



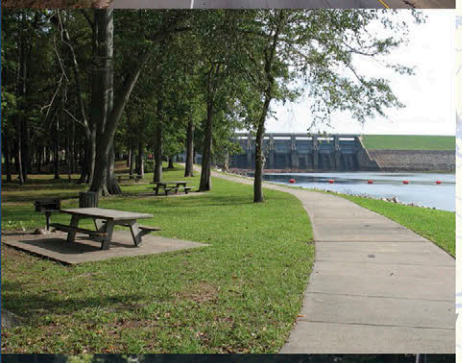







Volume 1

DRAFT
Environmental Impact Statement

Update of the Water Control Manual for the Apalachicola-Chattahoochee-Flint River Basin in Alabama, Florida, and Georgia and a Water Supply Storage Assessment

October 2015

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Abbreviations and Acronyms

aad-mgd	average annual day-million gallons per day
ACF	Apalachicola-Chattahoochee-Flint River
ac	acre
ac-ft	acre-feet
ac-ft/yr	acre-feet per year
ACT	Alabama-Coosa-Tallapoosa River
ADAPT	Alabama Drought Assessment and Planning Team
ADCNR	Alabama Department of Conservation and Natural Resources
ADEM	Alabama Department of Environmental Management
AMEA	Alabama Municipal Electric Authority
ANERR	Apalachicola National Estuarine Research Reserve
ANSI	American National Standards Institute
AOR	areas of responsibility
APC	Alabama Power Company
AQCR	Air Quality Control Regions
ARC	Atlanta Regional Commission
ARPA	Archaeological Resources Protection Act
AWAWG	Alabama Water Agencies Working Group
BA	Biological Assessment
BI	basin inflow
BO	Biological Opinion
C	Celsius
CAA	Clean Air Act
CCPC	Crisp County Power Commission
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
cm	centimeter
CMIP5	Coupled Model Intercomparison Project, Phase 5
CO	carbon monoxide
CO_2	carbon dioxide

CRNRA	Chattahoochee River National Recreation Area
CRMS	Chattahoochee River Management System
CRS	Congressional Research Service
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	decibels
dBA	a-weighted decibels
DCA	Department of Community Affairs (Georgia)
D.C.	District of Columbia
DDCWSA	Douglasville-Douglas County Water and Sewer Authority
DEP	Department of Environmental Protection (Florida)
DIG	Drought Impact Group
DMR	discharge monitoring report
DNL	day-night sound level
DO	dissolved oxygen
DOE	Department of Energy
DR	Division Regulation
DWMP	District Water Management Plans
EA	Environmental Assessment
EC	Engineering Circular
ECB	Engineering and Construction Bulletin
EDO	Extreme Drought Operations
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EM	Engineering Manual
EOP	Environmental Operating Principles
EO	Executive Order
EPD	Environmental Protection Division (Georgia)
ER	Engineering Regulation
ESA	Endangered Species Act
ENWR	Eufaula National Wildlife Refuge
F	Fahrenheit
F.S.	Florida Statutes
FCMP	Florida Coastal Management Program

FDACS	Florida Department of Agriculture and Consumer Services
FERC	Federal Energy Regulatory Commission
FLDEP	Florida Department of Environmental Protection
ft	foot/feet
ft/day	feet per day
ft/mi	feet per mile
FWCA	Fish and Wildlife Coordination Act
FWOPC	future without project condition
GAEPD	Georgia Environmental Protection Division
GADNR	Georgia Department of Natural Resources
GCM	general circulation model
GDM	General Design Memorandum
GEFA	Georgia Environmental Finance Authority
GGMN	Georgia Groundwater Monitoring Network
GHG	greenhouse gases
GIS	Geographical Information System
GIWW	Gulf Intracoastal Waterway
GLUT	Georgia Land Use Trends
GPC	Georgia Power Company
gpcd	gallons per capita per day
gpd	gallons per day
gpf	gallons per flush
gpm	gallons per minute
GSA	Geological Survey of Alabama
GWh	gigawatt-hour
GWIN	Georgia Water Information Network
GWIPS	groundwater information and project support
GWQMN	groundwater quality monitoring network
GWSP	Governor's Water Supply Program (Georgia)
HEC	Hydrologic Engineering Center
HEC-5Q	Hydrologic Engineering Center water quality model
HFC	hydrofluorocarbons
HPMP	Historic Property Management Plan
Hz	Hertz
in	inch

in/yr	inches per year
IIL	initial impact level
IOAA	Independent Offices Appropriations Act
IOP	interim operating plan
IPCC	Intergovernmental Panel on Climate Change
IWR	Institute for Water Resources
JSOC	Joint Statement of Commitment
JWLD	Jim Woodruff Lock and Dam
kW	kilowatt
lbs/ac-ft	pounds per acre-feet
LLNL	Lawrence Livermore National Laboratory
L_{eq}	Equivalent Sound Level
m	meter
M&I	municipal and industrial
MAG	Monitoring Advisory Committee
µg/L	microgram per liter
MAAWRMS	Metropolitan Atlanta Area Water Resources Management Study
mgd	million gallons per day
mg/L	milligrams per liter
MG	million gallons
mi	mile
mm	millimeter
mL	milliliter
MNGWPD	Metropolitan North Georgia Water Planning District
MOA	Memorandum of Agreement
MS4	municipal separate storm sewer systems
MW	megawatt
MWh	megawatt-hour
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAWQA	national water quality assessment
NED	National Economic Development
NEPA	National Environmental Policy Act
NERC	North American Electrical Reliability Council
NERR	National Estuarine Research Reserve

1	NGVD	National Geodetic Vertical Datum
2	NHPA	National Historic Preservation Act
3	N_2O	nitrous oxide
4	NO_x	nitrous oxides
5	NOA	Notice of Availability
6	NOAA	National Oceanic and Atmospheric Administration
7	NOI	Notice of Intent
8	NPDES	National Pollutant Discharge Elimination System
9	NPS	National Park Service
10	NRHP	National Register of Historic Places
11	NRCS	Natural Resources Conservation Service
12	NWR	National Wildlife Refuge
13	NWFWMD	Northwest Florida Water Management District
14	O_3	ozone
15	O.C.G.A.	Official Code of Georgia Annotated
16	OWR	Office of Water Resources (Alabama)
17	P&G	Principles and Guidelines
18	PAC	Post-Authorization Change Report
19	PCB	Polychlorinated Biphenyls
20	PET	potential evapotranspiration
21	PFCs	perfluorocarbons
22	P.L.	Public Law
23	PM	particulate matter
24	Ppt	parts per thousand
25	Ppb	parts per billion
26	RBI	revised basin inflow
27	RDC	regional developmental centers
28	ResSim	Reservoir System Simulation
29	RFPM	Reservoir Fisheries Performance Measure
30	RHA	River and Harbor Act
31	RIL	recreation impact level
32	RIOP	revised interim operating plan
33	RM	river mile
34	ROD	Record of Decision
35	ROI	region of influence

RONA	record of non-applicability
RPM	reasonable and prudent measures
RVA	range of variability approach
SADR	South Atlantic Division Regulation
SF_6	sulfur hexafluoride
SeFPC	Southeastern Federal Power Customers, Inc.
SEPA	Southeastern Power Administration
SERC	Southeastern Electrical Reliability Council
SET	Science & Engineering Technology
SFMRWSA	South Fulton Municipal Regional Water and Sewer Authority
SLF	State Line Flow
SO_2	sulfur dioxide
SOP	standard operating procedure
sq mi	square mile
STATSGO	State Soil Geographic
SWMP	Strategic Water Management Plan
SWP	statewide water management plan
TEN	Technical Excellence Network
TES	Threatened and Endangered Species
TMDL	total maximum daily load
UIF	unimpaired flow
USACE	US Army Corps of Engineers
U.S.C.	United States Code
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
VIC	variable infiltration capacity (model)
VISA	very intense study area
WAL	water access limited level
WCIP	water conservation implementation plan
WCM	water control manual
WDCP	Water Development and Conservation Plan
WRD	Wildlife Resources Division
WSA	Water Supply Act

WSSA	water supply storage assessment
WSTF	Water Supply Task Force
yr	year

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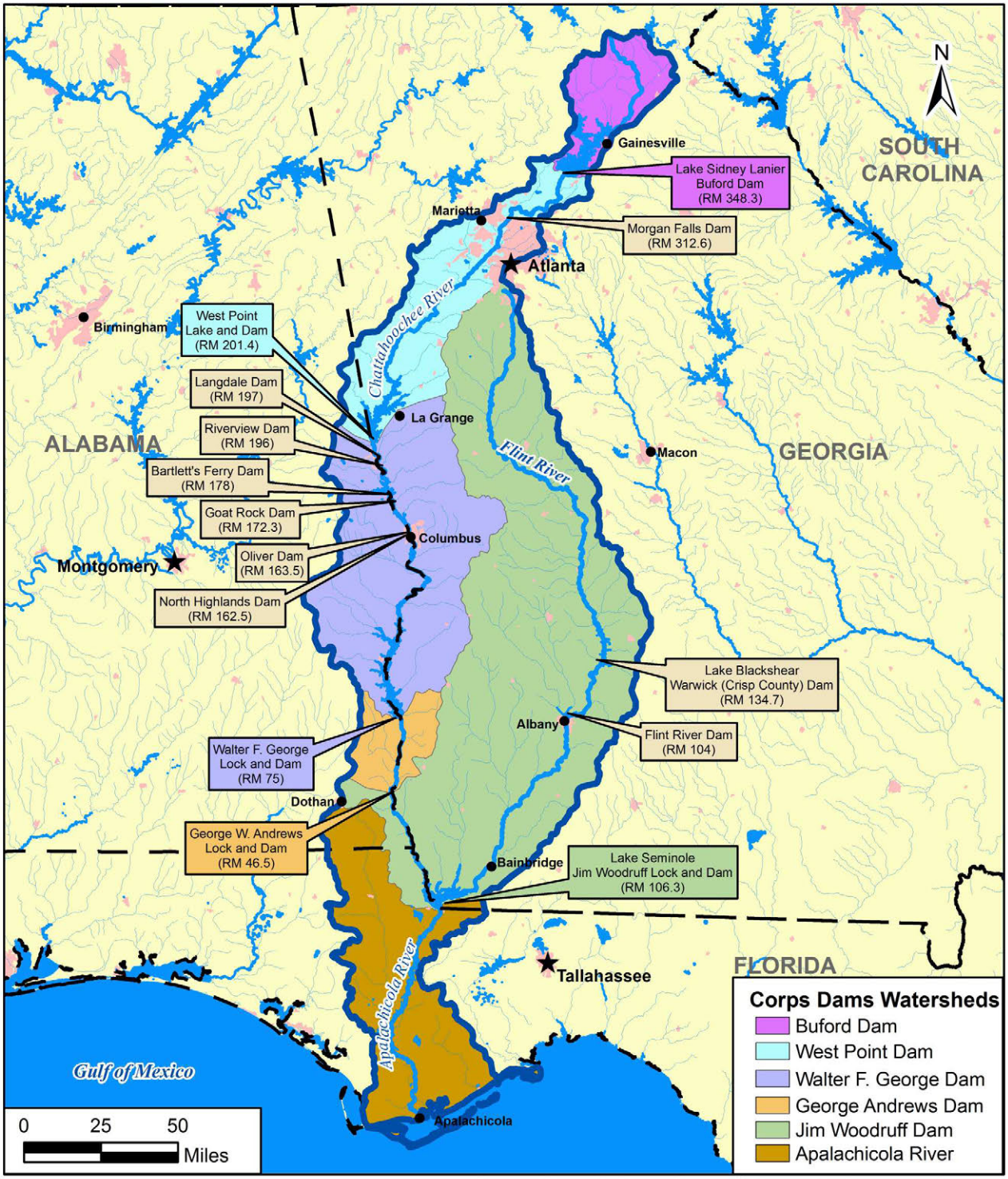
EXECUTIVE SUMMARY

This environmental impact statement (EIS) evaluates proposals by the U.S. Army Corps of Engineers (USACE) to adopt an updated *Master Water Control Manual, Apalachicola-Chattahoochee-Flint River Basin, Alabama, Florida, Georgia* (Master WCM or Master Manual); including a water supply storage assessment (WSSA) addressing reallocation of storage in Lake Sidney Lanier (Lake Lanier). The WSSA addresses a request from the state of Georgia for reallocation of storage in Lake Lanier to satisfy future water supply needs of certain north Georgia communities. The Apalachicola-Chattahoochee-Flint River (ACF) Basin comprises 19,573 square miles in Alabama, Florida, and Georgia. USACE operates five reservoir projects in the basin: Buford Dam and Lake Lanier; West Point Dam and Lake; Walter F. George Lock, Dam, and Lake; George W. Andrews Lock, Dam and Lake; and Jim Woodruff Lock and Dam and Lake Seminole.

Federal legislation authorizing project purposes in the ACF Basin was originally enacted in the mid-1940s. Section 2 of the River and Harbor Act of 1945 (Public Law [P.L.] 79-14) approved the plan for developing flood control, hydroelectric power generation, water supply, and navigation on the ACF Basin rivers, in Georgia and Florida. Those purposes are often referred to as "expressly authorized project purposes". Other operational objectives derive from authorities that generally apply to all USACE reservoirs, such as fish and wildlife conservation (Fish and Wildlife Coordination Act of 1958 [P.L. 85-624] and Endangered Species Act of 1973 [P.L. 93-205]), recreation (Flood Control Act of 1944 [P.L. 78-534]), water quality (Water Pollution Control Act Amendments of 1972 [P.L. 92-500]), and water supply (Water Supply Act of 1958 [P.L. 85-500]). Thus, USACE operates and manages the ACF Basin projects as one system to meet the following authorized purposes: flood risk management,[1] hydropower, navigation, fish and wildlife conservation, recreation, water quality, and water supply.

All of USACE projects are on the Chattahoochee River arm of the ACF Basin except for the Jim Woodruff Lock and Dam, which is immediately downstream of the confluence of the Chattahoochee and Flint rivers and marks the upstream extent of the Apalachicola River. Buford Dam, West Point Dam, Walter F. George Lock and Dam, and Jim Woodruff Lock and Dam each form a reservoir (i.e., Lake Lanier, West Point Lake, Walter F. George Lake, and Lake Seminole, respectively) with a combined conservation storage capacity (relative to the top of each reservoir's full summer pool) of about 1.6 million acre-feet (ac-ft). Jim Woodruff Lock and Dam is operated as a run-of-river project and has very limited storage is available to support project purposes. George W. Andrews Lock and Dam is also a run-of-river project principally for navigation with no conservation storage. In addition to the five USACE projects, nine non-USACE reservoir projects are on the mainstems of the Chattahoochee and Flint rivers in the ACF Basin. Those non-USACE projects are operated by the Georgia Power Company and Crisp County Power Commission. Figure ES-1 depicts the project locations in the ACF Basin and Table ES-1 provides pertinent data on the reservoir projects in the basin.

[1] USACE generally uses the term "flood risk management," rather than "flood control" or "flood damage reduction," to characterize the USACE mission to manage and reduce risk of loss of life and property damage associated with flood events (USACE IWR 2009). Therefore, the term "flood risk management" is used, along with "flood control" where appropriate, throughout this EIS to describe that mission area. The updated terminology does not reflect any change in the originally authorized flood control purpose or to operations in support of that authorized purpose.



Apalachicola, Chattahoochee, and Flint Rivers Basin Map

Figure ES-1

Table ES-1.
Reservoirs on Mainstem ACF Basin Rivers

Basin/river/project name	Owner/state/ year initially completed	Drainage area (sq mi)	Reservoir size (ac)	Total storage (ac-ft)[a]	Conservation storage (summer elev) (ac-ft)	Power capacity (kW)	Normal (summer) lake elev (ft)	Authorized purposes for USACE-owned projects[b]
Chattahoochee River		*8,708*						
Buford Dam/Lake Sidney Lanier	USACE/GA/1957	1,034	38,542	2,554,000	1,087,600	127,000	1,071	FRM, HP, NAV, FW, REC, WQ, WS[c]
Morgan Falls Dam/Bull Sluice Lake	GPC/GA/1903	1,360	580	2,450	0	16,800	866	
West Point Dam and Lake	USACE/GA/1975	3,440	25,864	774,798	306,131	87,000	635	FRM, HP, NAV, FW, REC, WQ
Langdale Dam and Lake	GPC/GA/1860	3,640	152	NA[d]	0	1,040	547.7	
Riverview Dam and Lake	GPC/GA/1902	3,661	75	NA[d]	0	480	530.5	
Bartletts Ferry Dam/Lake Harding	GPC/GA/1926	4,240	5,850	181,000	0	173,000	521	
Goat Rock Dam and Lake	GPC/GA/1912	4,510	1,050	11,000	0	38,600	404	
Oliver Dam/Lake Oliver	GPC/GA/1959	4,630	2,150	32,000	0	60,000	337	
North Highlands Dam and Lake	GPC/GA/1900	4,630	131	1,500	0	29,600	269	
Walter F. George Lock, Dam, and Lake	USACE/GA/1963	7,460	45,181	934,400	244,400	168,000	190	HP, NAV, FW, REC, WQ
George W. Andrews Lock, Dam, and Lake	USACE/GA/1963	8,210	1,540	18,180	0	None	102	NAV, FW, REC, WQ
Flint River		*8,456*						
Warwick Dam/Lake Blackshear	Crisp Co./ GA/1930	3,770	8,700	144,000	0	15,200	237	
Flint River Dam/Lake Worth	GPC/GA/1920	5,290	1,400	NA[d]	0	5,400	182.3	
Apalachicola River		*2,409*	*(Total ACF Basin – 19,573 sq mi)*					
Jim Woodruff Lock and Dam/ Lake Seminole	USACE/FL/1954	17,164	37,500	367,318	0	43,350	77	HP, NAV, FW, REC, WQ

Notes:

a. Measured at top of storage for flood risk management.

b. As used in this table, the term *authorized purposes* includes purposes expressly identified in the project authorizing documents; incidental benefits recognized in projection authorizations; and objectives that result from other authorities, such as general authorities contained in congressional legislation, for which USACE operates each listed project as of 2009. FRM = flood risk management; HP = hydroelectric power generation; NAV = navigation; FW = fish and wildlife conservation; REC = recreation; WQ = water quality; WS = municipal & industrial water supply.

c. USACE operates the Buford Dam/Lake Sidney Lanier project in a manner that accommodates water supply withdrawals from Lake Lanier and from the Chattahoochee River downstream of Buford Dam.

d. NA = not available.

PURPOSE AND NEED

Section 7 of the Flood Control Act of 1944 provides that "it shall be the duty of the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations...." (33 U.S.C. 709).

The Master WCM for the ACF Basin dates to 1958 and does not include water control manuals for the West Point Dam, Walter F. George Lock and Dam, or George W. Andrews Lock and Dam project, which all were completed after the Buford Dam project. The individual reservoir project WCMs were completed as the projects were completed and placed in operation. The last technical updates to the documents were made at various times, extending as far back as the 1970s and 1980s; primarily administrative updates were approved in the 1990s. USACE has continued to operate essentially in accordance with the status quo reflected in the 1989 draft Master WCM update, with minor adjustments as subsequent experience and circumstances have dictated.

The proposed action updates the Master WCM and individual project WCMs for the ACF Basin as directed by Secretary of the Army Pete Geren on January 30, 2008. Specifically, the purpose and need for the federal action is to determine how federal projects in the ACF Basin should be operated for their authorized purposes, in light of current conditions and applicable law, and to implement those operations through updated water control plans and manuals. The proposed action will result in an updated Master WCM and individual project WCMs that comply with existing USACE regulations and reflect operations under existing congressional authorizations, taking into account changes in basin hydrology and demands from years of growth and development, new/rehabilitated structural features, legal developments, and environmental issues.

On May 16, 2000, the Governor of the state of Georgia submitted a formal request to the Assistant Secretary of the Army (Civil Works) to adjust the operation of Lake Lanier, and to enter into agreements with the State, or water supply providers, to accommodate increases in water supply withdrawals from Lake Lanier and downstream at Atlanta over the next thirty years. The Assistant Secretary of the Army (Civil Works) in 2002 denied Georgia's request. The 2011 decision of the 11th Circuit Court of Appeals ordered USACE to reconsider whether it has the legal authority to operate the Buford Project to accommodate Georgia's request. USACE provided a legal opinion on remand, concluding that it has sufficient authority under applicable law to accommodate that request, but noting that any decision to take action on Georgia's request would require a separate analysis. On January 11, 2013, the Governor of the state of Georgia provided updated demographic and water demand data to confirm the continued need for 705 mgd to meet Georgia's water needs from Lake Lanier and the Chattahoochee River to approximately the year 2040 rather than 2030 as specified in the 2000. Because updating the water control plans and manuals requires making a decision on Georgia's water supply request, this EIS will consider, along with operations for all authorized purposes, an expanded range of water supply alternatives associated with the Buford Dam/Lake Lanier project, including current levels of water supply withdrawals and additional amounts that Georgia in 2013 requested from Lake Lanier and downstream at Atlanta.

SCOPE OF THE EIS

This EIS identifies, documents, and evaluates the environmental effects of operating USACE projects in the ACF Basin under alternative management regimes that could reasonably be expected to accomplish the purpose and need of the proposed federal action. The scope of the proposed federal action described in the EIS for the ACF Master WCM update was refined as a result of the July 2009 federal district court order in the case *In re Tri-State Water Rights Litigation*. In 2012, the scope of the federal action was further refined because of the June 2011 ruling of the U.S. Court of Appeals for the 11th Circuit, which

vacated the 2009 district court order in the case and directed USACE to determine its legal authority to operate Buford Dam and Lake Lanier to accommodate water supply withdrawals. USACE's chief counsel issued a legal opinion in June 2012 concluding that USACE has the legal authority to accommodate both current and increased levels of water supply withdrawals from Lake Lanier and downstream at Atlanta, in light of several different statutory authorities and based on preliminary analysis of impacts to other authorized purposes. Therefore, along with operations for all authorized project purposes, this EIS will consider an expanded range of water supply alternatives associated with the Buford Dam/Lake Lanier project, including current levels of water supply withdrawals and additional amounts that Georgia has requested from Lake Lanier and downstream at Atlanta.

The EIS is intended to inform decision makers and the public of the likely environmental consequences of the Proposed Action Alternative (PAA) and other alternatives. The range of actions, alternatives, and effects considered in this EIS are driven by the requirements set forth by Congress and USACE policies for project operation. This EIS considers operational changes within existing congressional authorities, as determined by recent court rulings, and delegated discretionary authorities. Potential changes to ACF Basin water control operations that would not support authorized purposes of the projects, would require substantial structural modifications, or would otherwise exceed current USACE authority are not consistent with the purpose and need for the WCM update and are not considered further in the EIS.

PUBLIC INVOLVEMENT

Public participation is an important element of the National Environmental Policy Act of 1969 (NEPA) process and is guided by both Council on Environmental Quality's (CEQ) and USACE regulations for implementing NEPA. In accordance with those regulations, USACE process for the Master WCM update includes five specific opportunities for public participation: (1) Notice of Intent (NOI) to prepare an EIS, (2) scoping, (3) public review of the draft EIS, (4) public meeting(s) in conjunction with the draft EIS, and (5) public review of the final EIS. The NOI and public scoping have been completed as summarized below. The remaining opportunities for public input are either currently underway or to be completed in the future as described below.

Notice of Intent and Scoping

In February 2008, USACE published an NOI in the *Federal Register* declaring its intent to prepare an EIS for the proposed action. Supplemental NOIs were published to announce additional information for the public scoping process.

A supplement to the initial NOI was published in September 2008 requesting scoping input from agencies and the public and announcing the dates and locations of public scoping meetings. USACE's scoping objectives were to identify public and agency concerns; define the environmental issues and alternatives to be examined in the EIS; identify related issues that originate from separate legislation, regulations, or executive orders; identify relevant state and local agency requirements; and identify available sources of data, studies, or tools that could provide information valuable in preparing the EIS. The scoping meetings were held in October 2008 at five locations throughout the ACF Basin. A total of 1,018 stakeholders participated in the five public scoping meetings. USACE published a *Final Scoping Report* in January 2009.

In November 2009, an NOI was published to announce the reopening of public scoping in response to the memorandum and order issued in July 2009 by the United States District Court for the Middle District of Florida in the case *In re Tri-State Water Rights Litigation*. The ruling included a severely limited interpretation of USACE's authority to provide water supply benefits through its operation of the Lake Lanier project and introduced new information and circumstances that affected some of the

determinations reflected in the January 2009 *Final Scoping Report*. USACE published an updated *Final Scoping Report* in March 2010.

A subsequent NOI was published in the *Federal Register* in October 2012 to reopen public scoping in light of the June 2011 decision of the United States Court of Appeals for the 11th Circuit and the associated June 2012 legal opinion of USACE's chief counsel regarding authority to accommodate municipal and industrial water supply from the Buford Dam and Lake Lanier project. USACE revised the scope of the EIS and ACF Basin Master WCM update to include consideration of the following: operations that are within its existing authority under the River and Harbor Act of 1946, taking into account the 2011 11th Circuit Court of Appeals opinion and USACE 2012 Legal Opinion; the authority under the 1956 Act to contract for 11,200 ac-ft of withdrawals (10 million gallons per day [mgd]); and Georgia's 2000 water supply request (updated in January 2013). USACE published an updated *Final Scoping Report* in March 2013.

Scoping Comments and USACE Analysis of Scoping Comments

The public scoping effort (2008, 2009, and 2012) for updates to the ACF Basin Master WCM resulted in a total of 3,600 comments from over 960 individuals, organizations, and agencies. All the comments from scoping were reviewed, analyzed, and organized into the 12 categories.

The greatest number of comments (1,228) was related to water management recommendations, which include the seven authorized project purposes and USACE ability to balance needs throughout the ACF Basin. Other comments in that category addressed potential alternatives for consideration (or potential mitigation measures); demand projections as they relate to downstream and future water supply needs; and water conservation. Issues and concerns regarding socioeconomics and the tie between water levels, recreation, and regional economics received the second-largest number of comments (706). Most of the comments received in this category pertained to the adverse socioeconomic impacts that have occurred in the northern portions of the ACF Basin due to extremely low water levels in Lake Lanier and low or inconsistent water levels in West Point Lake during periods of drought and drought recovery.

Stakeholder comments were helpful in identifying water resources/water management problems as well as measures (or alternatives) the public wished to have considered as the ACF Basin Master WCM is updated. Considering the purpose and need for this EIS, USACE developed eight screening criteria to guide information gathering, to help identify solutions, and to formulate alternatives. The screening criteria helped to define the scope of proposed updates to the Master WCM, identify relevant public/agency issues and concerns to be addressed in the EIS, and guide the consideration of input received from agencies and the public, as well as suggestions from USACE project team. Any proposed measure (or alternative) considered in the update process for the ACF Basin Master WCM:

1. Should meet the purpose and need of the proposed federal action
2. Should address one or more of the congressionally authorized project purposes
3. Should maintain at least the current level of flood risk management
4. Should be consistent with the contemporary water resources needs of the basin to the extent practicable
5. Should support the operation of the projects in the ACF Basin as a system
6. Should not increase the risk to public safety in the facility or downstream of the project
7. Should not exceed the physical limitations or pose risks to the structural integrity of the projects
8. Should not violate USACE responsibilities under the Endangered Species Act (ESA)

Draft and Final EIS

This draft EIS has been filed with the U.S. Environmental Protection Agency (USEPA) and is available for public review and comment. A notice of availability (NOA) of the draft EIS has been published in the *Federal Register*. Agencies, organizations, and individuals have been invited to review and comment on the document with respect to its completeness and on the proposed action, the alternatives, and the adequacy of the analysis. During the 60-day comment period, USACE will hold public meetings to receive comments on the draft EIS.

As provided for in CEQ regulations, USACE will consider all comments provided by the public and agencies on the draft EIS. The final EIS will address all comments received during the draft EIS public review period, will incorporate appropriate changes derived from the draft EIS comments, and will be made available for 30-day public review prior to any final decision.

Record of Decision

No sooner than 30 days after filing the final EIS with USEPA and publication of the NOA for the final EIS in the *Federal Register*, USACE will prepare a record of decision that will state the decision in regard to updating the ACF Basin Master WCM and the individual project WCMs, summarize alternatives that were considered and relevant factors that were balanced in making the decision, and identify means that have been adopted to mitigate adverse effects.

APPLICABLE USACE GUIDANCE

The following USACE regulations and manuals apply to operation of the ACF Basin projects and management by use of water control manuals and have been applied in the ACF Master WCM update process:

- ER 1110-2-240, *Water Control Management* (October 8, 1982) (also published as 33 CFR Part 222.5).
- ER 1110-2-1150, *Engineering and Design for Civil Works Projects* (August 31, 1999).
- ER 1110-2-1941, *Drought Contingency Plans* (September 15, 1981).
- ER 1110-2-8154, *Water Quality and Environmental Management for Corps Civil Works Projects* (May 31, 1995).
- ER 1110-2-8156, *Preparation of Water Control Manuals* (August 31, 1995).
- Engineering Manual (EM) 1110-2-3600, *Management of Water Control Systems* (November 30, 1987).
- EM 1110-2-3600, *Management of Water Control Systems* (November 30, 1987).
- ER 1105-2-100, *Planning Guidance Notebook*, (April 22, 2000).
- *The Water Supply Handbook* (Revised IWR Report 96-PS-4).

Water control manuals are guidance documents that assist federal water managers in operating individual and multiple interdependent USACE reservoirs on the same river system. They provide technical, historical, hydrological, geographic, demographic, policy, and other information that guides the proper management of reservoirs during times of high water, low water, and normal conditions. The manuals contain water control plans for each of USACE's reservoirs in the basin system and specify how the various reservoir projects will be operated as a balanced system. The manuals also contain drought operations plans and zones to assist federal water managers in knowing when to reduce or increase

reservoir releases and conserve storage in USACE reservoirs. The manuals further ensure the safety of dams during extreme conditions such as floods.

In addition to the above guidance, USACE established Environmental Operating Principles (EOP) in 2002 to guide and ensure that USACE mission activities include totally integrated sustainable environmental practices. These seven principles were reviewed, updated, and reissued in August 2012. The EOP are applicable to the ACF Master WCM update and were fully considered in the update process, as described in the EIS.

RELEVANT STATUTES AND EXECUTIVE ORDERS

The EIS has been prepared to comply with the requirements of the NEPA, as amended (Title 42 of the *United States Code* [U.S.C.], Sections 4321−4347); the CEQ's *Regulations for Implementing the Procedural Provisions of the NEPA* (Title 40 of the *Code of Federal Regulations* [CFR] Parts 1500–1508); and Engineer Regulation (ER) 200-2-2, *Environmental Quality—Procedures for Implementing NEPA* (also published as 33 CFR Part 230). In addressing environmental considerations, the Army is guided by other relevant statutes (and their implementing regulations) and executive orders that established standards and provide guidance on environmental and natural resources management and planning. Those relevant requirements, as well as USACE actions taken to ensure compliance with those requirements, are fully addressed in the EIS. Full compliance with all pertinent requirements will be attained upon completion and coordination of the final EIS and signing of the record of decision.

BACKGROUND ON ATLANTA WATER SUPPLY NEEDS

The Metropolitan Atlanta Area Water Resources Management Study (MAAWRMS), authorized by a resolution of the United States Senate adopted March 2, 1972, and initiated in 1973, focused on developing a plan for assuring a long-term water supply for the Atlanta region. The final MAAWRMS report in 1981 recommended construction of a reregulation dam approximately 6.3 miles downstream of Buford Dam for the purpose of reregulating peak power releases from the dam and providing a minimum flow to meet 2010 average summer water supply demands of 487 mgd, plus 750 cubic feet per second (cfs) for water quality purposes. Although the final report was never officially transmitted to Congress, construction of the reregulation dam was authorized in the Water Resources Development Act of 1986 (P. L. 99-662), subject to approval of a General Design Memorandum (GDM) and with project costs shared 25 percent federal and 75 percent non-federal. The draft GDM, when submitted to the South Atlantic Division in March 1988, confirmed that the reregulation dam still had the greatest net benefits of the four plans investigated, but only by a small margin. Due to the closeness of the net benefits in the plans for a reregulation dam and for reallocation of storage in Lake Lanier, a more detailed evaluation of the hydropower impacts was conducted. In October 1988, the plan for reallocation of reservoir storage was designated the NED plan and recommended for implementation.

In March 1989, USACE initiated a Post-Authorization Change (PAC) report to implement the findings of the GDM for the reregulation dam. The PAC was conducted under the authority of the Water Supply Act of 1958, which provides that storage may be included for present and future municipal or industrial water supply in USACE projects, and Section 216 of the Flood Control Act of 1970, which allows USACE to review the operation of completed federal projects and recommend project modifications. The evaluation confirmed that the reallocation of storage in Lake Lanier should be designated the National Economic Development plan (the plan that would provide the greatest overall net benefits). Reallocation of storage was recommended for implementation in the *Draft Reallocation and Post-Authorization Change Report and a Draft Environmental Assessment*, completed in October 1989. The PAC report recommended reallocation of 206,839 ac-ft of storage in Lake Lanier to supply water for municipal and industrial purposes to address the future water needs for the Atlanta region to 2010.

During the 1970s and 1980s, as the MAAWRMS and related activities were underway, USACE worked with the Atlanta Regional Commission and local water authorities to develop interim water withdrawal contracts to address the growing water demands in metropolitan Atlanta, both around Lake Lanier and downstream of Buford Dam and, including pertinent adjustments in releases at Buford Dam to accommodate increased withdrawals. The EIS includes a detailed summary of these activities.

NEGOTIATIONS AND LITIGATION

Upon completion of the draft PAC report in 1989, USACE efforts to update the Master WCM and address water supply storage reallocation issues associated with Buford Dam and Lake Lanier, in conjunction with multiple agencies and stakeholders, have been the subject of litigation, studies, and negotiations as summarized in the EIS. Since 2011, the Master WCM update has proceeded in accordance with the most recent court rulings:

- The U.S. Court of Appeals for the 11th Circuit issued an opinion on June 28, 2011, that reversed the judgment of the federal district court for the Middle District of Florida on Phase I of the consolidated ACF litigation and concluded that the authorizing documents for the Buford Dam project include water supply as an authorized purpose. The case was remanded to the district court with instructions to remand to USACE for further proceedings. As to the merits, the court held that the majority of plaintiffs' claims in the ACF were not final agency actions and therefore not subject to judicial review.
- On January 24, 2013, the federal district court for the Middle District of Florida vacated its Phase II ruling of the consolidated ACF litigation on the grounds that USACE and the U.S. Fish and Wildlife Service (USFWS) reinitiated consultation while the appeal was pending, thus rendering the appeal moot and making it proper to vacate the underlying order.

