550,918	549,403
THURLOW	non-Federal	273,720	273,720	273,720	273,732	273,731	273,316	273,704	273,715
WALTER-BOULDIN	non-Federal	847,320	847,667	847,227	846,259	846,234	846,471	850,548	846,410
WEISS	non-Federal	200,742	200,850	200,681	200,352	200,343	200,441	201,422	200,435
YATES	non-Federal	159,796	159,796	159,794	159,801	159,901	159,791	159,782	159,791
non-Federal	**subtotal**	**4,194,064**	**4,195,243**	**4,193,537**	**4,190,087**	**4,190,016**	**4,190,494**	**4,201,536**	**4,190,382**
System	**TOTAL**	**5,556,728**	**5,558,402**	**5,555,090**	**5,549,690**	**5,549,602**	**5,551,266**	**5,571,007**	**5,551,137**

*Units in MWH per year

Table 3-5. Individual Plant and ACT System Energy – Modified Flood Operations Alternatives

<u>Alternatives</u> > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS1MF	A13_WS3MF
ALLATOONA	Federal	106,508	104,756	105,686	104,764	105,693
CARTERS	Federal	659,601	659,601	659,601	659,601	659,601
HARRIS	non-Federal	191,254	191,255	191,255	191,254	191,255
HN HENRY	non-Federal	199,980	199,668	199,686	199,673	199,683
JORDAN	non-Federal	275,028	274,938	274,902	274,931	274,928
LAY	non-Federal	647,718	646,975	646,993	646,993	647,042
LOGAN MARTIN	non-Federal	427,838	427,276	427,282	427,282	427,326
MARTIN	non-Federal	417,193	417,191	417,194	417,187	417,211
MILLERS FERRY	Federal	326,674	326,509	326,653	326,617	326,740
MITCHELL	non-Federal	547,550	546,998	547,007	547,005	547,014
RF HENRY	Federal	266,636	266,491	266,576	266,507	266,584
THURLOW	non-Federal	273,753	273,756	273,748	273,755	273,755
WALTER-BOULDIN	non-Federal	843,352	842,350	842,494	842,392	842,535
WEISS	non-Federal	202,114	201,768	201,878	201,775	201,885
YATES	non-Federal	159,814	159,816	159,812	159,815	159,816
non-Federal	**subtotal**	**4,185,593**	**4,181,991**	**4,182,251**	**4,182,063**	**4,182,450**
System	**TOTAL**	**5,545,013**	**5,539,348**	**5,540,766**	**5,539,553**	**5,541,069**

3.3 Energy Prices

Energy prices can significantly change hourly, daily, and seasonally. Therefore, to estimate lost hydropower energy value, the energy price forecast must consider when hydropower energy value will be lost and the variability of the associated energy price.

3.3.1 Locational Marginal Pricing (LMP)

For this study we assume the energy prices for the ACT River Basin are best estimated using Locational Marginal Pricing (LMP) of the Southern Company energy market hub reported in the SERC Southeastern sub-region.

LMP is a computational technique that determines an hourly shadow price for an additional megawatt-hour of demand. The Historical LMP values for the Southern Company hub were downloaded from the Midcontinent Independent System Operator, Inc. (MISO) website.

LMP provides historical pricing, so the data was utilized in combination with information from the Energy Information Administration (EIA) to develop an energy price forecast.

3.3.2 Energy Price Forecast

The Energy Information Administration (EIA) publishes an Annual Energy Outlook (AEO) that includes thirty years of forecasted electricity costs for different electric market sub-regions organized by the three cost categories of generation, transmission and distribution. The forecasted values encompass a wide range of assumptions, including a Reference Case that is used for calculating energy value in this study. The AEO also lists actual electricity prices for a historical year. The EIA generation forecast for the SERC Southeastern sub-region of the electric market module (EMM) was used in the development of the LMP forecast values for this study.

3.3.3 Shaping Ratio

The EIA forecast energy prices are transformed to LMP forecast energy prices through the use of shaping ratios. The shaping ratios are computed in the following procedure.

To shape the values the following ratio is assumed:

$$\frac{LMP_{Future}}{LMP_{Past}} = \frac{EIA\_Generation_{Future}}{EIA\_Generation_{Past}}$$

This can be rewritten as:

$$LMP_{Future} = EIA\_Generation_{Future} * \frac{LMP_{Past}}{EIA\_Generation_{Past}}$$

Future LMP values can then be computed by the product of the EIA generation forecast and a shaping ratio defined as:

$$ShapingRatio = \frac{LMP_{Past}}{EIA\_Generation_{Past}}$$

These shaping ratios are defined to reflect the daily and seasonal variability of the daily generation blocks in Table 3-1. To replicate this schedule, daily historical LMP values are sorted from high to low and divided into three blocks, with the highest LMP values associated with the on-peak weekday hours, and the lowest LMP values associated with the weekend off-peak hours. Seasonal variability is taken into account by computing shaping ratios for each month. These shaping ratios are computed as averages among days with like generation block (weekday/weekend) and months:

$$ShapingRatio(month, generation\_block) = Average\left(\frac{LMP_{Past}(month, generation\_block, year)}{EIA\_Generation_{Past}(year)}\right)$$

This produces the following equation to estimate LMP forecasts for the daily energy blocks described in Table 3-6 for each month.

$$LMP_{Future}(generation\_block, month) = EIA\_Generation_{Future} * ShapingRatio(generation\_block, month)$$

Table 3-6. Shaping Factors

	On-Peak Hours (contract)	On-Peak Hours (non-contract)	Off-Peak Hours	
	Weekdays			Weekends
January	0.473751	0.376322	0.322503	0.344950
February	0.362913	0.298967	0.245991	0.292730
March	0.365837	0.303617	0.224593	0.280336
April	0.492236	0.394892	0.257294	0.320353
May	0.532180	0.383469	0.233514	0.318436
June	0.619715	0.420258	0.253566	0.381268
July	0.646630	0.445351	0.280607	0.388363
August	0.538627	0.384729	0.262246	0.351247
September	0.548345	0.383078	0.249688	0.335886
October	0.552511	0.410040	0.283738	0.393701
November	0.540467	0.427261	0.338400	0.385549
December	0.494269	0.394246	0.322543	0.401079

3.3.4 EIA Long Term Forecast

Figure 3-1 depicts the 2019 EIA reference case generation cost forecast for the SERC Southeast sub-region. The average annual energy value based upon the EIA 30-year price forecast is amortized to a single number using the current federal discount rate of 2.875%.

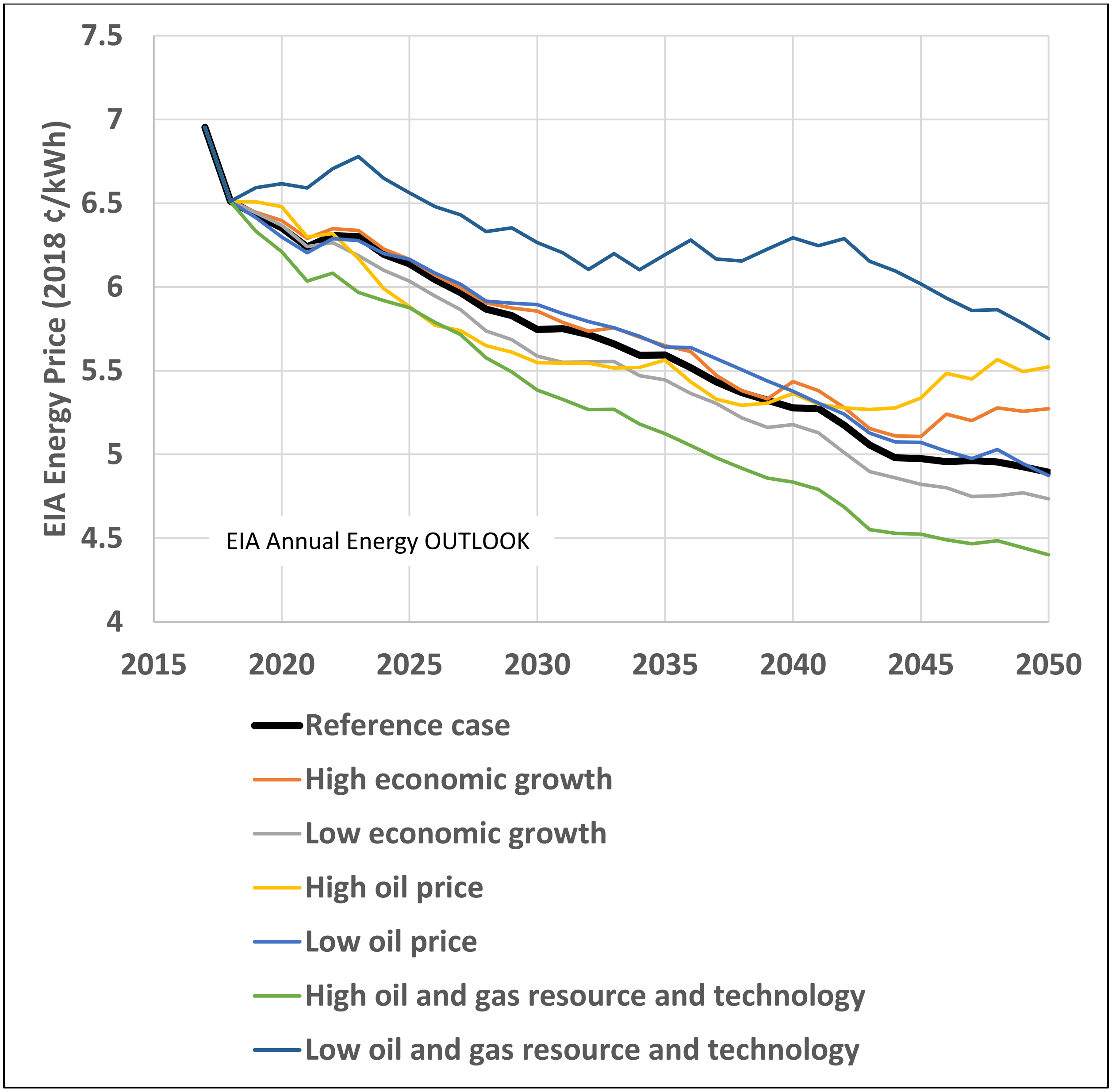


Figure 3-1. EIA Generation Cost forecast for SERC Southeast Sub-region

3.3.5 Energy Price Sensitivity

The 2019 EIA Energy Price Forecast included a number scenarios that influence the Energy Price Forecast. These 2019 scenarios were amortized to show the possible range or variability due to a number of factors that influence 2019 EIA Energy Price forecast. Table 3-7 shows the possible magnitude of variability, or sensitivity in energy forecast values. The Reference Case is used for this study.

Table 3-7. Energy Price Sensitivity to 2019 Forecast Scenarios

EIA Price Forecast Scenarios	Annual Energy Price (Resl $/MWh)	Referance Case Deviation
Low oil and gas resource and technology	$6.34	10.59%
High economic growth	$5.87	2.33%
High oil price	$5.85	2.09%
Low oil price	$5.77	0.58%
Reference case	$5.73	---
Low economic growth	$5.62	-2.02%
High oil and gas resource and technology	$5.37	-6.29%

Federal Interest Rate 2.875%
Period of Years 50
[EIA Annual Energy OUTLOOK]

3.3.6 Energy Prices - Reference Case

The amortized value (long-term) for the current 2019 EIA Reference Case of $57.65/MWh is then multiplied by the daily shaping factors for each generation block (weekday/weekend) for the daily energy prices (LMP) for each month. These energy prices were applied to the Average Annual Energy blocks (Base2018 in Table 3-3).