There is no active litigation regarding operation of USACE projects in the ACF Basin.

ALTERNATIVE FORMULATION

The Master WCM update process involved formulation and evaluation of water management alternatives to refine project operations to more effectively meet authorized project purposes. As part of this process, USACE considered, along with operations for all authorized purposes, an expanded range of water supply options associated with the Buford Dam and Lake Lanier project, including current levels of water supply withdrawals and additional amounts that Georgia, in 2013, requested from Lake Lanier and downstream of Buford Dam at Atlanta. To respond to Georgia's 2013 request, a WSSA was prepared following USACE guidance for reports on reallocation of reservoir storage. USACE used a 6-step planning process described in ER 1105-2-100. This process is a structured approach to problem solving that provides a rational framework for sound decision making. Iterations of the six steps were conducted as necessary to formulate efficient, effective, complete, and acceptable plans.

The Master WCM update process addressed in the EIS involved a 2-phased approach. In the first phase, water management measures were identified and screened to identify the set of measures that were then combined to form water management alternatives. For analytical purposes, the evaluation of water management alternatives in this phase assumed that the water supply withdrawals from Lake Lanier would be limited to the 20 mgd currently authorized to be withdrawn by the cities of Buford and Gainesville under the relocation contracts and releases from Buford Dam would be made in accordance with the CRMS to support water supply withdrawals from the Chattahoochee River in Metro Atlanta limited to the amounts withdrawn in 2007 (277 mgd). Water supply providers contributed return flows to Lake Lanier and downstream, and those returns were also taken into account. Withdrawals elsewhere within the basin were similarly limited to the amounts withdrawn in 2007. These assumptions facilitated the comparison of the

performance of the water management alternatives using a consistent baseline condition that is relatively independent of the influence of the water supply withdrawals from Lake Lanier under the expired contracts. Additionally, this approach established a baseline for determining the severity of effects on other project purposes of reallocating storage in Lake Lanier for water supply as required by the Water Supply Act of 1958.

The result of this formulation phase was the identification of a proposed water management alternative. In the second phase of alternative formulation, measures to address Georgia's 2013 request for water supply from Lake Lanier and from the Chattahoochee River downstream of Buford Dam were developed, screened, and then combined to form water supply options. For this phase, the Water Management No Action Alternative and the Water Management Proposed Action Alternative were combined with water supply options to form alternatives that were evaluated and compared. The result of this formulation phase was the identification of a PAA to improve water management and address water supply needs in the ACF Basin.

WATER MANAGEMENT ALTERNATIVE FORMULATION

On the basis of operational experience gained under the draft 1989 *Master WCM*, a number of challenges were identified. These challenges included the basis for the configuration and operational criteria associated with *action zones* within the conservation storage of the reservoirs; certain operational criteria associated with the May 2012 Revised Interim Operating Plan (RIOP); the relationship of sustained hydropower operations to operations for endangered and threatened species; and dependability of navigation on the Apalachicola River. Additional information on these challenges is in the EIS.

After identifying those water management challenges and problems, USACE developed several objectives for the Master WCM update and the WSSA to address the issues as follows:

- Define action zones on a scientific basis that eliminate disproportionate impact on reservoirs and address current system needs.
- Develop and implement a basinwide USACE reservoir drought operation plan.
- Reduce or eliminate the chances of prematurely returning to drought operations and reducing flows below Jim Woodruff Lock and Dam below 5,000 cfs.
- Reduce or eliminate the adverse effect of system operations on federally listed threatened and endangered species.
- Improve system performance to achieve congressionally authorized project purposes.
- Increase the reliability of navigation on the ACF system.

USACE identified numerous management measures for possible consideration in the updated Master WCM, based on public scoping comments and USACE experience with ACF project operations. A measure can be defined as a feature or activity that can be implemented at a specific geographic site to address one or more of the objectives. The measures considered in updating the Master WCM included variations for revising reservoir drawdown and refill periods, reshaping action zones, and balancing zone drawdown proportionally among projects; revising hydroelectric power generation; revising drought operations and environmental flows; and developing navigation-specific operations. USACE considered each measure individually and determined whether it passed the eight screening criteria. Measures failing to pass the screening criteria were not carried forward for further evaluation (i.e., eliminated from further consideration). Initial screening of measures is discussed in greater detail in Chapter 4.1. Measures carried forward for further evaluation were refined, if required, and then combined to form basinwide alternatives that address one or more of the objectives identified above.

Water Management Measures Eliminated from Consideration (First Screening)

Water management measures that did not pass the screening criteria or were found to be outside the scope of the EIS were eliminated from consideration. The following sentences include examples of proposed measures eliminated from consideration. Because navigation is one of the congressionally authorized purposes in the ACF Basin, any recommendations to eliminate navigation as a project purpose were not considered. Management measures that suggest use of flood storage for purposes other than flood storage were not considered. Recommendations for studies to determine the allocation of water among Alabama, Florida, and Georgia were also not carried forward for further consideration. USACE did not carry forward management measures that change minimum releases or minimum flows, ensuring other entities meet their future federal compliance requirements. USACE recognizes existing minimum flow requirements in the system but is not authorized to operate its projects to meet requirements for which others parties are responsible. Setting minimum flow targets to ensure compliance with water quality standards is the responsibility of states, not USACE. Changes to the existing head at dams in the ACF Basin could increase the risk to the structural integrity of the projects. Therefore, measures that would change the existing head limits for projects in the ACF Basin were eliminated from consideration. Management measures that suggest structural modifications to the ACF project or other USACE projects do not meet the purpose and need of this EIS. Accordingly, suggestions such as repairing and reversing channel degradation in the Apalachicola River or halting or limiting the current diversion of fresh water caused by the Chipola Cutoff were not carried forward for further consideration. Separate authorities that may be pursued to address some of those issues include Section 216 of the River and Harbor and Flood Control Act of 1970 (Review of Completed Projects); Section 1135 of the Water Resources Development Act (WRDA) 1986, as amended (Project Modifications for Improvement of the Environment); and Section 206 of WRDA 1996, as amended (Small Aquatic Ecosystem Restoration Projects). The latter two authorities have specific limits on federal funds that can be expended on each project ($10 million).

Water Management Measures Considered for Further Evaluation

Potential management measures that passed the screening criteria were considered in the formulation of alternatives. The following provides a general description of the measures considered, each of which was considered individually and refined iteratively.

Revised Guide Curves and Action Zones

USACE considered redefining guide curves and action zones at federal projects in the ACF Basin. A guide curve is the seasonally variable desired pool elevation in a reservoir, and is normally defined as the elevation at the top of the conservation storage. Action zones are partitions of a reservoir's conservation storage, as defined in the reservoir water control plan, to guide reservoir managers in meeting project purposes under a wide variety of hydrologic conditions. In the *1989 draft ACF WCM*, four action zones were first defined for Lake Lanier, West Point Lake, and Walter F. George Lake storage projects in the ACF Basin. The action zones were originally developed by USACE based on past experience in water management, considering the time of year, the relationship of historic pool levels and water releases, operational limits for conservation storage, and recreational impact levels. Each of the four action zones has a set of specific operational rules or guidelines that govern water management operations for the reservoir when the pool elevation lies within that zone. The following specific guide curve/action zone measures were considered: *maintain existing guide curves*; *modify guide curves* at West Point Lake and Walter F. George Lake; *modify action zones* at Lake Lanier, West Point Lake and Walter F. George Lake.

Drought Operations

Under *current drought operations*, a minimum release from Jim Woodruff Dam is specified and the other minimum release and maximum fall rate provisions of the May 2012 RIOP are temporarily suspended

until composite conservation storage within the basin is replenished to a level that can support them. "Composite conservation storage" equals the cumulative daily conservation storage values by action zone for the ACF Basin reservoirs (Lanier, West Point, and Walter F. George). Composite conservation storage and the associated zones are discussed in more detail in sections 2 and 4 of the EIS. The minimum discharge is determined in relation to composite conservation storage and not average basin inflow. The drought plan is *triggered* when composite conservation storage falls below the bottom of zone 3 into zone 4. At that time, all the composite conservation storage zone 1-3 provisions are suspended and management decisions are based on the provisions of the drought plan. While composite conservation storage is in zone 4, the minimum release from Jim Woodruff Lock and Dam is 5,000 cfs any basin inflow above 5,000 cfs may be stored. Below composite storage zone 4 is the drought zone (roughly equivalent to the inactive storage in Lake Lanier, West Point Lake, and Walter F. George Lake plus zone 4 storage in Lake Lanier). When composite conservation storage falls into the drought zone, the minimum release from Jim Woodruff Dam is 4,500 cfs and any basin inflow above 4,500 cfs may be stored. When transitioning from a minimum release of 5,000 to 4,500 cfs, maximum fall rates are limited to 0.25 ft/day. The 4,500 cfs minimum release is maintained until composite conservation storage returns to a level above the top of the drought zone, at which time the 5,000 cfs minimum release is reinstated. Per the May 2012 RIOP, the drought plan provisions remain in place until the composite conservation storage reaches a level above the top of zone 2 (i.e., within zone 1). At that time, the drought plan provisions are suspended and all other provisions for normal operations are reinstated.

Revised drought operations would incorporate two potential revisions into the drought plan. Under revised operations, the drought plan would be *triggered* when composite conservation storage falls below the bottom of Zone 2 into Zone 3. The drought plan provisions would remain in place until composite conservation storage reaches a level above the top of Zone 2 (i.e., within Zone 1). If recovery conditions are not achieved in February, drought plan provisions will not be suspended until April, provided composite conservation storage remains above Zone 4.

Minimum Flows at Peachtree Creek

Three measures have been considered regarding minimum flows at Peachtree Creek: *current operations* (maintain continuous net minimum flow of 750 cfs for water quality purposes); *revised minimum flow* (reduce continuous minimum flow to 650 cfs from November through April); *monthly varying flow* (specify a variable minimum flow for each month depending on the reservoir composite storage zone).

Hydropower

Four specific measures were considered for operations of hydroelectric power generation: *current schedule* at Buford Dam, West Point Dam, and Walter F. George Lock and Dam; *modified schedule* at Buford Dam, West Point Dam, and Walter F. George Lock and Dam (variable schedule in zone 1); *reduced hydroelectric power* under drought operations; and *modified schedule with reduced hydroelectric power* under drought operations.

Navigation

The lack of dredging and routine maintenance has led to inadequate depths in the Apalachicola River navigation channel, and commercial navigation is possible only seasonally when flows in the river are naturally high, with flow support for navigation suspended during drier times of the year. Specific navigation operations occur on a case-by-case basis, with limited releases for navigation being made for special shipments when a determination can be made that other project purposes will not be significantly affected and any fluctuations in reservoir levels or river stages will be minimal. Measures considered by USACE for navigation included: continuing the *current operations* in support of navigation; *periodic navigation* based upon the number of opportunities during the year when sufficient flows would be available

to provide channel depths of 7-ft or 9-ft; *defined navigation seasons* such as December–May, January–April, and January–May; *defined navigation season (variable),* which would specify the navigation season as four months in duration or, when sufficient water is available, five months; and *year-round navigation*.

Basin Inflow

Basin inflow is currently defined as the amount of water that would flow by Jim Woodruff Dam during a given time period if all of USACE reservoirs maintained a constant water surface elevation during that period. Basin inflow is not the natural or *unimpaired* flow of the basin at the site of Jim Woodruff Dam, because it reflects the influences of reservoir evaporative losses, inter-basin water transfers, and consumptive water uses (e.g., municipal and industrial water supply and agricultural irrigation). Two alternative methods for computing basin inflow were considered. One alternative method of calculating basin inflow, referred to as *revised basin inflow method 1*, adds depletions to the basin inflow calculation. Revised basin inflow is not true basin inflow, but it is intended to estimate inflow that would have resulted in the absence of reservoirs and withdrawals for municipal and industrial (M&I) and agricultural water supply demands. A second alternative method of computing basin inflow (*revised basin inflow method 2)* would track observed flow in the Apalachicola River at Chattahoochee, Florida, and add considerations of storage change in Lake Lanier, West Point Lake, Walter F. George Lake, and Lake Seminole. Positive storage change represents a net increase in total composite conservation storage, and negative change represents a net decrease.

Fish and Wildlife Conservation

Current operations considered in developing alternatives for the updated Master WCM included lake and river *fish spawn standard operating procedures*; *lockage for fish passage* at Jim Woodruff Lock and Dam; and *May 2012 RIOP* for federally listed threatened and endangered species.

Other measures that were considered included small pulses or non-hydroelectric power peaking in the Chattahoochee River below Buford Dam and West Point Dam; lockage for fish passage at George W. Andrews Lock and Dam and Walter F. George Lock and Dam similar to that which currently occurs at Jim Woodruff Lock and Dam; a request by USFWS to cycle Walter F. George Lake between the highest levels (190 ft) in late winter/early spring to the lowest levels (185 ft) in late summer to accommodate Eufaula National Wildlife Refuge operations; revisions to federally listed threatened and endangered species operations (revised ramping rate [maximum fall rate], revised percent of basin inflow stored, suspend ramping during prolonged low flow, revised seasonal flow targets, pulse flows, monthly flow targets, daily flow targets).

Water Supply

For analytical purposes, USACE used the following water supply withdrawal assumptions to evaluate and compare the water management alternatives for ACF system operations: currently authorized water supply withdrawals from, and returns to, Lake Lanier (20 mgd water withdrawals under relocation contracts with cities of Buford and Gainesville, with a 50 percent return rate) and releases from Buford Dam in accordance with the Chattahoochee River Management System to support current withdrawals by Atlanta area water providers (277 mgd) with an 82 percent return rate to the Chattahoochee River.

Water Management Measures Considered and Eliminated from Detailed Evaluation (Second Screening)

The measures identified above were considered for each of USACE reservoirs in the ACF Basin and the basin as a whole, and a preliminary evaluation was performed. Based on this preliminary evaluation and screening process, a number of the potential measures related to modified guide curves and action zones,

hydropower operations, navigation, basin inflow computation, and fish and wildlife conservation were eliminated from detailed evaluation as described in more detail in the EIS.

WATER MANAGEMENT MEASURES COMBINED INTO WATER MANAGEMENT ALTERNATIVES

The measures remaining for consideration following preliminary evaluation and screening process are presented in Table ES-2. Table ES-2 further depicts various combinations of these water management measures to establish an array of seven discreet water management alternatives, including No Action (representing current water management operations).

ANALYSIS AND COMPARISON OF WATER MANAGEMENT ALTERNATIVES

USACE used the Hydrologic Engineering Center (HEC)-ResSim model to simulate ACF operations for the Water Management No Action Alternative and the six other water management alternatives over a 73-year hydrologic period of record (1939 through 2011). USACE used an iterative process to identify the various measures that would be further developed, analyzed, and refined toward the goal of developing an updated WCM. The process relied extensively on modeling using the latest software application, HEC-ResSim[2]. The software incorporates characteristics of the basin and individual reservoirs including physical constraints (i.e., spillway capacities, area-discharge curves, flows associated with hydroelectric power generation, and such) and operational procedures (e.g., action zones, balancing, and the like). As the HEC-ResSim model for the ACF Basin was refined and initial baseline model runs were conducted, USACE conducted two workshops to familiarize stakeholders with the model and its capabilities.

The water quality effects associated with the water management alternatives and water supply storage options in the ACF Basin were analyzed with the HEC-5Q model developed by USACE Hydrologic Engineering Center. For the simulation of water quality conditions under the various alternatives, HEC-5Q inputs included in-stream flows, tributary flows and water quality data, withdrawals, reservoir operations, and other point and nonpoint source flows and quality loads to the system. The HEC-5Q model was linked with the HEC-ResSim model.

Based upon the HEC-ResSim and HEC-5Q outputs, the alternatives were compared to assess their performance relative to authorized project purposes and other factors, including hydropower production, reliable navigation channel availability, fish and wildlife conservation considerations, effects on recreation, and water supply considerations. None of the water management alternatives would affect the flood risk management function. The detailed analysis of water management alternatives is presented in the EIS.

[2] The USACE Hydrologic Engineering Center (HEC) developed the software that is now the standard for USACE reservoir operations modeling.

Table ES-2.
Summary of Water Management Alternatives

Water Management Measures			Water Management Alternatives						
			1	2	3	4	5	6	7
Guide Curves	Maintain existing guide curve		X	X	X	X	X	X	X
Action Zones	Maintain existing action zones		X						
	Revised Level 1 action zones			X	X	X	X	X	X
Drought Operations	Drought operations trigger *		Zone 4	Zone 4	Zone 4		Zone 4	Zone 4	Zone 3
	Extreme drought operations		X	X	X	X	X		X
	Drought operations suspension trigger*		Zone 1	Zone 1	Zone 1		Zone 1	Zone 3	Zone 1
Peachtree Creek Minimum Flows	Current (750 cfs)		X						
	Seasonal flow 750 cfs/650 cfs			X	X	X	X		X
	Monthly (FWS) determination by zone							X	
Hydropower Generation	Current generation schedule		X					X	
	Modified generation schedule with drought operations			X	X	X	X		X
Navigation	Current-no navigation operations		X						
	4/5 Month			X		X	X	X	X
	Year-round				X				
Basin Inflow	Current computational method		X	X	X			X	X
	Revised Method 1					X			
	Revised Method 2						X		
Fish and Wildlife	Current fish spawn and passage		X	X	X	X	X	X	X
Listed Species Management	RIOP May 2012		X						
	Ramping Rate	Current ramping rate**	X	X	X		X	X	X
		Revised ramping rate				X			
		Suspend during prolonged low flow		X	X		X	X	X
		Suspend in drought		X	X			X	X
	Flow Target	Current (seasonal)**	X	X	X				X
		Revised seasonal flow target					X		
		Monthly flow target						X	
		Daily flow target (historic exceedance)				X			
	Pulse flow						X		
Water Supply	Water supply operations: 20 mgd for relocation contracts and 277 mgd downstream withdrawal by Metro Atlanta***		X	X	X	X	X	X	X

Notes:
* Based upon composite conservation storage zones (cumulative conservation storage [by zone] for USACE ACF reservoirs [Lanier, West Point, and Walter F. George]).
** Component of the May 2012 RIOP.
*** For the purpose of comparing alternatives, currently authorized water supply withdrawals from Lake Lanier and downstream at Atlanta were factored into each water management alternative. Those authorized, currently occurring, annual average amounts are 20 mgd from Lake Lanier and 277 mgd at Atlanta.

IDENTIFICATION OF WATER MANAGEMENT PROPOSED ACTION ALTERNATIVE

To assist in identifying the water management alternative that best satisfied the objectives for the Master WCM update, USACE developed a process for ranking the performance of the alternatives based on HEC-ResSim modeling results. Based on the values of various performance measures, the alternatives were ranked from one (best performance) to seven (worst performance). As shown in Table ES-3, which summarizes the results of the ranking of water management alternatives, the water management alternative that best balances the authorized project purposes is Water Management Alternative 7 and is the Water Management Proposed Action Alternative.

Table ES-3.
Composite Ranking of Water Management Alternatives

	Composite ranking						
Water Management Alternative	**Navigation**	**Hydropower**	**Recreation**	**Fish & wildlife**	**Water supply**	**Sum of rankings**	**Composite ranking**
Alt1	**5**	**1**	**1**	**5**	**4**	16	**3**
Alt2	**1**	**6**	**3**	**2**	**2**	14	**2**
Alt3	**1**	**5**	**5**	**7**	**5**	23	**6**
Alt4	**6**	**7**	**7**	**3**	**6**	29	**7**
Alt5	**7**	**3**	**4**	**5**	**3**	22	**5**
Alt6	**1**	**3**	**6**	**1**	**7**	18	**4**
Alt7	**1**	**2**	**2**	**3**	**1**	9	**1**

DEVELOPMENT AND DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

In the first phase of the plan formulation process for the Master WCM update, water management measures were identified, screened, and subsequently combined into water management alternatives. These water management alternatives were evaluated and ranked based on performance metrics aligned with the ACF project purposes. As a result, Water Management Alternative 7 was identified as the Water Management Proposed Action Alternative. The second phase of alternative formulation identified and screened measures to address the current and future water supply demand, up to and including the Georgia 2013 request for water supply from Lake Lanier and for withdrawers in the metropolitan Atlanta area downstream of Buford Dam. This process identified an array of water supply options that were combined with either the Water Management Alternative 1 (Alt1) or the Water Management Proposed Action Alternative (Alt7) to form combined ACF water management/water supply alternatives (Atlanta region) for detailed evaluation and impact analysis.

USACE developed the following objectives for the WSSA to address the identified water supply issues:

- Improve system operation to provide for Georgia's current and 2040 water supply demand downstream of Buford Dam, and currently authorized withdrawals from Lake Lanier.
- Determine whether, and in what amount, to reallocate storage in Lake Lanier to support additional environmentally sustainable withdrawals for municipal and industrial water supply while ensuring sufficient water is available to meet other ACF authorized project purposes.

Potential water supply management measures that did not pass the previously described screening criteria or that recommended addressing other water supply needs not included in Georgia's 2013 request were eliminated and not carried forward for further consideration.

Based on the June 2011 11th Circuit Court of Appeals ruling and USACE Legal Opinion of June 25, 2012, USACE has conducted a WSSA for a potential storage reallocation to accommodate *current levels* of withdrawal for water supply from Lake Lanier as well as increased levels of withdrawals from the lake as specified in Georgia's 2013 request. The Hall County, Georgia, Board of Commissioners has applied for a Department of the Army permit for a proposed water supply reservoir project (Glades Reservoir) to be located in Hall County to operate as part of a public water supply system. Even though the Section 404 permit process for the proposed project has not been completed, Glades Reservoir has been considered together with other water supply measures to address Georgia's 2013 request.

The following management measures to address Georgia's 2013 request for M&I water supply from Lake Lanier were identified and screened to determine their viability for detailed consideration: the proposed Glades Reservoir; reallocation of Lake Lanier conservation storage (with and without Glades Reservoir); reallocation from inactive storage in Lake Lanier; reallocation of Lake Lanier flood risk management storage (with and without Glades Reservoir); desalinization and pumping to service areas; new non-USACE reservoirs; expansion of existing non-USACE reservoirs; groundwater supplies; and conservation and water use efficiency programs (including potable water reuse).

Reallocation of Lake Lanier conservation storage (with or without Glades Reservoir) was determined to be the most viable and cost-effective measure to meet the water supply need identified by Georgia. The other potential measures were not pursued further because they (1) would not satisfy the identified need for water supply, (2) would not be cost effective, and/or (3) would involve other more significant consequences.

Responding to Georgia's request involved considering not only the quantity of water requested but also the rates at which treated wastewater would be returned to Lake Lanier and downstream of Buford Dam. The current return rate of water withdrawn from Lake Lanier is 29 percent. The overall return rate assumed in Georgia's 2013 request was 55 percent. A review of the Wastewater Plan published by the Metro North Georgia Water Planning District indicated that, based on the treatment infrastructure envisioned for 2035, a 55 percent return was optimistic. Accordingly, USACE developed alternative return rates that more closely matched the capability of the 2035 waste treatment infrastructure.

The withdrawal values and return rate assumptions for the different water supply options considered for detailed analysis are shown in Table ES-4 and described more fully in the EIS. Water Supply Option A (No Action) represents a continuation of withdrawals from Lake Lanier that are currently occurring without water storage agreements. Option B (without project condition) represents the condition expected to exist in future in the absence of a reallocation of storage in Lake Lanier. Options C, D, E, F and G provide for Georgia's 2013 request but with different estimates of return rate. Option H would provide for a portion of Georgia's 2013 request and would have the same net withdrawal as Option D. The alternatives described below combine either the Water Management No Action Alternative (Water Management Alternative 1 (Alt1)) or the Water Management Proposed Action Alternative (Water Management Alternative 7 (Alt7)) with one of the water supply options A through H shown in Table ES-4. Option G was not combined with a water management alternative and carried forward for more detailed consideration because it was not reasonable to expect waste treatment plants to operate at their maximum capacities. The combined water management/water supply alternatives are identified by the number of the water management plan followed by the letter designating the water supply option included therein.

Table ES-4.
Water Supply Options Considered

Water Supply Option	Lake Lanier relocation (mgd)	Lake Lanier withdrawal (mgd)	Lake Lanier total withdrawals (mgd)	Lake Lanier returns (mgd/% returned)	Glades Reservoir withdrawals (mgd)	Glades Reservoir returns (mgd/% returned)	Net Withdrawal from Lake Lanier and Glades Reservoir (mgd)	Storage required to support reallocation (ac-ft)	River withdrawals (mgd)	River returns (mgd/% returned
A - No Action	20	108	128	37/29%	0	0	91	124,034	277	227/82%
B – Relocation only	20	0	20	10/50%	0	0	10	n/a	277	227/82%
C - Future without project condition (w/Glades pumping)	20	0	20	10/50%	40	20/50%	30	n/a	408	335/82%
D - GA 2013 request	20	277	297	163*/55%	0	0	134	318,126	408	384/94%
E - GA 2013 request w/Glades pumping	20	237	257	141/55%	40	22/55%	134	272,187	408	384/94%
F - GA 2013, projected return volume for 2035	20	277	297	91/30.6%	0	0	206	318,126	408	335/82%
G - GA 2013 max treatment facility capacity	20	277	297	128/43%	0	0	169	*	408	477/117%
H - Projected return volume for 2035 w/Glades pumping	20	165	185	75/40.4%	40	16/40.4%	134	189,497	408	384/94%

Note: * Storage for this water supply option was not computed because this option was not carried forward for further consideration as explained in Section 5.1.4.1.1.

Table ES-5 shows the combination of water management plans and water supply options considered as alternatives.

Alt1A (NAA), Alt1B, Alt1C, Alt7A, and Alt7C would meet neither or only one of the two water supply objectives identified above. Thus, none were selected for the Proposed Action Alternative (PAA). Alt7D, Alt7E, and Alt7F would meet both water supply objectives but were not selected as the PAA because either (1) the return rates were considered to be overly optimistic or (2) the effects on the resource areas addressed in Section 6 associated with the alternative would be more adverse than those for Alt7H.

Alt7H would satisfy both of the water supply objectives. Although this alternative does not provide for Georgia's request for a gross withdrawal of 297 mgd from Lake Lanier—barring a significant increase in return treatment rates and facilities, beyond what is currently anticipated—it does provide for a considerable increase in water supply use (i.e., greater than that currently withdrawn). Based on analysis of historic return rates and common industry practice, this alternative incorporates a treated wastewater return rate to Lake Lanier that is reasonably foreseeable. Compared to the NAA, the PAA results in some slightly adverse to adverse effects to lake levels at Lake Lanier and Walter F. George Lake; flow conditions below Buford Dam and below Walter F. George Dam; some water quality parameters; land use; some listed-species parameters; hydroelectric power generation; and recreation. More conservative "drought operations", including more operational restrictions, would occur more frequently under the PAA; however, this operation would likely prevent more severe drought conditions from occurring than under the NAA. Effects on navigation are substantially beneficial. The PAA has the least overall adverse effects lake levels, stream flow conditions, water quality, and other natural resource and socioeconomic resource considerations of all the alternatives that fully or partially met both the water management and water supply objectives. Alt7H was selected as the PAA.

ENVIRONMENTAL CONSEQUENCES

The EIS evaluates the environmental and socioeconomic effects of the alternatives, potential for cumulative effects, and potential mitigation measures and their potential impacts. Seven resource areas are evaluated. For purposes of evaluating alternative operational plans for the Master WCM update, a 73-year hydrologic period of record (1939 through 2011) was used to run simulations using the HEC-ResSim model. Simulations to evaluate water quality consequences were conducted using the HEC-5Q model. The NAA and eight alternatives, including the PAA, were simulated.

Table ES-6 and the following sections summarize the principal conclusions drawn from the analyses. The following terms characterize or define the various levels of impact presented in the impact matrix:

- No change – positive or negative impacts would be negligible, amounting to no effective change.
- Slightly adverse/slightly beneficial – impact would be perceptible and measurable, but would not have an appreciable effect.
- Adverse/beneficial – the impact would be clearly detectable and would have an appreciable effect.
- Substantially adverse/substantially beneficial – impact would result in a highly noticeable effect.

The general assessment of environmental consequences in the impact matrix for each natural and socioeconomic resource area is supported in the EIS by more detailed information and analysis, both qualitative and quantitative. While Table ES-6 presents a qualitative assessment for all the alternatives with respect to all the natural, socioeconomic, and cultural resource areas, the subsequent paragraphs highlight key environmental consequences for the PAA compared to the NAA.

Table ES-5.
Summary of Water Management / Water Supply Alternatives

Water Management Measures			Water management / water supply alternatives								
			1A	1B	1C	7A	7C	7D	7E	7F	7H
Guide Curves	Maintain existing guide curve		X	X	X	X	X	X	X	X	X
Action Zones	Maintain existing action zones		X	X	X						
	Revised Level 1 action zones					X	X	X	X	X	X
Drought Operations	Drought operations trigger *		Zone 4	Zone 4	Zone 4	Zone 3	Zone 3	Zone 3	Zone 3	Zone 3	Zone 3
	Extreme drought operations		X	X	X	X	X	X	X	X	X
	Drought operations suspension trigger *		Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1
Peachtree Creek Minimum Flows	Current (750 cfs)		X	X	X						
	Seasonal flow (750 cfs / 650 cfs)					X	X	X	X	X	X
Hydropower Generation	Current generation schedule		X	X	X						
	Modified generation schedule with drought operations					X	X	X	X	X	X
Navigation	Current-no navigation operations		X	X	X						
	4/5 Month					X	X	X	X	X	X
Basin Inflow	Current computational method		X	X	X	X	X	X	X	X	X
Fish and Wildlife	Current fish spawn and passage		X	X	X	X	X	X	X	X	X
Listed Species Management	RIOP May 2012		X	X	X						
	Ramping Rate	Current rate**	X	X	X	X	X	X	X	X	X
		Suspend during prolonged low flow				X	X	X	X	X	X
		Suspend in drought*	X	X	X	X	X	X	X	X	X
	Current (seasonal) minimum flow provision**		X	X	X	X	X	X	X	X	X
Water Supply Options (EIS Table 5.1-1)***	A – No action		L=128 D=408			L=128 D=408					
	B – Relocation contracts only (in Lake Lanier)			L=20 D=277							
	C – Future without project condition (with Glades Reservoir pumping)				L=20 G=40 D=408		L=20 G=40 D=408				
	D – GA 2013 request							L=297 D=408			
	E – GA 2013 request (with Glades Reservoir pumping)								L=257 G=40 D=408		
	F – GA 2013 (projected return volume for 2035)									L=297 D=408	
	H – GA 2013 (projected return volume for 2035 with Glades Reservoir pumping)										L=185 G=40 D=408

Notes:* Based upon composite conservation storage zones (cumulative conservation storage [by zone] for USACE ACF reservoirs [Lanier, West Point, and Walter F. George]).

**Component of the May 2012 RIOP.

***Numbers indicate withdrawals in mgd from Lake Lanier (L), Glades Reservoir (G), and the Chattahoochee River downstream (D) of Buford Dam.

Table ES-6.
Summary of Effects

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Water Quantity									
Lake Levels									
Lake Lanier	Baseline	Beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly adverse	Substantially adverse	Slightly adverse
West Point Lake	Baseline	No change	No change	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial
Walter F. George Lake	Baseline	No change	No change	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
George W. Andrews Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE Reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Flow conditions downstream of USACE reservoirs									
Buford Dam to Bull Sluice Lake	Baseline	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Adverse	Slightly adverse
Morgan Falls Dam to West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	Slightly adverse	Slightly adverse
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	Adverse	No change
Walter F. George Lock and Dam to Jim Woodruff Lock and Dam	Baseline	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Drought operations and management									
ACF Basin	Baseline	Beneficial	No change	Adverse	Adverse	Adverse	Adverse	Substantially adverse	Adverse
Navigation flow targets/channel availability									
7.0-ft channel	Baseline	No change	No change	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial
9.0-ft channel	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Water supply intake structure operation									
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	Adverse	No change
Buford Dam to West Point Dam	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Elsewhere in the ACF Basin	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Water Quality									
Water temperature									
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Buford Dam to Atlanta	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Atlanta to West Point Lake	Baseline	No change	No change	No change	No change	Slightly adverse	No change	No change	No change
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Dissolved oxygen									
Lake Lanier	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	No change
Buford Dam to Atlanta	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	No change	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Total phosphorus									
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Buford Dam to Atlanta	Baseline	Slightly beneficial	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Slightly adverse	No change	Substantially adverse	Substantially adverse	Substantially adverse	Adverse	Substantially adverse
West Point Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
West Point Dam to Walter F. George Lake	Baseline	Slightly adverse	Substantially adverse	Slightly adverse	Substantially adverse	Substantially adverse	Substantially adverse	Substantially adverse	Substantially adverse

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Walter F. George Lake	Baseline	No change	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Total nitrogen									
Lake Lanier	Baseline	Slightly beneficial	Slightly beneficial	No change	Slightly beneficial	Adverse	Adverse	Slightly adverse	Slightly adverse
Buford Dam to Atlanta	Baseline	Slightly beneficial	No change	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Adverse	No change	Adverse	Adverse	Adverse	Adverse	Adverse
West Point Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Adverse	Adverse	Slightly adverse	Slightly adverse
West Point Dam to Walter F. George Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Chlorophyll a									
Lake Lanier	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Buford Dam to Atlanta	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Atlanta to West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Geology and Soils									
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
WestPoint Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
George W. Andrews Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE Reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Land Use									
Buford Dam/Lake Lanier	Baseline	Slightly beneficial	Slightly beneficial	Slightly beneficial and adverse	Slightly beneficial	Slightly adverse	Slightly adverse	Substantially adverse	Slightly adverse
West Point Dam and Lake	Baseline	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lock, Dam, and Lake	Baseline	No change	No change	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
George W. Andrews Lock, Dam, and Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Jim Woodruff Lock and Dam/ Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE Reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Biological Resources									
Vegetation and wildlife resources									
Chattahoochee River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Flint River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Riverine fish and aquatic resources									
Buford Dam to Atlanta	Baseline	Slightly beneficial	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Adverse	No change	Substantially adverse	Substantially adverse	Substantially adverse	Adverse	Substantially adverse
West Point Dam to Walter F. George Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	Slightly adverse	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Reservoir fish and aquatic resources									
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	Slightly beneficial	No change
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
George W. Andrews Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Estuarine fish and aquatic resources									
Estuarine fish and aquatic resources	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Protected Species—Gulf sturgeon									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Protected Species—Mussels									
Interannual frequency (percent of years) of flow rates <5,000 cfs/<10,000 cfs	Baseline	No change	No change	Adverse	No change	Adverse	Adverse	Adverse	Adverse
Median number of days/year with flows <10,000 cfs	Baseline	Slightly beneficial	No change	Slightly beneficial	No change	Slightly adverse	No change	No change	No change
Median number of consecutive days/year with flows <10,000 cfs	Baseline	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Beneficial	Slightly adverse
Median fall rates when discharge <10,000 cfs	Baseline	No change	No change	No change	No change	No change	No change	Beneficial	No change
Maximum fall rates when discharge <10,000 cfs	Baseline	No change	Slightly beneficial	Slightly beneficial	Slightly beneficial	No change	No change	No change	No change
Shoal bass recruitment									
	Baseline	No change	Slightly beneficial	Slightly beneficial	Slightly beneficial	Beneficial	Beneficial	Beneficial	Beneficial
Eufaula National Wildlife Refuge									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Fish hatcheries									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Socioeconomic Resources									
Municipal and industrial water supply									
From Lake Lanier	Baseline	Substantially adverse	Substantially adverse	Substantially adverse	Substantially adverse	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial
Downstream of Buford Dam for metro Atlanta	Baseline	Substantially adverse	Substantially beneficial	Substantially adverse	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Navigation									
Navigation 7-ft	Baseline	No change	No change	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial
Navigation 9-ft	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Hydroelectric power generation									
	Baseline	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly beneficial	Slightly adverse	Slightly adverse	Adverse	Slightly adverse
Agricultural water supply									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Flood risk management									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Recreation									
Lake Lanier	Baseline	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly beneficial	Slightly adverse	Slightly adverse	Substantially adverse	Slightly adverse
West Point Lake	Baseline	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial
Walter F. George Lake	Baseline	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Environmental justice									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Protection of children									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Aesthetic Resources									
	Baseline	No change	No change	No change	No change	No change	No change	Slightly adverse	No change
Cultural Resources									
	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Other Resource Areas									
Air quality	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Noise	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Traffic and transportation (nonnavigation)	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Hazardous, toxic, and radioactive waste (HTRW)	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

WATER QUANTITY

The change in lake levels, flow conditions downstream of USACE reservoirs, drought operations, navigation flow targets, and water supply intake structures depend mainly on the basin inflows, hydrologic conditions, system operations, and water supply options incorporated for the different alternatives.

Lake levels and conservation storage. Under the PAA, conditions are expected to be slightly adverse at Lake Lanier, West Point Lake, and Walter F. George Lake compared to the NAA. Water surface elevations are expected to be slightly lower under certain conditions as a result of increased water supply withdrawals and consumptive use. No appreciable changes would be expected at George W. Andrews Lake, Lake Seminole, and non-USACE reservoirs in the basin compared to the NAA.

Flow conditions downstream of USACE reservoirs. Slightly adverse (reduced) flow conditions would be expected to occur at times under the PAA between Buford Dam and Peachtree Creek and between Walter F George Lock and Dam and Jim Woodruff Lock and Dam compared to conditions under the NAA. No appreciable changes in flow conditions would be expected for the PAA in other riverine reaches of the ACF Basin compared to the NAA. Between Buford Dam and Peachtree Creek, the slight declines in flow conditions under the PAA are likely to be more associated with increased water demands and the lower minimum flow target at Peachtree Creek (from November-April). Between Walter F. George Lock and Dam and Jim Woodruff Lock and Dam, the slight declines would be more attributable to revised action zones and proposed revisions to drought operations. The PAA would have no appreciable effect on flow conditions downstream of Jim Woodruff Lock and Dam or on freshwater inflows into Apalachicola Bay compared to the NAA.

Drought operations and management. Compared to the NAA, implementation of the PAA would be expected to have an adverse effect in terms of the number of occurrences when drought operations would be triggered over the modeled period of record and the percent of time when the system would be in drought operations. Under the NAA, drought operations would be triggered three times over the period of record with drought operations in effect 6.7 percent of the time. Under the PAA, drought operations would be triggered 22 times over the period of record with drought operations in effect 18.1 percent of the time. The benefit of the expanded drought operations (triggering drought sooner when composite conservation storage falls into zone 3 instead of zone 4) would be the improved management of conservation storage in the system, particular with the onset of extreme drought conditions.

Navigation flow targets. The PAA would provide a substantially beneficial improvement in the provision of sufficient navigation target flows and in the availability of a reliable 7-ft navigation channel depth in the Apalachicola River. The PAA would essentially double the percent of time that channel depths would be available in a January through May navigation season and the number of navigation seasons over the period of record that 7-ft depths would be fully available compared to the NAA. Improvements in the availability of a 9-ft navigation channel depth under the PAA compared to the NAA would be minimal.

Water supply intake structures. Under the PAA, lake levels and stream profiles would be sufficient at all times to allow for full continued operation of water supply intake structures in the basin. Overall, no changes would be expected compared to the NAA.

WATER QUALITY

Water temperature. The effects of water temperature are based on the water quality standards set by the states where a substantially beneficial change is defined by a decrease in water temperature by 3.2°C, and a substantially adverse change is defined by an increase in water temperature by 3.2°C. Subsequent changes would be based on changes to water temperature within the criteria indicative of a reduction in fish growth at 1-2°C. These changes were assumed to be slightly adverse/beneficial changes. Compared to the NAA, changes under the PAA and the other alternatives would be negligible.

Dissolved oxygen. The effects of dissolved oxygen (DO) are based on the water quality standards set by the states where a substantially beneficial change is defined by meeting the water quality standards when they would not be met under the NAA, and a substantially adverse change is defined by not meeting the standard when it would be met under the NAA. Minimum DO concentrations can be within 4-5 mg/L. A 10 percent decrease of this range is considered to have adverse effects as defined in existing USEPA work. Based on the measurement error of 0.1 mg/L, a decrease of DO by 0.1-0.5 mg/L was used to define slightly adverse effects and a decrease greater than 0.5 mg/L was set to define an adverse change.

At Lake Lanier, no change would be expected under the PAA as compared to the NAA. From Buford Dam to Peachtree Creek (Atlanta), slightly adverse changes would be expected under the PAA. From Atlanta to West Point Lake, slightly adverse changes would be expected under the PAA. No changes would be expected at the remaining sections of the ACF Basin under the PAA.

Phosphorous. The states of Georgia and Alabama have established total phosphorus (TP) standards to protect lakes in the ACF Basin from harmful algal problems. The effects of TP are based on the water quality standards set by the states for the lakes, where a substantially beneficial change is defined by meeting the water quality standard when it would be exceeded under the NAA, and a substantially adverse change is defined by exceeding the standard when it would be met under the NAA. A 10 percent increase in TP concentrations, 0.01 mg/L, and a 20 percent increase, 0.02 mg/L, define slightly adverse and adverse effects; similar decreases would result in beneficial effects.

At Lake Lanier, no change would be expected under the PAA. From Buford Dam to Peachtree Creek (Atlanta), slightly adverse changes would be expected under the PAA. From Atlanta to West Point Lake, substantially adverse changes would be expected under the PAA. At West Point Lake, slightly adverse changes would be expected under the PAA. From West Point Dam to Walter F. George Lake, slightly adverse changes would be expected under the PAA. No changes would be expected at the remaining sections of the ACF Basin under the PAA.

Nitrogen. The effects of total nitrogen (TN) are based on the water quality standards set by the states where a substantially beneficial change is defined by meeting the water quality standard when it would be exceeded under the NAA, and a substantially adverse change is defined by exceeding the standard when it would be met under the NAA. Subsequent changes would be based on an increase by 0.5 mg/L from the NAA, which was set as the dividing line between slightly adverse and adverse changes; or a decrease of 0.5 mg/L from the NAA for slightly beneficial or beneficial.

At Lake Lanier, slightly adverse changes would be expected under the PAA. From Buford Dam to Peachtree Creek (Atlanta), slightly adverse changes would be expected under the PAA. From Atlanta to West Point Lake, adverse changes would be expected under the PAA. From West Point Lake to Walter F. George Lake, slightly adverse changes would be expected under the PAA. At Lake Seminole, no changes would be expected under the PAA. No changes would be expected at Apalachicola River of the ACF Basin for the PAA and the other alternatives.

Chlorophyll *a*. The effects of chlorophyll *a* are based on the water quality standards set by the states for the reservoirs, where a substantially beneficial change is defined by meeting the water quality standard when the NAA exceeds the standard and a substantially adverse change is defined by exceeding the standard when it would be met under the NAA. The breakpoint for slightly adverse/beneficial and adverse/beneficial effects was based on best professional judgment.

No changes would be expected in chlorophyll *a* under the PAA.

GEOLOGY AND SOILS

Tailwater degradation downstream of projects and bank erosion within the river portions above the project pools and downstream of Jim Woodruff Lock and Dam are important channel forming processes in the ACF Basin. Similarly, lake sedimentation is dominated by flood events when the erosive forces throughout the watershed are most severe and the most sediment is delivered to the rivers and lakes. Lake shorelines at all of the ACF projects are expected to continue to erode at the present rate and lake sedimentation to continue at the present rate. In general, the shoreline erosion trends indicate that the highest rates occurred during the first 20 to 25 years after impoundment and have since slowed. Compared to the NAA, the PAA would have a negligible effect on tailwater degradation and bank erosion downstream of reservoirs in the ACF Basin as well as a negligible effect on reservoir shoreline erosion.

LAND USE

An adverse effect on land use is any change in use that would be incompatible with adjacent land uses. Adverse effects on land use around reservoirs may be experienced with lower water surface elevation conditions, which can diminish or impair the shoreline for its intended land use because of exposed shoreline and lake bed. As water surface elevations decline, boat launching ramps, beaches, and shoreline fishing areas may become unusable; navigation hazards can surface; channels to marinas can become impassable; and private boat docks can become unusable. The PAA would be expected to have a slightly adverse effect on land use at Lake Lanier, West Point Lake, and Walter F. George Lake due to the increased likelihood that lake levels would be slightly lower at certain times compared to current operations reflected in the NAA.

BIOLOGICAL RESOURCES

In conjunction with the analysis of potential effects of the ACF Basin Master WCM update and WSSA on biological resources, as summarized herein and presented in more detail in the EIS, USACE has sought the input of the USFWS in accordance with the Fish and Wildlife Coordination Act and the Endangered Species Act throughout the entire process, beginning as early as 2006. Wherever practicable, USFWS and other natural resource agency input has been considered and incorporated into the alternative plans. These coordination and consultation efforts are documented in the EIS.

Vegetation and Wildlife Resources. Compared to the NAA, no change would be expected to vegetation and wildlife resources along the Chattahoochee, Flint, or Apalachicola rivers under the PAA. Flows along the Chattahoochee and Flint rivers is controlled, and the rivers downstream of Buford Dam are disconnected from their floodplains, so under all alternatives considered the proposed changes in water management in the ACF Basin would have no effect on terrestrial biological resources. Although there would be slight variations among the PAA and other alternatives considered in drought conditions in the Apalachicola River and Bay, the magnitude and duration of floodplain inundations along the river and bay would be very similar to those under the NAA.

Riverine fish and aquatic resources. In the Chattahoochee River between Buford Dam and Peachtree Creek (Atlanta), the PAA would likely have a slightly adverse effect on fish and aquatic resources compared to the NAA. A slight decrease in DO and increase in nutrients below the dam would be expected under the PAA. Between Peachtree Creek (Atlanta) and West Point Lake, effects on fish and aquatic resources would be expected to be substantially adverse because of a larger increase in nutrients and decrease in DO than under the NAA. As in past years of drought, working closely with states and affected stakeholders USACE releases may be made to assist with public health and safety throughout the ACF Basin. In the Chattahoochee River downstream of West Point Dam, minor increases in nutrients under the PAA would have slightly adverse effects on fish and aquatic resources. In the Chattahoochee River downstream of Walter F. George Lock and Dam, the PAA would have little to no effect on fish and aquatic resources compared to the NAA. In the Apalachicola River, no appreciable effects on fish and aquatic resources would be expected under the PAA compared to the NAA.

Reservoir fish and aquatic resources. The effects of the PAA on fish and aquatic resources in reservoirs in the ACF Basin compared to the NAA would be negligible.

Estuarine fish and aquatic resources. Compared to the NAA, the PAA would be expected to have a negligible effect on the hydrodynamic and salinity characteristics of the Apalachicola Bay estuary. No effects on fish and aquatic resources in estuaries would be expected under the PAA as compared to the NAA. Because the changes in flow and water quality conditions in the Apalachicola River and Bay between the NAA and the PAA would be negligible, no incremental effects on species for which essential fish habitat has been designated under a Fishery Management Plan would be expected to occur as a result of implementing the PAA.

Protected Species. Formal section 7 consultation with the USFWS under the Endangered Species Act (ESA) will be conducted and completed for the PAA prior to public review of the final EIS for the Master WCM update. Current operations represented by the NAA have been subjected to section 7 consultation and are in compliance with the ESA. The following summary represents a preliminary assessment of potential effects of the PAA on listed species in advance of section 7 consultation. This preliminary assessment will be updated in the final EIS upon completion of consultation with the USFWS and will reflect the results of that process. No effects on Gulf sturgeon would be expected under the PAA or the other alternatives. No appreciable change in the amount of median spawning habitat for the Gulf sturgeon would be expected. Compared to the NAA, adverse effects on listed mussel species in the Apalachicola River would not be expected under the PAA. Potential adverse effects on performance measures for mussels would arise primarily from potential increased exposure of the animals during low flow conditions. Among the pertinent factors affecting mussels, USACE considered fall rates in the Apalachicola River and the ramping of releases from Jim Woodruff Lock and Dam in the development of the alternatives considered for evaluation. The PAA would be expected to have a slightly beneficial effect on shoal bass because recruitment performance would be slightly higher compared to the NAA.

Fish and wildlife management facilities. Compared to existing USACE operations under the NAA, the PAA would not be expected to affect the facilities or operations of the Eufaula National Wildlife Refuge or the four fish hatcheries (including the Buford Trout Hatchery) in the ACF Basin.

SOCIOECONOMICS

Municipal and industrial water supply. The PAA assumes 185 mgd would be withdrawn from Lake Lanier, an additional 40 mgd would be provided by Glades Reservoir, and 408 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River. Glades Reservoir, together with a reallocation to support a withdrawal of 165 mgd under the PAA, would satisfy a substantial portion of Georgia's 2040 water supply need. This gross withdrawal of 165 mgd would require a reallocation of

about 189,500 ac-ft of storage at a first cost of about $79.0 million. The PAA would represent a substantially beneficial effect relative to M&I water supply in the upper Chattahoochee River basin compared to the NAA. All of the other M&I water supplies in the basin are not likely to be affected by the implementation of the PAA.

Navigation. Under the NAA, a 9-ft channel would be available 2.7 percent of the time over the modeled period of record for the months of January through May. A 7-ft channel would be available 20.5 percent of the time over the period of record from January through May. Under the PAA, a 9-ft channel would be available 2.7 percent of the time over the period of record from January through May (no change from the NAA). A 7-ft channel would be available 42.5 percent of the time over the period of record from January through May. This represents a 22 percent difference over the NAA. This increase could likely have a beneficial effect for commercial navigation on the system.

Hydroelectric power generation. The NAA would provide a total energy and capacity benefit of about $173.18 million. Under the PAA, a slight reduction in the total energy and capacity benefit of about $876,000 (or about 0.5 percent) would be expected.

Agricultural water supply. Neither the NAA nor the PAA would be expected to have any effect on the agricultural water supply in the basin.

Flood risk management. Under the PAA, flood risk management operations would remain unchanged from those currently employed under the NAA. There would be no effect on the flood risk management function in the ACF Basin or the associated benefits.

Recreation. The PAA would be expected to result in a slightly decreased combined annualized recreational value (by 0.16 percent) for Lake Lanier, West Point Lake, and Walter F. George Lake compared to the NAA. Recreation value for other reservoir projects in the ACF Basin would not be affected by the PAA.

Environmental justice. Seasonal fluctuations in the water surface elevations under the NAA could create minor inconveniences for local residents, including low-income and minority populations, who use USACE reservoirs for fishing and other forms of recreation. These effects are likely to be more pronounced at USACE reservoirs under extreme drought conditions. USACE project managers at the lakes work closely with the public under such circumstances and pursue reasonable temporary measures to maintain at least a minimum level of access to the lakes until extreme conditions improve. The PAA would be expected to have the same effects from an environmental justice standpoint as the NAA.

Protection of children. Public use of large reservoir projects for water-based recreation inherently includes a level of health and safety risk to both adults and children. USACE actively pursues measures at operating projects to minimize such risks by implementing water safety and other education programs, providing clear signage, marking designated uses areas, removing hazards where appropriate, restricting public access to certain areas designed for authorized personnel only, and other activities designed to promote safe use, many of which are directly focused on children who visit the projects. The PAA would be expected to have the same effects on protection of children as the NAA.

AESTHETIC RESOURCES

The PAA would not appreciably affect the aesthetic characteristics (scenic areas and viewsheds) of the rivers and reservoirs in the ACF Basin compared to current conditions under the NAA. Minor deviations in lake levels at times under the PAA would have a negligible effect on scenic areas and viewsheds on the reservoirs.

CULTURAL RESOURCES

Potential effects on cultural resources due to the proposed WCM update are difficult to predict but are most likely to occur around areas that may be susceptible to erosion or deposition of sediments over time. Potential effects are expected to be consistent with a 2009 study where 93 percent of the cultural sites would be expected to experience erosion and 33 percent would be expected to experience deposition. Additional investigations in 2014, as discussed in more detail in the EIS, reaffirmed the findings of the 2009 study. These percentages represent multi-variant trends rather than an indication of adverse effects to cultural resources that would be specifically tied to USACE water management. These trends correlate with the geomorphology of the existing environment as represented in the NAA rather than with modified water management practices that would occur under the PAA or any of the other alternatives.

OTHER RESOURCE AREAS

The PAA would not result in a change to existing air quality, noise, or traffic and transportation conditions in the ACF Basin or an increased likelihood of exposure to hazardous, toxic, or radioactive waste materials.

CLIMATE CHANGE ANALYSIS

The project team, in response to USACE guidance and public scoping input, engaged the Institute for Water resources to conduct an analysis of the potential effects of climate change on ACF reservoir operations for the NAA and the other alternatives, including the PAA. The analysis is described in detail in the EIS. The high-low range of potential climate change-affected outputs generally follow the same seasonal trends as the NAA values. However, the range of high and low boundaries for the modeled climate change-affected values generally indicate greater extremes. The high and low extremes are no more severe than those that have been historically experienced in the ACF Basin. Generally, the plotted PAA values tend to fall within the range of climate change-affected results, indicating that the PAA water management scenario would likely be flexible and adaptable enough to perform effectively within the range of hydrologic conditions represented.

CUMULATIVE EFFECTS

Constructing dams in riverine ecosystems abruptly, severely, and permanently alters many important physical and biological processes involving the movement of water, energy, sediments, nutrients, and biota. In addition to the 14 major dams impounding the ACF mainstem rivers, there are several hundred reservoirs 20 ac or larger and many more farm ponds and local impoundments of smaller size in the ACF Basin. These existing impoundments serve a variety of purposes, including water supply for livestock and irrigation, fish and wildlife conservation, recreation, M&I water supply, and other localized uses. There are 11 non-USACE reservoir projects in the ACF Basin for which USACE has issued a Section 404 permit since 1988 or for which a USACE permit is pending, representing local public water supply projects for the metropolitan Atlanta area in Georgia. Studies have identified 16 additional locations in the ACF Basin in Georgia that may be suitable for future water supply reservoir development. No specific plans presently exist for these sites, and it is not appropriate to speculate on what actions water providers might elect to pursue in the future in response to water resource-related litigation or water allocation formulas that may be derived by the states of Alabama, Florida, and Georgia.

One effect of converting flowing water habitat to still water by dam construction along ACF Basin mainstem rivers and tributaries has been the decline or loss of river-dependent species of freshwater fishes, mussels, and snails including the decline of anadromous fish habitat. New dams in the basin would

replicate many of those effects elsewhere in the tributary streams and add to the cumulative alteration of natural flow regimes and habitat fragmentation.

Human-induced stressors can further compromise resources in the basin. As population growth continues, the impacts on terrestrial ecosystems, aquatic systems (including wetlands), and important archaeological resources are expected to become more vulnerable and potentially degraded. Proposals for non-federal development activities (recreation, power line crossing, roads, etc.) on and adjacent to USACE project lands are periodically considered and typically involve leases or easements from USACE. Such activities in the ACF Basin are not expected to directly impact water management decisions or project purposes nor would these activities likely be impacted by the PAA. Various private sector power interests have also pursued steps to acquire a FERC license for non-federal hydroelectric power development at George W. Andrews Lock and Dam, beginning in 1983 and continuing to the present. If the current effort does not result in non-federal hydropower development, it is likely that other permit applications will be forthcoming.

Apalachicola Bay estuary faces a variety of anthropogenic pressures. Amid that pressure, even with variable system conditions, the estuary has generally remained a productive estuarine ecosystem. The PAA for update of the Master WCM would likely have negligible effect on the aquatic resources and ecological function of the Apalachicola Bay estuary. Review of HEC-ResSim model outputs for flow on the Apalachicola River at Chattahoochee and Blountstown indicate that the PAA would have little effect on the flow regime in the river at those locations and, consequently, little effect on inflow to the Apalachicola Bay estuary compared to the NAA. Therefore, the PAA, or any of the other alternatives, would be expected to have a negligible incremental effect on the hydrodynamic regime, aquatic resources, and ecological function of the Apalachicola Bay estuary compared to the NAA. Any negligible changes to hydrodynamic conditions in the bay that would occur under the PAA would most likely be inconsequential compared to the cumulative effects of anticipated sea level rise on physical and ecological conditions in the estuary.

Water quality is influenced by a number of factors, including pollutant loads and in-stream flows (water quantity). A water body's ability to assimilate pollutants is dependent on the amount of water in-stream, especially during low flow periods. Agencies regulating water quality in rivers and reservoirs will continue to monitor them for impairment and improvement and enforce reductions until standards are met. That balance of what is allowable and what is discharged is an ongoing cycle of monitoring, assessment, and implementation. Changes in discharges during low flow conditions by some entities holding discharge permits would be expected to affect water quality during low flow periods. However, over time it is expected that water quality standards will be met because of reductions achieved through the Water Pollution Act of 1972, as amended.

MITIGATION

Mitigation includes measures to avoid, reduce, minimize, or compensate for adverse impacts that could result from a selected course of action. As potential water management measures were identified and alternatives were developed, potential actions to offset any adverse effects also were identified, analyzed, and considered in the planning process. For example, increased water withdrawals from the Chattahoochee River to meet the needs of Metro Atlanta communities would result in a corresponding increase in treated wastewater returns to the river between Atlanta and West Point Lake. The impact analysis showed that the PAA would result in increased loadings of total phosphorus that would have a substantially adverse effect on water quality. The substantially adverse effects would also be expected downstream of West Point Lake to the headwaters of Walter F. George Lake. The adverse water quality effects in these portions of the Chattahoochee River would principally be associated with increased treated wastewater discharges to the river rather USACE project operations. The Georgia Environmental

Protection Division may require changes to discharge permits for some facilities. After a thorough analysis of the impacts from the PAA and other alternatives, it was determined that specific compensatory mitigation measures for USACE were not required or necessary.

Water management inherently involves adapting to unforeseen conditions. Because adverse effects of the water control plan might occur in the future due to unforeseen conditions, actions would be taken within applicable authority and policies, and in coordination with other interests, to address such conditions when they occur through the implementation of temporary deviations to the water control plan, such as interim operation plans.

1 Purpose, Need, and Scope

1.1 Introduction

This environmental impact statement (EIS) evaluates proposals by the U.S. Army Corps of Engineers (USACE) to adopt an updated *Master Water Control Manual, Apalachicola-Chattahoochee-Flint (ACF) River Basin, Alabama, Florida, Georgia* (Master WCM or Master Manual); including a water supply storage assessment (WSSA) addressing reallocation of storage in Lake Sidney Lanier (Lake Lanier). The WSSA addresses a request from the state of Georgia for reallocation of storage in Lake Lanier to satisfy future water supply needs of certain north Georgia communities. The EIS has been prepared to comply with the requirements of the National Environmental Policy Act of 1969 (NEPA), as amended, 42 U.S.C. § 4321−4347; the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, 40 C.F.R. 1500–1508; and Engineer Regulation (ER) 200-2-2, *Environmental Quality—Procedures for Implementing NEPA* (also published as 33 C.F.R. 230).

The Apalachicola-Chattahoochee-Flint River (ACF) Basin comprises 19,573 square miles in Alabama, Florida, and Georgia (Figure 1.1-1). USACE operates five reservoir projects in the ACF Basin:

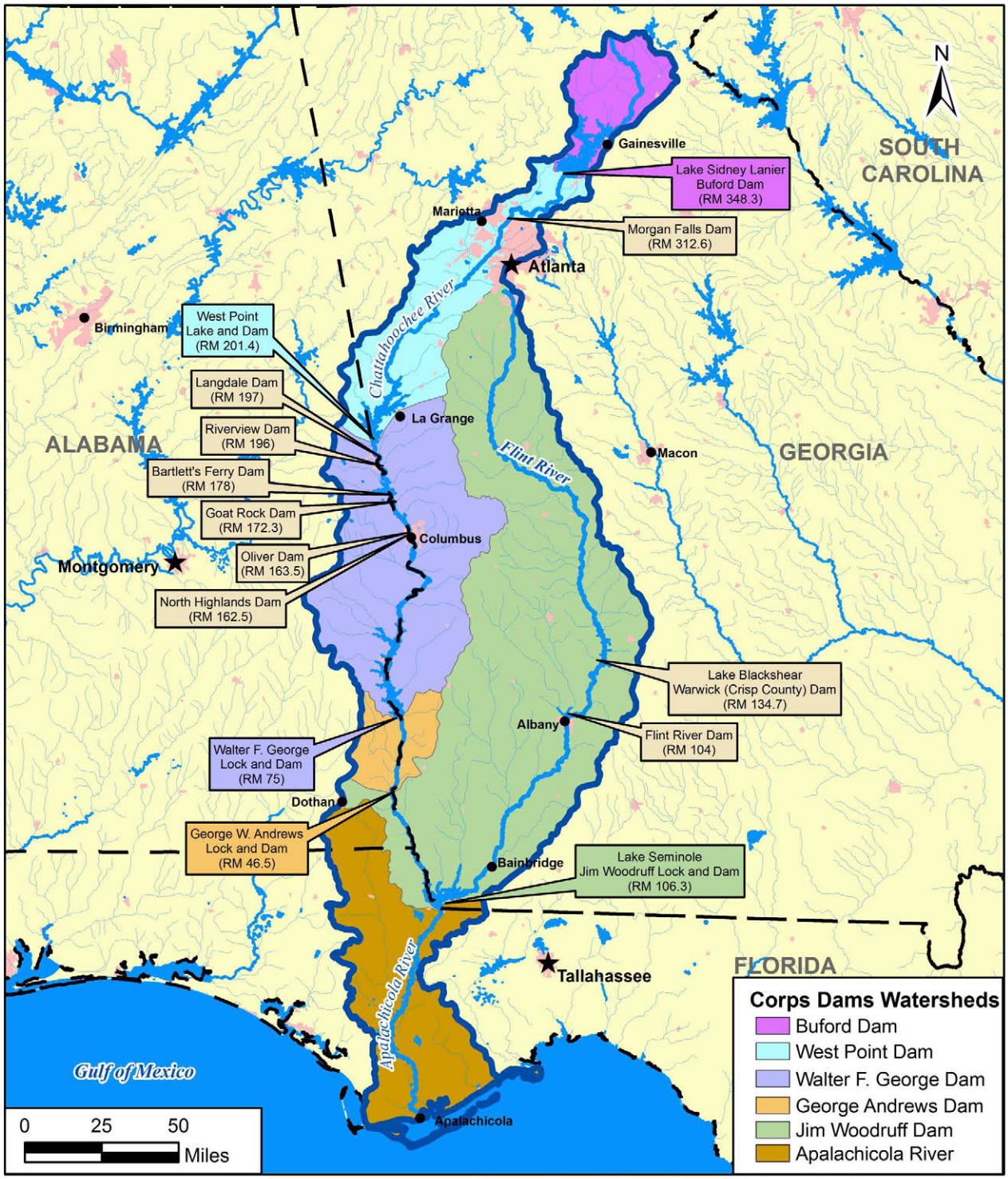
- Buford Dam and Lake Lanier
- West Point Dam and Lake
- Walter F. George Lock, Dam, and Lake
- George W. Andrews Lock, Dam, and Lake
- Jim Woodruff Lock and Dam and Lake Seminole

USACE operates and manages those projects as a system to meet their authorized purposes, which include flood risk management[1], hydropower, navigation, fish and wildlife conservation, recreation, water quality, and water supply.

1.2 Purpose and Need

Section 7 of the Flood Control Act of 1944 provides that "it shall be the duty of the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations..." (33 U.S.C. 709).

[1] USACE generally uses the term "flood risk management" rather than "flood control" or "flood damage reduction" to characterize the USACE mission to manage and reduce risk of loss of life and property damage associated with flood events (USACE IWR 2009). Therefore, the term "flood risk management" is used, along with "flood control", where appropriate, throughout this EIS to describe that mission area. The updated terminology does not reflect any change in the originally authorized flood control purpose or to operations in support of that authorized purpose.



Apalachicola, Chattahoochee, and Flint Rivers Basin Map

Figure 1.1-1

The original Master Manual for the ACF Basin dates to 1958, shortly after completion of the Jim Woodruff Lock and Dam and about the time Buford Dam was completed. The original 1958 Master Manual does not include water control manuals (WCMs) for Buford Dam, West Point Dam, Walter F. George Lock and Dam, or George W. Andrews Lock and Dam projects, all of which were completed later. The individual reservoir project WCMs were completed as the projects were constructed and placed into operation, and when approved, the project-specific manuals were attached as appendices to the 1958 Master Manual. The individual WCMs were updated at various dates extending as far back as the 1970s and 1980s; additional updates were approved in the 1990s.

A draft update to the main body of the 1958 Master Manual for the ACF Basin was prepared in 1989, along with certain changes to the project manuals. Those proposed updates, however, were never finalized or formally approved because of litigation that ensued in 1990 and thereafter. Section 3.5 summarizes the history of this litigation. The 1989 manual update incorporated several operational adjustments, primarily focusing on adjustments gathered through experience and lessons learned during severe drought periods in the 1980s and proposed reallocations of storage at Lake Lanier, to accommodate then-current and future water supply withdrawals—a proposed action that was never completed because of the ensuing litigation.

USACE has continued to operate the ACF projects essentially in accordance with the status quo reflected in the 1989 manual update, making minor adjustments as additional experience and circumstances have dictated. In addition, USACE has continued to accommodate water supply withdrawals from Lake Lanier and from the Chattahoochee River downstream, although USACE, due to ensuing litigation, has never taken action to effect a formal reallocation of storage in Lake Lanier, nor to accommodate the future water supply needs that were anticipated in 1989. A more detailed background of the Master Manual and individual project water control manuals, as well as a more thorough discussion of the issue of water supply from the Buford project, is provided in section 3. The draft updated Master Manual and individual project manuals are included in Appendix A.

The proposed action is to update the water control plans and manuals for the ACF Basin as directed by Secretary of the Army Pete Geren on January 30, 2008. Specifically, the purpose and need for the federal action is to determine how the federal projects in the ACF Basin should be operated for their authorized purposes, in light of current conditions and applicable law, and to implement those operations through updated water control plans and manuals. Conditions in the basin (e.g., population, socioeconomic, land use, infrastructure, and demand for water resources) have changed substantially since USACE reservoirs were authorized and constructed, and a variety of applicable federal and state environmental laws have been passed and implemented. Operation of USACE reservoir projects in the basin both affect, and are affected by, current conditions in the basin and must comply with current laws and regulations. This action will result in an updated Master Manual, including updated water control plans and manuals for the ACF system and each federal project within that system, that reflect operations under existing congressional authorizations, taking into account changes in basin hydrology and demands from years of growth and development, new/rehabilitated structural features, legal developments, and environmental issues. For more detail, see section 3.3.

The updated Master Manual will also include a comprehensive basinwide drought operations plan in accordance with the pertinent USACE regulations. Both the WCM and the drought operations plan are needed to accomplish specific congressionally authorized and general statutory authorized project purposes in the basin.

Updates to the WCMs are also needed to:

- Capture project and system operations that have been refined over the years because of changes in basin hydrology and withdrawals/consumption that resulted from years of growth and development.
- Reflect drought operations requirements to account for new data and operational changes.
- Update data reflecting basin conditions.
- Account for new or rehabilitated project structural features.
- Address environmental objectives for water quality, federally listed threatened and endangered species, and fish management.
- Capture and use real-time data provided by additional gages and monitoring devices installed since the last manual updates.
- Use the latest computer models and techniques to evaluate and establish guidelines for project operations.
- Improve and streamline methods for data exchange between USACE and other agencies.

On May 16, 2000, the Governor of the state of Georgia submitted a formal request to the Assistant Secretary of the Army (Civil Works) to adjust the operation of Lake Lanier, and to enter into agreements with the state or water supply providers to accommodate increases in water supply withdrawals from Lake Lanier and downstream at Atlanta over the next 30 years, culminating in total gross withdrawals of 705 million gallons per day (mgd)—297 mgd from Lake Lanier and 408 mgd downstream—by the year 2030. The Assistant Secretary of the Army (Civil Works) in 2002 denied Georgia's request concluding that a reallocation of conservation storage in Lake Lanier sufficient to accommodate the requested withdrawals would exceed the Secretary's authority. The 2011 decision of the 11th Circuit Court of Appeals, discussed in more detail in section 3.5.2.8.2, set aside the Army's 2002 decision to deny Georgia's request and ordered USACE to reconsider whether it has the legal authority to operate the Buford project to accommodate Georgia's request. USACE provided a legal opinion on remand, concluding that it has sufficient authority under applicable law to accommodate that request, but noting that any decision to take action on Georgia's request would require a separate analysis. On January 11, 2013, the Governor of the state of Georgia provided updated demographic and water demand data to confirm the continued need for 705 mgd to meet Georgia's water needs from Lake Lanier and the Chattahoochee River to approximately the year 2040 rather than 2030 as specified in the 2000 request (Appendix B).

Because of the Circuit Court ruling of June 2011 and the USACE legal opinion, updating the water control plans and manuals will include making a decision on Georgia's water supply request. Accordingly, this EIS considers, along with operations for all authorized purposes, an expanded range of water supply alternatives associated with the Buford Dam/Lake Lanier project, including current levels of water supply withdrawals and additional amounts that Georgia in 2013 requested from Lake Lanier and downstream at Atlanta. The litigation discussed in the previous paragraph has now been vacated and Georgia's request for water supply from Lake Lanier is considered in this EIS.