Table 3-8. Block Energy Prices ($2019)

Month	Southern Co Energy Prices (2019$)			
	On-Peak Hours (contract)	On-Peak Hours (non-contract)	Off-Peak Hours	
	Weekday			Weekend
January	$27.15	$21.57	$18.48	$19.77
February	$20.80	$17.14	$14.10	$16.78
March	$20.97	$17.40	$12.87	$16.07
April	$28.21	$22.63	$14.75	$18.36
May	$30.50	$21.98	$13.38	$18.25
June	$35.52	$24.09	$14.53	$21.85
July	$37.06	$25.53	$16.08	$22.26
August	$30.87	$22.05	$15.03	$20.13
September	$31.43	$21.96	$14.31	$19.25
October	$31.67	$23.50	$16.26	$22.57
November	$30.98	$24.49	$19.40	$22.10
December	$28.33	$22.60	$18.49	$22.99

3.4 Energy Value

Although all plants in this system are defined as peaking plants the actual hydropower operations of the individual power plants can vary significantly. For example, some plants may turn completely off and then back on again during peak demand periods, while others may have a minimum flow requirement that constantly generates a small amount of electricity with a maximum generation occurring during peak demand periods. Unfortunately, the detailed hourly generation information required from each plant to determine the daily peak and off peak percentage of total generation is not available. To calculate the energy value, the method assumes that plants will operate to maximize energy; that is, to generate the maximum amount of energy during periods of peak demand.

Table 3-9. Individual Plant and ACT System Energy Value – Water Supply Alternatives

Alternatives > **Projects V**		**Base2018**	**BaseCap**	**FWOP**	**A03_WS1**	**A04_WS2**	**A05_WS3**	**A06_WS4**	**A08_WS6**
ALLATOONA	Federal	$2,798,856	$2,809,182	$2,774,994	$2,726,580	$2,725,766	$2,754,460	$2,964,617	$2,753,646
CARTERS	Federal	$18,923,780	$18,923,710	$18,923,710	$18,923,710	$18,923,710	$18,923,710	$18,923,710	$18,923,710
MILLERS FERRY	Federal	$8,010,343	$8,012,540	$8,010,476	$8,007,748	$8,007,197	$8,012,265	$8,029,824	$8,011,968
RF HENRY	Federal	$6,614,757	$6,616,692	$6,614,046	$6,610,772	$6,611,094	$6,612,731	$6,643,416	$6,613,056
Federal	**subtotal**	**$36,347,736**	**$36,362,125**	**$36,323,227**	**$33,542,231**	**$36,267,767**	**$36,303,166**	**$36,543,567**	**$36,302,380**
HARRIS	non-Federal	$4,827,088	$4,827,062	$4,826,838	$4,826,846	$4,826,700	$4,827,152	$4,828,992	$4,827,192
HN HENRY	non-Federal	$4,780,779	$4,783,367	$4,780,153	$4,772,799	$4,772,638	$4,773,862	$4,798,503	$4,773,626
JORDAN	non-Federal	$6,677,094	$6,677,665	$6,675,459	$6,673,885	$6,673,994	$6,672,128	$6,645,794	$6,672,433
LAY	non-Federal	$15,220,398	$15,227,083	$15,220,263	$15,202,267	$15,201,539	$15,205,917	$15,251,580	$15,205,038
LOGAN MARTIN	non-Federal	$10,051,710	$10,056,510	$10,056,073	$10,036,309	$10,035,824	$10,038,434	$10,067,467	$10,037,879
MARTIN	non-Federal	$10,345,042	$10,346,206	$10,345,042	$10,345,586	$10,345,459	$10,345,880	$10,351,852	$10,345,876
MITCHELL	non-Federal	$12,926,416	$12,931,186	$12,925,421	$12,911,977	$12,911,548	$12,912,693	$12,937,150	$12,912,372
THURLOW	non-Federal	$6,636,499	$6,636,569	$6,635,776	$6,636,323	$6,636,242	$6,636,420	$6,636,450	$6,636,306

WALTER-BOULDIN	non-Federal	$19,430,198	$19,439,579	$19,429,401	$19,405,367	$19,404,268	$19,411,552	$19,487,999	$19,409,723
WEISS	non-Federal	$4,925,009	$4,927,949	$4,924,083	$4,915,269	$4,915,112	$4,917,587	$4,939,114	$4,917,589
YATES	non-Federal	$3,872,811	$3,872,858	$3,872,345	$3,872,671	$3,872,623	$3,872,738	$3,874,560	$3,872,676
non-Federal	**subtotal**	**$99,693,044**	**$99,726,035**	**$99,684,854**	**$99,599,299**	**$99,595,946**	**$99,614,364**	**$99,822,461**	**$99,610,708**
System	**TOTAL**	**$136,040,780**	**$136,088,161**	**$136,008,082**	**$136,141,530**	**$136,863,713**	**$136,917,530**	**$136,366,029**	**$136,913,088**

NEXT PAGE - Individual Plant and ACT System Energy Value – APC Modified Flood Management Plan

Table 3-10. Individual Plant and ACT System Energy Value – APC Modified Flood Management Alternatives

Alternatives > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS6MF	A13_WS1MF
ALLATOONA	Federal	$2,774,994	$2,725,766	$2,753,646	$2,726,580	$2,754,460
CARTERS	Federal	$18,923,710	$18,923,710	$18,923,710	$18,923,710	$18,923,710
MILLERS FERRY	Federal	$7,978,320	$7,974,232	$7,977,722	$7,976,875	$7,979,883
RF HENRY	Federal	$6,586,316	$6,582,491	$6,584,769	$6,583,063	$6,585,330
Federal	**subtotal**	**$36,263,342**	**$36,206,199**	**$36,239,848**	**$36,210,229**	**$36,243,384**
HARRIS	non-Federal	$4,824,344	$4,824,462	$4,824,717	$4,824,439	$4,824,678
HN HENRY	non-Federal	$4,751,628	$4,743,767	$4,744,254	$4,743,933	$4,744,404
JORDAN	non-Federal	$6,627,187	$6,625,071	$6,624,386	$6,624,926	$6,624,836
LAY	non-Federal	$15,134,169	$15,115,448	$15,116,269	$15,116,269	$15,118,620
LOGAN MARTIN	non-Federal	$10,084,065	$10,069,676	$10,070,042	$10,070,042	$10,071,950
MARTIN	non-Federal	$10,334,649	$10,334,332	$10,335,251	$10,334,563	$10,335,376
MITCHELL	non-Federal	$12,854,427	$12,840,492	$12,841,539	$12,840,914	$12,841,878
THURLOW	non-Federal	$6,630,486	$6,630,683	$6,630,912	$6,630,888	$6,630,117
WALTER-BOULDIN	non-Federal	$19,304,500	$19,278,886	$19,284,328	$19,280,308	$19,285,392
WEISS	non-Federal	$4,956,007	$4,946,973	$4,949,787	$4,947,245	$4,950,091
YATES	non-Federal	$3,869,225	$3,869,335	$3,869,502	$3,869,413	$3,869,582
non-Federal	**subtotal**	**$99,370,686**	**$99,279,126**	**$99,290,986**	**$99,282,941**	**$99,297,923**
System	**TOTAL**	**$135,634,027**	**$135,485,325**	**$135,530,834**	**$135,493,170**	**$135,541,307**

4 Capacity & Capacity Value

Capacity value is defined as the product of the change in dependable capacity and a capacity unit value, representing the capital cost of constructing replacement thermal generating plant capacity for the lost hydropower.

4.1 Dependable Capacity

The dependable capacity of a hydropower project is a measure of the amount of capacity that the project can reliably contribute towards meeting system peak power demands. If a hydropower project always maintains approximately the same head, and there is always an adequate supply of stream flow so that there is enough generation for the full capacity to be usable in the system load, the full installed generator capacity can be considered dependable. In some cases even the overload capacity is dependable.

At storage projects, normal reservoir drawdown can result in a reduction of capacity due to a loss in head. At other times, diminished stream flows during low flow periods may result in insufficient generation to support the available capacity in the load. Dependable capacity accounts for these factors by giving a measure of the amount of capacity that can be provided with some degree of reliability during peak demand periods.

4.1.1 Basis for Dependable Capacity Calculation Method

Dependable capacity can be computed in several ways. The method that is most appropriate for evaluating the dependable capacity of a hydropower plant in a predominantly thermal generating plant-based power system, like the ACT River Basin, is the Average Availability Method.

This method is described in Section 6-7g of EM 1110-2-1701, Hydropower, dated 31 December 1985.

The occasional unavailability of a portion of a hydropower project's generating capacity due to hydrologic variations should be treated in the same manner as the occasional unavailability of all or part of a thermal generating plant's generating capacity due to forced outages.

In order to evaluate the average dependable capacity for a project, a long-term record of project operation must be used. Actual project operating records would be most desirable; however, certain factors may preclude the use of these records. The period of operation may not be long enough to give a statistically reliable value. Furthermore, operating changes may have occurred over the life of the project, which would make actual data somewhat inconsistent. In order to assure the greatest possible consistency in this calculation, the fifty-year RESSIM model simulation for the ACT River Basin was used.

4.1.2 Dependable Capacity Calculation Procedure

The dependable capacity calculation procedure for the ACT River Basin projects begins with approximating each project’s contribution (weekly hours operating on peak) in meeting the system capacity requirements demand for the regional critical year.

- This contribution estimate is determined by first calculating each project's weekly average (generation) energy produced (MWh) for the peak demand months of mid-May through mid-September of 1981, the critical year from the RESSIM baseline model run. This number is then divided by SEPA's defined marketable capacity[1] (MW). This gives an estimate of the required/expected weekly hours (H) on peak for each project (Table 4-1).

Table 4-1. Project's Capability

Plant	Owner	Average Weekly Energy (critical period of 1981) (MWh)	Capacity (MW)	Average Weekly Generation (critical period) (hours)
Weiss Dam	Alabama Power Company	2,414.01	81	29.8
H. Neely Henry	Alabama Power Company	2,076.26	70	29.7
Logan Martin	Alabama Power Company	3,648.24	135	27.0
Martin	Alabama Power Company	3,192.34	186	17.2
Lay	Alabama Power Company	5,813.83	180	32.3
Mitchell	Alabama Power Company	4,358.50	166	26.3
Jordan	Alabama Power Company	3,578.86	100	35.8
Walter Bouldin	Alabama Power Company	4,794.22	225	21.3
Harris	Alabama Power Company	1,879.97	132	14.2
Yates	Alabama Power Company	1,448.38	47	30.8
Thurlow	Alabama Power Company	2,460.48	78	31.5
RF Henry	USACE	3,836.27	82	46.8
Millers Ferry	USACE	5,034.17	90	55.9
Allatoona	USACE	991.43	72	13.8
Carters	USACE	11,864.74	575	20.6

Note: SEPA marketable capacity used for USACE plants

- Next, each project's weekly average energy produced (MWh) during the peak demand months was calculated for each simulated year.