Any proposed changes to the ACF Basin water control operations that would not accomplish all authorized purposes of the system or that would require substantial structural modifications or congressional authorization would not be consistent with the purpose and need of updating the WCM. Accordingly, this EIS does not address any structural changes to federal ACF Basin improvements or proposed changes to water management practices that are expected to exceed existing authority. Further, to the extent that existing operations must be adjusted to come into compliance with applicable law, such changes will be included as part of any proposed action (other than the no-action alternative).

1.3 Scope of the EIS

The purpose of scoping, in accordance with the requirements of NEPA, is to solicit input from other agencies and the public to help determine the range of issues to be addressed and to identify the significant issues to be analyzed in-depth with respect to the proposed action. The process also helps to deemphasize insignificant issues, thereby allowing USACE to identify the range of actions, alternatives, and impacts to be considered in the EIS for the update of the Master Manual. The scoping process for this EIS was initiated in February 2008 with the issuance of a Notice of Intent to prepare an EIS and publication in the *Federal Register* of a notice in September 2008 announcing public scoping meetings. Public scoping meetings were held at five strategic locations within the ACF Basin between October 20 and 29, 2008. The formal scoping period ended November 21, 2008. The results of this scoping were published by USACE in a *Final Scoping Report* in January 2009.

The scope of the federal action was subsequently refined because of a July 17, 2009, federal district court order in the case *In re Tri-State Water Rights Litigation*. The court's ruling introduced new information and circumstances that affected some of the determinations reflected in the January 2009 *Final Scoping Report*. Accordingly, on November 19, 2009, USACE reopened public scoping to address the court's ruling. The reopened scoping period provided the public an opportunity to submit comments on the significant new information and circumstances introduced by the July 17, 2009, court order. The results of the reopened scoping were documented in the March 2010 *Updated Scoping Report.*

In 2012, the scope of the federal action was further refined because of a ruling by the U.S. Court of Appeals for the 11th Circuit in June 2011, which vacated the 2009 district court order in the case *In re Tri-State Water Rights Litigation* and directed USACE to determine its legal authority to operate Buford Dam and Lake Lanier to accommodate water supply withdrawals. In compliance with the 11th Circuit's order, USACE's chief counsel issued a legal opinion on June 25, 2012, concluding that USACE has the legal authority to accommodate both current and increased levels of water supply withdrawals from Lake Lanier and downstream at Atlanta, in light of several different statutory authorities, and based on preliminary analysis of impacts to other authorized purposes (Stockdale 2012). In light of this legal opinion and the 11th Circuit's ruling, USACE again reopened scoping on October 12, 2012, to provide the public an opportunity to submit comments on the new circumstances resulting from the ruling.

The scope of the federal action examined in this EIS is to update the water control plans and manuals to reflect operations as they have evolved because of changing conditions in the basin and to fully comply with agency regulations, federal laws, and applicable law. The scope of this EIS also includes a WSSA that considers both current and increased levels of water supply withdrawals from Lake Lanier and downstream at Atlanta. The WSSA fully complies with agency regulations and federal laws pertaining to water supply from a federal reservoir and is included as Appendix B to this EIS. As further described in the EIS, the scope is limited to the geographic areas in the ACF Basin directly or indirectly affected by the proposed action.

This EIS identifies, documents, and evaluates the environmental effects of operating USACE projects in the ACF Basin under alternative management regimes that could reasonably be expected to accomplish the purpose and need of the proposed federal action. The purpose of the EIS is to inform decision makers and the public of the likely environmental consequences of the proposed action and alternatives. The range of actions, alternatives, and effects considered in this EIS are driven by the requirements set forth by Congress and USACE policies for project operation. As explained in section 1.2, this EIS considers operational changes within existing congressional authorities, as determined by recent court rulings, and delegated, discretionary authorities, and does not consider operational changes that would be expected to require additional congressional authority. Accordingly, this EIS considers, along with operations for all authorized purposes, an expanded range of water supply alternatives associated with the Buford

Dam/Lake Lanier project, including current levels of water supply withdrawals and additional amounts that Georgia has requested from Lake Lanier and downstream at Atlanta.

Environmental impact analysis must be proportionate to the nature and scope of the action, the complexity and level of anticipated effects on important resources, and the capacity of USACE decisions to influence those effects in a productive, meaningful way from the standpoint of environmental quality. The environmental analysis for this EIS is consistent with the diverse array of operations associated with water management. The project site for the proposed action encompasses federal projects in the ACF Basin. The regions of influence (ROIs) for the environmental resources and socioeconomic conditions are resource-dependent. The use and management of water resources and the influence of water use and management on environmental and socioeconomic conditions has attracted much interest in the region since before construction of USACE reservoirs. Since the late 1980s, when the increased demands on water resources in the ACF Basin prompted litigation as described in section 3.5, the ACF Basin has experienced additional water demands and undergone several periods of record drought.

1.4 Public Involvement

Under the regulations issued by the CEQ, the evaluation of potential environmental effects of federal actions is open to the public (40 C.F.R. parts 1500-1508). Public participation in the NEPA process promotes both open communications between the public and USACE and better decision making. All persons and organizations that have a potential interest in the proposed action, including minority, low-income, disadvantaged, and Native American groups, are urged to participate in the NEPA environmental analysis process.

Opportunities for public participation with respect to the proposed action are guided by CEQ regulations and USACE regulations. Those regulations provide for six major opportunities for public participation in conjunction with preparing this EIS: (1) issuance of a Notice of Intent (NOI) to prepare an EIS, (2) scoping, (3) independent external peer review, (4) public review of the draft EIS, (5) public meeting(s) on the draft EIS, and (6) public review of the final EIS. Each of those steps in the process provides for public involvement and is briefly discussed below. Throughout the process, the public can obtain information on the status and progress of the proposed action and the EIS through USACE, Mobile District Public Affairs Office by calling 251-690-2505. In addition, interested persons can visit USACE, Mobile District's Web site for the Master WCM update at www.sam.usace.army.mil/Missions/PlanningEnvironmental/ACFMasterWaterControlManualUpdate.aspx.

1.4.1 Notice of Intent

The NOI informing the public that an EIS is being prepared is the first formal step in the NEPA public involvement process. The agency proposing the action publishes the NOI in the *Federal Register* before the start of the scoping process. The NOI includes a description of the proposed action and gives the name and address of an agency contact person. On February 22, 2008, USACE published an NOI declaring its intent to prepare an EIS for the proposed action (Appendix C Pertinent Correspondence).

Supplemental NOIs were published to announce additional information for the public scoping process.

- A supplement to the February 22, 2008, NOI was published on September 19, 2008, announcing the dates and locations of five public scoping meetings.
- On November 19, 2009, another NOI was published to announce the reopening of public scoping, in response to a July 2009 federal court ruling in the case *In re Tri-State Water Rights Litigation*.
- Another NOI was published in the *Federal Register* on October 12, 2012, reopening the public scoping process to revise the scope of the EIS in light of a June 28, 2011, Decision of the United

States Court of Appeals for the 11th Circuit and a June 2012 legal opinion of USACE's chief counsel regarding authority to accommodate municipal and industrial water supply from the Buford Dam and Lake Sidney Lanier project.

1.4.2 Scoping Process

In fall 2008, USACE, Mobile District conducted public scoping for preparation of this EIS. The purpose of the scoping, in accordance with the requirements of NEPA, was to solicit input from other agencies and the public. The hope was that the input would help identify all the relevant issues and alternatives that should be addressed in the EIS as well as supporting documentation for a decision on implementing an update to the Master Manual and the reservoir-specific WCMs to be included as appendices to the Master Manual. All materials related to the scoping are available from USACE, Mobile District's Web site for the Master Manual update at www.sam.usace.army.mil/Missions/PlanningEnvironmental/ACFMasterWaterControlManualUpdate/ACFDocumentLibrary.aspx, and so are not included as an appendix to this document.

USACE had the following scoping objectives:

- Identify public and agency concerns;
- Clearly define the environmental issues and alternatives to be examined in the EIS, including the elimination of insignificant issues;
- Identify related issues that originate from separate legislation, regulations, or Executive Orders (EOs) (e.g., federally listed threatened and endangered species or environmental justice concerns);
- Identify state and local agency requirements that must be addressed; and
- Identify available sources of data, studies, or tools that could provide information valuable in preparing the EIS.

In 2008 USACE's scoping process consisted of the following elements:

- Publishing an NOI to prepare an EIS in the *Federal Register*
- Publishing an announcement of the dates and locations of five public scoping meetings in the *Federal Register*
- Updating the existing mailing list by means of an initial postcard requesting accurate contact information
- Distributing a newsletter and a public notice announcing public scoping meetings and locations to federal, state, and local agencies and officials; stakeholders; and other interested parties
- Preparing and launching a Web site that described the NEPA process and all the public involvement activities planned during EIS preparation and served as a tool for collecting public comments and updating the project mailing list
- Distributing a press release to media outlets
- Sending agency scoping and tribal consultation letters by e-mail
- Sending agency scoping and tribal consultation letters by the U.S. Postal Service
- Holding a federal agency meeting and Web conference to inform the agencies and solicit comments

- Hosting a stakeholder's workshop to share the new and improved version of reservoir simulation software called Hydrologic Engineering Center-Reservoir System Simulation (HEC-ResSim) with all stakeholders groups involved with water management issues in the basin
- Holding five public scoping meetings to inform the public about the proposed action and to solicit oral and written comments on the issues that should be addressed in the EIS
- Reviewing and evaluating the oral and written comments received during the open comment period
- Publishing the scoping report on a Web site (http://www.sam.usace.army.mil/Missions/PlanningEnvironmental/ACFMasterWaterControlManualUpdate/ACFDocumentLibrary.aspx)
- Distributing a newsletter announcing publication of the scoping report to federal, state, and local agencies and officials; stakeholders; tribes; and other interested parties

As noted above, on September 19, 2008, a supplement to the NOI was published in the *Federal Register* to invite the public to participate in the NEPA scoping process and provided details on the dates and locations of the five open-house-style public scoping meetings scheduled at various locations throughout the ACF Basin, as well as on the various methods to be used to collect comments from the public for consideration by USACE in preparing the draft EIS.

Public scoping meetings for the ACF Basin were held in October 2008 at five locations throughout the basin (Gainesville, Georgia; Atlanta, Georgia; LaGrange, Georgia; Dothan, Alabama; and Apalachicola, Florida). An open-house format was used at each meeting, and information stations with displays and handouts were set up. Subject matter experts from USACE and environmental contractors staffed each station at which information on various aspects of the proposed action was disseminated. A total of 1,018 stakeholders participated in the five public scoping meetings. USACE published a *Final Scoping Report* in January 2009, which is available at http://www.sam.usace.army.mil/Missions/PlanningEnvironmental/ACFMasterWaterControlManualUpdate/ACFDocumentLibrary.aspx.

1.4.2.1 Rescoping in 2009

On July 17, 2009, the United States District Court for the Middle District of Florida issued an order in the case *In re Tri-State Water Rights Litigation,* which addressed USACE's authority to provide water supply benefits through its operation of the Lake Lanier project. The court's ruling introduced new information and circumstances that affected some of the determinations reflected in the *Final Scoping Report* issued by USACE in January 2009. On November 19, 2009, USACE reopened public scoping in response to the court's ruling. The reopened scoping period provided the public an opportunity to submit comments on the new information and circumstances introduced by the court order. As a result of the order, USACE proposed to revise the scope of the EIS and Master Manual updates in the following respects:

- In updating the ACF Basin water control plans and manuals, USACE would consider only operations that are within its existing authority. USACE previously announced its intent to update the plans and manuals *to reflect current operations*. Because the court had held that USACE lacked authority to continue to support present levels of water supply withdrawals at Lake Lanier or to reallocate storage to accommodate those or additional withdrawals, and because the court had ordered that most withdrawals from Lake Lanier must cease in 2012, USACE proposed to update the plans and manuals for operating the Lake Lanier project in a manner that reflected the court's order. Thus, USACE would not continue to accommodate the present level of withdrawals beyond July 2012, nor would USACE consider a reallocation of storage for water supply at Lake Lanier as part of the process for updating the ACF Basin water control plans and manuals.

- Pursuant to the court's order, as of July 17, 2012, the updated manuals would reflect that water supply withdrawals from Lake Lanier would be limited to the amounts authorized by relocation agreements with the cities of Gainesville and Buford, Georgia. Those agreements, which were executed at the time of the reservoir's construction, authorize withdrawals of 8 mgd for Gainesville and 2 mgd for Buford—a combined 10 mgd[2].
- Pursuant to the court's order, as of July 17, 2012, the updated manuals would reflect that "the required off-peak flow [at Buford Dam] would be 600 cfs [cubic feet per second]." Thus, when USACE was not generating hydroelectric power to meet the peak demand, it would not release more than 600 cfs from Buford Dam to support downstream water supply withdrawals.
- The relocation agreements, as described above, represent legal instruments that provided compensation to property owners (the cities of Buford and Gainesville) for the taking of property associated with construction of Buford Dam (Lake Lanier). Both cities had existing intake structures and water treatment plants on riparian lands prior to commencement of project construction. Under relocation agreements, the cities were allowed to relocate their existing water supply intakes and continue to withdraw water.

USACE's reopened scoping process in 2009 consisted of the following additional elements:

- Publishing an announcement in the *Federal Register* on November 19, 2009, that public scoping was to be reopened
- Distributing a public notice announcing the reopening of public scoping by email and through the U.S. Postal Service for those who did not have an email address or who requested hard-copy notices
- Preparing and launching a Web site that described the NEPA process and all the public involvement activities planned during EIS preparation and served as a tool for collecting public comments and updating the project mailing list
- Distributing a press release to media outlets
- Reviewing and evaluating the written comments received during the open comment period
- Publishing the scoping report on a Web site at http://www.sam.usace.army.mil/Missions/PlanningEnvironmental/ACFMasterWaterControlManualUpdate/ACFDocumentLibrary.aspx
- Distributing a newsletter announcing publication of the scoping report to federal, state, and local agencies and officials; stakeholders; tribes; and other interested parties

1.4.2.2 Rescoping in 2012

In compliance with the 11th Circuit's order discussed in section 3.5.2.8.2, USACE's chief counsel issued a legal opinion on June 25, 2012, concluding that USACE has the legal authority to accommodate both current and increased levels of water supply withdrawals from Lake Lanier and downstream at Atlanta (see section 3.5.2.8.3). In light of this legal opinion and the 11th Circuit's ruling, USACE reopened scoping on October 12, 2012, to provide the public an opportunity to submit comments on the new circumstances resulting from the ruling.

[2] Presently, Gainesville withdraws 18 mgd and returns 10 mgd resulting in a net withdrawal of 8 mgd. The total gross withdrawal under relocation contracts is 20 mgd.

As a result of the June 2011 ruling, USACE revised the scope of the EIS and Master Manual updates in the following respects:

- In updating the ACF Basin water control plans and manuals, USACE will consider operations that are within its existing authority under the River and Harbor Act of 1946 by taking into account the 2011 11th Circuit Court of Appeals opinion and USACE 2012 legal opinion.
- In updating the manuals, USACE will consider the authority under Public Law 84-841, enacted July 30, 1956 (the 1956 Act) (see discussion in section 2.1.1.2.1) to contract for 11,200 acre-feet of storage with Gwinnett County.
- USACE will reconsider Georgia's 2000 water supply request (updated in 2013).

USACE's reopened scoping process in 2012 included the following additional elements:

- Publishing an announcement in the *Federal Register* on October 12, 2012, that public scoping was to be reopened
- Distributing a newsletter on October 12, 2012, announcing the reopening of public scoping by email and through the U.S. Postal Service for those who did not have an email address or who requested hard-copy notices
- Updating the project Web site to reflect the 2011 decision and to serve as a tool for collecting public comments and expanding the project mailing list
- Distributing a press release on October 12, 2012, to media outlets
- Reviewing and evaluating the written comments received during the open comment period
- Distributing a newsletter during the public scoping process notifying the public of an extension of the comment period end date by email and through the U.S. Postal Service for those who did not have an email address or who requested hard-copy notices
- Publishing the updated scoping report on a Web site at http://www.sam.usace.army.mil/Missions/PlanningEnvironmental/ACFMasterWaterControlManualUpdate/ACFDocumentLibrary.aspx
- Distributing a newsletter on April 4, 2013, announcing publication of the scoping report to federal, state, and local agencies and officials; stakeholders; tribes; and other interested parties

1.4.2.3 Additional Public Involvement Activities

USACE, Mobile District and the Hydrologic Engineering Center (HEC) hosted a workshop from September 30 to October 2, 2008, at Jim Woodruff Lock and Dam to share information and data pertaining to a new and improved version of HEC's reservoir simulation software called HEC-ResSim. Workshop attendees included all stakeholders groups involved with water management issues in the basin. Twenty-eight modelers attended the workshop. Twenty-three of the modelers represented three federal agencies, three state agencies, and one university; the five remaining modelers were private consultants representing the stakeholders.

The session proved very successful in terms of its objectives:

- To introduce the participants to the HEC-ResSim software.
- To initiate technology transfer by providing the participants with a copy of the software and the Alabama, Coosa, and Tallapoosa (ACT)/Apalachicola, Chattahoochee, and Flint models, walk the participants through the model, and answer questions.
- To foster relationships by continuing longstanding technical working relationships with the stakeholders.

On May 3-5, 2011, the Mobile District hosted a follow-up HEC-ResSim technical workshop. Representatives from all three states (Alabama, Georgia, and Florida), federal agencies, and technical experts from other stakeholders, academia, and consulting firms attended the workshop. The purpose of the workshop was to update the participants on further development and refinement of the HEC-ResSim model for specific application to the ACF and to present model results for runs of the baseline (existing) project operations. The workshop served as an excellent vehicle for continued technology transfer and relationship building among the technical experts.

USACE, Mobile District offers several opportunities for public involvement at the request of stakeholders. The opportunity to be a *Water Manager for a Day* includes an introduction to river forecasting, participating in a weekly meeting with all the Mobile District basin managers, and one-on-one time with each basin manager. USACE district and division leaders have participated in numerous river excursions to meet and listen to stakeholders. A number of briefings and presentations on the WCM update process have also been given to groups at their request.

1.4.3 Public Comments

The public scoping effort for updates to the WCM in 2008, 2009, and 2012 resulted in a total of 3,600 comments from over 960 individuals, organizations, and agencies. The agencies consisted of federal, state, and local governments. The federal agencies that submitted comments were the U.S. Environmental Protection Agency (EPA) Region 4; the Southeastern Power Administration (SEPA); the National Park Service (Chattahoochee River National Recreation Area), the National Marine Fisheries Service (Southeast Regional Office), and the U.S. Fish and Wildlife Service (USFWS). Leaders from the Alabama, Florida, and Georgia congressional delegations submitted comments, as did the Governor of Georgia, the Georgia State House of Representatives, and a Georgia State Senator. The three states—Alabama, Florida, and Georgia—submitted comments through their associated state agencies. Other local governmental agencies, including the Metropolitan North Georgia Water Planning District; Atlanta Regional Commission; Franklin County, Florida; Forsyth, Hall, Troup, and Gwinnett counties in Georgia; and the cities of Cumming, Columbus Consolidated Government, Douglasville, and LaGrange in Georgia submitted comments as well.

Two petitions were received during the scoping process in 2008. One was from West Point Lake Advisory Council Needs Your Show of Support, signed by 2,809 individuals. The second petition included comments on the *Potential for the Turkey Run Landfill to Pollute Groundwater and Surface Waters in Violation of Georgia Environmental Protection Division Solid Waste Management Rules and Landfill Permit*, signed by 58 individuals. During the reopened scoping process in 2012, the LaGrange-Troup County Chamber of Commerce distributed a petition *U.S. Army Corps of Engineers: Change operation rule curve for West Point Lake*, signed by 2,985 individuals. The petition described the local economic effect of West Point Lake and the local economy's dependence on lake levels and requested that USACE change the guide curve at West Point Lake in the late summer/early fall. This petition was received through email, U.S. mail, and original signature pages.

All the comments from scoping were reviewed, analyzed, and organized into the 12 categories shown in Table 1.4-1. The table also shows the number of comments by category.

As shown in Table 1.4-1, the greatest number of comments (1,228) was related to water management recommendations, which included the seven authorized project purposes and USACE ability to balance needs throughout the ACF Basin. Other comments in that category addressed alternatives to consider (or potential mitigation measures), demand projections as they relate to downstream and future needs, and overall water conservation in the basin.

Issues and concerns regarding socioeconomics and the tie between water levels, recreation, and regional economics received the second most comments (706). Most of the comments received in this category pertained to the adverse socioeconomic impacts that have occurred in the northern portions of the ACF Basin due to extremely low water levels in Lake Lanier and low or inconsistent water levels in West Point Lake. Similar comments were made by stakeholders in the middle and lower reaches of the basin that attributed adverse economic conditions to low water flows. Comments were also made regarding the following concerns:

- Adverse impacts on low-income and minority populations of low lake levels;
- The potential for collapse of the seafood and fishing industry in the Apalachicola Bay region;
- Safety hazards due to low water levels;
- Property values, aesthetics, and quality of life; and
- Direct and indirect impacts of basin water management practices on socioeconomics.

Table 1.4-1.
Comments Categorized by Segment

Category	2008	2009	2012	Total number of comments
Water Management Recommendations	868	53	307	1,228
Socioeconomics and Recreation	404	14	288	706
Biological Resources	284	35	265	584
National Environmental Policy Act	79	80	82	241
Drought Operations	191	5	12	208
Water Quality	155	12	22	189
Water Supply	117	19	13	149
Data, Studies, and Analytical Tools	56	4	37	97
Flood Risk Management	9	2	71	82
Other Resources	52	6	7	65
Navigation	28	4	9	41
Hydropower	26	0	5	31
Total	*2,269*	*234*	*1,118*	*3,621*

The primary message stakeholders conveyed was that USACE should fully assess in the EIS the socioeconomic impacts of water management practices at the individual projects and in the overall system.

The three categories that received the next most comments were biological resources (584), drought operations (208), and NEPA (241).

- Biological resources comments pertained to fisheries; threatened and endangered species; flow concerns for Apalachicola Bay; and other biological issues such as habitat, research, and monitoring.
- The drought operation comments generally referenced drought conditions in the Lake Lanier watershed over the past decade. Some comments suggested that during periods of extreme drought conditions, USACE needs to redirect and optimize its operational practices to balance project purposes by establishing management triggers, conservative reservoir operations,

emergency drought measures, and water supply conservation measures and/or by prioritizing reservoir purposes.

- NEPA-related comments discussed public involvement, the schedule, the baseline, the proposed action and alternatives, mitigation measures, compliance with other regulations, and cooperating agencies.

Water quality (189 comments) and water supply (149 comments) were the next two categories. Water quality concerns were related to the following issues:

- Wastewater dilution
- Recreational uses
- Impacts of low lake levels and low flows
- Reevaluation of low flow requirements
- Salinity in Apalachicola Bay
- Monitoring
- Effects of population growth
- Industrial discharges
- Maintaining existing minimum flows
- The effect of the Revised Interim Operating Plan (RIOP)
- Total maximum daily loads (TMDL)

The water supply comments pertained to the following issues:

- Importance compared to downstream uses
- Public water supply
- Real-time monitoring at the city of Atlanta's intake
- Concern over future availability
- Consideration of the Metropolitan North Georgia Water Planning District's plans
- Lack of congressional authority
- Cumulative effects
- Population growth
- Monitoring of the use of storage

The remaining comment categories, with a total of 316 comments, were data, studies, and analytical tools; flood risk management; other resources; navigation; and hydropower.

Throughout this process, the public can obtain information on the status of the Master Manual update and the EIS by checking the Mobile District Web site at www.sam.usace.army.mil. The scoping reports covering all three rounds of public scoping are posted at http://www.sam.usace.army.mil/Missions/PlanningEnvironmental/ACFMasterWaterControlManualUpdate.aspx and can be downloaded with or without the appendices.

1.4.4 Analysis of Public Comments

As described in more detail in section 4, stakeholder comments assisted in identifying water resources/water management problems as well as measures (or alternatives) the public wished to have considered in updating the Master WCM. Considering the purpose and need for this EIS, USACE developed eight screening criteria to guide information gathering, to help identify solutions, and to formulate alternatives. The screening criteria, which are summarized below, helped define the scope of the proposed updates to the Master Manual and to identify relevant public/agency issues and concerns to be addressed in the EIS. They also guided the consideration of input received from the public and from federal and state agencies, as well as suggestions from within USACE.

Any proposed measure (or alternative) considered in the update process for the Master Manual should:

1. Meet the purpose and need of the proposed federal action
2. Address one or more of the congressionally authorized project purposes
3. Maintain at least the current level of flood risk management
4. Be consistent with the contemporary water resources needs of the basin to the extent practicable
5. Support the operation of the projects in the ACF Basin as a system
6. Not increase the risk to public safety in the facility or downstream of the project
7. Not exceed the physical limitations of or pose risks to the structural integrity of the projects
8. Not violate USACE responsibilities under the Endangered Species Act (ESA)

In addition to their application in considering public and agency input, these criteria were also used to conduct initial screening of potential water management measures for more detailed evaluation and possible inclusion in one or more of the WCM update alternatives. The initial screening process is described in more detail in section 4.

The following paragraphs provide additional discussion of the screening criteria:

1. A measure (or alternative) should meet the purpose and need of the proposed federal action.

   As explained in section 1.2, the purpose of the proposed action is to update the Master WCM for the ACF Basin to specify how federal projects should be operated for their congressionally authorized purposes, taking into account changes in basin hydrology and demands from years of growth and development, new/rehabilitated structural features, legal developments, and environmental issues. This includes considering, along with operations for all authorized purposes, an expanded range of water supply alternatives associated with the Buford Dam/Lake Lanier project, including current levels of water supply withdrawals and additional amounts that Georgia has requested from Lake Lanier and downstream at Atlanta. Any other proposed changes that would require feasibility-level studies and additional congressional authorization (e.g., changes that would significantly affect other project purposes or require substantial structural modifications) are not consistent with the purpose and need of updating the Master WCM or of this EIS.

2. A measure (or alternative) should address one or more of the congressionally authorized project purposes.

   In accordance with USACE governing regulations, water control plans are prepared giving appropriate consideration to all applicable congressional acts relating to the operation of federal facilities. For the ACF Basin, the congressional acts include the authorizing legislation, referenced project documents, and relevant general authorities (e.g., the Fish and Wildlife

Coordination Act, Federal Water Project Recreation Act-Uniform Policies, Water Pollution Act of 1972 as amended, the ESA, the Flood Control Act of 1944, and the Water Supply Act of 1958).

3. A measure (or alternative) should maintain at least the current level of flood risk management.

   USACE operates projects in the ACF Basin to provide flood risk management, as Congress intended when authorizing the system and projects. Continued growth and development in the ACF Basin floodplain have implications to flood risk management that must be considered. Any proposed action should not significantly alter the level of flood risk management intended by the Congress in its authorizing language or increase the current levels, frequency, and duration of flood damage.

4. A measure (or alternative) should be consistent with the contemporary water resources needs of the basin to the extent practicable.

   Engineer Manual (EM) 1110-2-3600(2)(1)(b) and (3)(1)(b) states than an overarching goal of water control plans is to account for changing local conditions and needs in the basin (USACE 1987). Even after the projects are constructed, further refinements or enhancements of the water control procedures are often necessary to account for changed conditions resulting from new requirements, additional data, or changes in the basin. Such changes, however, must be consistent with the project's authorized purposes.

5. A measure (or alternative) should support the operation of the projects in the ACF Basin as a system.

   Authorizing documents call for operation of the projects proposed for the ACF Basin as a system. The operation of a multiple-project system such as the ACF Basin requires integrated WCM and plans whereby projects are regulated jointly to achieve the overall river basin management objectives (USACE 1987).

6. A measure (or alternative) should not increase the risk to public safety in the facility or downstream of the project.

   Pursuant to ER 1110-2-240(6) (g) and EM 1110-2-3600, one of the prime requirements in project or system regulation is the safety of the users of the facility and the general public at the projects and downstream of the projects (USACE 1982; USACE 1987). USACE operates the projects and systems in full compliance with USACE safety regulations. Measures (or alternatives) that would pose safety risks to the facility personnel or the general public were not considered.

7. A measure (or alternative) that exceeds the physical limitations of or pose risks to the structural integrity of the projects should not be considered.

   The federal action is an updated Master WCM to reflect existing infrastructure and authorized project purposes. Therefore, measures (or alternatives) that would physically modify one or more projects or that would pose risks to the structural integrity of the existing projects were not considered.

8. Any measure (or alternative) that violates USACE responsibilities under the ESA will not be considered.

USACE has previously met those obligations through formal consultation that resulted in a 2006 Interim Operation Plan (IOP) and, subsequently, revised IOPs (RIOP) in 2008 and 2012[3]. As part of its WCM and plans update, USACE intends to enter into section 7 formal consultation with the USFWS regarding federally listed threatened and endangered species in the ACF Basin. The results of that consultation will be incorporated into operations under the updated Master WCM.

USACE has not developed formal responses to the comments received during scoping but reviewed the comments and suggestions received as categorized in the scoping report and developed summaries of the major themes. The major comments and suggestions received during the scoping process are each listed in Appendix D together with a statement of whether the comment or suggestion was eliminated by the screening criteria or was considered in updating the Master WCM, including reference to where in the EIS the comment or suggestion was addressed in more detail. The comments and suggestions are identified by a 2-letter abbreviation of the category of the comment or suggestion followed by a number, as shown in Table 1.4-2.

Table 1.4-2.
Summary of Comment/Suggestion Identifiers Used in Appendix D

Category	Appendix D identifier
Water Management	WM1-WM73
Socioeconomics and Recreation	SR1-SR15
NEPA Process	NEPA1-NEPA18
Biological Resources	BR1-BR23
Drought Operations	DO1-DO9
Water Quality	WQ1-WQ22
Water Supply	WS1-WS25
Data, Studies, and Analytical Tools	DS1-DS19
Other Resources	OR1-OR5
Navigation	NV1-NV4
Hydropower	HP1-HP9
Flood Risk Management	FRM1-FRM6

1.4.5 Public Review of the Draft EIS

This draft EIS has been filed with EPA and is available for public review and comment. A notice of availability (NOA) of the draft EIS was published in the *Federal Register*. Copies of the draft EIS have been provided to agencies, interest groups, and members of the public who have an interest in the WCM update process or have specifically requested a copy. In addition, copies of the draft EIS have been provided to local libraries in locations throughout the ACF Basin. A complete distribution list is provided in section 10. Agencies, organizations, and individuals will be invited to review and comment on the document with respect to the completeness and on the proposed action, the alternatives, and the adequacy of the analysis. During the 60-day comment period, USACE will hold one or more public meetings to receive comments on the draft EIS. USACE will advertise the time and place of the meeting(s) through a

[3] Consultation with the USFWS under section 7 of the Endangered Species Act was initiated by USACE in 2006 resulting in a biological opinion for an IOP. See section 2.1.1.2.4.4.

newsletter distribution to the project mailing list, press releases to local newspapers, radio, and television news, and on the project Web site.

1.4.6 Final EIS

As provided for in CEQ regulations, USACE will consider all comments provided by the public and agencies on the draft EIS. The final EIS will incorporate changes derived from the comments on the draft EIS, as appropriate, and will address comments received during the review period. USACE will make copies of the final EIS available to agencies, interest groups, and members of the public who received the draft EIS and will place copies in local libraries. Upon the final EIS being filed with EPA, EPA will publish a NOA of the final EIS in the *Federal Register* in accordance with established procedures reflected in the CEQ and USACE NEPA regulations. In addition, USACE will advertise the availability of the final EIS through a newsletter distribution to the project mailing list; press releases to local newspapers, radio, and television news; and the project Web site.

1.4.7 Record of Decision

No sooner than 30 days after filing the final EIS with the EPA and publication of the NOA for the final EIS in the *Federal Register* by EPA, USACE will prepare a record of decision (ROD) for the update of the Master Manual and the individual project WCMs that will summarize alternatives that were considered and relevant factors that were balanced in making the decision, and identify means that have been adopted to mitigate for adverse effects. USACE will notify the public of the approved ROD in a newsletter distribution to the project mailing list; in press releases to local newspapers, radio, and television news; and on the project Web site.

1.4.8 Impact Analysis Performed

An interdisciplinary team of environmental scientists, biologists, planners, economists, engineers, archaeologists, and historians has analyzed the proposed action and alternatives in light of existing conditions and has identified relevant beneficial and adverse effects associated with the action.

- Existing conditions are described in section 2, “Affected Environment”.
- Understanding existing conditions provided a framework for water management as described in section 3, “Framework for Decision Making”, to define the proposed action.
- Development and description of water management and water supply alternatives, including the No Action Alternative and Proposed Action Alternative, are described in sections 4 and 5.
- The expected effects of the proposed action are described in section 6, “Environmental Consequences”, for each environmental resource area. Section 6 also addresses the potential effects associated with climate change, cumulative effects, and potential mitigation measures.

The environmental resources addressed in this EIS include water resources, geology and soils, climate, land use, biological resources and ecosystems, socioeconomic resources, aesthetic resources, air quality, noise, traffic and transportation, cultural resources, and hazardous and toxic materials.

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2 Affected Environment

This section of the EIS describes the physical and social conditions of the geographic area in which the impacts of the proposed action and alternatives are expected to occur, referred to as the *region of influence* (ROI). The affected environment serves as a baseline from which potential environmental and socioeconomic effects likely to result from proposed changes in the way USACE manages individual projects within the ACF Basin will be identified and evaluated. More importantly, the baseline will assist in demonstrating how those proposed changes will affect the functioning of the ACF Basin as a whole.

For the proposed Master WCM update and WSSA, the ROI is generally defined as the ACF Basin in Alabama, Florida, and Georgia, downstream to and including Apalachicola Bay, as depicted in Figure 1.1-1. The affected environment depicts conditions, as they exist, in accordance with the most recent available data for each resource area. The level of detail provided is commensurate with the intensity, context, and duration of the potential impacts to a given resource. The ROI may vary by resource area depending on a variety of factors including natural boundaries, geopolitical boundaries, and the likely extent of impacts to the resource. When historical context is particularly relevant to understanding the current conditions for a given resource area, pertinent, historical data and information has also been included.

Understanding water resources in the ACF Basin (including water management, use, and quality) is the foundation for understanding the affected environment. This section begins with a description of water resources and continues by addressing the resource areas of geology and soils, climate, land use, biological resources, socioeconomics, cultural resources, air quality, noise, traffic and transportation, and hazardous and toxic waste. Navigation, hydroelectric power generation, recreation, and environmental justice are captured within socioeconomics.

2.1 Water Resources

This section examines the complex interrelationships between surface water, groundwater, and the numerous competing demands on water resources in the ACF Basin. Water resource conditions in the ACF Basin can generally be described in the context of four variables:

- Quantity (or volume) of available water;
- Quality (physical, chemical, and biological integrity);
- Timing (when water is available in the system for natural and human use); and
- Distribution (the extent to which available water in the system is controlled, managed, or consumed for various purposes).

Section 2.1.1 addresses water quantity conditions for the ACF Basin, including timing and distribution (water management) aspects. Section 2.1.2 principally focuses on characterizing water quality conditions in the basin.

Much of the information in this section was developed during the Comprehensive Study in the 1990s involving the states of Alabama, Florida, and Georgia, and USACE, which were the principal partners in the study. Substantial additional water quantity and quality data have been collected and analyzed since the Comprehensive Study was completed by those parties as well as the U.S. Geological Survey (USGS), EPA, the three states, and other interests.

2.1.1 Water Quantity Affected Environment

This section discusses the water quantity aspects of the ACF Basin under existing conditions. It examines issues such as flow rates, flow durations, reservoir water levels, and groundwater quantities in the ACF Basin. It also discusses the many factors that can affect water quantity, including weather conditions, municipal and industrial (M&I) consumption, agricultural use for irrigation, thermal power plants, and reservoirs for hydroelectric power generation and flood risk management.

In conjunction with meeting authorized project purposes, an important function of the many reservoirs in the ACF Basin is to store water when there is an abundance of rain and to release water when there is less rain in an effort to ensure that all water needs can be met throughout the year. Water management in this context is a complex process that requires consideration of many competing demands for water in the basin, consideration of past and anticipated future hydrologic conditions, collaboration with agencies and stakeholders, and determination of the most appropriate operating conditions for all the reservoirs in the basin to meet both human and natural system needs.

Water is managed in the reservoir projects in the ACF Basin for a variety of purposes, including flood risk management, hydroelectric power generation, navigation, fish and wildlife conservation, recreation, water supply, and water quality. Water demands can be consumptive or nonconsumptive. *Consumptive* demands involve withdrawal of water from the basin for some purpose and not returning it or any portion thereof, directly back to the basin. Municipal, industrial, and thermal power water supply consumes a portion of the withdrawn water and returns a portion of the water back to the basin as treated wastewater. For purposes of this analysis, agricultural water supply withdrawals are assumed to provide no return flows to the surface water streams. In contrast, hydroelectric power generation demand is a *nonconsumptive* use of water. It uses the flow in the river to drive hydroelectric power turbines to generate electricity, but no water is withdrawn or lost from the system.

In considering basin water management, it is critical to account for the various withdrawals (losses) from and returns (gains) to the system. Water is lost to the system through evapotranspiration (the total of evaporation and plant transpiration), M&I water withdrawals, thermal cooling water withdrawals, agricultural water withdrawals, groundwater transfers, and interbasin transfers. Water is returned, or added, to the basin through precipitation, treated M&I wastewater discharges, thermal power plant discharges, groundwater baseflow contribution, and interbasin transfers. Figure 2.1-1 schematically illustrates the gains of water to and losses of water from the basin. Water uses within the ACF Basin, and their associated gains and losses, are discussed in more detail later in the sections to follow.

2.1.1.1 Hydrologic Characteristics of the ACF Basin

Hydrologic characteristics of the basin are defined by various parameters, including precipitation, runoff, land use, geology, and man-made structures to manage water resources.

2.1.1.1.1 Precipitation

The mean annual rainfall in the Flint River Basin (Georgia) and Chattahoochee River Basin (Alabama and Georgia) generally ranges from about 50 to 55 inches per year (in/yr). In the Apalachicola River Basin (Florida), the mean annual rainfall generally is above 55 in/yr and may be as high as 66 in/yr in certain locations. Table 2.1-1 depicts the mean annual rainfall, along with the record high and low annual rainfall totals from four precipitation stations in the ACF Basin, all with periods of record of more than 100 years. The highest recorded rainfall occurred in 1964 for most of the ACF Basin.

The average monthly total rainfalls at these four stations are also presented in Figure 2.1-2 to provide an indication of the seasonal variations in rainfall over the basin. At the upper end of the basin, rainfall is distributed throughout the year but tends to be more prevalent in the winter months (December through March) and lowest in the fall (September through November). In the lower end of the basin, rainfall is distributed throughout the year but tends to be higher in the summer months (June through August) (SERCC 2010).

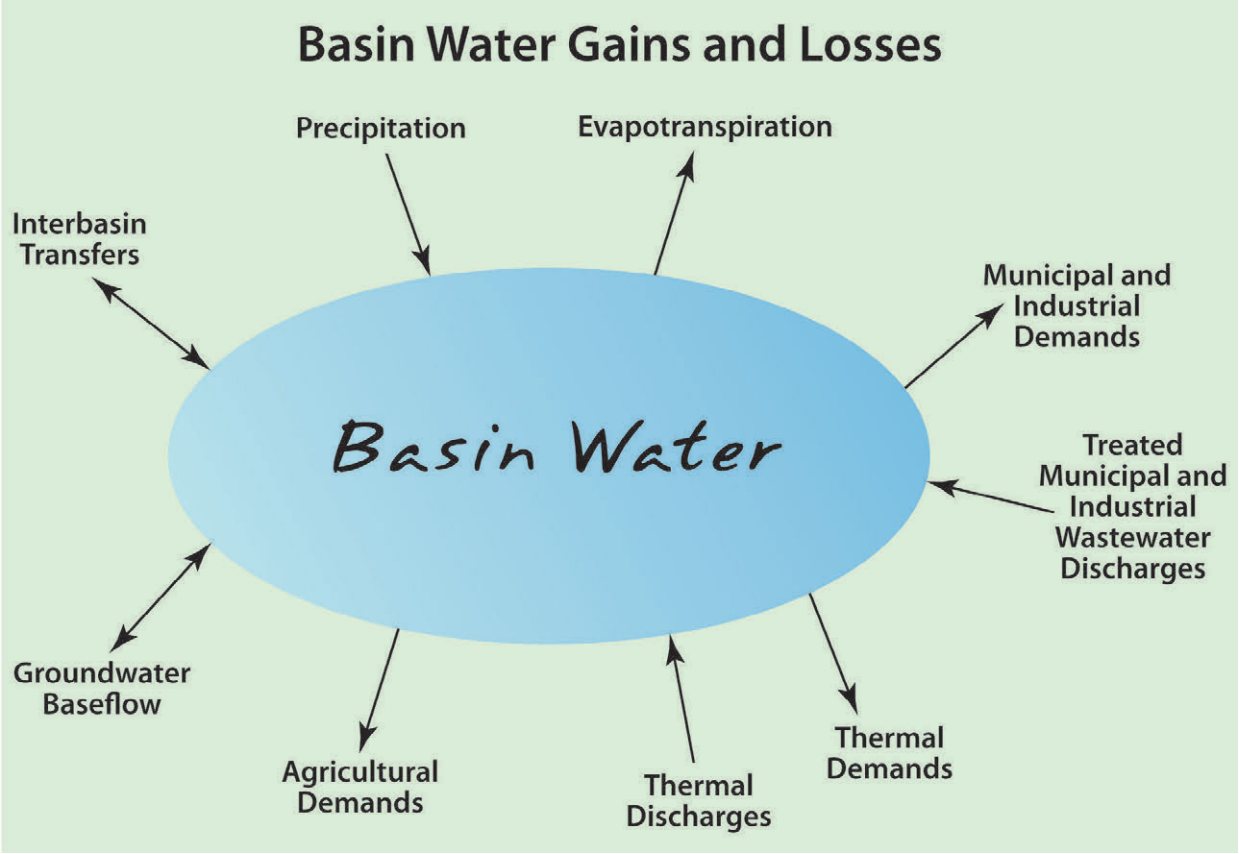


Figure 2.1-1. ACF Basin Water Gains and Losses

Table 2.1-1.
Precipitation Record for the ACF Basin

Station number	Location	Period of record	Average (inches)	High (inches)	Year	Low (inches)	Year
093621	Gainesville, GA	1891–2012	53.27	74.64	1964	20.96	1904
099291	West Point, GA	1891–2012	51.24	74.34	1964	29.99	1954
090140	Albany, GA	1891–2012	50.04	71.46	1964	32.06	1954
089566	Wewahitchka, FL	1901–2012	65.81	104.13	1965	40.89	2000

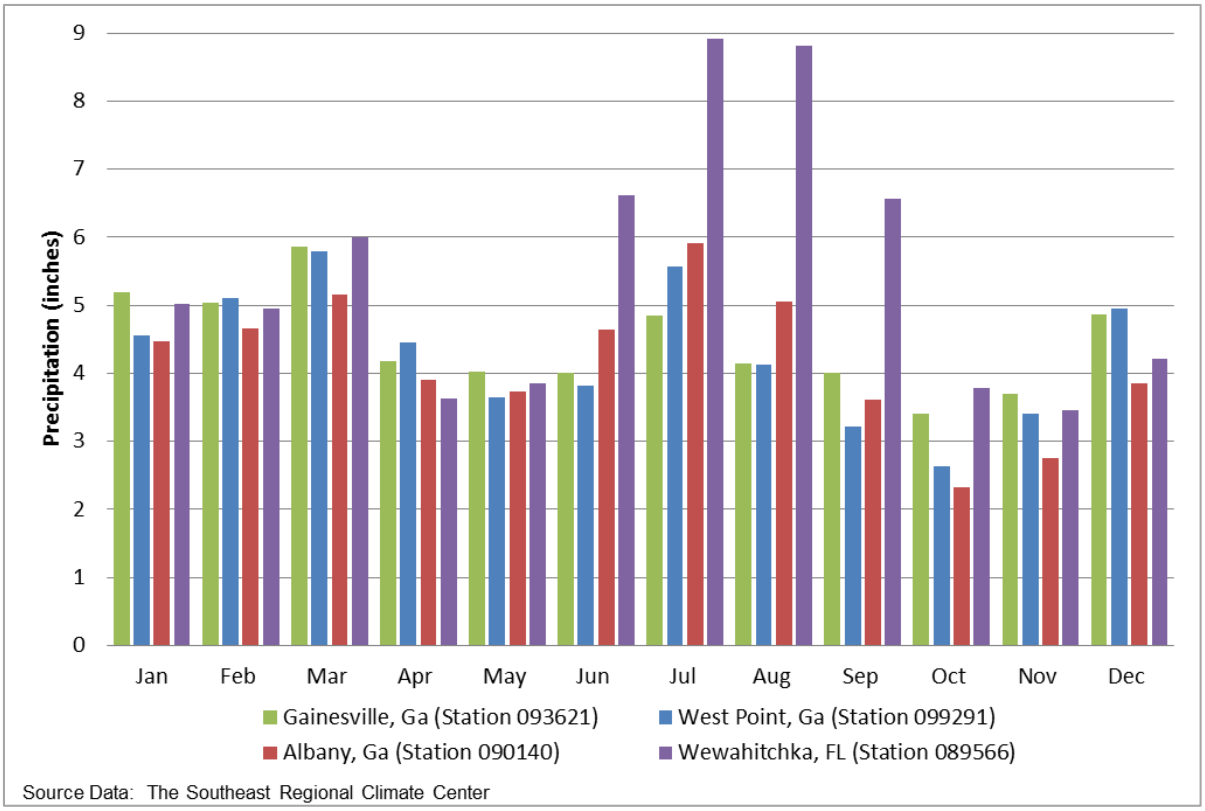


Figure 2.1-2. Average Total Monthly Precipitation Record (10/1/1891 to 4/30/2012) for the ACF Basin

Yearly rainfall amounts can be highly variable from year to year, as shown in Figure 2.1-3 and Figure 2.1-4, with yearly totals ranging over 40 inches in a 3-year span. The wet and drought periods produced by these variations in rainfall are cyclical in nature, and the differences in rainfall can be attributed to changes in climate and weather patterns. Periods of heavy rainfall can be caused by El Niño events, which bring heavy winter rain to the Southeast, and active hurricane seasons, which can bring heavy rainfall in the late summer and fall. Droughts are loosely associated with La Niña events, but they are more likely caused by atmosphere-ocean climate variability and by internal atmosphere variability (Seager et al. 2009).

Additional detailed information on precipitation characteristics in the ACF Basin is available in the draft Master WCM and individual ACF project WCMs in Appendix A.

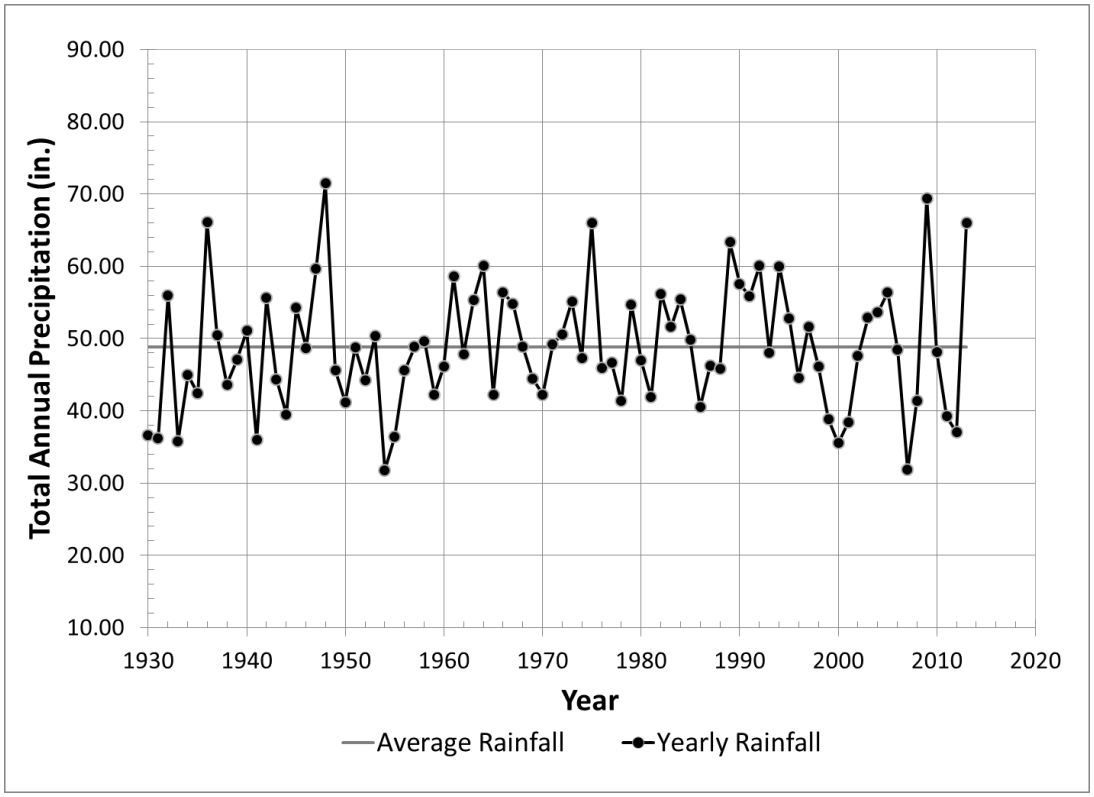


Figure 2.1-3. Yearly Rainfall for Atlanta, Georgia

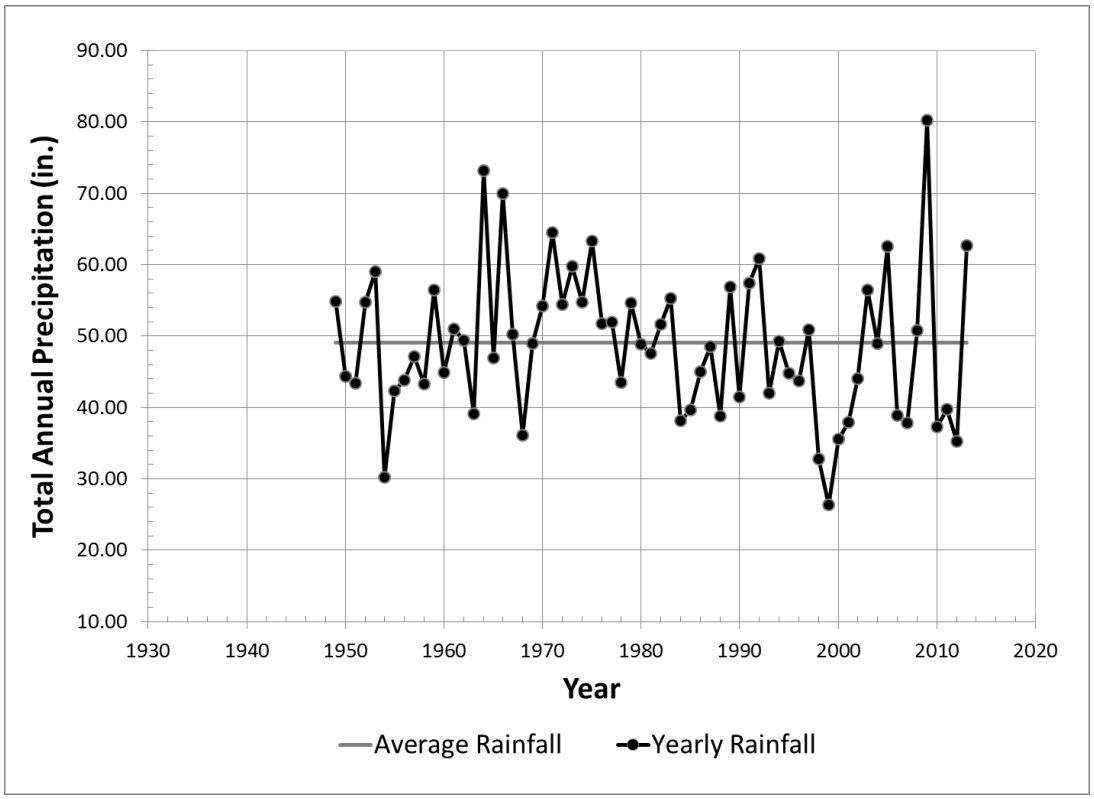


Figure 2.1-4. Yearly Rainfall for Columbus, Georgia

2.1.1.1.1.1 Extreme Rainfall Events and Floods

Major flood-producing storms over the ACF Basin are usually of the frontal type, occurring in the winter and spring and lasting from 2 to 4 days. Their effect on the basin depends on their magnitude and orientation. The axes of the frontal-type storms generally cut across the long, narrow basin. Occasionally, a tropical storm or hurricane in summer or early fall will cause major flooding over the entire basin. Summer storms are typically thunderstorms with high intensities over relatively small areas that can produce serious local flooding. Under normal runoff conditions, from 5 to 6 inches of intense rainfall over a large area is required to produce widespread flooding. On many of the minor tributaries, 3 to 4 inches is sufficient to produce local floods. Some of the more significant rainfall and flooding events in the ACF Basin since 1900 are described in detail in the draft Master WCM and individual project manuals in Appendix A. The following paragraphs provide a brief summary of those events.

July 1916 Event—The storm of July 5-10, 1916, resulted from a hurricane that formed in the *Caribbean* Sea and moved northwest across the Gulf of Mexico, entering the U.S. east of the mouth of the Mississippi River on the evening of July 5. The disturbance continued inland across western Mississippi, turned eastward on July 7, and subsequently moved northeastward across Alabama. The heavy precipitation covered a large portion of the region, including nearly all of Alabama, the northwestern part of Florida, and large areas of Mississippi and Georgia. The storm produced general flood conditions throughout the southeastern states and, because it occurred during the middle of the growing season, caused enormous agricultural damage. The heaviest recorded rainfall in the ACF Basin was 23 inches at Blakeley, Georgia. A total of 22.7 inches fell at Alaga, Alabama, where 12.7 inches were recorded in one day. Flood stages were exceeded throughout the basin.

December 1919 Event—Flood-producing rainfall was experienced December 8-9, 1919, diminishing on December 10. The area of heaviest precipitation extended across southeastern Mississippi, central Alabama, and northern Georgia. The center of greatest rainfall was at Norcross, Georgia, with a total of 12.9 inches. The storm caused extreme flooding in the Chattahoochee River north of Columbus and on the upper Flint River. Flooding was moderate in the lower part of the basin.

March 1929 Event—The storm of March 11-16, 1929, resulted from a widely extending low-pressure area that developed over eastern Colorado and moved rapidly eastward causing heavy rains, particularly in Alabama and parts of Mississippi, Georgia, and Tennessee. This storm was one of the greatest storms ever recorded in this country and is outstanding with regard to intensities of precipitation over large areas. The main center was at Elba, in southeast Alabama, with a total of 29.6 inches recorded in 3 days, of which 20 inches were estimated to have fallen in 24 hours. In the ACF Basin, the most intense rainfall was recorded at Blakely, Georgia, which had a storm total of 12.9 inches and Goat Rock, which had 12.8 inches. Essentially, the entire ACF Basin received at least 4 inches of rain. Floods were moderate in the upper basin and more severe in downstream areas.

February 1961 Event—February 1961 started out cold and dry, a continuation of the weather experienced over the area during most of the preceding months of December and January. Some scattered light rains occurred during the first week of February, but not nearly enough to overcome the moisture deficit. Drought conditions were further intensified from February 9 to 18. Beginning on February 18, the dry period was abruptly followed by the rainiest 8-day period experienced in Georgia since weather records began. The rains were heaviest in the west central part of the state where both LaGrange and West Point recorded more than 17 inches in 8 days, with as much as 7 inches falling during a 24-hour period. Most locations northwest of Columbus reported more than 8 inches of rain during this period, with several areas exceeding 12 inches, enough to make February 1961 the wettest February since 1929. The heavy rainfall caused flash flooding along many northern Georgia streams with major flooding developing on the Chattahoochee River in the West Point to Columbus, Georgia, area.

July 1994 Event—On the afternoon of June 30, 1994, Tropical Storm Alberto formed in the southeastern Gulf of Mexico between the Yucatan Peninsula and the western tip of Cuba. During the first 18 hours, the storm slowly drifted to the west, and then it began a more northwestward course. It continued that course until Saturday, July 2, when the storm began turning northerly. Alberto was near-hurricane strength when it made landfall near Ft. Walton Beach, Florida, on Sunday, July 3. The main threats over portions of Alabama, Florida, and Georgia were heavy rainfall and the potential for tornadoes. Due to climatic conditions, Tropical Storm Alberto became nearly stationary for several days as it moved over Georgia. Many stations reported rainfall totals exceeding 10 inches. Atlanta received 12 to 15 inches of rainfall, and other locations in central and southern Georgia reported 20 to 26 inches. Cuthbert, Georgia, in Randolph County reported 23.87 inches. The greatest flooding occurred in the Flint and Apalachicola basins. The storm caused the worst flooding on record in the lower Flint Basin, resulting in exceptional damage in Albany and other communities in the area.

May 2003 Event—During the 3-day period of May 5-7, 2003, heavy rain fell across north and central Georgia, especially in western and extreme northern counties. Some locations such as Troup and southern Meriwether counties between Atlanta and Columbus received nearly a foot of rain. Soils were already saturated from previous rainfall, resulting in rapid rises on many of the small streams in the western half of north and central Georgia. Moderate flooding was noted on numerous rivers and creeks in Georgia, including the Flint River near Culloden, the Conasauga River near Tilton, Sweetwater Creek near Austell, and the Chattahoochee River at West Point. At the city of West Point, the Chattahoochee River crested at 23.2 feet, more than 4 feet above flood stage, shortly after midnight on May 8, the highest level since February 1961, when the river rose to 24.9 feet (prior to construction of West Point Dam). USACE calculated the peak flow at 170,000 cfs. Without West Point Dam, USACE estimated that the Chattahoochee River at the city of West Point would have risen to around 34 feet.

September 2009 Event—The flood of September 2009 resembled a tropical event but was, in fact, caused by steady rain for 8 days. Rain began falling on Metro Atlanta on September 15, with the National Weather Service (NWS) reporting only 0.04 inch that day at the Hartsfield-Jackson Atlanta International Airport. Additional rain fell throughout the week, with only a trace amount recorded for September 18. However, a large rain event occurred in north Georgia, particularly Metro Atlanta, September 19. The NWS monitoring station at the Atlanta airport recorded 3.70 inches of rainfall from daybreak to 8:00 p.m. (more than doubling the previous record for rainfall on that date), while outlying monitoring stations recorded 5 inches of rainfall in a 13-hour period. Inside the city limits of Atlanta, several neighborhoods were flooded. The I-75/I-85 Downtown Connector, one of Georgia's busiest expressways, was submerged by floodwaters. The Governor of Georgia declared a state of emergency and requested a disaster declaration from the U.S. Government for 17 counties in Georgia. The counties were Bartow, Carroll, Cherokee, Cobb, Coweta, DeKalb, Douglas, Fulton, Gwinnett, Heard, Newton, Paulding, and Rockdale around Metro Atlanta; Catoosa, Chattooga, and Walker in far northwest Georgia; and Stephens in northeast Georgia. According to the USGS, the magnitude of flooding in rivers and streams in Cobb and Douglas counties, just west of the city of Atlanta, was so great that the likelihood of recurrence was on the order of 0.2 percent (1 in 500) in any given year (commonly referred to as a "500-year storm").

2.1.1.1.1.2 Historic Droughts

Most drought experts agree that when drought occurs, it progresses in stages. The first stage of drought is *meteorological drought*—when precipitation falls below normal levels—is usually the first indicator because it can develop quickly. This type of drought is normally expressed as a "rainfall deficit," in a measure of deviation from normal—such as inches below normal, or a percentile. The second stage of drought is *agricultural drought,* which occurs when the amount of moisture in the soil no longer meets the needs of a particular crop. When agricultural drought occurs at a critical time of year, it can result in water-deficient topsoil, which may hinder germination, and reduce crop yield—especially if moisture is

not replenished during the growing season. This type of drought is usually measured in soil moisture levels and can be devastating to agricultural communities (GAEPD 2000).

Hydrological drought is the third stage of drought and occurs when surface and subsurface (ground) water supplies fall below normal levels due to prolonged meteorological drought. Indicators of hydrological drought include decreased streamflow rates (measured in cubic feet per second, or cfs), lake levels, and groundwater levels. Hydrological drought can be detrimental to the environment, upsetting the hydrologic cycle and impacting fish, wildlife, and plant species. If hydrological drought persists for prolonged periods, demand for water may exceed supply, leading to the fourth stage—*socioeconomic drought*. A socioeconomic drought can take many months or even years to develop, often with devastating social and economic consequences for the people who are dependent on water resources for health, drinking water, and jobs (GAEPD 2000). The historic droughts affecting the ACF Basin discussed in this section have progressed to hydrological and, in most cases, to socioeconomic drought stages.

During the past 8 decades, the ACF Basin has experienced numerous droughts, several of which are considered severe. The impacts of each drought have varied across the basin. For instance, the 1930 to 1935 drought exceeded the 25-year recurrence interval in the southwestern portion of Georgia, but exceeded the 10-year recurrence interval for the northeast portion of the ACF Basin. The recurrence interval is the average time between droughts of a given severity. For example, a 25-year drought recurrence interval means that the drought conditions experienced would be expected to occur, on average, once every 25 years (or a 4 percent chance in any given year). In 1938 to 1940, the upper Chattahoochee River basin experienced a drought with a recurrence interval of 50 years, and in 1950 to 1957 the basin experienced a 25 year-recurrence-interval drought (USGS 2000).

Subsequent to the construction of Jim Woodruff Lock and Dam and Buford Dam by USACE in the 1950s, the ACF Basin experienced several serious droughts. These events are summarized below.

1980–1982 Drought—The 1980 to 1982 drought resulted in the lowest streamflows since 1954 in most areas, and the lowest streamflows since 1925 in some areas. Recurrence intervals of 10 to 25 years were common in most of Georgia. Pool levels at four major reservoirs receded to the lowest levels since first filling. Groundwater levels in many observation wells were lower than previously observed. Nearly continuous declines were recorded in some wells for as long as 20 consecutive months, and water levels remained below previous record lows for as long as 9 consecutive months (USGS 2000).

1985–1989 Drought—The 1985 to 1989 drought in northern Georgia resulted in streamflows that were near the lowest of the 1900s. By 1988, the drought had reached recurrence intervals of 50 to 100 years in extreme northern Georgia, 10 to 25 years in central Georgia, and less than 10 years in southern Georgia. Water supply shortages occurred in Georgia in 1986. Shortages first occurred in a few Atlanta metropolitan systems, primarily because of large demand and small reservoir storage. As the drought continued, other systems in the southern part of the metropolitan area also had water supply problems as did several municipalities in northern and central Georgia. During 1986, USACE significantly decreased the release of water from Lake Lanier, but reservoir levels continued to recede to about 2 feet above the record minimum lake level, which occurred during the 1980 to 1982 drought. Groundwater levels in northern Georgia were significantly less than normal during the 1985 to 1989 drought, and shortages in groundwater supplies from domestic wells occurred in the northern one-third of the state (USGS 2000). During this drought period (in 1986), USACE and the states of Georgia, Florida, and Alabama established a drought management committee, which for the ACF Basin meant opening communication among the stakeholders to prepare for future supply stresses.

1998–2003 Drought—During the 1998 to 2003 period, streamflow gauging stations throughout Georgia established new record daily low flows, with recurrence intervals ranging from about 20 years to greater than 50-year recurrence interval low flows. From 1998 and 2000, streamflow averaged between 50 to 80 percent of normal. The rainfall deficit in 1999 was close to 11 inches. From January to August 2000, more than 40 wells statewide, mostly in the southwest parts of Georgia, recorded low water levels (Chaisson 2012). The drought reached a peak in the summer of 2000, and severe conditions prompted the Georgia Department of Natural Resources (GADNR) to implement statewide restrictions on outdoor water use.

2006–2008 Drought—The 2006 to 2008 drought was the most devastating recorded in Alabama and western Georgia. Precipitation declines began in December 2005. The shortfalls continued through winter 2006–2007 and spring 2007, exhibiting the driest winter and spring in the period of record. The drought reached peak intensity in 2007, resulting in a D-4 Exceptional Drought Intensity (the worst measured) throughout the summer of 2007. Rainfall at Gainesville, Georgia, (Lake Lanier) was only about 20 inches for the entire year (USACE, Mobile District 2010a). The drought continued through the winter of 2008. The summer of 2007 was especially hot, and wildfires plagued southern Georgia. Tropical systems did not affect north Georgia during the hurricane season, but the drought of southern Georgia ended with Tropical Storm Barry in 2007.

During the drought, Governor Sonny Perdue issued a declaration of disaster and asked for federal aid for the 85 counties affected by the "historic" drought. Outdoor water use was banned in Metro Atlanta, except under very limited circumstances. Lake Lanier's historic low, recorded on December 26, 2007, was 1050.79 feet, which was 20.21 feet below full summer pool level. In May 2008, Lake Lanier was still 13 feet below its full level.

2011–2012 Drought—From about May 2011 through 2012, areas in central and southwest Georgia experienced drought conditions ranging from severe to extreme. This drought did not appreciably affect the upper Chattahoochee River Basin, but the Flint River portion of the ACF Basin was directly and significantly affected. The Flint River experienced record low flow conditions during much of the drought period, and agricultural activities in the Flint River Basin were significantly affected (Knox 2012). Groundwater levels in the lower Flint River Basin were, in many cases, at or near record lows (Stooksbury 2011). The depletion of flows in the Flint River placed more pressure on USACE reservoirs in the Chattahoochee River Basin to provide releases necessary to meet minimum flow requirements downstream of Jim Woodruff Lock and Dam.

2.1.1.1.2 Runoff Characteristics

Within the ACF Basin, rainfall occurs throughout the year but is less abundant in August through November. The amount of rainfall that actually contributes to streamflow varies much more than the rainfall. Several factors such as plant growth and seasonal rainfall patterns contribute to the volume of runoff. In severe droughts in the upper Chattahoochee River Basin, the runoff from significant (3+ inches) rain events can be as low as 5 percent of the rainfall. Figure 2.1-5, Figure 2.1-6, and Figure 2.1-7 present the average monthly rainfall and runoff for three segments of the basin: (1) above Atlanta, Georgia; (2) Atlanta to Columbus, Georgia; and (3) Columbus to Blountstown, Florida. These figures also show runoff as a percent of rainfall (by month) for the three segments. The mountainous areas in the headwaters of the basin exhibit flashier runoff characteristics and somewhat higher percentages of runoff, ranging from about 28 to 60 percent of rainfall depending on the time of year. In contrast, runoff as a percent of rainfall between Blountstown, Florida, and Columbus, Georgia, ranges from about 16 to 53 percent depending on the time of year. In all portions of the ACF Basin, runoff as a percentage of rainfall is lowest in July through September.