- Dividing these values by each project's required/expected weekly average hours (H) on peak determined in the previous step, yields an array of yearly supportable capacity values.

- The average across the array is each project's supportable capacity is the dependable capacity. (illustrated in Table 4-2)

[1] Coordination with SEPA confirmed marketable capacity values for the Corps hydropower plants and the critical water year of 1981. Installed capacity was assumed for all non-Corps plants

Table 4-2. Dependable Capacity by the Average Availability Method (Base2018)

Year	Annual Critical Period			
	Average Weekly Energy (MWh)	**Potential Supportable Capacity (MW)**	**Machine Capability (MW)**	**Actual Supportable Capacity (MW)**
1939	1,501.15	108.78	81.689	81.689
1940	1,398.89	101.37	82.133	82.133
1941	1,180.87	85.57	81.171	81.171
1942	1,344.17	97.40	81.864	81.864
1943	1,725.72	125.05	82.069	82.069
1944	1,693.29	122.70	81.772	81.772
1945	1,410.03	102.18	81.754	81.754
1946	2,570.70	186.28	81.279	81.279
1947	1,240.05	89.86	81.540	81.540
1948	2,177.03	157.76	82.245	82.245
1949	2,870.93	208.04	82.019	82.019
1950	1,626.02	117.83	81.956	81.956
1951	1,225.11	88.78	81.237	81.237
1952	1,450.72	105.12	81.609	81.609
1953	1,227.99	88.98	81.015	81.015
1954	990.86	71.80	80.804	71.801
---	---	---	---	---
---	---	---	---	---
---	---	---	---	---
2001	1,723.68	124.90	81.653	81.653
2002	687.21	49.80	79.612	49.798
2003	3,627.60	262.87	81.475	81.475
2004	1,316.63	95.41	81.741	81.741
2005	2,947.44	213.58	82.009	82.009
2006	647.39	46.91	80.154	46.912
2007	343.71	24.91	77.739	24.907
2008	478.24	34.65	79.808	34.655
2009	958.25	69.44	80.853	69.439
2010	1,384.01	100.29	81.366	81.366
2011	720.32	52.20	80.189	52.197
			Dependable Capacity	**75.618**

4.1.3 Alternative's Dependable Capacity

This process is repeated for Base2018 and alternative water control operations using the RESSIM model runs. The average dependable capacity difference between the flow scenarios and Base2018 is the gain or loss in dependable capacity caused by changes in water control operations. Results are shown in Table 5.

Table 4-3. Individual Plant Dependable Capacity – Water Supply Alternatives

Alternatives > **Projects V**		**Base2018**	**BaseCap**	**FWOP**	**A03_WS1**	**A04_WS2**	**A05_WS3**	**A06_WS4**	**A08_WS6**
ALLATOONA	Federal	75.6	75.8	75.7	74.8	74.7	76.1	77.8	76.0
CARTERS	Federal	587.9	587.0	587.0	587.0	587.0	587.0	587.0	587.0
MILLERS FERRY	Federal	95.9	87.1	87.1	87.1	87.1	87.2	87.3	87.2
RF HENRY	Federal	81.8	75.9	75.9	75.9	75.9	76.0	76.1	76.0
Federal	**subtotal**	**832.1**	**825.8**	**825.7**	**824.8**	**824.7**	**826.2**	**828.1**	**826.1**
HARRIS	non-Federal	130.8	125.0	125.0	125.1	125.1	125.0	124.9	125.0
HN HENRY	non-Federal	58.9	56.8	56.8	56.8	56.8	56.8	57.0	56.8
JORDAN	non-Federal	104.8	104.8	104.8	104.8	104.8	104.8	104.8	104.8
LAY	non-Federal	165.5	159.4	159.4	159.3	159.3	159.5	159.8	159.9
LOGAN MARTIN	non-Federal	134.6	127.4	127.3	127.3	127.3	127.5	128.0	127.5
MARTIN	non-Federal	183.8	180.6	180.7	183.8	180.7	183.8	180.6	183.8
MITCHELL	non-Federal	167.5	159.4	159.4	159.3	159.3	159.5	160.0	159.5
THURLOW	non-Federal	78.5	76.8	76.8	76.8	76.9	76.8	76.7	76.9
WALTER-BOULDIN	non-Federal	228.3	210.0	209.8	209.7	209.7	210.2	211.4	210.1
WEISS	non-Federal	71.3	71.3	71.3	71.2	71.2	71.4	71.8	71.3
YATES	non-Federal	45.8	44.9	44.9	44.9	44.9	44.9	44.9	44.9
non-Federal	**subtotal**	**1,369.8**	**1,316.4**	**1,316.3**	**1,319.1**	**1,316.0**	**1,320.2**	**1,319.9**	**1,320.2**
System	**TOTAL**	**2,202.0**	**2,142.3**	**2,142.0**	**2,144.0**	**2,140.7**	**2,146.4**	**2,147.9**	**2,146.3**

Table 4-4. Individual Plant Dependable Capacity – Modified Flood Operations Alternatives

Alternatives > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS1MF	A13_WS3MF
ALLATOONA	Federal	75.7	74.7	76.0	74.8	76.1
CARTERS	Federal	587.0	587.0	587.0	587.0	587.0
MILLERS FERRY	Federal	87.1	87.1	87.2	87.1	87.2
RF HENRY	Federal	75.9	75.9	75.9	75.9	75.9
Federal	**subtotal**	**825.7**	**824.7**	**826.1**	**824.8**	**826.1**
HARRIS	non-Federal	125.1	125.1	125.1	125.1	125.1
HN HENRY	non-Federal	56.8	56.7	56.8	56.7	56.8
JORDAN	non-Federal	104.8	104.8	104.9	104.8	104.9
LAY	non-Federal	159.3	159.2	159.2	159.2	159.4
LOGAN MARTIN	non-Federal	127.3	127.2	127.2	127.2	127.3
MARTIN	non-Federal	183.8	183.8	183.8	183.8	183.8
MITCHELL	non-Federal	159.3	159.2	159.4	159.2	159.4
THURLOW	non-Federal	76.9	76.8	76.9	76.8	76.8
WALTER-BOULDIN	non-Federal	209.6	209.3	209.7	209.3	209.8
WEISS	non-Federal	71.1	71.1	71.2	71.1	71.2
YATES	non-Federal	45.0	44.9	44.9	44.9	44.9
non-Federal	**subtotal**	**1,318.9**	**1,318.2**	**1,319.0**	**1,318.3**	**1,319.3**
System	**TOTAL**	**2,144**	**2,142.9**	**2,145.1**	**2,143.1**	**2,145.5**

4.2 Capacity Unit Value Calculation

Capacity unit values represent the capital cost and the fixed O&M cost of the most likely thermal generation alternative that would carry the same increment of load as the proposed hydropower project or modification. As discussed below in the screening curve analysis description, the cost effectiveness of the different thermal resources depends on how and when the resource is used. For example, coal fired plants may be used to replace a base loading hydropower plant while a gas fired turbine plant may be used to replace a peaking hydropower operation. A gas fired combined cycle plant would be used in an intermediate mode of load-following. In this section the process of determining the least costly, most likely combination of thermal generating resources, which would replace lost hydropower, is described. Also, the method calculating the capacity unit value is presented.

4.2.1 Typical Hourly System Generation

To establish the most likely thermal generation alternative, an analysis of how hydropower is currently dispatched/operated in the regional power system. The goal of this analysis is to show how much capacity can be defined as base load, how much can be defined as intermediate load, and how much can be defined as peaking. Typically the process of computing a capacity value is done on a plant by plant basis, however the necessary data, hourly generation for a typical year was only available for the four USACE plants. In this regard, a total system typical hourly generation exceedance curve is developed.

Production of the total system exceedance chart is based on two assumptions;

- The non-USACE plants acted similar in operation to the four USACE plants.

  This assumption is reasonable since the non-Corps plants are similarly defined as peaking plants like the USACE facilities.

- The USACE hydropower plants' typical year occurred concurrently.

With these assumptions the typical hourly generations for the USACE plants were combined and then divided by nameplate capacity of all four USACE plants. This allows for an exceedance curve for percent of nameplate capacity. (Figure 4-1). This can then be made to represent the entire system by simply multiplying the y-axis in Figure 4-1 by the total system capacity of ACT system.(Figure 8)

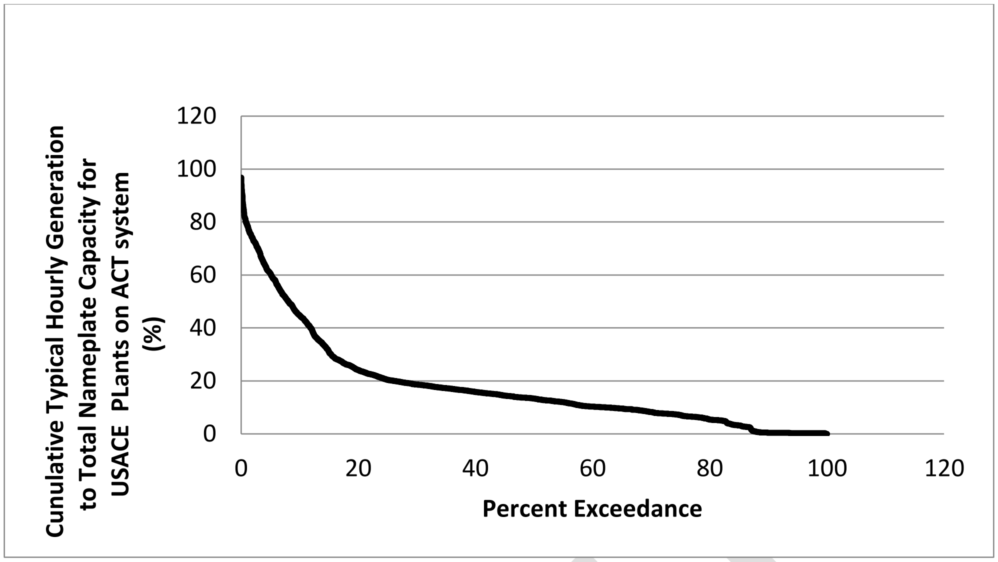


Figure 4-1. Percent of Nameplate capacity exceedance chart for USACE plants

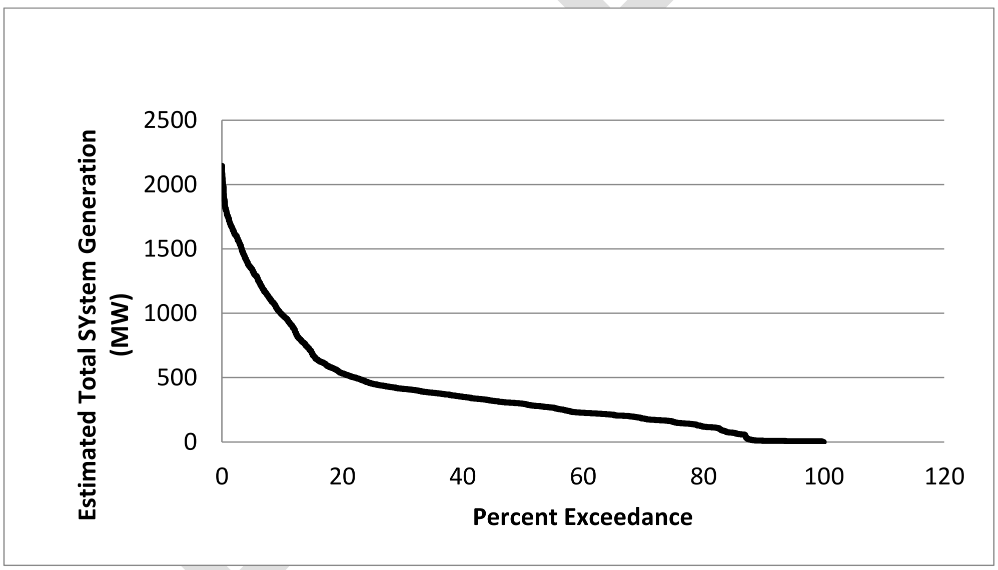


Figure 4-2. Load duration curve for ACT watershed hydropower system

4.2.2 Screening Curve Analysis

A screening curve is a plot of annual total plant costs for a thermal generating plant [fixed (capacity) cost plus variable (operating) cost] versus annual plant factor (PF). When this is applied to multiple types of thermal generation resources, the screening curve provides an algebraic way to show which type of thermal generation is the least cost alternative for each plant factor range.