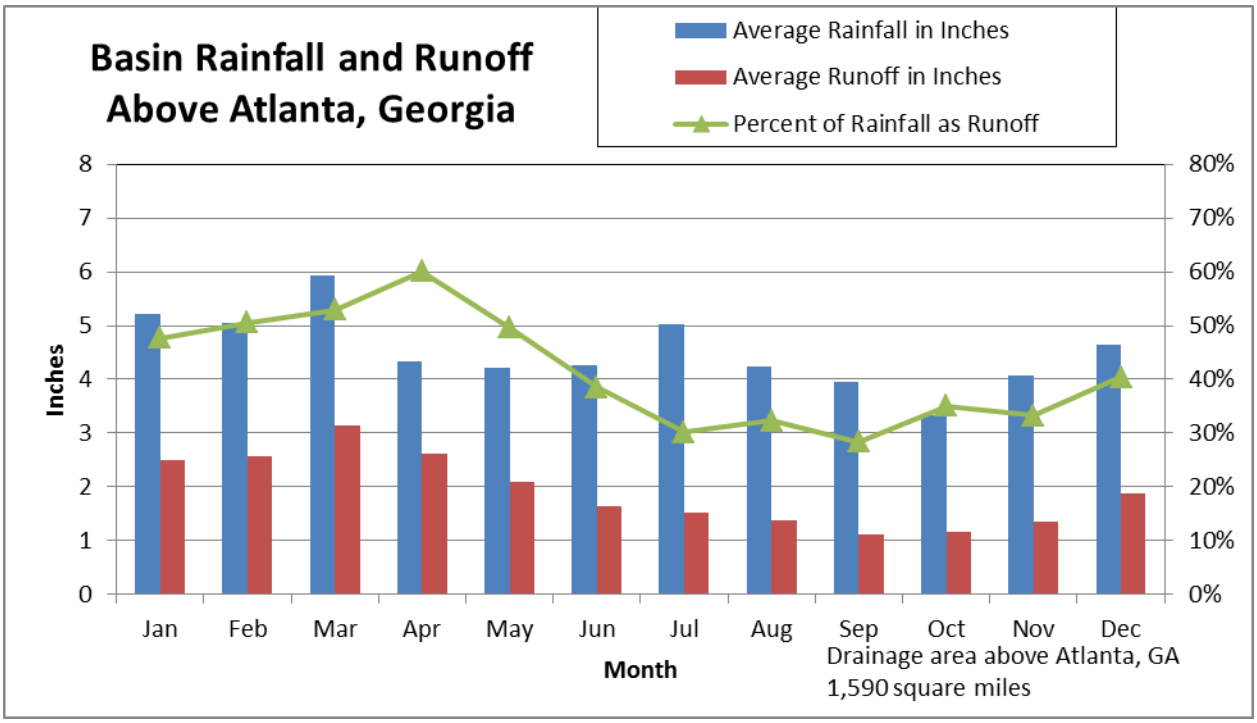


Figure 2.1-5. Basin Rainfall and Runoff above Atlanta, Georgia

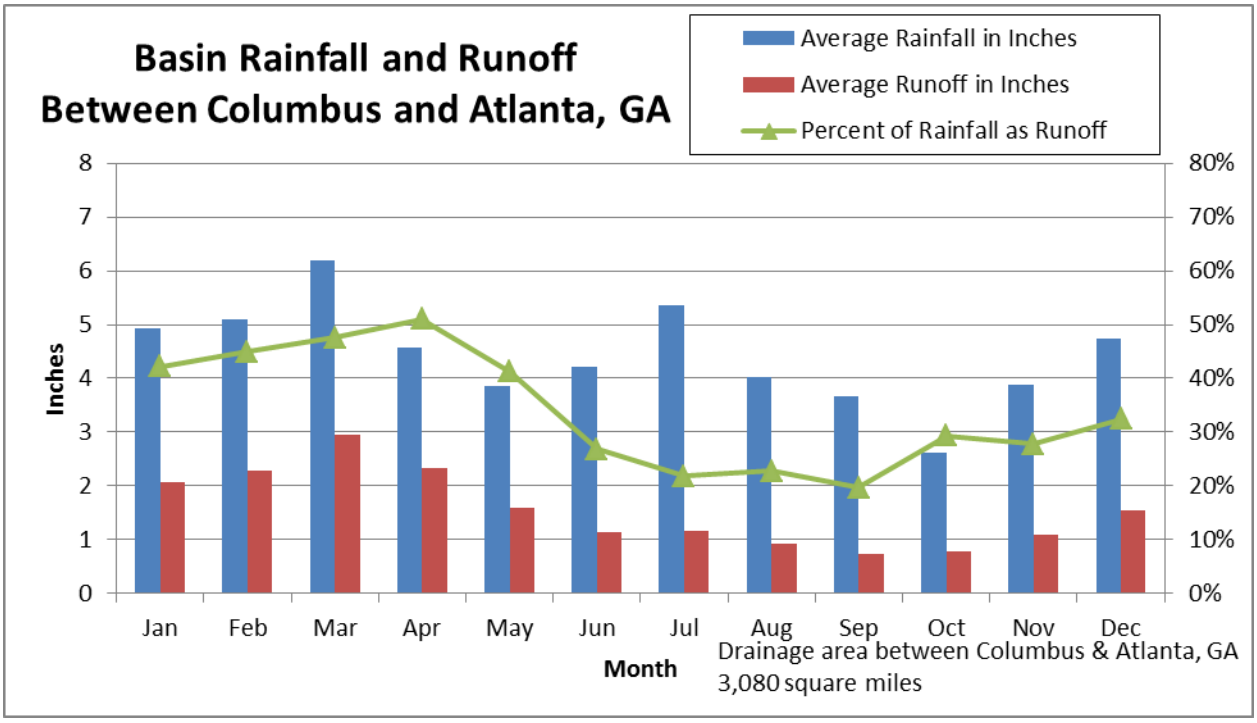


Figure 2.1-6. Basin Rainfall and Runoff between Columbus and Atlanta, Georgia

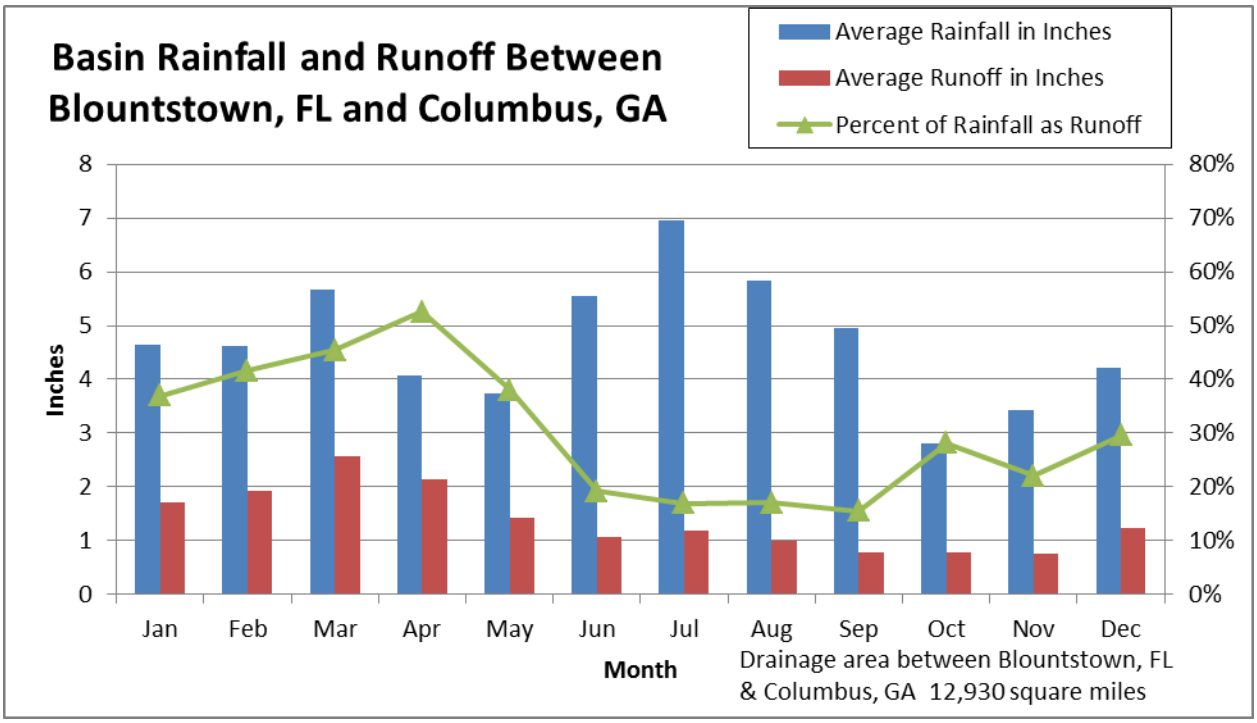


Figure 2.1-7. Basin Rainfall and Runoff between Blountstown, Florida and Columbus, Georgia

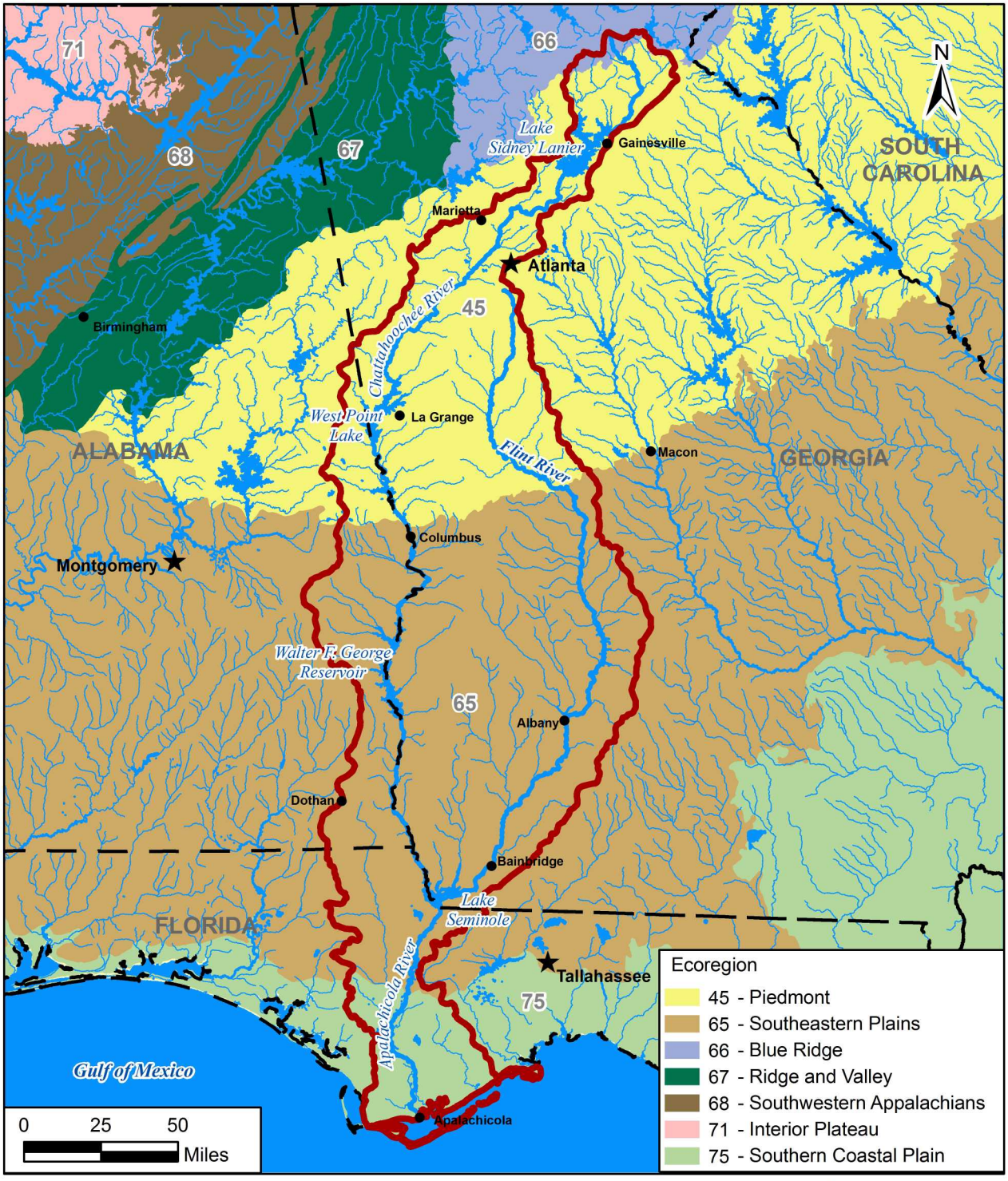
2.1.1.1.3 The Relationship between Geology and Water Quantity

As described in more detail in section 2.2.1, the ACF Basin is divided into four level III ecoregions (Figure 2.1-8). The northernmost portion of the upper Chattahoochee River Basin lies in the Blue Ridge ecoregion, comprising only about 1 percent of the ACF Basin. This ecoregion is characterized by mountain ridges ranging up to about 3,500 ft in altitude. The balance of the upper Chattahoochee River Basin and the upper Flint River Basin are in the Piedmont ecoregion. Most streams in the Chattahoochee River have trellised and rectangular drainage patterns due to the Brevard fault. The Flint River and streams in its basin have dendritic drainage patterns, resembling a branching tree. The streams in the Piedmont are fast flowing and are characterized by rapids and riffles, making them ideal for hydroelectric power generation.

The Southeastern Plains begin at the "Fall Line", which is the contact point between the crystalline bedrock of the Piedmont and unconsolidated sediments of the Plains (GAEPD 1997). The area is highly dissected by streams, especially in the northern Georgia Sand Hills. The Dougherty Plain district in the south is underlain by limestone, and its karst topography is very flat and has numerous sinkhole-created marshes and wetlands (GAEPD 1997).

Streams in the Southeastern Plains are relatively low-gradient and sandy bottomed, and rivers are wide and sinuous with large floodplains (GAEPD 1997). Streams can be deeply entrenched into aquifers, and many receive significant contributions from groundwater. A description of aquifers is presented in section 2.1.1.1.7. The area has little runoff because annual precipitation and evapotranspiration rates are similar. During times of heavy rainfall events, the wide floodplains are able to store large quantities of water.

The Southern Coastal Plain is a flat, lowland area that contains barrier islands, coastal lagoons, marshes, and swampy lowlands. Soils in the area are generally hydric and have a high capacity to hold and store water. The Southern Coastal Plain is dominated by large alluvial rivers, such as the Apalachicola River, which has a broad floodplain that ranges from 1 to 5 miles and is dominated by substantial flooding.



Level III Ecoregions

Figure 2.1-8

2.1.1.1.4 The Relationship between Land Use and Water Quantity

Land use can significantly alter watershed hydrographs through increases in impervious surfaces and in anthropogenic water consumption. A more detailed description of land use is presented in section 2.4.

Nearly 50 percent of the ACF Basin is forested; this is down from 55 percent in the 1990s (USGS NLCD 1992). A large portion of the precipitation on forested lands is intercepted and prevented from quickly reaching surface water streams through infiltration and evapotranspiration processes. Following pine plantation harvesting, water yields can increase as much as 35 percent due to decreases in interception and evapotranspiration. Forested ecosystems have high stream baseflows and low, lengthy storm peaks compared to other common land uses because of high infiltration and permeability rates. Forest cover (e.g., leaves and mulch) reduces raindrop velocities, allowing for higher infiltration, and soils have organic concentrations with higher porosities, allowing for higher permeability. During high storm flows, wetland forests, often streamside, can store large quantities of water and reduce downstream flooding impacts.

The intensity of drought and wet periods is exacerbated by changes in land use and population demand on resources. From 1970 to 1990, water use for public supply in the ACF Basin, which includes Metro Atlanta, more than tripled to almost 460 mgd. Severe droughts and increased development in the area have resulted in shortages and restrictions on limited surface water supplies. Demand continued to increase between 1990 and 2010. Concurrently, various conservation measures have been instituted and periodically strengthened to curb the increased demand and per capita water use (MNGWPD 2009). Demand and conservation measures are discussed in more detail in section 2.1.1.2.10.

Total agricultural land in the ACF Basin has decreased over the past couple of decades due to urbanization and farm abandonment, but more than 20 percent of the land cover is still used for agricultural purposes. Agriculture in the ACF Basin uses both surface water and groundwater for crop irrigation and livestock watering. Most crop irrigation occurs in the Lower Flint River Basin and Lower Chattahoochee River Basin. In the Flint River Basin groundwater supplies nearly all of the water needed for crop irrigation, whereas in the Chattahoochee River Basin groundwater supplies only 44 percent of the water needed for crop irrigation. Livestock agricultural uses are throughout the basin, and farmers use both groundwater and surface water to water livestock. Water used for crop irrigation is considered to be 100 percent consumptive because it is incorporated into crops or lost through evapotranspiration. Details of water withdrawals in the basin are provided in section 2.1.1.2.5.

Compared to forested land use, agricultural land uses produce larger storm flows during rain events because of the reduced soil cover. The runoff rates from agricultural areas are similar to the rates from low- and medium-density residential areas.

Urban areas significantly affect water quantity because of the high percentage of impervious cover and increases in water consumption. Rainfall on impervious surfaces is immediately transported to streams, causing high peak flows. Urban areas also have large areas of land with significantly reduced infiltration and permeability rates, such as grassy and barren land. These areas also shed water extremely quickly during storm events. Because less infiltration occurs in residential and industrial areas, very little groundwater recharge occurs and stream baseflows are reduced.

Figure 2.1-9 illustrates the impact of impervious cover on storm peaks and baseflow. The USGS's Peachtree Creek gage (USGS02336300) watershed is in a high- and medium-density urban area, while the USGS's Sweetwater Creek gage (USGS023368400) watershed is in a forested and low- to medium-density urban area. Both streams are major tributaries to the Chattahoochee River and flow through portions of the Metro Atlanta. Although the two gages have a similar contributing area, baseflow in Sweetwater Creek is higher because of the high infiltration and permeability rates of the forested areas.

The peak flow in Peachtree Creek is much higher because of the high percentage of impervious surfaces, which quickly transport water during storm events.

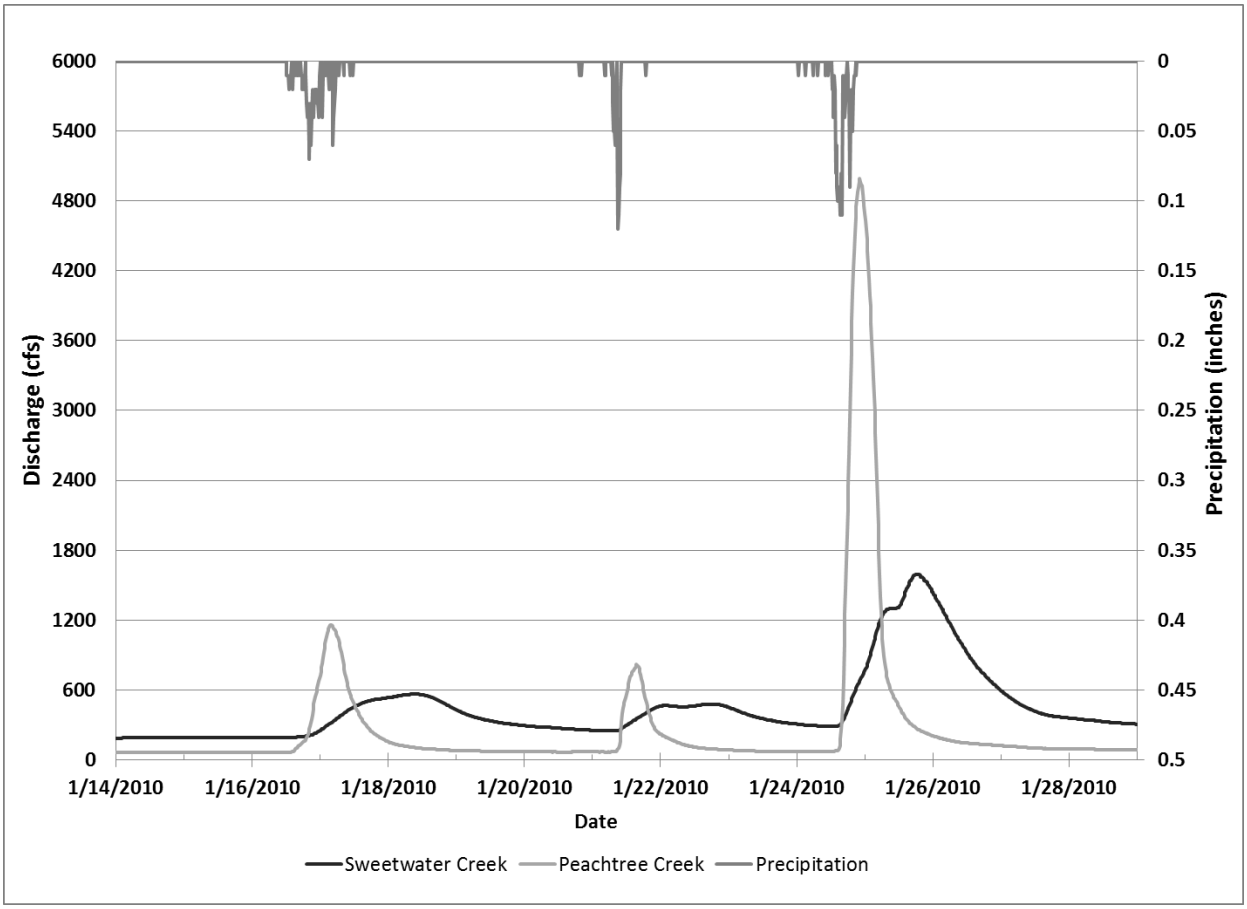


Figure 2.1-9. Discharges during Storm Events for Peachtree Creek (USGS02336300) and Sweetwater Creek (USGS023368400)

Most water removed from the basin for M&I water demands is returned to the basin as treated waste, but demands can alter natural channel flow. In the Chattahoochee River Basin, approximately 82 percent of the water withdrawn is returned (GAEPD 1997), although sources cited elsewhere in this EIS indicate that the returned percentage could be more in the range of 60 to 80 percent. Water is lost from the system through evapotranspiration, interbasin transfers, and thermal water demands. Municipal water suppliers use both surface water and groundwater, depending on supply levels. Water is often returned downstream of the supply source, and groundwater is often returned to the system as surface water. Water use for hydroelectric power generation is nonconsumptive, but hydroelectric dams can alter natural flow regimes because large releases occur during peak power demand periods. Water used for thermoelectric power generation (i.e., fossil fuels and nuclear) is moderately consumptive to nonconsumptive (GAEPD 1997). Historically, the Chattahoochee and Apalachicola rivers were used for barge traffic, and water has been released from dams to help maintain navigable channel depths downstream; navigation is also nonconsumptive. More recent operations for navigation are described in section 2.1.1.2.4.3.

2.1.1.1.5 Surface Water: Rivers

The three principal rivers in the basin are the Chattahoochee, Flint, and Apalachicola rivers (Figure 1.1-1). The Chattahoochee and Flint rivers join to form the Apalachicola River in northwest Florida. The Chattahoochee River has a drainage area of 8,708 sq mi. The drainage area of the Flint River measures 8,456 sq mi. The remaining 2,409 sq mi of the ACF Basin drain directly into the Apalachicola River. The rivers are shown in profile view on Figure 2.1-10, which reflects the gradient of the rivers and the relative locations of dams and other key geographical features. Major tributaries to the mainstem rivers in the ACF Basin are listed with their respective drainage areas and number of mile above the mouth of its confluent stream, in Table 2.1-2.

Rivers in the ACF Basin include both natural (unregulated) rivers and regulated rivers. The natural rivers exhibit a more consistent pattern, responding to precipitation and drought periods as expected with short periods of high flows and prolonged periods of low flows, respectively. Regulated streams exhibit a variable pattern, with daily variations due to hydroelectric power generation operations (most prominent below peaking projects), navigation releases, lower flood peaks, and higher sustained minimum flows through dry periods as the upstream reservoirs augment low flows. Typical flow patterns (i.e., mean daily discharge) for a regulated stream over a year are illustrated in Figure 2.1-11 (Chattahoochee River), and typical patterns for a more natural (or minimally regulated) stream are illustrated in Figure 2.1-14 (Flint River). Although the two rivers have only slightly different drainage areas, the figures demonstrate the distinctive characteristics of a natural stream vs. a regulated stream.

2.1.1.1.5.1 Chattahoochee River

The Chattahoochee River originates in the Blue Ridge Mountains of north Georgia, near the westernmost tip of South Carolina, and extends to the southwest corner of the state. The Chattahoochee River covers a distance of 434 mi from the Blue Ridge Mountains to Lake Seminole. It flows out of the mountains, past Metro Atlanta, and reaches the Georgia-Alabama border, at which point it forms the border between the two states. From there, the Chattahoochee River flows south to its confluence with the Flint River at Lake Seminole and into the Apalachicola River.

Over most of its length, the Chattahoochee River is controlled by dams, with navigation locks and hydroelectric plants, that provide for navigational use of the river, release water for the production of hydroelectric power generation, temporarily store water for flood risk management, and serve other purposes. The slope of the Chattahoochee River for 50 mi above Buford Dam is approximately 4 ft/mi. The Chattahoochee River is free-flowing only in the headwaters upstream of Lake Lanier. Between Buford Dam and West Point Dam, the slope is fairly uniform and averages about 2.7 ft/mi. Downstream of Buford Dam, the river is affected by dam and reservoir operations. Many of the dams and hydroelectric plants operate in a peaking mode, which can result in daily water level fluctuations in the river of 4 ft or more (USGS 1996). Storage for flood risk management at several of the larger reservoirs reduces the peak flow in the river by storing much of the flood flow.

In contrast to the mainstem of the river, the numerous tributaries of the Chattahoochee River are free-flowing. These streams typically have higher sustained flows during winter months and show sharper responses to storm events throughout the year (USGS 1996).

Table 2.1-2.
Tributaries of the ACF Basin

Stream	Drainage area in sq mi	Miles above mouth of confluent stream
Chattahoochee River Basin		
Soque River	166	402
Chestatee River	318	363
Peachtree Creek	122	301
Sweetwater Creek	287	289
Dog River	70	274
Cedar Creek	51	261
New River	172	228
Yellowjacket Creek	192	214
Flat Shoal Creek	200	190
Mulberry Creek	209	174
Upatoi Creek	560	151
Uchee Creek	340	143
Hannahatchee Creek	142	122
Cowikee Creek	480	105
Barbour Creek	101	93
Pataula Creek	40	85
Cemochechobee Creek	105	75
Colomokee Creek	103	67
Abbie Creek	204	59
Omusee Creek	144	48
Sowhatchee Creek	72	35
Bryans Creek	52	29
Chattahoochee River	8,708	108
Flint River Basin		
Line Creek	220	296
Whiteoak Creek	179	291
Redoak Creek	172	282
Liza Creek	185	256
Potato Creek	240	250
Swift Creek	114	244
Auchumpkee Creek	97	235
Patsiliga Creek	152	214
Whitewater Creek	236	186
Buck Creek	189	181
Turkey Creek	174	154
Muckafoonee Creek	1,000	104
Dry Creek	66	91
Racoon Creek	157	81
Cooleewahee Creek	157	70
Ichawaynochaway Creek	1,080	53
Spring Creek	710	3
Flint River	8,456	108
Apalachicola River Basin		
Chipola River	1,270	28
Apalachicola River	2,409	0
New River	569	0
Apalachicola Bay	266	0

The capacity of the Chattahoochee River within its banks varies substantially throughout the river's length. The capacity is about 10,000 cfs between Lake Lanier and Norcross, about 18,000 cfs from Atlanta to Whitesburg, and about 47,500 cfs near West Point and Columbus (USACE, Mobile District 1997). Historically, flows at the USGS gage on the Chattahoochee River at Columbus have been as low as 480 cfs (in October 1931) and as high as 120,000 cfs (in February 1961). The river's slope becomes quite steep through the Fall Line hydroelectric power generation projects, from West Point Dam to Columbus, Georgia, averaging about 10 ft/mi. Downstream of Columbus to Jim Woodruff Lock and Dam, the slope of the river is relatively flat at 1.2 to 0.6 ft/mi. The river's gradient is illustrated in the profile map in Figure 2.1-10. This profile presents river miles from the mouth of the Apalachicola River; other references may indicate river miles from the mouth of the Chattahoochee River or Flint River.

The highest monthly average flows occur in the late winter/early spring months of February to April, which is typically the rainy season. Through late spring and summer, lower precipitation and high evapotranspiration combine to reduce river flows. The lowest average monthly flows typically occur at the end of the summer in September. The mean daily discharges during the year at several gages in the Chattahoochee River Basin are illustrated in Figure 2.1-11 through Figure 2.1-13.The reservoirs depicted on Figure 2.1-10 are discussed in detail in section 2.1.1.1.7.

2.1.1.1.5.2 Flint River

The Flint River originates just south of Atlanta and flows about 350 mi in a southerly direction, curving to the west to join the Chattahoochee River at Lake Seminole in the southwest corner of Georgia. The Flint River drainage basin has an average width of about 40 mi. The Flint River is generally fed by groundwater from its headwaters to its mouth. North of the Fall Line, the Flint River receives groundwater by diffuse leakage into the river bottom; south of the Fall Line, groundwater flow from springs becomes more prevalent (Torak 1996).

In the upper reach of the Flint River, above the Fall Line, the slope of the river averages about 2 ft/mi. For about 55 mi across the Fall Line, in the general vicinity of Thomaston, Georgia, the slope averages about 6.7 ft/mi. The lower portion of the Flint River has an average slope of about 1.0 ft/mi (see Figure 2.1-10).

Three tributaries of the lower Flint River have drainage areas of considerable size: Spring Creek (710 sq mi), Ichawaynochaway Creek (1,080 sq mi), and Muckafoonee Creek (1,000 sq mi). There are only two limited-storage-capacity reservoirs on the Flint River (i.e., Lake Blackshear and Lake Worth), and they do not substantially modify the flow in the river. The remainder of the river is free-flowing until it empties into Lake Seminole near the confluence with the Chattahoochee River.

The capacity of the Flint River within its banks ranges from about 30,000 cfs near Montezuma to about 35,000 cfs near Bainbridge, in the headwaters of Lake Seminole. Historically, flows at the Albany gage, which is about midway between Lake Seminole and the Flint River's headwaters, have been as low as 327 cfs (in August 1930) and as high as 119,000 cfs (in July 1994 as a result of Tropical Storm Alberto) (USGS 2008).

Stream flows on the Flint River exhibit a more natural pattern than those on the Chattahoochee River because of the lack of regulation on the Flint. There also is a substantial groundwater-to-surface water transfer in the lower portions of the Flint River, which helps to sustain higher winter flows in the river. Figure 2.1-14 through Figure 2.1-16 depict mean daily discharges throughout the year at several gages on the Flint River.

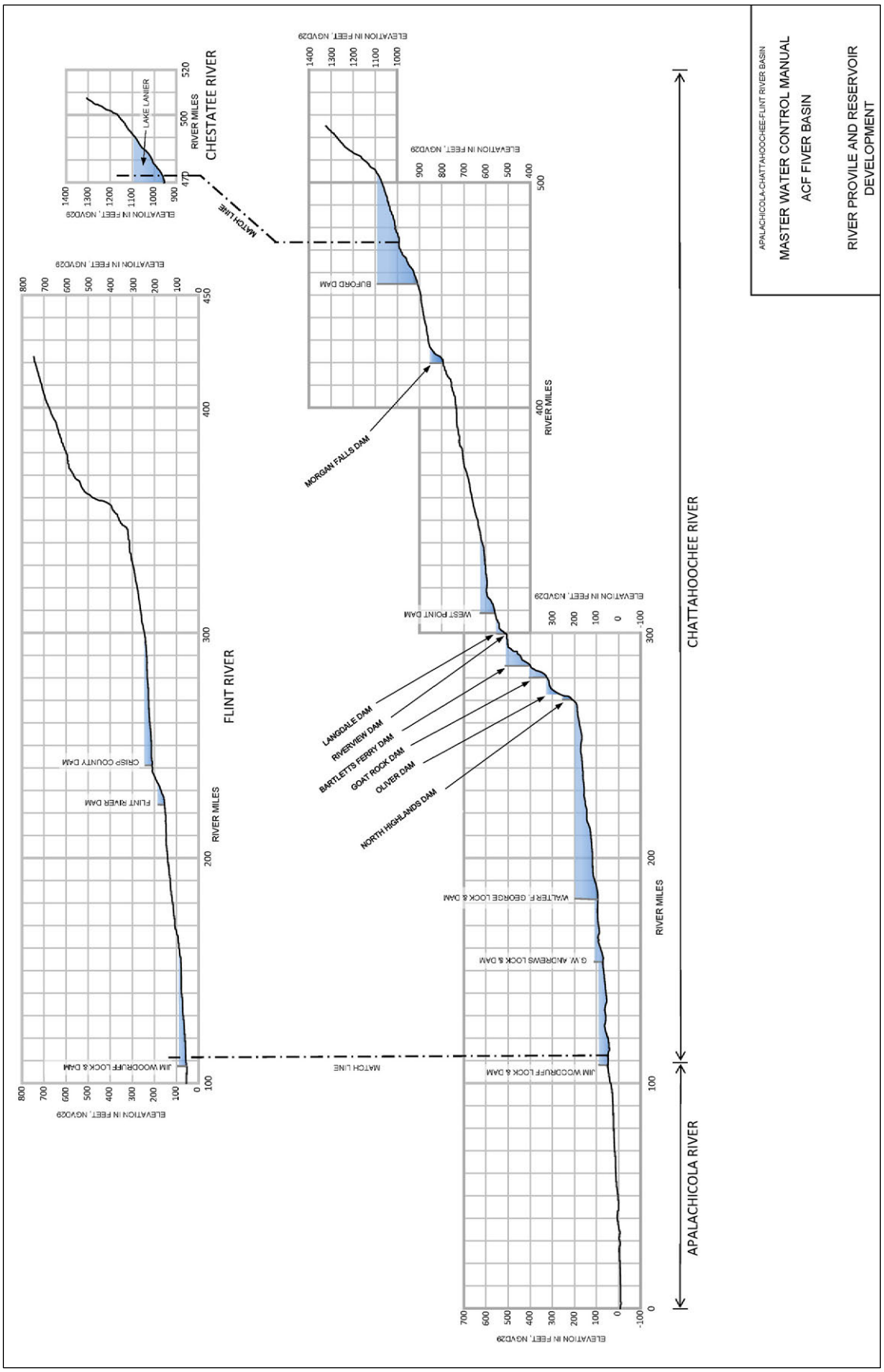


Figure 2.1-10. Apalachicola-Chattahoochee-Flint River Basin Profile Map

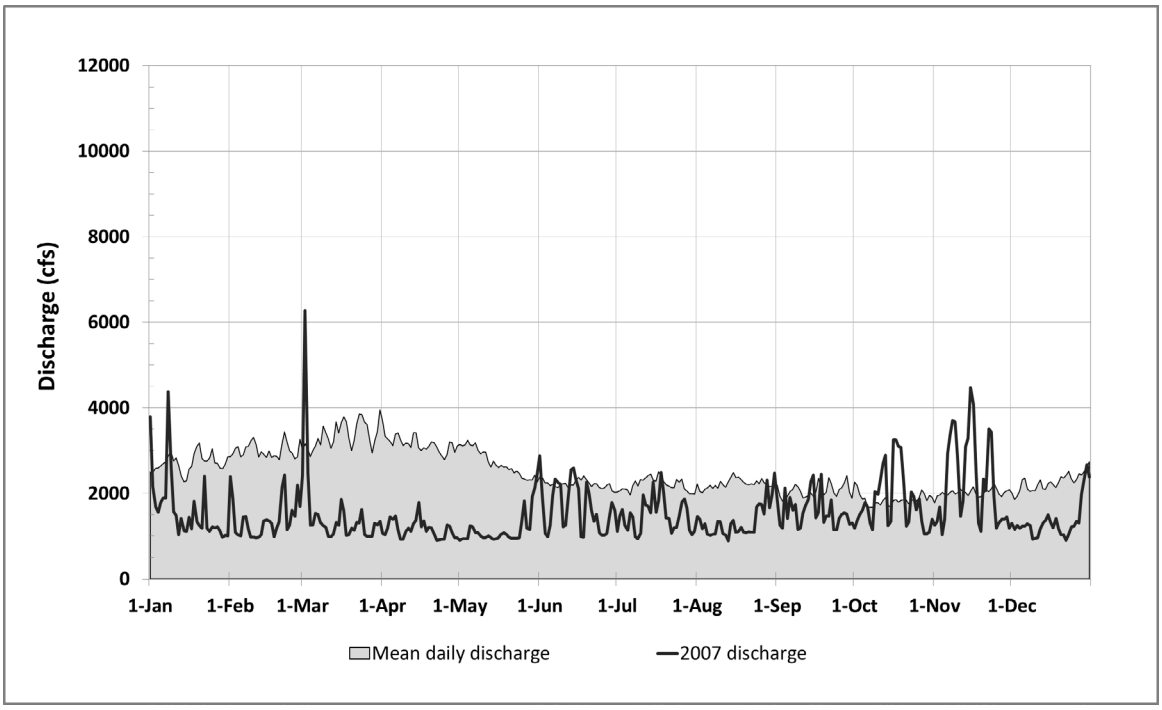


Figure 2.1-11. Chattahoochee River Discharge at USGS Gage 02336000 at Atlanta, Georgia (1928–2013)