The screening curve assumes a linear function defined by the following equation:

$$AC = CV + (EV * 0.0876 * PF)$$

where: AC = annual thermal generating plant total cost ($/kW-year)
CV = thermal generating plant capacity cost ($/KkW-year)
EV = thermal generating plant operating cost ($/MWh)

4.2.2.1 Plant Capacity Cost

Plant capacity cost for coal-fired steam, gas-fired combined cycle and gas-fired combustion turbine plants were computed using procedures developed by the Federal Energy Regulatory Commission (FERC). Capacity values were computed for the states in the SEPA region (AL,GA,MS,FL) based on a 2-7/8 percent interest rate and 2019 price levels. Adjusted capacity values are shown in Table 4-5. The adjusted capacity values incorporate adjustments to account for differences in reliability and operating flexibility between hydropower and thermal generating power plants. See EM 1110-2-1701, Hydropower, Section 9-5c for further discussion of the capacity value FERC adjustments.

4.2.2.2 Plant Operating Costs

Operating costs for coal-fired steam, gas-fired combined cycle and gas-fired combustion turbine plants were developed using information obtained from the publication EIA Electric Power Monthly (DOE/EIA-0226) and other sources. The information obtained included fuel costs, heat rates and variable O&M costs. The resulting values, based on 2019 price levels, are shown in Table 4-5. Since current Corps of Engineers policy does not allow the use of real fuel cost escalation, these values were assumed to apply over the entire period of analysis.

Table 4-5. Adjusted Capacity and Operating Costs for SEPA Region

State	CO		CC		CT	
	Capacity $/KW-yr	Energy $/MWh	Capacity $/KW-yr	Energy $/MWh	Capacity $/KW-yr	Energy $/MWh
Alabama	$311.48	$23.53	$139.84	$25.53	$118.70	$37.58
Georgia	$311.61	$27.54	$139.84	$28.87	$118.70	$42.70
Mississippi	$311.59	$27.09	$139.84	$24.59	$118.70	$36.15
Florida	$311.66	$28.95	$139.84	$32.84	$118.70	$48.79
Average	**$311.56**	**$26.06**	**$139.84**	**$26.33**	**$118.70**	**$38.81**

4.2.2.3 Screening Curve

The plot for each thermal generation type was developed by computing the annual plant cost for various plant factors ranging from zero to 100 percent. The plots are shown in the lower portion of Figure 4-3.

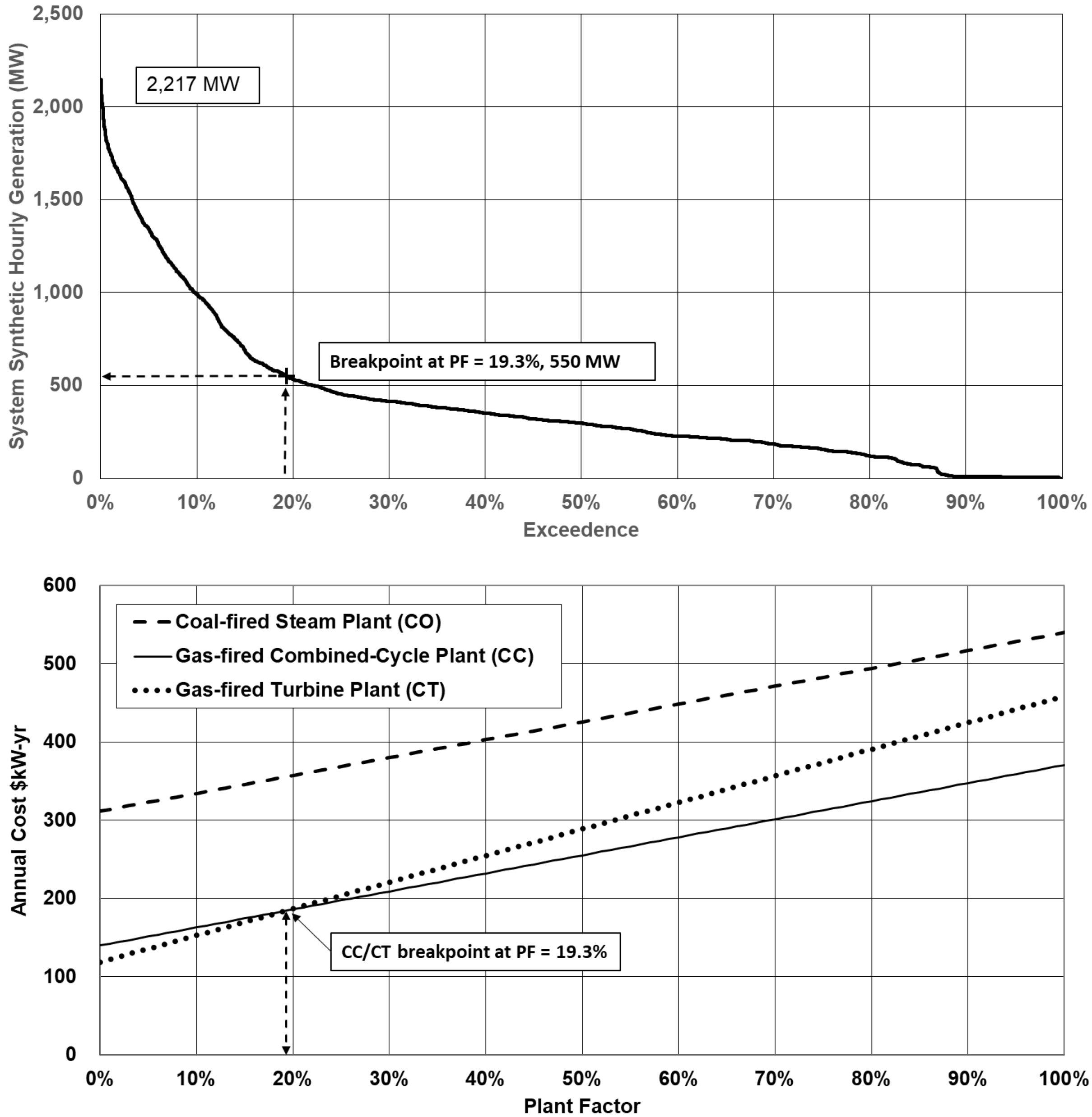


Figure 4-3. Screening Curve for Thermal Generating Plant Types in the SEPA Region

4.2.2.4 Interpretation

The Screening Curve shows that the gas-fired combustion turbine plant type is the least expensive for plants operating less than 19.3% of the time, while plant operating more of the time the gas-fire combined cycle plant is the least expensive. The maximum system operating capacity is shown as 2,217 MW, of that total system capacity up to 550 MW would operate more than 19.3% of time and the least cost operation plant type would be gas-fired combined cycle plant type. The remaining system capacity of 1,667 MW runs less than 19.3% of time and the least cost thermal generating plant type would be the gas-fired combustion plant type.

The most likely least cost combination of thermal generating plant types that could be used to replace the system hydropower would be 1,667 MW of gas-fired combustion turbine plant type and 550 MW of gas-fired combined cycle plant type.

4.2.3 Composite Capacity Unit Value

The process for calculating the composite unit capacity value for the ACT River Basin system is described by the following algorithm;

- From the screening curve, determine the "breakpoints" (the plant factors at which the least cost plant type changes).
- Find the points on the generation-duration curve where the percent of time generation is numerically identical to the plant factor breakpoints defined in the preceding step; these intersection points define the portion of the generation that would be carried by each thermal generation plant type.
- Calculate percent of total generating capacity for each thermal alternative using the portions defined in the prior step above.
- Calculate the composite unit capacity of the system as an average of each the thermal alternative's capacity cost weighted by their percent of total generating capacity defined in the prior step.

The composite unit capacity values are computed for ACT river basin system is calculated in Table 4-6

Table 4-6. Composite Unit Capacity Value for ACT system

Thermal Generating Plant Type	**Capacity MW**	**Proportion %**	Plant Type **Cost $/kW-yr**	Proportion **of Cost $/kW-yr**
Combustion Turbine	1,667	75.19%	$118.70	$89.25
Combined Cycle	550	24.81%	$139.84	$34.69
System Total	2,217	100.00%		$123.95

Estimated Replacement Generation Dependable Capacity Value is $123.95/kW-yr.

The value of capacity for each alternative is determined by multiplying the dependable capacity for each alternative in Tables 4-3 and 4-4 by the composite unit capacity value in Table 4-6. The value of capacity under each alternative is listed in Tables 4-7 and 4-8 below.