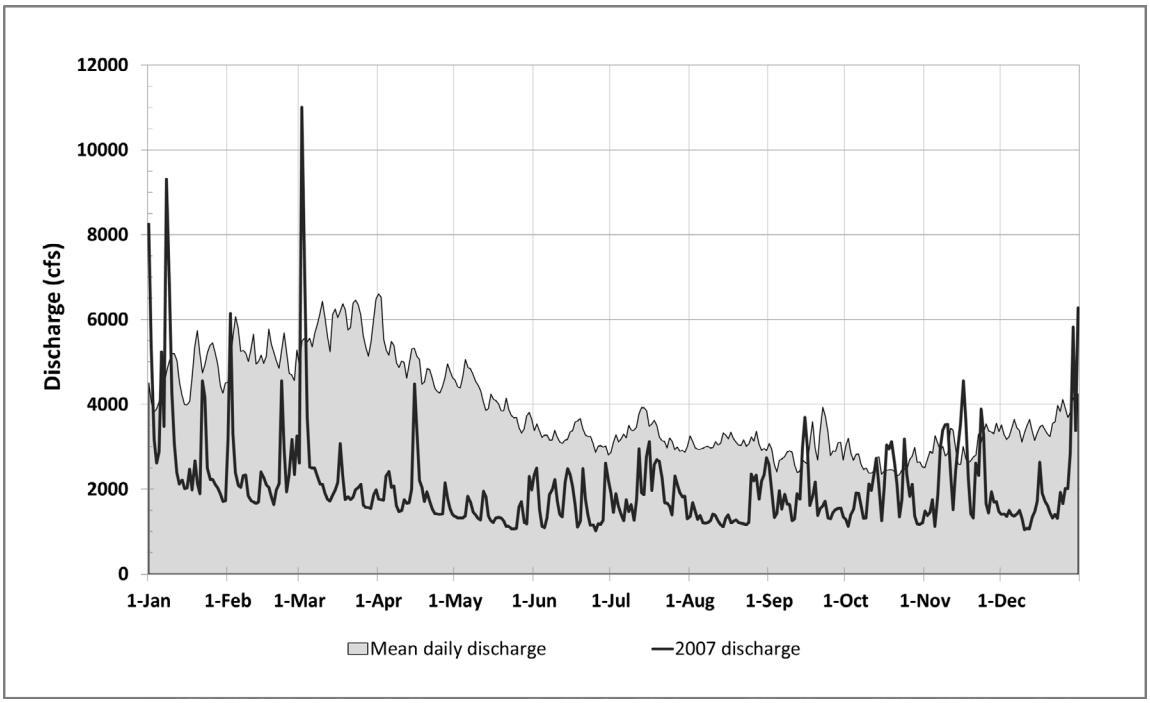


Figure 2.1-12. Chattahoochee River Discharge at USGS Gage 02338000 at Whitesburg, Georgia (1938–2013)

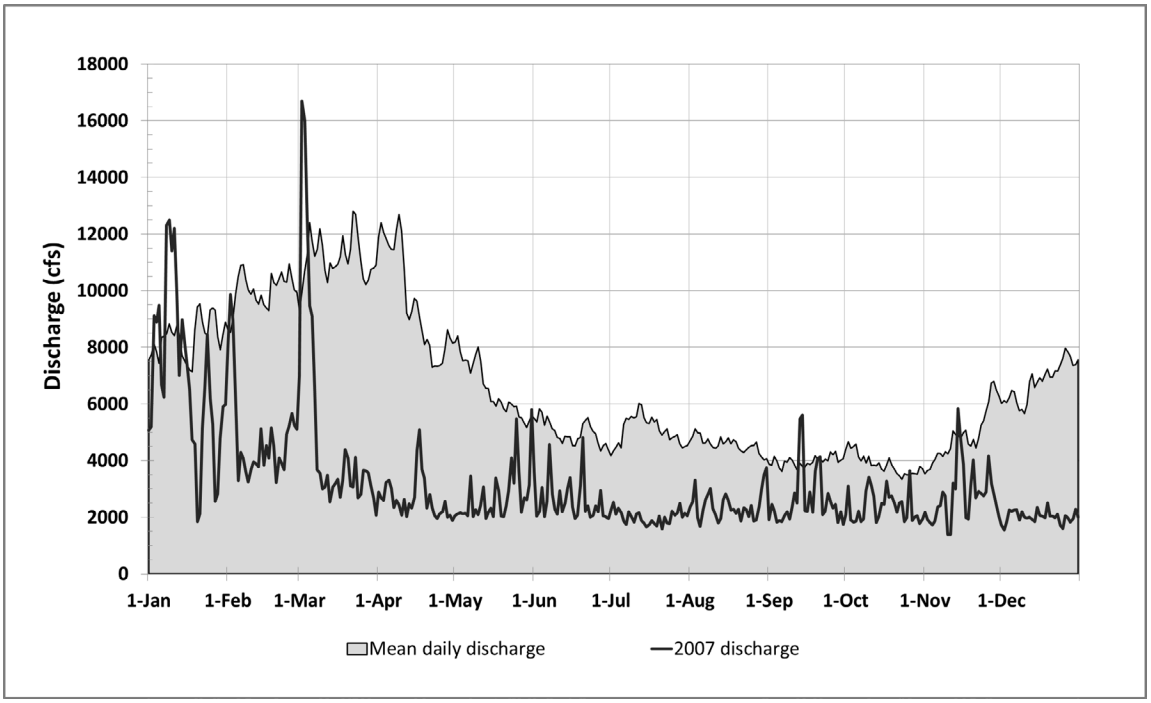


Figure 2.1-13. Chattahoochee River Discharge at USGS Gage 02341505 at Columbus, Georgia (1929–2013)

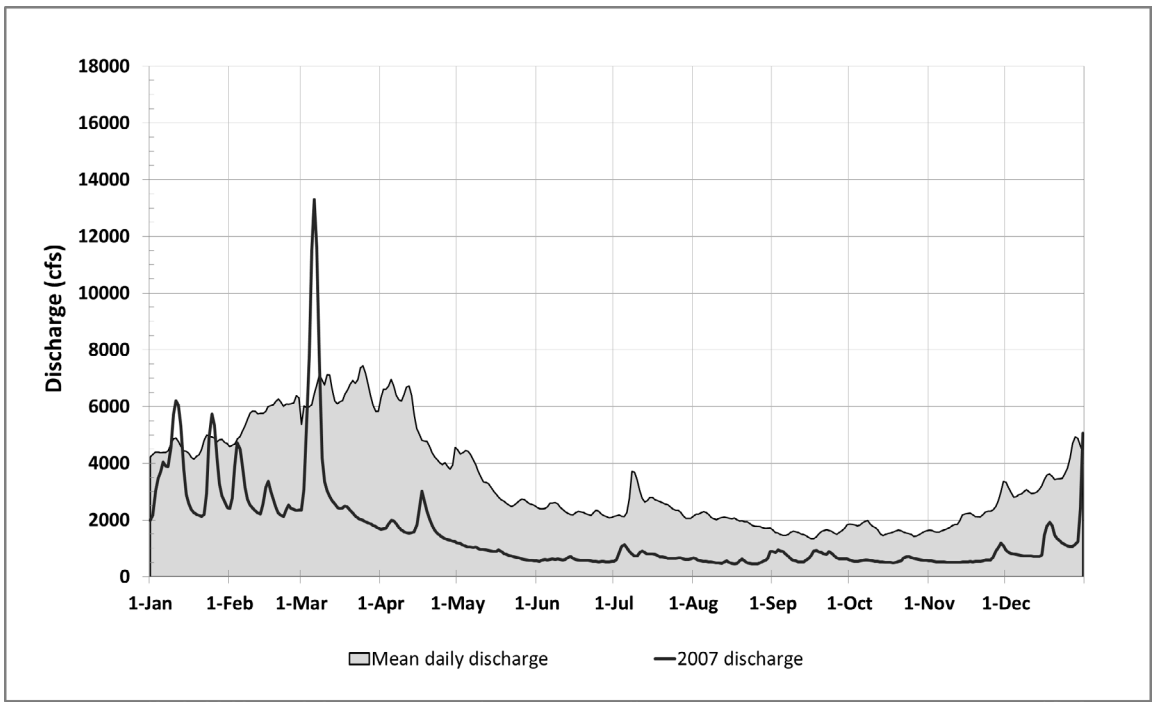


Figure 2.1-14. Flint River Discharge at USGS Gage 02349605 at Montezuma, Georgia (1904–2013)

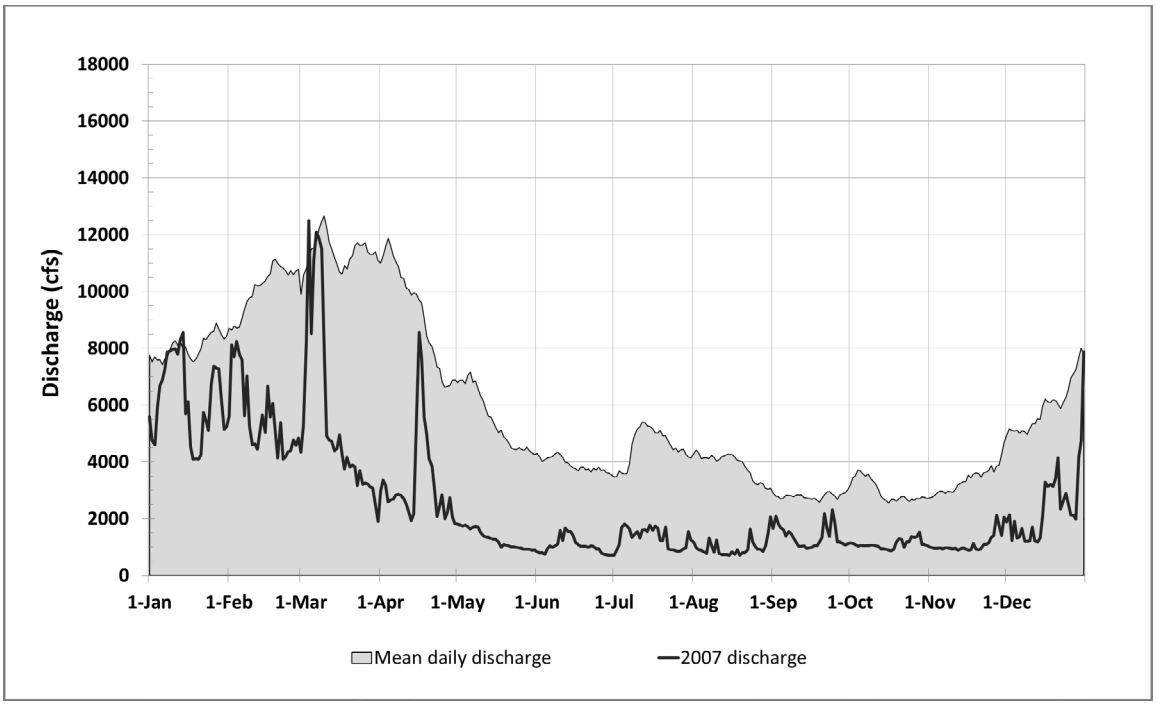


Figure 2.1-15. Flint River Discharge at USGS Gage 02352500 at Albany, Georgia (1901–2013)

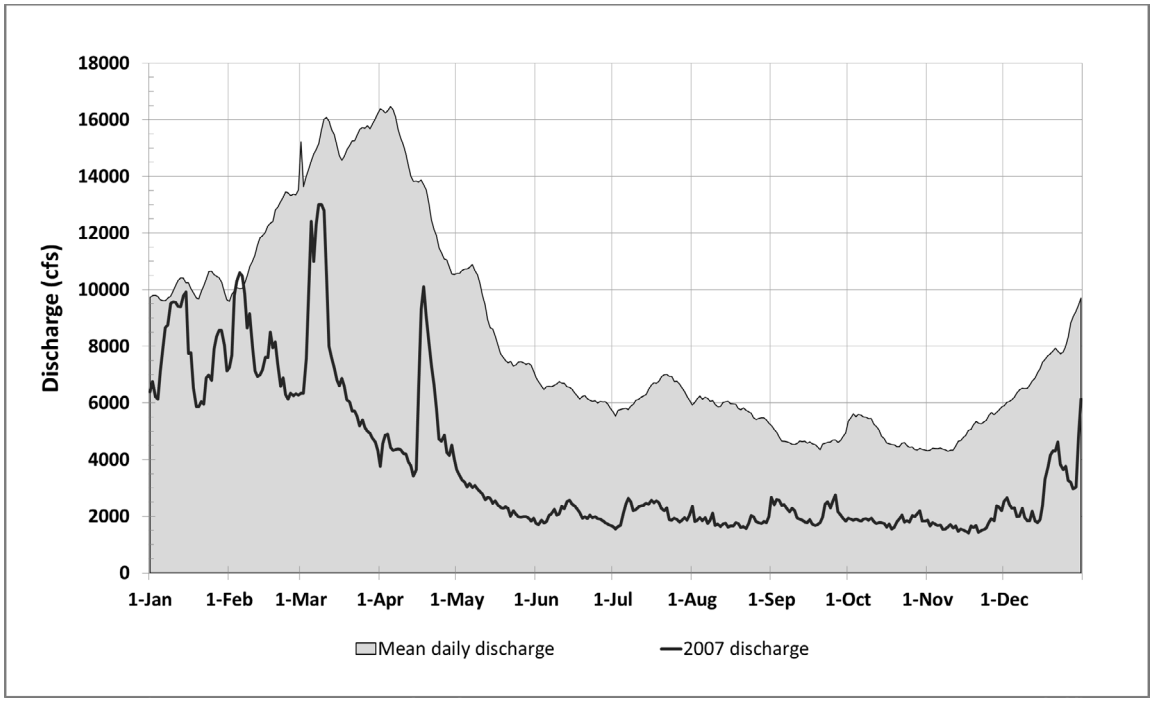


Figure 2.1-16. Flint River Discharge at USGS Gage 02356000 at Bainbridge, Georgia (1907–2013)

2.1.1.1.5.3 Apalachicola River

The Flint and Chattahoochee rivers converge at Lake Seminole, which is formed by the Jim Woodruff Lock and Dam. The Apalachicola River flows unimpeded for approximately 106 mi from the dam near the Florida-Georgia state line to the Gulf of Mexico at Apalachicola Bay, a major fishery resource for oysters, shrimp, and finfish. The river drains about 2,409 sq mi, and its shallow estuary covers about 208 sq mi. Tides in the Gulf of Mexico influence the Apalachicola River over approximately the lower 25 mi of the river. The tides have a mean range of 2 ft. The width of the river ranges from several hundred feet when confined to its banks to nearly 4.5 mi during flood flows. The discharge of the Apalachicola River accounts for 35 percent of the freshwater flow on the western coast of Florida (USGS 1996). The slope of the Apalachicola River is fairly flat at 0.5 to 0.7 ft/mi over its entire length (see Figure 2.1-10).

The Chipola River is the only sizable tributary to the Apalachicola River besides the Flint and Chattahoochee rivers. The Chipola River Basin drains 1,270 sq mi, which accounts for about one-half of the Apalachicola River's drainage area in Florida. The Chipola River is a spring-fed river with baseflow derived principally from aquifers (Frick et al. 1996).

The capacity of the Apalachicola River within its banks is approximately 100,000 cfs at Chattahoochee, Florida. Historically, flows at the Chattahoochee gage ranged from a low of 3,900 cfs (during the 1986 to 1987 drought period) to a peak of 291,000 cfs in 1929 before many of the upstream reservoirs were built (USGS 2009). More recently, flows have been as high as 203,000 cfs in July 1994 after Tropical Storm Alberto brought heavy rains to Georgia.

Mean daily discharge at two gages (Chattahoochee and Blountstown, Florida) are illustrated in Figure 2.1-17 and Figure 2.1-18. Similar to the pattern exhibited by the Chattahoochee and Flint rivers, flows on the Apalachicola River are highest in spring and lowest in late summer. The large seasonal fluctuation in flow in the Apalachicola River is important to the ecological function of the river and its estuary (USGS 1996).

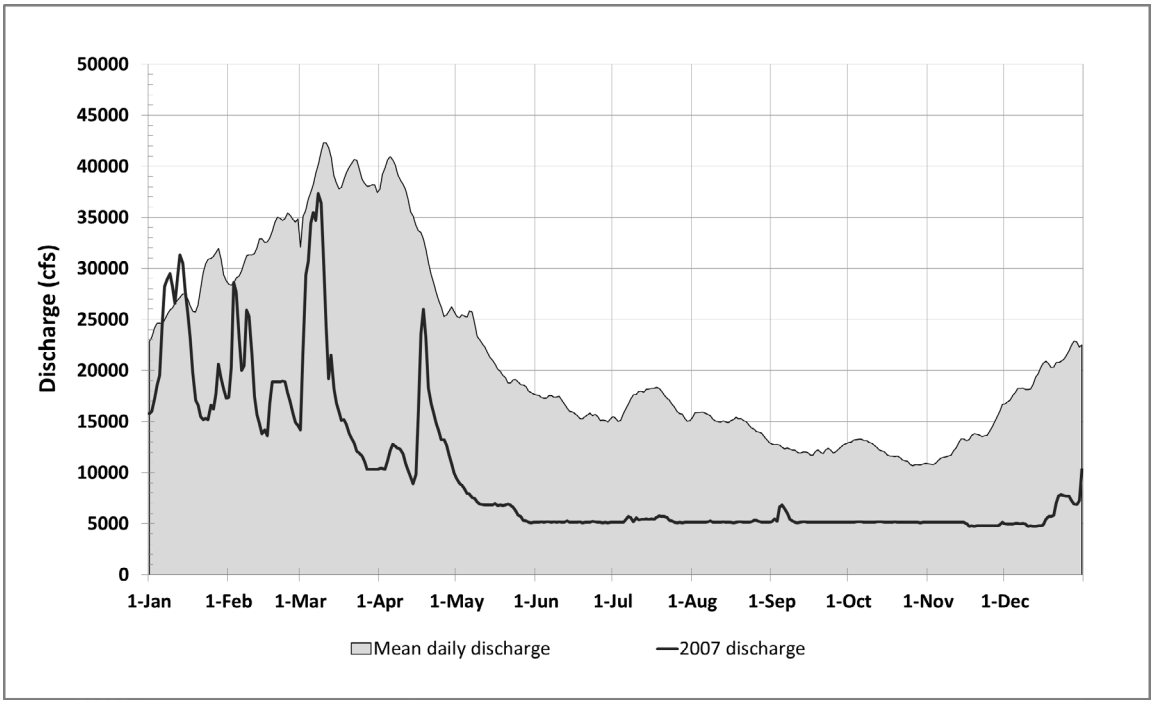


Figure 2.1-17. Apalachicola River Discharge at USGS Gage 02358000 at Chattahoochee, Florida (1922–2013)

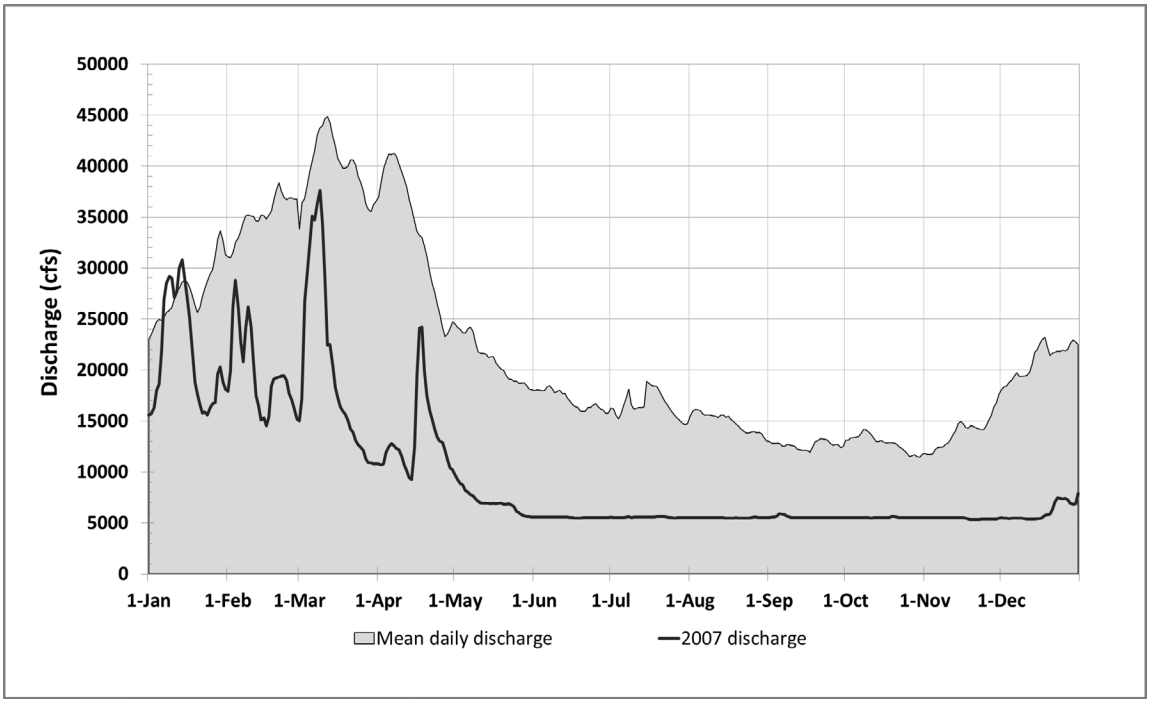


Figure 2.1-18. Apalachicola River Discharge at USGS Gage 02358700 at Blountstown, Florida (1957–2011)

2.1.1.1.6 Surface Water: Reservoirs

The history of dam construction on the Chattahoochee River dates back to the early 1800s. Projects on the river at and above Columbus, Georgia, were built to take advantage of the natural stream gradients for power production. Federal interest in the ACF Basin also dates back to the 1800s. Navigation improvements were authorized under the River and Harbor Act of 1874. Later, flood control and hydroelectric power generation interests were addressed. The River and Harbor Acts of 1945 and 1946 provided for the construction of a series of locks, dams, and reservoirs within the ACF Basin by USACE as part of a general plan to provide systemwide benefits for multiple purposes including navigation, flood control (flood risk management), hydropower generation, water supply, water quality, recreation, and fish and wildlife conservation. Modifications of this plan resulted in the completion of five USACE dams—four on the Chattahoochee River and one at the confluence of the Chattahoochee and Flint rivers. Operations of the ACF system and of the individual projects within it are governed by the original authorizing legislation, as amended, and by other general authorities and applicable law.

There are 14 reservoirs on the mainstems of the ACF Rivers: five are federally owned (USACE) projects and nine are privately owned projects. Of the 14 reservoirs, 11 are on the Chattahoochee River, two are on the Flint River, and one is on the Apalachicola River. Figure 1.1-1 shows the location of mainstem dams and power-generating plants in the basin. The reservoirs are also depicted on the profiles of the mainstem rivers in the ACF Basin (Figure 2.1-10). The 14 projects and their key characteristics are listed in Table 2.1-3. A description of each USACE and non-USACE dam (presented in order from upstream to downstream) follows the table.

Table 2.1-3.
Reservoirs on Mainstem ACF Basin Rivers

Basin/river/project name	Owner/state/ year initially completed	Drainage area (sq mi)	Reservoir size (ac)	Total storage (ac-ft)[a]	Conservation storage (summer elev) (ac-ft)	Power capacity (kW)	Normal (summer) lake elev (ft)	Authorized purposes for USACE-owned projects[b]
Chattahoochee River		*8,708*						
Buford Dam/Lake Lanier	USACE/GA/1957	1,034	38,542	2,554,000	1,087,600	127,000	1,071	FRM, HP, NAV, FW, REC, WQ, WS[c]
Morgan Falls Dam/Bull Sluice Lake	GPC/GA/1903	1,360	580	2,450	0	16,800	866	
West Point Dam and Lake	USACE/GA/1975	3,440	25,864	774,798	306,131	87,000	635	FRM, HP, NAV, FW, REC, WQ
Langdale Dam and Lake	GPC/GA/1860	3,640	152	NA[d]	0	1,040	547.7	
Riverview Dam and Lake	GPC/GA/1902	3,661	75	NA[d]	0	480	530.5	
Bartletts Ferry Dam/Lake Harding	GPC/GA/1926	4,240	5,850	181,000	0	173,000	521	
Goat Rock Dam and Lake	GPC/GA/1912	4,510	1,050	11,000	0	38,600	404	
Oliver Dam/Lake Oliver	GPC/GA/1959	4,630	2,150	32,000	0	60,000	337	
North Highlands Dam and Lake	GPC/GA/1900	4,630	131	1,500	0	29,600	269	
Walter F. George Lock, Dam, and Lake	USACE/GA/1963	7,460	45,181	934,400	244,400	168,000	190	HP, NAV, FW, REC, WQ
George W. Andrews Lock, Dam, and Lake	USACE/GA/1963	8,210	1,540	18,180	0	None	102`	NAV, FW, REC, WQ
Flint River		*8,456*						
Warwick Dam/Lake Blackshear	Crisp Co./ GA/1930	3,770	8,700	144,000	0	15,200	237	
Flint River Dam/Lake Worth	GPC/GA/1920	5,290	1,400	NA[d]	0	5,400	182.3	
Apalachicola River		*2,409*	*(Total ACF Basin – 19,573 sq mi)*					
Jim Woodruff Lock and Dam/Lake Seminole	USACE/FL/1954	17,164	37,500	367,318	0	43,350	77	HP, NAV, FW, REC, WQ

Notes:

[a.] Measured at top of storage for flood risk management.

[b.] As used in this table, the term "authorized purposes" includes purposes expressly identified in the project authorizing documents; incidental benefits recognized in projection authorizations; and objectives that result from other authorities, such as general authorities contained in congressional legislation, for which USACE operates each listed project as of 2009. FRM = flood risk management; HP = hydroelectric power generation; NAV = navigation; FW = fish and wildlife conservation; REC = recreation; WQ = water quality; WS = municipal & industrial water supply.

[c.] USACE operates Buford Dam/Lake Lanier project in a manner that accommodates water supply withdrawals from Lake Lanier and from the Chattahoochee River downstream of Buford Dam.

[d.] NA = not available.

Most of the USACE and non-USACE dams in the ACF Basin have hydroelectric power generating capability. Hydroelectric power generation dams convert the force of falling water into electrical power. Although not the primary source of energy in the U.S., hydroelectric power generation is still an important source of electricity because it can be started quickly to meet immediate needs and is both a renewable and clean source of energy. Much of the hydroelectric power generation in the ACF Basin is *peaking* power; that is, the generators are turned on when there is the most, or *peak,* demand for power. Air-conditioning and heating are the power uses that often cause the peak demand for power, so the hydroelectric power generation releases are usually made when temperatures are extreme.

USACE operates five dams in the ACF Basin (in upstream to downstream order): Buford, West Point, Walter F. George (George), and George W. Andrews (Andrews) on the mainstem of the Chattahoochee River, and Jim Woodruff (Woodruff), immediately below the confluence of the Chattahoochee and Flint rivers at the upstream extent of the Apalachicola River. Buford Dam, West Point Dam, and Walter F. George Lock and Dam are reservoirs (Lake Lanier, West Point Lake, and Walter F. George Lake, respectively) with a combined conservation storage capacity (relative to the top of each reservoir's full summer pool) of about 1.64 million acre-feet (ac-ft). Jim Woodruff Lock and Dam (Lake Seminole) is operated as a run-of-river project and only very limited pondage is available to support project purposes (USACE, Mobile District 1998a). Andrews is a lock and dam without any appreciable water storage behind it.

Each USACE multipurpose storage reservoir is typically subdivided into separate storage levels, as shown in Figure 2.1-19. The lowest level is the top of the *inactive pool*. No reservoir releases are made when the pool level is below this level. Level 2 is usually associated with the top of the *conservation pool*, or the guide curve elevation. A *guide curve* is the seasonally variable desired pool elevation in a reservoir to fully meet project purposes. *Conservation storage* is the level of the water stored in a reservoir that can be jointly used or released for all useful purposes, including hydroelectric power, recreation, fish and wildlife, municipal and industrial water supply, and water quality. The conservation pool, Level 2, can be subdivided into multiple *action zones*, which are discussed in more detail below. Each action zone triggers a different operating schedule. Level 3 is the top of the flood risk management pool. Typically, the area between the top of the conservation pool and flood risk management is active *flood storage*. Water is stored in this area when it cannot be safely passed through the downstream channel system. Usually, the top of the flood storage level is not the maximum level at which water can be stored. Typically, a reservoir with flood storage has *surcharge storage* to accommodate water above the emergency spillway. In surcharge storage, the outflow is determined by the spillway capacity and cannot be controlled by the operators.

Action zones have been defined for each of the major storage projects on the ACF Basin: Buford, West Point, and Walter F. George. "Action zones" are partitions of a reservoir's conservation storage, as defined in the reservoir water control plan, to guide reservoir managers in meeting project purposes during a wide variety of hydrologic conditions. Each action zone has a set of specific operational rules or guidelines that govern water management operations for the reservoir when the pool elevation is within that zone. For each of the three USACE storage projects, guide curves and action zones within the conservation pools are presented in the following sections. These sections also discuss these three projects in more detail. The action zones for these USACE projects were first outlined in the 1989 draft Master Manual. A more detailed discussion of action zone considerations relative to the USACE ACF Basin projects is presented in section 4.1.2.2.

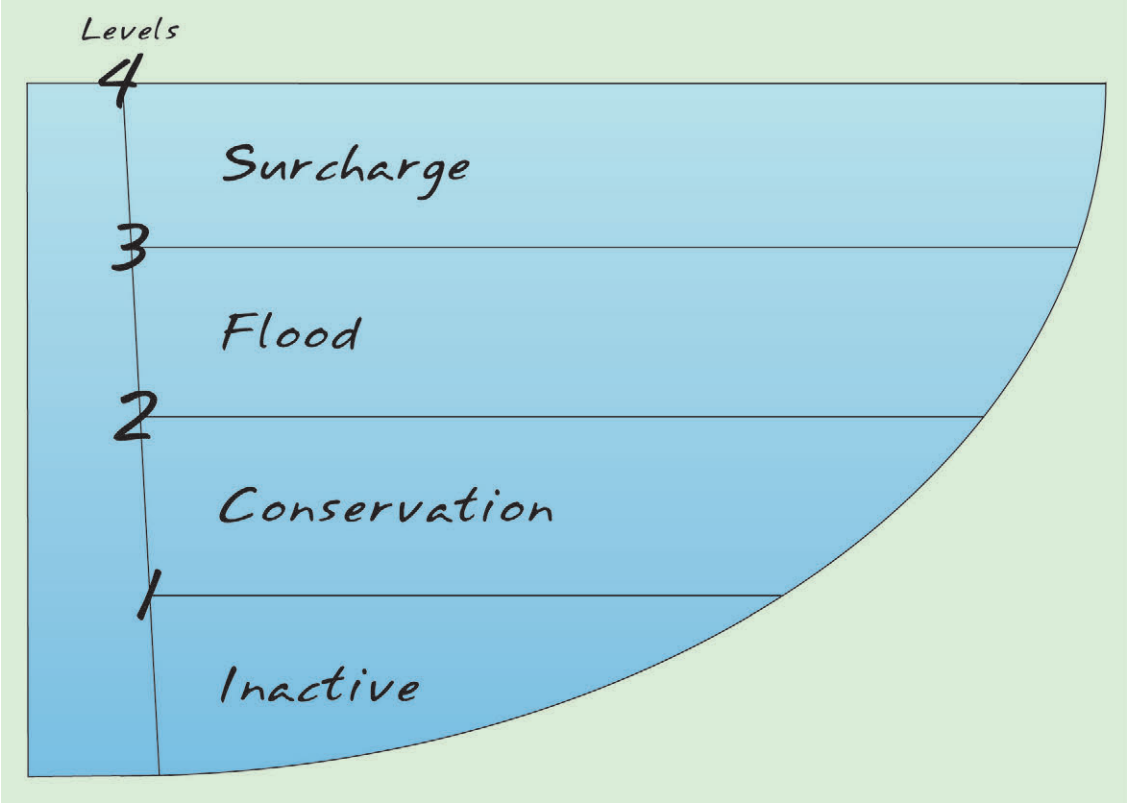
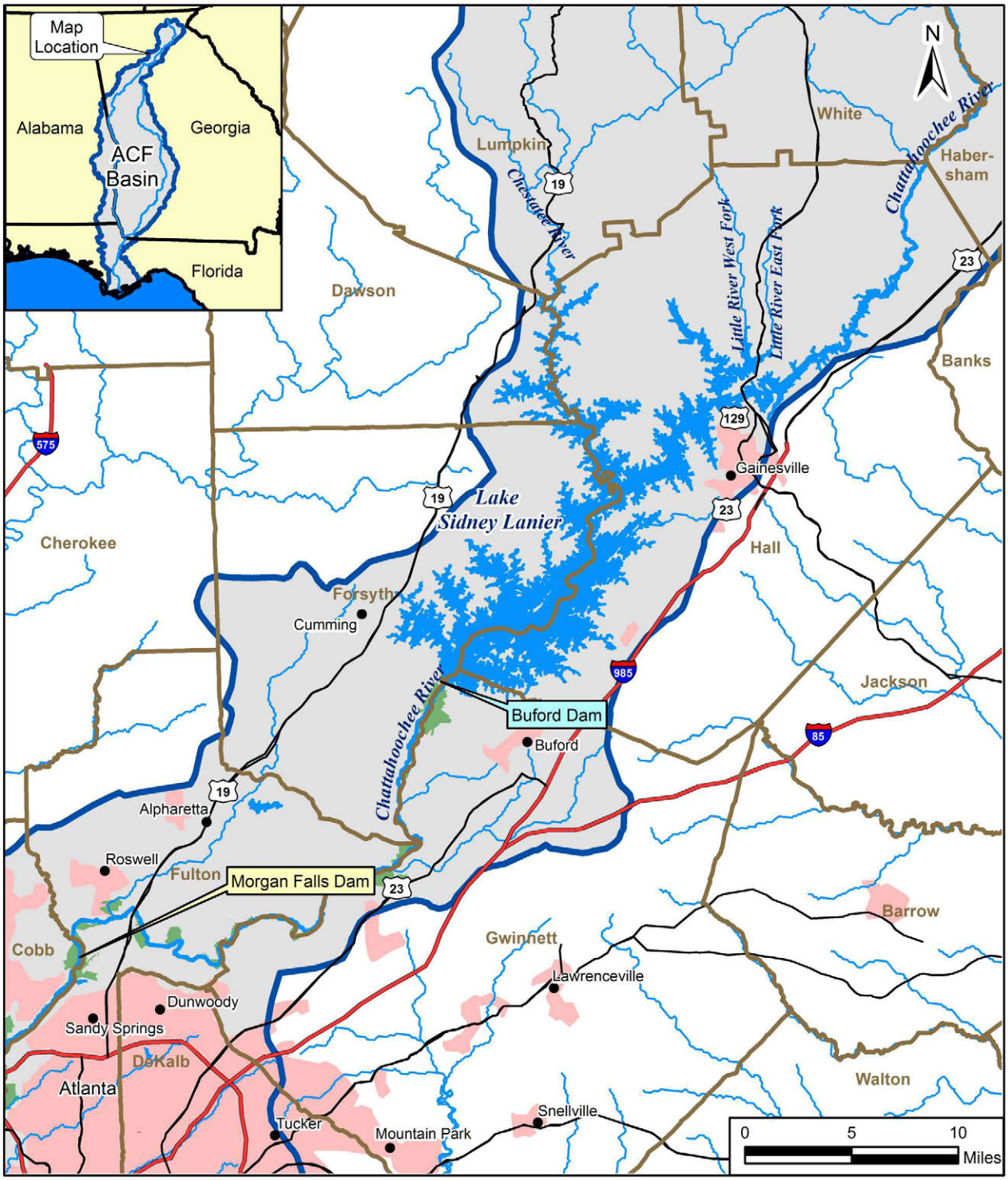


Figure 2.1-19. Schematic of Reservoir Storage

2.1.1.1.6.1 Lake Lanier and Buford Dam

Lake Lanier is formed by Buford Dam, which is about 48 mi northeast of Atlanta on the Chattahoochee River at river mile (RM) 348.3. Buford Dam is a USACE multipurpose project, originally authorized by the Rivers and Harbors Act of July 24, 1946, to be operated in conjunction with the other federal works of improvement in the ACF Basin for the authorized system purposes. Buford Dam is operated to provide benefits for authorized purposes including flood risk management, hydropower, navigation, water supply, recreation, water quality, and fish and wildlife conservation. Project purposes for Buford Dam and other USACE projects in the ACF Basin are discussed in more detail in section 2.1.1.2. Construction of the Buford Dam project was completed in 1957, and the reservoir reached full pool by 1959. The Chestatee and Chattahoochee rivers combine in the upper reservoir pool and comprise about 84 percent of the 1,034 sq mi of drainage area into the pool. The size of the reservoir is 38,542 ac at elevation 1,071 ft. The Buford Dam drainage area is located on the southern slope of the Blue Ridge Mountains and is characterized by the steep slopes of mountain streams. A general map depicting Lake Lanier and Buford Dam is provided as Figure 2.1-20. The authorized project provides for a rolled-earth dam 1,630 ft long with crest at elevation of 1,106 ft at National Geodetic Vertical Datum of 1929 (NGVD), or about 192 ft above streambed elevation; three earthen saddle dikes with a total length of 6,600 feet; a chute spillway with crest at elevation 1,085 ft; a powerhouse in a deep cut, with steel penstocks in tunnels and concrete intake structure at the upstream end of the tunnels; and a flood-control sluice tunnel paralleling the power tunnels.