Table 4-7. Value of Individual Plant Dependable Capacity – Water Supply Alternatives

Alternatives > **Projects V**		**Base2018**	**BaseCap**	**FWOP**	**A03_WS1**	**A04_WS2**	**A05_WS3**	**A06_WS4**	**A08_WS6**
ALLATOONA	Federal	$9,372,583	$9,397,236	$9,380,919	$9,272,351	$9,261,517	$9,430,648	$9,639,658	$9,422,583
CARTERS	Federal	$72,752,236	$72,752,058	$72,752,058	$72,752,058	$72,752,058	$72,752,058	$72,752,058	$72,752,058
MILLERS FERRY	Federal	$10,799,329	$10,800,433	$10,799,286	$10,801,058	$10,800,586	$10,803,973	$10,815,615	$10,803,975
RF HENRY	Federal	$9,409,426	$9,410,520	$9,408,717	$9,410,158	$9,409,777	$9,414,445	$9,428,567	$9,414,395
Federal	**subtotal**	**$102,333,574**	**$102,333,574**	**$102,333,574**	**$102,333,574**	**$102,333,574**	**$102,333,574**	**$102,333,574**	**$102,333,574**
HARRIS	non-Federal	$15,496,976	$15,496,740	$15,498,613	$15,502,609	$15,502,998	$15,496,898	$15,486,363	$15,498,190
HN HENRY	non-Federal	$7,039,300	$7,041,904	$7,040,797	$7,036,750	$7,035,873	$7,044,322	$7,064,566	$7,043,719
JORDAN	non-Federal	$12,992,560	$12,992,728	$12,992,343	$12,990,909	$12,990,888	$12,994,715	$12,991,195	$12,995,225
LAY	non-Federal	$19,752,177	$19,758,215	$19,754,565	$19,747,810	$19,745,400	$19,767,127	$19,807,014	$19,765,749
LOGAN MARTIN	non-Federal	$15,783,554	$15,788,651	$15,782,950	$15,777.923	$15,774,858	$15,798,877	$15,860,695	$15,797,992
MARTIN	non-Federal	$22,396,921	$22,386,463	$22,396,921	$22,781,356	$22,402,793	$22,781,356	$22,379,621	$22,781,356
MITCHELL	non-Federal	$19,753,603	$19,758,704	$19,753,850	$19,747,980	$19,745,665	$19,768,684	$19,826,157	$19,767,516
THURLOW	non-Federal	$9,520,054	$9,518,066	$9,520,482	$9,525,199	$9,526,509	$9,524,856	$9,509,601	$9,525,442
WALTER-BOULDIN	non-Federal	$26,009,994	$26,023,691	$26,010,027	$25,994,855	$25,988,485	$26,048,316	$26,200,342	$26,044,915

WEISS	non-Federal	$8,833,220	$8,836,283	$8,831,530	$8,827,330	$8,826,051	$8,844,231	$8,902,551	$8,843,102
YATES	non-Federal	$5,676,747	$5,565,641	$5,566,653	$5,569,055	$5,569,907	$5,570,631	$5,562,872	$5,570,680
non-Federal	**subtotal**	**$163,255,106**	**$163,167,086**	**$163,148,730**	**$163,501,776**	**$163,109,427**	**$163,640,014**	**$163,590,976**	**$163,633,886**
System	**TOTAL**	**$265,588,680**	**$265,527,334**	**$265,489,709**	**$265,737,402**	**$265,333,365**	**$266,041,138**	**$266,226,874**	**$266,026,897**

Table 4-8. Value of Individual Plant Dependable Capacity – Modified Flood Operations Alternatives

Alternatives > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS1MF	A13_WS3MF
ALLATOONA	Federal	$9,380,919	$9,261,517	$9,422,583	$9,272,351	$9,430,648
CARTERS	Federal	$72,752,058	$72,752,058	$72,752,058	$72,752,058	$72,752,058
MILLERS FERRY	Federal	$10,801,818	$10,799,927	$10,802,838	$10,800,236	$10,802,428
RF HENRY	Federal	$9,410,753	$9,408,261	$9,412,958	$9,408,685	$9,412,712
Federal	**subtotal**	**$102,345,548**	**$102,221,762**	**$102,390,437**	**$102,233,331**	**$102,397,846**
HARRIS	non-Federal	$15,505,418	$15,506,608	$15,502,957	$15,507,305	$15,499,508
HN HENRY	non-Federal	$7,035,636	$7,029,775	$7,037,657	$7,030,211	$7,038,778
JORDAN	non-Federal	$12,995,204	$12,993,506	$12,997,678	$12,993,219	$12,997,776
LAY	non-Federal	$19,746,346	$19,733,773	$19,735,243	$19,735,243	$19,752,908
LOGAN MARTIN	non-Federal	$15,773,065	$15,761,147	$15,763,640	$15,763,640	$15,783,374
MARTIN	non-Federal	$22,781,356	$22,781,356	$22,781,356	$22,781,356	$22,781,356
MITCHELL	non-Federal	$19,743,212	$19,731,553	$19,751,943	$19,733,272	$19,752,830
THURLOW	non-Federal	$9,531,089	$9,524,875	$9,526,817	$9,524,749	$9,524,811
WALTER-BOULDIN	non-Federal	$25,973,445	$25,943,333	$25,996,323	$25,947,971	$25,998,566
WEISS	non-Federal	$8,815,916	$8,809,243	$8,827,458	$8,810,410	$8,828,933
YATES	non-Federal	$5,572,066	$5,568,268	$5,570,120	$5,568,191	$5,569,227
non-Federal	**subtotal**	**$163,472,753**	**$163,383,437**	**$163,491,195**	**$163,395,568**	**$163,528,068**
System	**TOTAL**	**$265,818,301**	**$265,605,199**	**$265,881,631**	**$265,628,899**	**$265,925,914**

5 Value of Hydropower - Summary

The following tables present a summary of the total hydropower value for the alternatives of this Allatoona-Coosa Reallocation (ACR) Study. Hydropower Value is the sum of energy value and capacity value.

Table 5-1. Value of Individual Plant Dependable Capacity – Water Supply Alternatives

Alternatives > Projects V		Base2018	BaseCap	FWOP	A03_WS1	A04_WS2	A05_WS3	A06_WS4	A08_WS6
ALLATOONA	Federal	$12,171,439	$12,206,419	$12,155,913	$11,998,932	$11,987,283	$12,185,108	$12,586,275	$12,176,229
CARTERS	Federal	$91,676,016	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768
MILLERS FERRY	Federal	$18,809,672	$18,812,973	$18,809,672	$18,808,806	$18,807,783	$18,816,238	$18,845,439	$18,815,943
RF HENRY	Federal	$16,024,183	$16,027,212	$16,022,763	$16,020,930	$16,020,871	$16,027,176	$16,071,984	$16,027,451
Federal	**subtotal**	**$138,681,310**	**$138,722,373**	**$135,664,206**	**$135,777,856**	**$138,704,290**	**$139,179,466**	**$139,179,466**	**$138,695,392**
HARRIS	non-Federal	$20,324,064	$20,323,803	$20,325,451	$20,329,455	$20,329,697	$20,324,409	$20,315,354	$20,325,382
HN HENRY	non-Federal	$11,820,078	$11,825,270	$11,820,949	$11,809,549	$11,808,511	$11,818,184	$11,863,068	$11,817,345
JORDAN	non-Federal	$19,669,654	$19,670,394	$19,667,801	$19,664,794	$19,664,881	$19,666,843	$19,636,988	$19,667,658
LAY	non-Federal	$34,972,575	$34,985,298	$34,974,828	$34,950,076	$34,946,939	$34,973,044	$35,058,594	$34,970,786
LOGAN MARTIN	non-Federal	$25,835,264	$25,845,161	$25,833,023	$25,814,232	$25,810,682	$25,837,311	$25,928,163	$25,835,870
MARTIN	non-Federal	$32,741,963	$32,732,669	$32,741,963	$32,126,943	$32,748,252	$33,127,237	$32,731,473	$33,127,232
MITCHELL	non-Federal	$32,680,019	$32,689,890	$32,679,272	$32,659,957	$32,657,212	$32,681,377	$32,763,306	$32,679,888

THURLOW	non-Federal	$16,156,554	$16,154,635	$16,156,258	$16,161,523	$16,162,752	$16,161,276	$16,149,051	$16,161,748
WALTER-BOULDIN	non-Federal	$45,440,193	$45,463,270	$45,439,428	$45,400,221	$45,392,754	$45,459,869	$45,688,342	$45,454,638
WEISS	non-Federal	$13,758,229	$13,764,232	$13,755,613	$13,742,600	$13,741,164	$13,761,819	$13,841,666	$13,760,691
YATES	non-Federal	$9,549,558	$9,438,499	$9,438,999	$9,441,726	$9,442,529	$9,443,368	$9,437,432	$9,443,356
non-Federal	**subtotal**	**$262,948,149**	**$262,893,121**	**$262,833,585**	**$263,101,075**	**$262,705,373**	**$263,254,378**	**$263,413,437**	**$263,244,594**
System	**TOTAL**	**$401,629,460**	**$401,615,494**	**$401,497,791**	**$398,878,931**	**$401,197,078**	**$401,958,668**	**$402,592,903**	**$401,939,986**

Table 5-2. Value of Individual Plant Dependable Capacity – Modified Flood Operations Alternatives

Alternatives > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS1MF	A13_WS3MF
ALLATOONA	Federal	$12,155,913	$11,987,283	$12,176,229	$11,998,932	$12,185,108
CARTERS	Federal	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768
MILLERS FERRY	Federal	$18,780,138	$18,774,159	$18,780,560	$18,777,111	$18,782,311
RF HENRY	Federal	$15,997,069	$15,990,752	$15,997,727	$15,991,748	$15,998,042
Federal	**subtotal**	**$138,608,889**	**$138,427,961**	**$138,630,285**	**$138,443,560**	**$138,641,230**
HARRIS	non-Federal	$20,329,762	$20,331,070	$20,327,674	$20,331,744	$20,324,186
HN HENRY	non-Federal	$11,787,264	$11,773,542	$11,781,911	$11,774,144	$11,783,182
JORDAN	non-Federal	$19,622,391	$19,618,577	$19,622,064	$19,618,146	$19,622,612
LAY	non-Federal	$34,880,515	$34,849,221	$34,851,512	$34,851,212	$34,871,529
LOGAN MARTIN	non-Federal	$25,857,129	$25,830,823	$25,833,682	$25,833,682	$25,855,324
MARTIN	non-Federal	$33,116,005	$33,115,689	$33,116,607	$33,115,919	$33,116,732
MITCHELL	non-Federal	32,597,640	$32,572,045	$32,593,482	$32,574,186	$32,594,708
THURLOW	non-Federal	$16,161,574	$16,155,558	$16,157,729	$16,155,637	$16,155,928
WALTER-BOULDIN	non-Federal	$45,277,945	$45,222,219	$45,280,651	$45,228,279	$45,283,958
WEISS	non-Federal	$13,771,923	$13,756,217	$13,777,245	$13,757,656	$13,779,024
YATES	non-Federal	$9,441,291	$9,437,603	$9,439,622	$9,437,605	$9,438,809
non-Federal	**subtotal**	**$262,843,439**	**$262,662,563**	**$262,782,180**	**$262,678,509**	**$262,825,991**
System	**TOTAL**	**$401,452,328**	**$401,090,524**	**$401,412,465**	**$401,122,069**	**$401,467,221**

6 PMA REVENUE

Revenue date is based on SEPA composite rate based on current power sales contract rate applicable to power generation in the Georgia-Alabama-South Carolina system hydropower plants.

6.1 Composite Revenue Rate

SEPA calculation procedure for developing the Composite Revenue Rate is in Table 8-1.

	GA-AL-SC System
Capacity (kW)	2,184,232
Energy (MWh)	3,012,000
Capacity Rate kw/mo	$4.090
Energy Rate $/MWh	$12.330
Capacity Revenue	$107,202,107
Energy Revenue	$37,137,960
Transmission and Non-Power Revenue	$57,165,405
Total Revenue	$201,505,472
Less: Transmission and Non-Power Revenue	$57,165,405
Revenue at Bus-Bar	$144,340,067
Total average energy available – MWh 2014-2018(less pumping)	3,012,000
Revenue per MWh generated ($/MWh)	$47.92

Note: Provided by SEPA 3/29/2019 1:54 PM Subject: Alabama-Coosa Reallocation Study-Composite Revenue Rate

Figure 6-1. SEPA Composite Revenue Rate

6.2 Hydropower Revenue

To compute energy revenue, the SEPA Composite Revenue Rate is applied to the average annual energy. Revenues are summarized in Tables 3-4 and 3-5.

Table 6-1. Revenue of Individual USACE Plants – Water Supply Alternatives

Alternatives > **Projects V**		**Base2018**	**BaseCap**	**FWOP**	**A03_WS1**	**A04_WS2**	**A05_WS3**	**A06_WS4**	**A08_WS6**
ALLATOONA	Federal	$5,154,003	$5,171,057	$5,103,884	$5,020,302	$5,019,919	$5,064,823	$5,377,620	$5,064,478
CARTERS	Federal	$91,676,016	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768	$91,675,768
MILLERS FERRY	Federal	$31,608,190	$31,608,078	$31,608,078	$31,608,078	$31,608,078	$31,608,078	$31,608,078	$31,608,078
RF HENRY	Federal	$12,825,097	$12,827,863	$12,822,426	$12,817,022	$12,817,543	$12,819,861	$12,886,962	$12,820,361
Federal	**subtotal**	**$65,298,868**	**$65,322,610**	**$65,245,635**	**$65,152,195**	**$65,151,361**	**$65,208,173**	**$65,625,053**	**$65,207,415**

Table 6-2. Revenue of Individual USACE Plants – Modified Flood Operations Alternatives

Alternatives > **Projects V**		**A09_FWOPMF**	**A10_WS2MF**	**A11_WS6MF**	**A12_WS1MF**	**A13_WS3MF**
ALLATOONA	Federal	$5,103,884	$5,019,919	$5,064,478	$5,020,302	$5,064,823
CARTERS	Federal	$31,608,078	$31,608,078	$31,608,078	$31,608,078	$31,608,078
MILLERS FERRY	Federal	$15,654,227	$15,646,309	$15,653,207	$15,651,488	$15,657,388
RF HENRY	Federal	$12,777,201	$12,770,229	$12,774,303	$12,771,025	$12,774,722
Federal	**subtotal**	**$65,143,390**	**$65,044,534**	**$65,499,047**	**$65,050,892**	**$65,105,010**

7 PMA CREDITS

7.1 Guidance

Project costs originally allocated to hydropower are being repaid through power revenues which are based on rates designed by the Federal power marketing agency (PMA) to recover allocated costs plus interest within 50 years of the date of commercial power operation. If a portion of the storage is reallocated from hydropower to water supply, the PMA's repayment obligation must be reduced in proportion to the lost energy and marketable capacity.

Planning Guidance Notebook, Appendix E-57d(3) of ER 1105-2-100 (22 April 2002) states that;

"If hydropower revenues are being reduced as a result of the reallocation, the power marketing agency will be credited for the amount of revenues to the Treasury foregone as a result of the reallocation assuming uniform annual repayment."

Paragraph d(2)(b) states that;

"Revenues foregone to hydropower are the reduction in revenues accruing to the Treasury as a result of the reduction in hydropower outputs based on the Baseline rates charged by the power marketing agency. Revenues foregone from other project purposes are the reduction in revenues accruing to the Treasury based on any Baseline repayment agreements."

ER 1105-2-100 also allows the marketing agency credit for any additional costs above the lost revenue to recover costs of purchased power to meet the obligations of the current power sales contract(s) relating to the marketing of power from the hydro project(s) where storage is being reallocated. The continuation of Appendix E-57d(3), provides the following guidance:

"In instances where Baseline contracts between the power marketing agency and their customer would result in a cost to the Federal Government to acquire replacement power to fulfill the obligations of contracts, an additional credit to the power marketing agency can be made for such costs incurred during the remaining period of the contracts."

In both cases the credit in each year will be based on the revenue actually lost or the replacement costs actually incurred (and documented) by the power marketing agency.

7.2 Estimate of Credits

Estimate of credit to the PMA will be the same as revenue foregone which is based on the change energy between an Alternative and a BaseCase multiplied by the SEPA Composite Revenue Rate.

Additional credit will be based on revenue actually lost or replacement costs actually incurred.

7.3 Remaining Period of Contract

SEPA contracts for the sale of power to the Georgia-Alabama-South Carolina system customers include an evergreen provision, which means they remain in effect until cancelled. As such, the contracts should be considered in effect in perpetuity.

8 GREENHOUSE GAS EMISSIONS

An environmental value associated with hydropower generation is avoided emissions. Emissions would be avoided by generating electricity from hydropower as opposed to generating electricity from a thermal, fossil fuel source. Quantifying these avoided emissions depends on the generating resource mix of the power that is displaced by the hydropower project. Although monetizing the value of these increased emissions is wrought with uncertainty, it does provide a way to compare consequence of lost hydropower in the region and to compare the addition of both financial and environmental consequences.

8.1 Emission Change due to Lost Hydropower

Lost hydropower may change emissions in two ways.

- First, a hydropower lost may cause a shift in the fuel generation mix, when capacity constraints cause the hydropower plant to shift from peaking to off-peak generation.
- Secondly, more thermal generation may be required when the capacity constraint actually causes losses in gross hydropower generation.

Calculating changes in emissions for the first case would require a detailed description of hourly regional generation mixes and some assumptions on how these would change given more demand. It is deemed beyond this study to look to qualify these changes in emissions; however, for the second case regional emission factors supplied the Environmental Protection Agency's (EPA) Emissions & Generation Resource Integrated Database (eGRID) are suitable. Only the second case is considered in this study.

8.2 Emissions & Generation Resource Integrated Database (eGRID)

A brief description of the eGrid database used to quantify emissions, a brief description of the Social Cost of Carbon used to monetize the increase in emissions, and the results and methodology used to estimate consequences of lost hydropower.

8.2.1 Generating Resource Mix

Since different regions have different generating resource mixes, this factor is regionally dependent. This factor may also be seasonally or even hourly dependent as different mixes of generating resources are required to meet demand.

The Environmental Protection Agency's eGrid (http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html) is a comprehensive database of environmental attributes of electric power systems, incorporating data from several federal agencies. One field of data stored in the eGrid database is emission rates for 26 eGrid sub-regions. These regions are constrained within a single North American Electric Reliability Corporation (NERC) region with similar emissions and generating resource mixes.

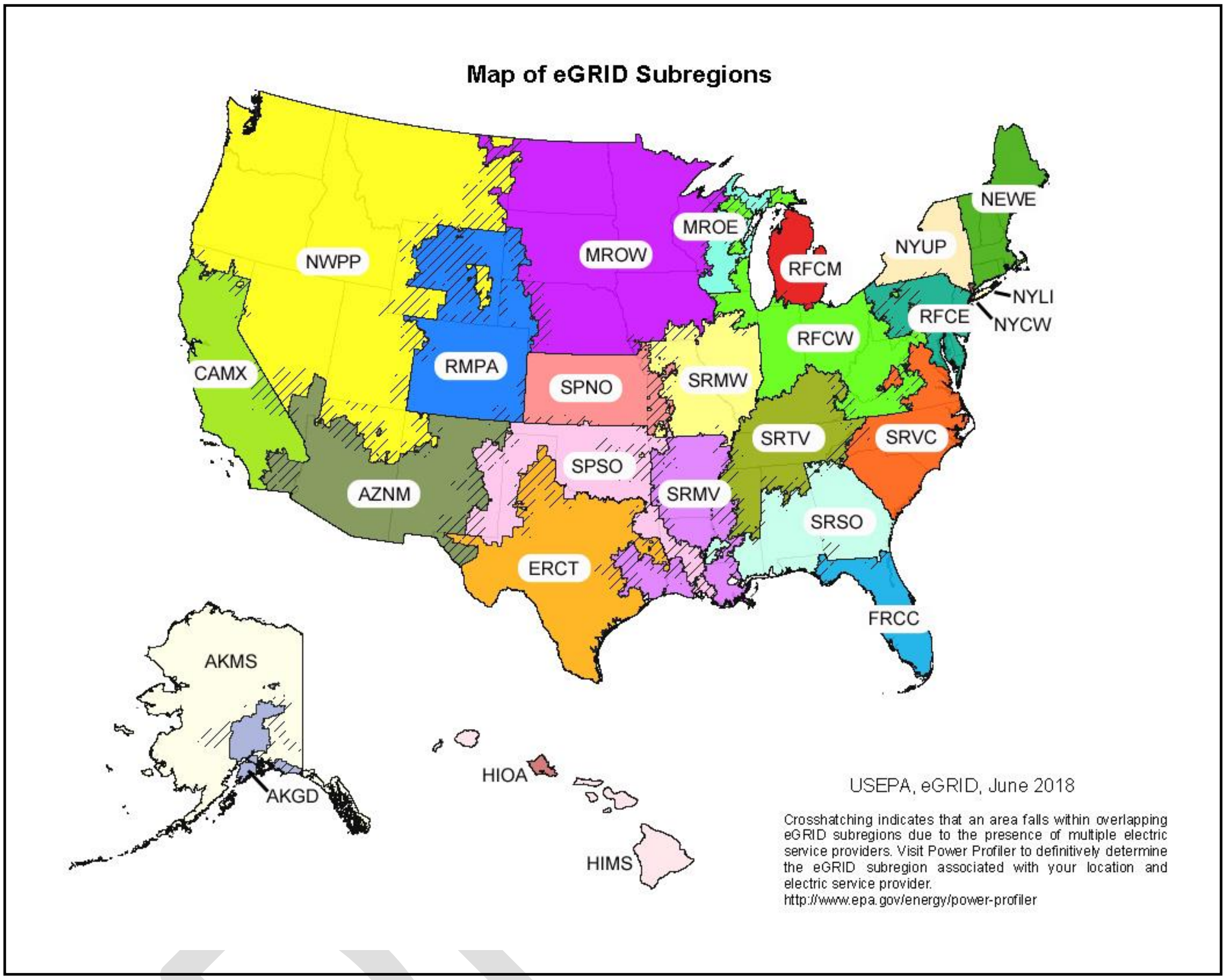


Figure 8-1. eGRID Sub-regions Map

Net generation for this sub-region SERC-Southeast (SRSO) is 264,562,049 MWh while the hydropower portion of the subregional hydropower is about 1.95% (~5,169,028 MWh) the average annual generation for Base2018 in this study, is 5,556,728 MWh or about 2.1% of the regional generating resources. If all hydropower were to be excluded from the subregional generating resources the emission rate may increase by about 2%. This study will result in very small incremental changes (<0.05%) in hydropower so no adjustment was made to emission rate.

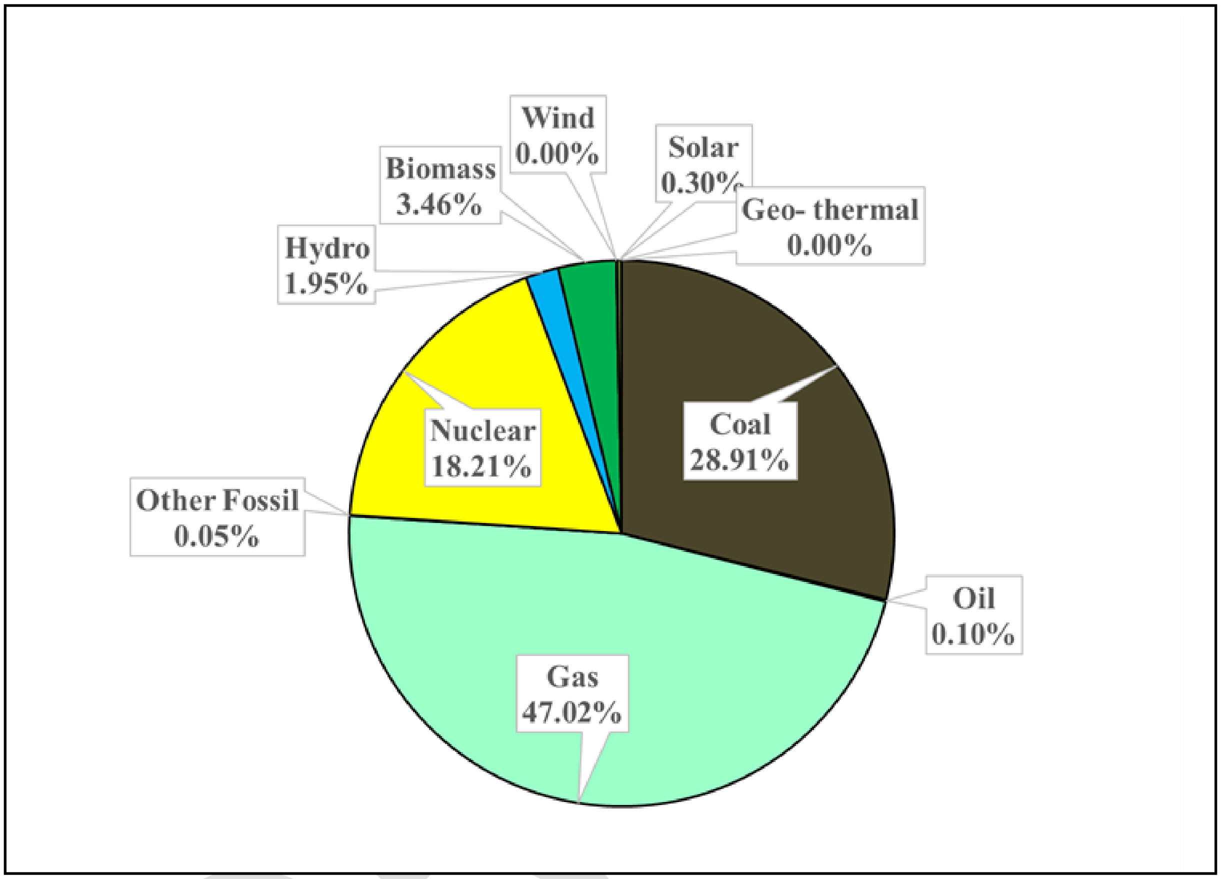


Figure 8-2. Generating Resource Mix for sub-region SERC Southeast (SRSO)

8.2.2 Emission Rates

Emission rates from the eGrid database are defined as pounds per MWh for three greenhouse gases (GHG): carbon dioxide, methane, and nitrous oxide. These are further divided into baseload and non-baseload generating resources. Since Alabama-Coosa-Tallapoosa Basin projects' hydropower is often used to replace the generating resources on the margin this study uses the non-baseload emission rates for SRSO (SERC Southeast) subregion.

Table 1-1 lists the emission rates used in this study for the GHG calculated in the eGrid database for the SRSO (SERC South) subregion. Also included in this table is the emission rate for equivalent carbon dioxide (CDE) for the generating resource mix. This metric is used to define the total global warming potential (GWG) from the mix of the greenhouse gases defined by the eGrid database using the equivalent concentration of carbon dioxide as a reference.

Table 8-1. Emission Rates

Subregion Output Emission Rates (eGRID2016)									
eGRID subregion acronym	eGrid subregion name	Non-baseload output emission rates lb/MWh							Grid Gross Loss (%)
		CO_2	CH_4	N_2O	CO_2e	Annual NO_X	Ozone Season No_x	SO_2	
SRSO	SERC Southeast	1,453.50	0.115	0.017	1,461.10	0.8	0.7	0.6	4.49%

The SERC South sub-regional emissions rate for GHG is the carbon dioxide equivalent (CO_2e) rate of 1,461.1 lb/MWh. This equivalent rate sums the GHG effect for all of the listed emissions.

8.3 GHG Emissions due to Loss of Hydropower Plant

This CO_2e (GHG) emissions rate is multiplied by the hydropower generation to quantify the emissions that would likely occur should hydropower plant become unavailable and be replaced by other electrical power generating resources within the sub-region to serve the demand for electrical power. CO_2e (GHG) emission quantities are expressed in thousands of metric tons (kt).

Table 8-2. GHG Emissions of Individual Plant – Water Supply Alternatives

Alternatives > Projects V		**Base2018**	**BaseCap**	**FWOP**	**A03_WS1**	**A04_WS2**	**A05_WS3**	**A06_WS4**	**A08_WS6**
ALLATOONA	Federal	71.281	71.517	70.588	69.432	69.427	70.048	74.374	70.043
CARTERS	Federal	437.148	437.146	437.146	437.146	437.146	437.146	437.146	437.146
MILLERS FERRY	Federal	217.294	217.350	217.290	217.228	217.215	217.347	217.859	217.335
RF HENRY	Federal	177.374	177.412	177.337	177.262	177.269	177.301	178.229	177.308
Federal	**subtotal**	**903.097**	**903.426**	**902.361**	**901.069**	**901.057**	**901.843**	**907.608**	**901.832**
HARRIS	non-Federal	126.750	126.749	126.749	126.751	126.750	126.751	126.752	126.751
HN HENRY	non-Federal	133.169	133.235	133.140	132.951	132.947	132.973	133.843	132.964
JORDAN	non-Federal	183.975	183.992	183.921	183.874	183.877	183.828	183.054	183.835
LAY	non-Federal	431.026	431.191	430.985	430.498	430.489	430.579	432.400	430.562
LOGAN MARTIN	non-Federal	281.733	281.850	281.662	281.298	281.292	281.335	282.406	281.326
MARTIN	non-Federal	276.510	276.508	276.510	276.514	276.513	276.504	276.494	276.505
MITCHELL	non-Federal	364.520	364.637	364.471	364.112	364.107	364.115	365.117	364.113
THURLOW	non-Federal	181.406	181.406	181.406	181.414	181.414	181.403	181.395	181.403
WALTER-BOULDIN	non-Federal	561.556	561.786	561.495	560.853	560.835	560.993	563.695	560.953

WEISS	non-Federal	133.041	133.112	133.000	132.782	132.776	132.841	133.491	132.837
YATES	non-Federal	105.903	105.904	105.903	105.907	105.907	105.901	105.894	105.900
non-Federal	**subtotal**	**2,779.590**	**2,780.371**	**2,779.241**	**2,776.954**	**2,776.907**	**2,777.224**	**2,784.542**	**2,777.149**
System	**TOTAL**	**3,682.687**	**3,683.797**	**3,681.602**	**3,678.023**	**3,677.964**	**3,679.067**	**3,692.150**	**3,678.982**

Table 8-3. GHG Emissions of Individual Plant – Modified Flood Operations Alternatives

Alternatives > **Projects V**		**A09_FWOPMF**	**A10_WS2MF**	**A11_WS6MF**	**A12_WS1MF**	**A13_WS3MF**
ALLATOONA	Federal	70.588	69.427	70.043	69.432	70.048
CARTERS	Federal	437.146	437.146	437.146	437.146	437.146
MILLERS FERRY	Federal	216.501	216.392	216.487	216.463	216.545
RF HENRY	Federal	176.711	176.615	176.671	176.626	176.677
Federal	**subtotal**	**900.947**	**899.580**	**905.866**	**899.668**	**900.416**
HARRIS	non-Federal	126.752	126.753	126.753	126.752	126.753
HN HENRY	non-Federal	132.535	132.329	132.341	132.332	132.339
JORDAN	non-Federal	182.273	182.213	182.189	182.209	182.207
LAY	non-Federal	429.271	428.779	428.791	428.791	428.823
LOGAN MARTIN	non-Federal	283.547	283.175	283.179	283.179	283.208
MARTIN	non-Federal	276.492	276.491	276.493	276.488	276.504
MITCHELL	non-Federal	362.886	362.519	362.526	362.524	362.530
THURLOW	non-Federal	181.428	181.430	181.425	181.430	181.429
WALTER-BOULDIN	non-Federal	558.926	558.262	558.358	558.290	558.385
WEISS	non-Federal	133.950	133.720	133.793	133.725	133.798
YATES	non-Federal	105.916	105.917	105.914	105.917	105.917
non-Federal	**subtotal**	**2,773.976**	**2,771.589**	**2,771.761**	**2,771.637**	**2,771.893**
System	**TOTAL**	**3,674.923**	**3,671.168**	**3,672.108**	**3,671.304**	**3,672.309**

8.4 Equivalent Passenger Vehicle GHG Emissions

- Extract from EPA “Energy and the Environment”- Greenhouse Gases Equivalencies Calculator - Calculations and References. Link to this information;

  https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

8.4.1 Passenger vehicles per year[2]

Passenger vehicles are defined as 2-axle 4-tire vehicles, including passenger cars, vans, pickup trucks, and sport/utility vehicles.

In 2016, the weighted average combined fuel economy of cars and light trucks was 22.0 miles per gallon (FHWA 2018). The average vehicle miles traveled (VMT) in 2016 was 11,507 miles per year (FHWA 2018).

In 2016, the ratio of carbon dioxide emissions to total greenhouse gas emissions (including carbon dioxide, methane, and nitrous oxide, all expressed as carbon dioxide equivalents) for passenger vehicles was 0.988 (EPA 2018).

The amount of carbon dioxide emitted per gallon of motor gasoline burned is 8.89×10^{-3} metric tons, as calculated in the “Gallons of gasoline consumed” section above.

To determine annual greenhouse gas emissions per passenger vehicle, the following methodology was used: VMT was divided by average gas mileage to determine gallons of gasoline consumed per vehicle per year. Gallons of gasoline consumed was multiplied by carbon dioxide per gallon of gasoline to determine carbon dioxide emitted per vehicle per year. Carbon dioxide emissions were then divided by the ratio of carbon dioxide emissions to total vehicle greenhouse gas emissions to account for vehicle methane and nitrous oxide emissions.

---

[2] **Sources:**

- EPA (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. Chapter 3 (Energy), Tables 3-12, 3-13, and 3-14. Environmental Protection Agency, Washington, D.C. EPA #430-R-18-003 (PDF) (109 pp, 3 MB About PDF)
- FHWA (2018). Highway Statistics 2016. Office of Highway Policy Information, Federal Highway Administration. Table VM-1. (1 pp, 11 KB About PDF)

8.4.2 Calculation

Note: Due to rounding, performing the calculations given in the equations below may not return the exact results shown.

$$8.89 \times 10^{-3} \text{ metric tons } CO_2\text{/gallon gasoline} \times$$

$$11{,}507 \text{ VMT}_{\text{(car/truck average)}} \times$$

$$1/22.0 \text{ miles per gallon}_{\text{(car/truck)}} \times$$

$$1\ CO_2,\ CH_4, \text{ and } N_2O\ /\ 0.988\ CO_2$$

$$= \mathbf{4.71 \text{ metric tons } CO_2e \text{ / vehicle / year}}$$

8.4.3 Passenger Vehicle Equivalent Emissions

Table 8-4. Passenger Vehicle Equivalent Emissions for Individual Plant Loss – Water Supply Alternatives

Alternatives > Projects V		Base2018	BaseCap	FWOP	A03_WS1	A04_WS2	A05_WS3	A06_WS4	A08_WS6
ALLATOONA	Federal	15,134	15,184	14,987	14,471	14,470	14,872	15,791	14,871
CARTERS	Federal	92,813	92,812	92,812	92,812	92,812	92,812	92,812	92,812
MILLERS FERRY	Federal	46,135	46,147	46,134	46,121	46,118	46,146	46,255	46,143
RF HENRY	Federal	37,659	37,667	37,651	37,635	37,637	37,644	37,841	37,645
Federal	**subtotal**	**191,740**	**191,810**	**191,584**	**191,310**	**191,307**	**191,474**	**192,698**	**191,472**
HARRIS	non-Federal	26,911	26,911	26,911	26,911	26,911	26,911	26,911	26,911
HN HENRY	non-Federal	28,274	28,288	28,267	28,227	28,226	28,232	28,417	28,230
JORDAN	non-Federal	39,061	39,064	39,049	39,039	39,040	39,029	38,865	39,031
LAY	non-Federal	91,513	91,548	91,504	91,401	91,399	91,418	91,805	91,415
LOGAN MARTIN	non-Federal	59,816	59,841	59,801	59,724	59,722	59,732	59,959	59,730
MARTIN	non-Federal	58,707	58,707	58,707	58,708	58,708	58,706	58,704	58,706
MITCHELL	non-Federal	77,393	77,418	77,382	77,306	77,305	77,307	77,520	77,306
THURLOW	non-Federal	38,515	38,515	38,515	38,517	38,517	38,514	38,513	38,514
WALTER-BOULDIN	non-Federal	119,226	119,275	119,213	119,077	119,074	119,107	119,681	119,098
WEISS	non-Federal	28,246	28,262	28,238	28,191	28,190	28,204	28,342	28,203
YATES	non-Federal	22,485	22,485	22,485	22,486	22,486	22,484	22,483	22,484
non-Federal	**subtotal**	**590,146**	**590,312**	**590,072**	**589,587**	**589,577**	**589,644**	**591,198**	**589,628**

System	**TOTAL**	**781,887**	**782,122**	**781,656**	**780,897**	**780,884**	**781,118**	**783,896**	**781,100**

Table 8-5. Passenger Vehicle Equivalent Emissions for Individual Plant Loss – Modified Flood Operations Alternatives

Alternatives > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS1MF	A13_WS3MF
ALLATOONA	Federal	14,987	14,740	14,871	14,741	14,872
CARTERS	Federal	92,812	92,812	92,812	92,812	92,812
MILLERS FERRY	Federal	45,966	45,943	45,963	45,958	45,976
RF HENRY	Federal	37,518	37,498	37,510	37,500	37,511
Federal	**subtotal**	**191,284**	**190,994**	**192,328**	**191,012**	**191,171**
HARRIS	non-Federal	26,911	26,911	26,911	26,911	26,911
HN HENRY	non-Federal	28,139	28,095	28,098	28,096	28,097
JORDAN	non-Federal	38,699	38,686	38,681	38,685	38,685
LAY	non-Federal	91,140	91,036	91,038	91,038	91,045
LOGAN MARTIN	non-Federal	60,201	60,122	60,123	60,123	60,129
MARTIN	non-Federal	58,703	58,703	58,703	58,702	58,706
MITCHELL	non-Federal	77,046	76,968	76,969	76,969	76,970
THURLOW	non-Federal	38,520	38,520	38,519	38,520	38,520
WALTER-BOULDIN	non-Federal	118,668	118,527	118,547	118,533	118,553
WEISS	non-Federal	28,439	28,391	28,406	28,392	28,407
YATES	non-Federal	22,487	22,488	22,487	22,488	22,488
non-Federal	**subtotal**	**588,955**	**588,448**	**588,484**	**588,458**	**588,512**
System	**TOTAL**	**780,238**	**779,441**	**779,641**	**779,470**	**779,683**

8.5 Social Cost of Carbon (SCC)

Social Cost of Carbon is an attempt to monetize the consequences of an incremental increase in carbon emissions for a given year. This estimate was developed by the Interagency Working Group on Social Cost of Carbon for the U.S government with the intent to include this cost into cost-benefit analysis. Consequences included in this valuation include net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change.

The reference used to calculate the social cost of carbon has been officially withdrawn but is listed here as basis for computing SCC;

Technical Support Document:
Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 *(withdrawn[3])*
Interagency Working Group on Social Cost of Greenhouse Gases, United States Government
August 2016
(https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf).

Table 8-6. Social Cost of CO_2, 2010 – 2050 (in 2007 dollars per metric ton of CO_2). [Ref. Table 2]

Year	5% Average	3% Average	2.5% Average	High Impact (95th Percentile - Discount Rate 3%)
2010	10	**31**	50	86
2015	11	**36**	56	105
2020	12	**42**	62	123
2025	14	**46**	68	138
2030	16	**50**	73	152
2035	18	**55**	78	168
2040	21	**60**	84	183
2045	23	**64**	89	197
2050	26	**69**	95	212

For purposes of this analysis the 3% Discount Rate for Average Conditions is used and the interpolated value in Table 8-4 for the year 2019 was updated from 2007 dollars to 2019 dollars using the gross domestic product (Chained) Price Index.

1 **Presidential Executive Order on Promoting Energy Independence and Economic Growth** Issued on: March 28, 2017 - … the following documents issued by the IWG shall be withdrawn as no longer representative of governmental policy: … (vi) Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis (August 2016).

8.5.1 Social Cost of Carbon Rate

The Social Cost of Carbon used in this analysis is $48 per metric ton (t) of CO_2.

Table 8-7. Social Cost of Carbon SCC [(CO_2) $/t]

	Year	**Interpolated (2007 $)**	**updated to (2019$)**
Discount Rate 3% Average Conditions	2019	$40	$48

The Social Cost of Carbon used in this analysis is $48 per metric ton (t) of CO_2.

The emission rate for CO_2 is 1,453.50 lb/MWh in Table 8-1, which different than CO_2e (GHG) emission rate.

8.6 Value of Social Cost of Carbon of Alternatives

These CO_2 emissions would likely occur should hydropower become unavailable and be replaced by other electrical power generating resources within the sub-region to serve the demand for electrical power. Thus the region would experience increased emissions and their concomitant social impacts.

The quantity of CO_2 emissions is then multiplied by the SCC rate of $48/t to obtain the Social Cost of Carbon.

The Social Cost of Carbon (SCC) are expressed in millions of dollars.

Table 8-8. Value of Social Cost of Carbon of Individual Plants – Water Supply Alternatives

Alternatives > **Projects V**		**Base2018**	**BaseCap**	**FWOP**	**A03_WS1**	**A04_WS2**	**A05_WS3**	**A06_WS4**	**A08_WS6**
ALLATOONA	Federal	$3.404	$3.415	$3.371	$3.315	$3.315	$3.345	$3.551	$3.345
CARTERS	Federal	$20.874	$20.874	$20.874	$20.874	$20.874	$20.874	$20.874	$20.874
MILLERS FERRY	Federal	$10.376	$10.379	$10.376	$10.373	$10.372	$10.378	$10.403	$10.378
RF HENRY	Federal	$8.470	$8.471	$8.468	$8.464	$8.465	$8.466	$8.511	$8.467
Federal	**subtotal**	**$43.123**	**$43.139**	**$43.088**	**$43.026**	**$43.026**	**$43.063**	**$43.339**	**$43.063**
HARRIS	non-Federal	$6.052	$6.052	$6.052	$6.052	$6.052	$6.052	$6.052	$6.052
HN HENRY	non-Federal	$6.359	$6.362	$6.357	$6.348	$6.348	$6.350	$6.391	$6.349
MITCHELL	non-Federal	$17.406	$17.412	$17.404	$17.386	$17.386	$17.387	$17.434	$17.387
THURLOW	non-Federal	$8.862	$8.862	$8.862	$8.863	$8.863	$8.862	$8.862	$8.862
WALTER-BOULDIN	non-Federal	$26.814	$26.825	$26.812	$26.781	$26.780	$26.788	$26.917	$26.786
JORDAN	non-Federal	$8.785	$8.786	$8.782	$8.780	$8.780	$8.778	$8.741	$8.778
LAY	non-Federal	$20.582	$20.590	$20.580	$20.556	$20.556	$20.560	$20.647	$20.559
LOGAN MARTIN	non-Federal	$13.453	$13.458	$13.449	$13.432	$13.432	$13.434	$13.485	$13.433
MARTIN	non-Federal	$13.203	$13.203	$13.203	$13.204	$13.204	$13.203	$13.203	$13.203
WEISS	non-Federal	$6.353	$6.356	$6.351	$6.340	$6.340	$6.343	$6.374	$6.343

YATES	non-Federal	$5.057	$5.057	$5.057	$5.057	$5.057	$5.057	$5.056	$5.057
non-Federal	**subtotal**	**$132.726**	**$132.764**	**$132.710**	**$132.600**	**$132.598**	**$132.613**	**$132.963**	**$132.610**
System	**TOTAL**	**781,887**	**782,122**	**781,656**	**780,897**	**780,884**	**781,118**	**783,896**	**781,100**

Table 8-9. Value of Social Cost of Carbon of Individual Plants – Modified Flood Operations Alternatives

Alternatives > Projects V		A09_FWOPMF	A10_WS2MF	A11_WS6MF	A12_WS1MF	A13_WS3MF
ALLATOONA	Federal	$3.371	$3.315	$3.345	$3.315	$3.345
CARTERS	Federal	$20.874	$20.874	$20.874	$20.874	$20.874
MILLERS FERRY	Federal	$10.338	$10.333	$10.337	$10.336	$10.340
RF HENRY	Federal	$8,438	$8.433	37,510	37,500	37,511
Federal	**subtotal**	**$43.021**	**$42.955**	**$43.255**	**$42.959**	**$42.995**
HARRIS	non-Federal	$6.052	$6.052	$6.053	$6.052	$6.052
HN HENRY	non-Federal	$6.329	$6.319	$6.319	$6.319	$6.319
MITCHELL	non-Federal	$17.328	$17.310	$17.311	$17.311	$17.311
THURLOW	non-Federal	$8.663	$8.663	$8.663	$8.663	$8.663
WALTER BOULDIN	non-Federal	$26.689	$26.657	$26.662	$26.659	$26.663
JORDAN	non-Federal	$8.704	$8.701	$8,700	$8,701	$8,700
LAY	non-Federal	$20.498	$20.474	$20.475	$20.475	$20.476
LOGAN MARTIN	non-Federal	$13.539	$13.522	$13.522	$13.522	$13.523
MARTIN	non-Federal	$13.203	$13.203	$13.203	$13.203	$13.203
WEISS	non-Federal	$6.396	$6.385	$6.389	$6.385	$6.389
YATES	non-Federal	$5.058	$5.058	$5.057	$5.058	$5.058
non-Federal	**subtotal**	**$132.458**	**$132.344**	**$132.352**	**$132.347**	**$132.359**

System	**TOTAL**	**$175.479**	**$175.299**	**$175.344**	**$175.306**	**$175.354**