Buford Dam/Lake Lanier

Figure 2.1-20

Lake Lanier has a storage capacity (at the top of the conservation pool - elevation 1,071 ft) of 1,955,200 ac-ft. Of that, 1,087,600 ac-ft is conservation storage and 867,600 ac-ft is inactive storage (Figure 2.1-21). The minimum conservation pool elevation is 1,035 ft, and the maximum conservation pool elevations are 1,071 ft in the summer and 1,070 ft in the winter. In addition, 598,800 ac-ft is reserved for flood storage between elevation 1,071 and 1,085 ft. The power installations consist of one 7-MW generating unit and two units of 60 MW each, for a total of 127 MW. The penstock capacity is 12,000 cfs. The project is typically operated for peaking power on a 5-day-a-week schedule, with occasional peaking on Saturday and Sunday. The number of hours of generation per day depends on the available storage, conditions in the basin, and electrical demand. The 7-MW unit runs continuously (at 600 cfs) to help meet downstream minimum flow requirements.

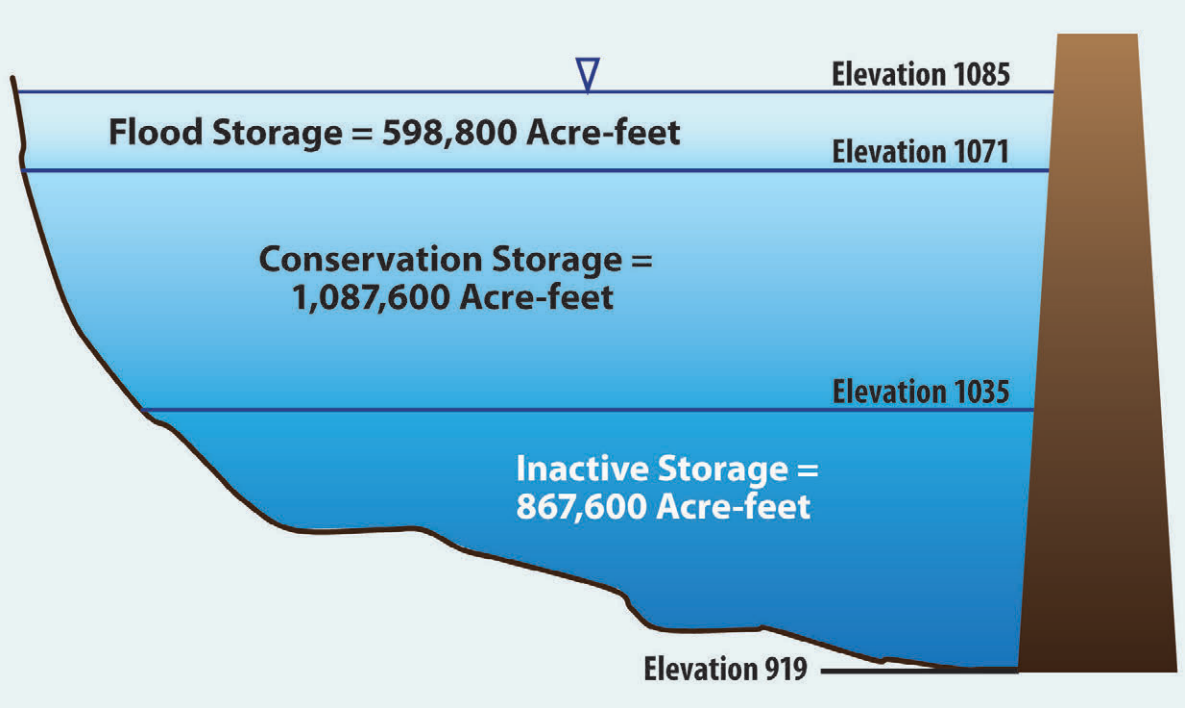


Figure 2.1-21. Storage at Lake Lanier

The reservoir has served as a primary water supply source and discharge location for several municipalities, including the cities of Cumming and Gainesville, and Gwinnett County. Lake Lanier waters are designated as *recreation* in Georgia Environmental Protection Division's (GAEPD's) water quality classification system. It has the highest annual recreational visitation of all the USACE lakes in the ACF Basin—more than 7.5 million visitors per year (USACE 2010b)—and its shoreline is highly developed.

The Lake Lanier guide curve (Figure 2.1-22) establishes the top of the conservation pool at elevation 1,071 ft during the late spring and summer months (May through September) and 1,070 ft during the remainder of the year. However, the lake level can fluctuate significantly from the guide curve over time, dependent primarily upon basin inflows but also influenced by project operations, evaporation, withdrawals, and return flows. The record high elevation for the reservoir under flood conditions was elevation 1,077.2 ft (April 1964) and the lowest level was 1,050.8 ft, experienced in December 2007 under extreme drought conditions. Under dry conditions when basin inflows are reduced, project operations are adjusted to conserve storage in Lake Lanier while continuing to meet project purposes in accordance with four action zones as shown on Figure 2.1-22 and as discussed in sections 2.1.1.2.2 and 5.2.2.

In 2004, rehabilitation of the three hydroelectric power generation units was completed. The goal of the project was to restore lost reliability and efficiency to the plant. Consideration was also given to improving water quality discharged from the dam. Several techniques were considered to increase low dissolved oxygen waters being discharged from Buford Dam. Ultimately, all the units have vents for air entrainment into water being released. Because of the peaking power operations, downstream releases and tailwater elevations can vary substantially over a 24-hour period. Figure 2.1-23 depicts a typical weekly pattern of flows immediately downstream of the project. During peak hydroelectric power generation periods, stages increase by about 3.5 to 5 ft immediately below the dam, over river levels during off-peak periods.

The 13.25-ft-diameter flood control sluice outlet is at the base of Buford Dam. The invert elevation of the sluice is 919 ft. The discharge capacity of the sluice (at pool elevation 1,070 ft) is 11,030 cfs. The total reservoir outflow capacity (spillway design capacity) under flood operations is 40,400 cfs at pool elevation 1,100 ft, which would be 15 ft above the emergency spillway crest elevation of 1,085 ft.

In the original design for Buford Dam, it was determined that the Standard Project Flood would be contained within the allocated flood pool (i.e., the pool elevation would not exceed elevation 1,085 ft). Subsequent revisions in computing the Standard Project Flood indicate that the pool would peak at elevation 1,086.78 ft, or 1.78 ft over the fixed emergency spillway. If a flood near that magnitude or larger occurred and the pool rose above the top of the flood pool (elevation 1,085 ft), the power plant and the flood control sluice would begin operating at full capacity as soon as flow over the spillway became imminent. When the dam was designed, reservoir operation for the spillway design flood assumed the power plant to be inoperative, with discharge over the spillway and through the sluice only. In actual operation, turbine discharge would supplement the spillway and sluice discharge. Any discharges that exceed downstream channel capacity would cause flooding, and affected parties would be notified accordingly. At pool elevations below 1,085 ft and as inflows fall to an amount equivalent to the downstream channel capacity, the combined releases through the sluice and turbines would be reduced to the downstream channel capacity. As long as flood waters are in storage above elevation 1,070 ft, continued emphasis would be placed on rapidly evacuating that flood storage.

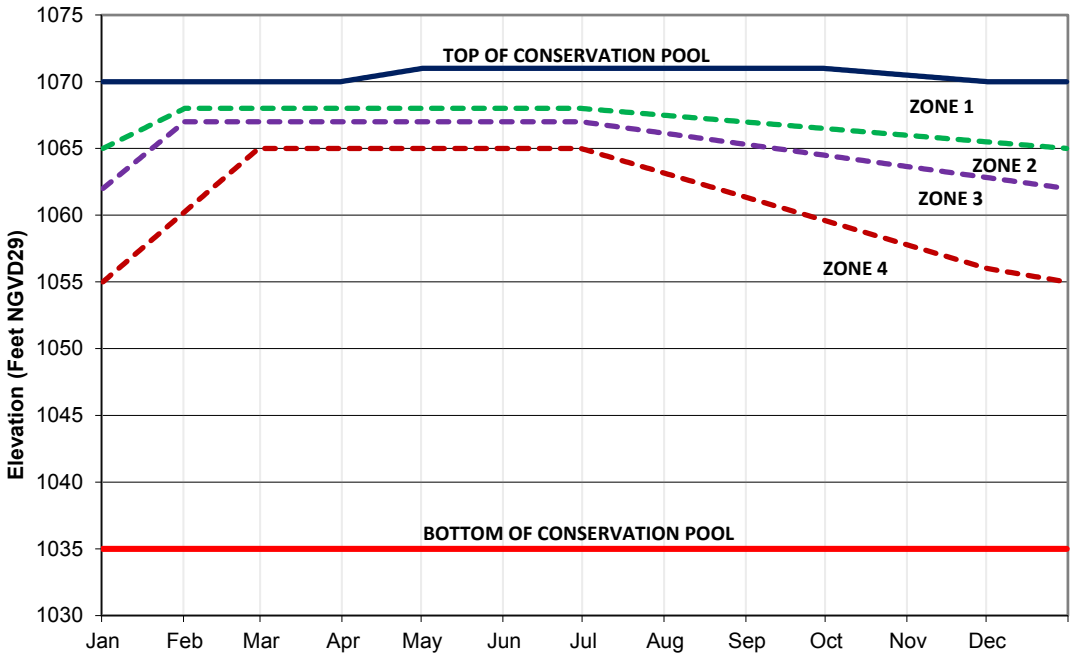


Figure 2.1-22. Lake Lanier/Buford Dam Water Control Action Zones

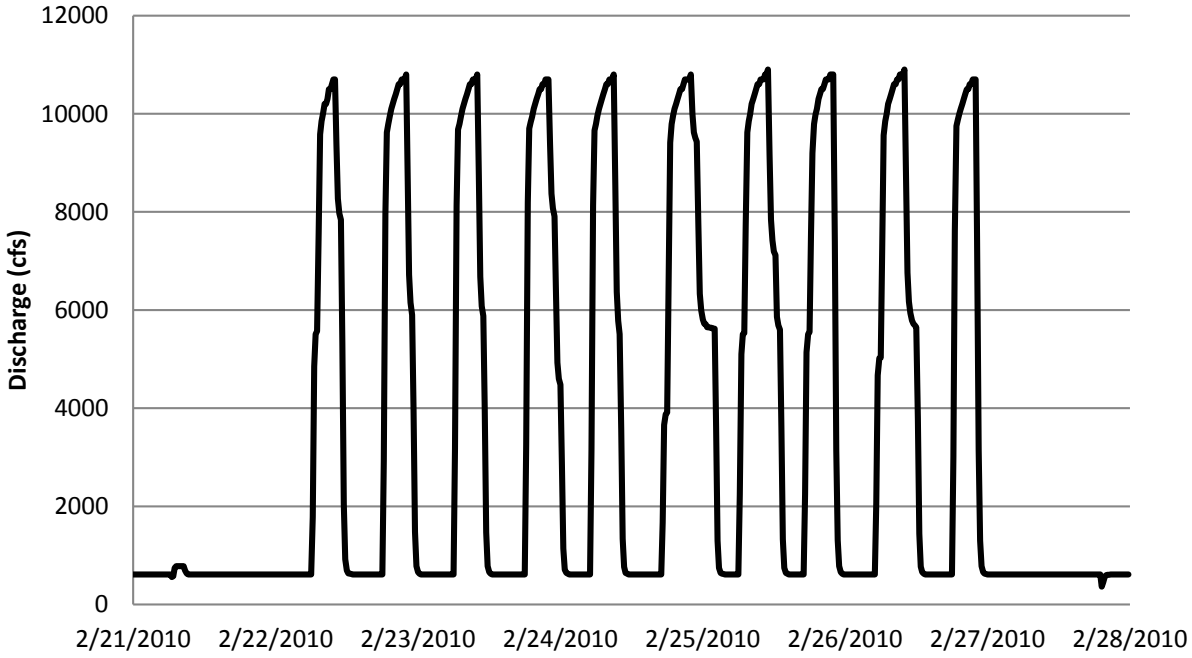


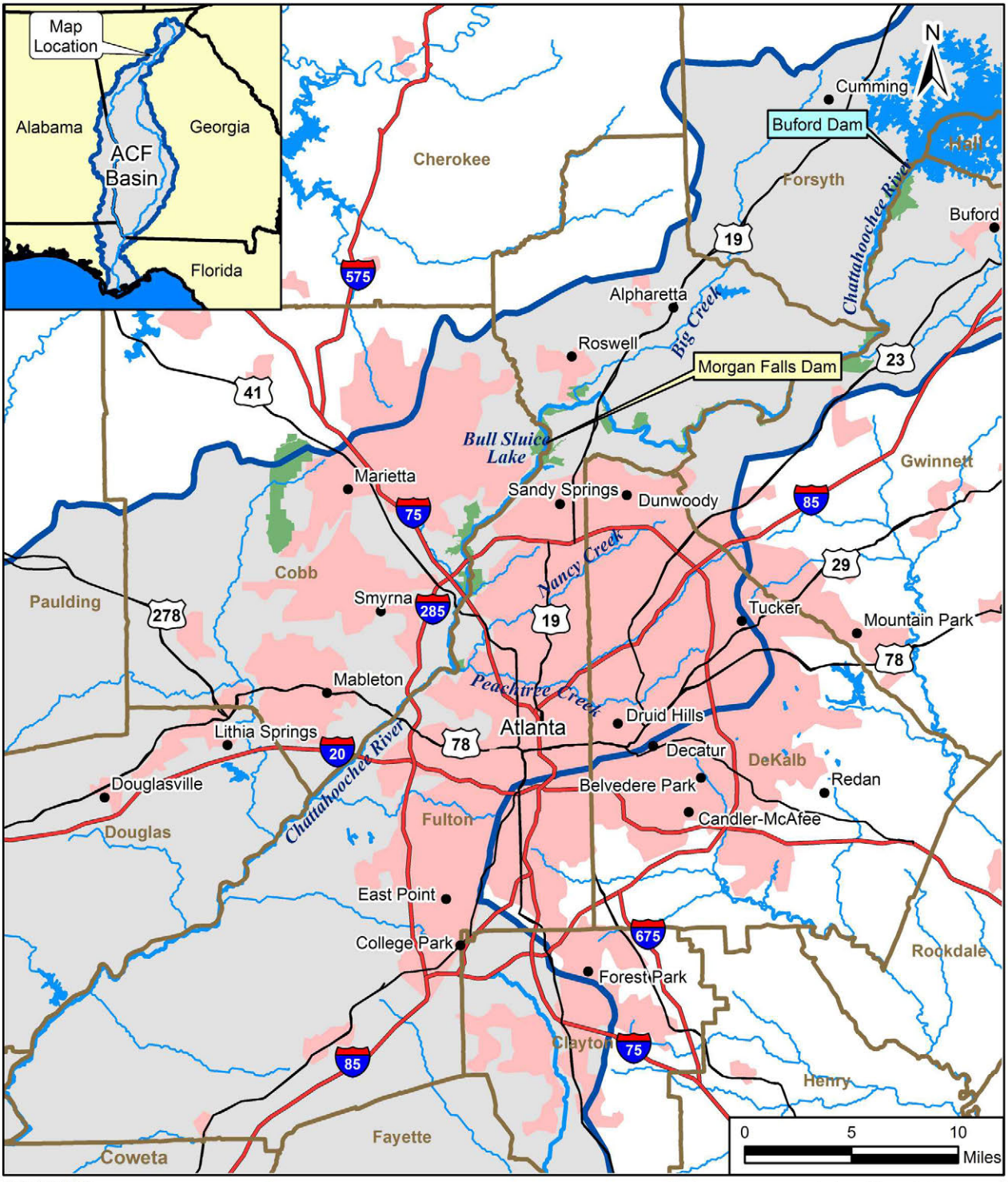
Figure 2.1-23. Chattahoochee River Discharge at USGS Gage 02334430 at Buford, Georgia, Directly Downstream of Buford Dam/Lake Lanier

Minimum flow requirements from Buford Dam have evolved over the period since project completion. The current plan, referred to as the *Interim Modified Plan*, was developed in 1986 and is described in more detail in section 2.1.1.2.4.6. It established the Chattahoochee River Management System (CRMS) under which USACE, when possible and practical, endeavors to make releases specifically required for water supply and to maintain the 750 cfs minimum in-stream flow at Peachtree Creek after accounting for water supply withdrawals at Atlanta. GPC agreed to continue to use Morgan Falls Dam (Bull Sluice Lake), about 30 miles downstream of Buford Dam, to reregulate Buford Dam releases to help meet that target. Pursuant to the CRMS, to ensure minimum downstream flows when accounting for water supply withdrawals downstream of Buford Dam, USACE has made releases of greater than 600 cfs through the large generating units, including on weekends, which are generally considered to be off-peak for hydroelectric power.

In addition, between 1973 and 1989, USACE entered into agreements according to which water supply providers made direct withdrawals from Lake Lanier. Although those contracts (apart from two relocation agreements entered into with the cities of Buford and Gainesville as compensation for relocation of existing facilities incidental to the construction of Buford Dam) expired in 1990, withdrawals have continued since then. These agreements are described in more detail in section 3.3.3.

2.1.1.1.6.2 Bull Sluice Lake and Morgan Falls Dam

Morgan Falls Dam impounds Bull Sluice Lake and is located on the Chattahoochee River 30 miles below Buford Dam at river mile (RM) 315. A general map depicting Morgan Falls Dam is provided as Figure 2.1-24. The dam impounds a 7-mile reservoir that has a surface area of 580 ac at elevation 866 ft. The total reservoir storage volume is about 2,450 ac-ft, of which about 2,250 ac-ft is usable. The maximum generating capacity of the project is 16.8 MW. The dam was constructed in 1904 and has since experienced a significant amount of sediment deposition. This sedimentation has created broad and shallow pools and wetlands, which are attractive for recreation and fishing in the lake. The reservoir has low flow velocities, moderate algal productivity, and dispersed aquatic vegetation.



Morgan Falls Dam/ Bull Sluice Lake

Figure 2.1-24

GPC operates the Morgan Falls project as a modified run-of-river project to reregulate peaking flows from the USACE upstream Buford Dam for power generation, drinking water supply, and assimilation of treated wastewater in Metro Atlanta. The project currently operates under FERC License No. P-2237, issued on May 22, 2008 (FERC 2014b). Operations at Morgan Falls Dam are an integral part of the CRMS. Reregulation of Buford Dam releases at Morgan Falls Dam are necessary to meet the minimum continuous flow target at Peachtree Creek for water quality purposes. Figure 2.1-25 depicts a typical weekly pattern of flows about 12 miles downstream of the Morgan Falls project at Peachtree Creek. The effects of the reregulation of river flows at Morgan Falls Dam are apparent when compared to discharge patterns from Buford Dam for the same time period (Figure 2.1-23).

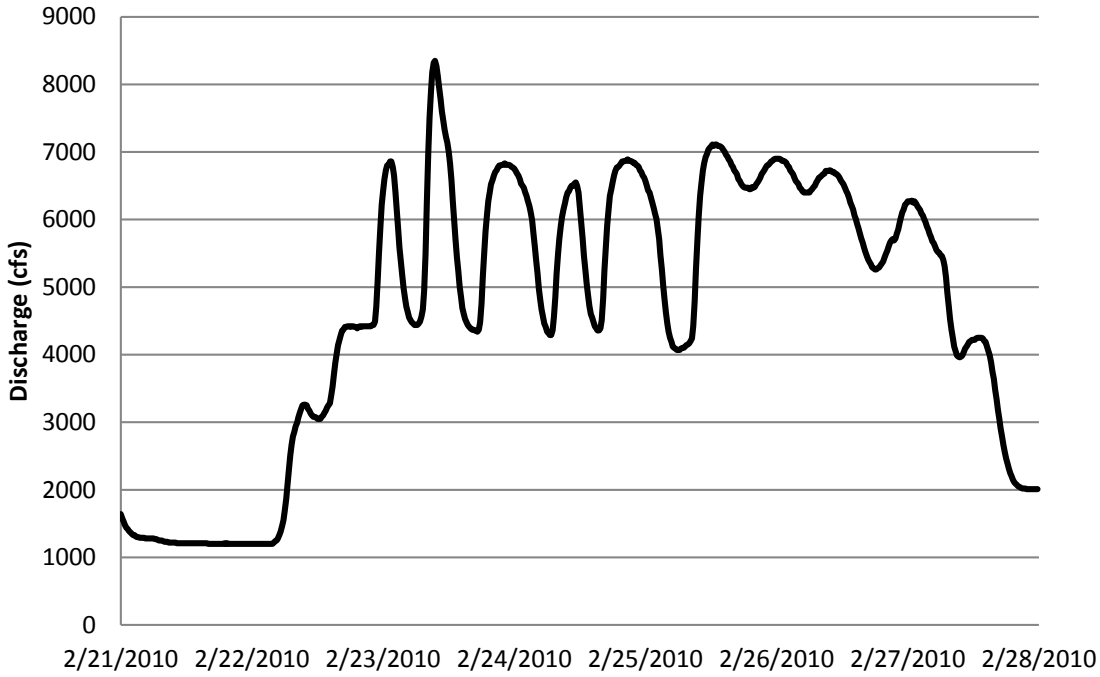
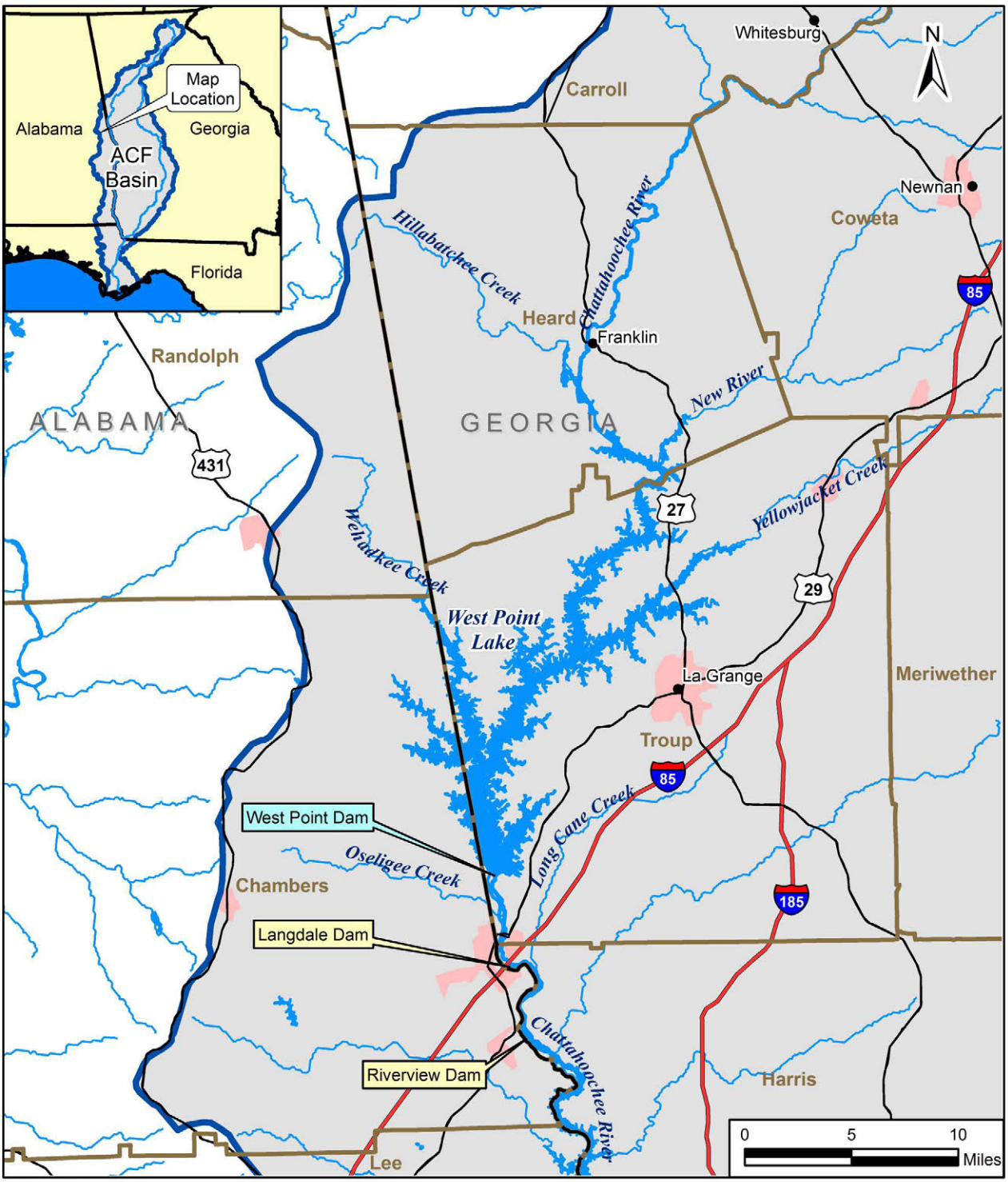


Figure 2.1-25. Chattahoochee River Discharge at USGS Gage 02336000 at Atlanta, Georgia

2.1.1.1.6.3 West Point Dam and Lake

West Point Dam and Lake is a USACE multipurpose project on the Alabama-Georgia state line near West Point, Georgia, at Chattahoochee RM 201.4. The headwaters of West Point Lake are about 120 mi downstream from Morgan Falls Dam, and the Chattahoochee River is free flowing across that distance. The drainage area above the dam is 3,440 sq mi, and the size of the reservoir is 25,864 ac. The project was completed in 1975. A general map depicting West Point Dam and Lake is provided as Figure 2.1-26. The West Point Dam and Lake is a multiple-purpose project, originally authorized by the Flood Control Act of October 23, 1962, to be operated in conjunction with the other federal works of improvement in the ACF basin for the authorized system purposes. West Point Dam is operated to provide benefits for authorized purposes including flood risk management, hydropower, navigation, recreation, fish and wildlife conservation, and water quality. In addition, the city of LaGrange, Georgia, makes water supply withdrawals directly from the reservoir pursuant to relocation agreements entered into at the time of construction of the West Point project.



West Point Dam and Lake

Figure 2.1-26

The authorized project provides for a gravity-type concrete dam 896 ft long with earthen embankments at either end 1,111 ft long on the east end and 5,243 ft long on the west end. The total length of the dam and spillway is 7,250 ft. The main dam consists of a concrete nonoverflow section, 185 ft long on the west side, and an earthen embankment retaining wall on the east side, as well as a gravity concrete spillway 350 ft long, including piers and abutments, with six tainter gates, each 50 ft by 41 ft. A monolith intake-powerhouse section and erection bay 321 ft long is constructed directly west of and adjacent to the spillway.

At the top of the conservation pool (elevation of 635 ft), the reservoir provides a total storage of 604,527 ac-ft, of which 306,131 ac-ft (to 620 ft) and 298,396 ac-ft is inactive storage (Figure 2.1-27). The total storage at maximum flood pool (elevation 641 ft) is 774,798 ac-ft. During the critical flood season, the reservoir is operated with a maximum conservation pool elevation of 628 ft to provide additional flood risk management storage. West Point Lake has a surface area of 25,864 ac at elevation of 635 ft. The power installations consist of one 3-MW generating unit and two units of 44 MW each, for a total of 91 MW.

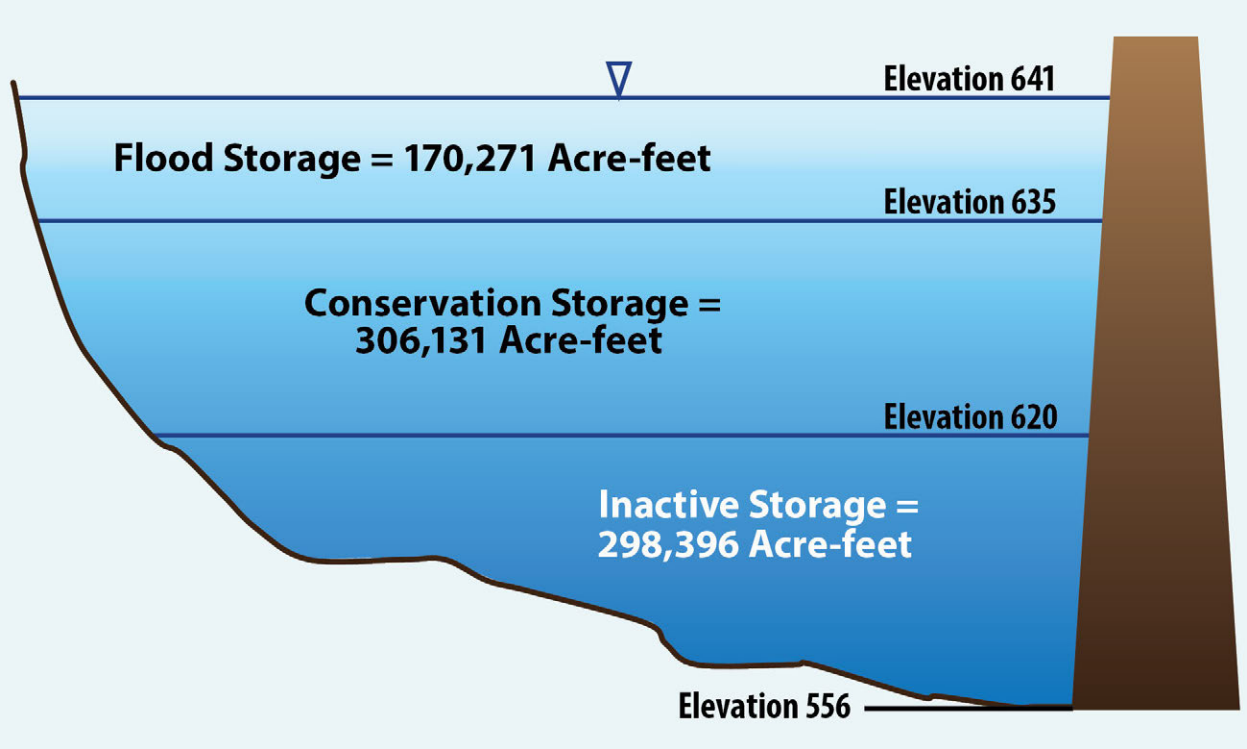


Figure 2.1-27. Storage at West Point Lake

The West Point Lake guide curve (Figure 2.1-28) establishes the top of the conservation pool at elevation 635 ft from June through October, transitioning to elevation 628 ft from December through mid-February. However, the lake level may fluctuate significantly from the guide curve over time, dependent primarily upon basin inflows but also influenced by project operations and evaporation, as well as withdrawals and return flows in the basin above the dam. The record high elevation for the reservoir under flood conditions was elevation 639.9 ft (in May 2003) and the lowest level was 619.7 ft (in November 1985). Under dry conditions when basin inflows are reduced, project operations are adjusted to conserve storage in West Point Lake while continuing to meet project purposes in accordance with four action zones as shown on Figure 2.1-28 and as discussed in sections 2.1.1.2.2 and 5.2.2. Flood flows captured in the reservoir are generally released slowly over subsequent weeks, unless additional flood flows are expected.

Power releases during the low flow season augment flows at the GPC projects along the Chattahoochee River. As a by-product of operation for project purposes, the flows provide for navigation on the Apalachicola River below Jim Woodruff Lock and Dam during the winter and also provide water for M&I needs in the Columbus, Georgia, area.

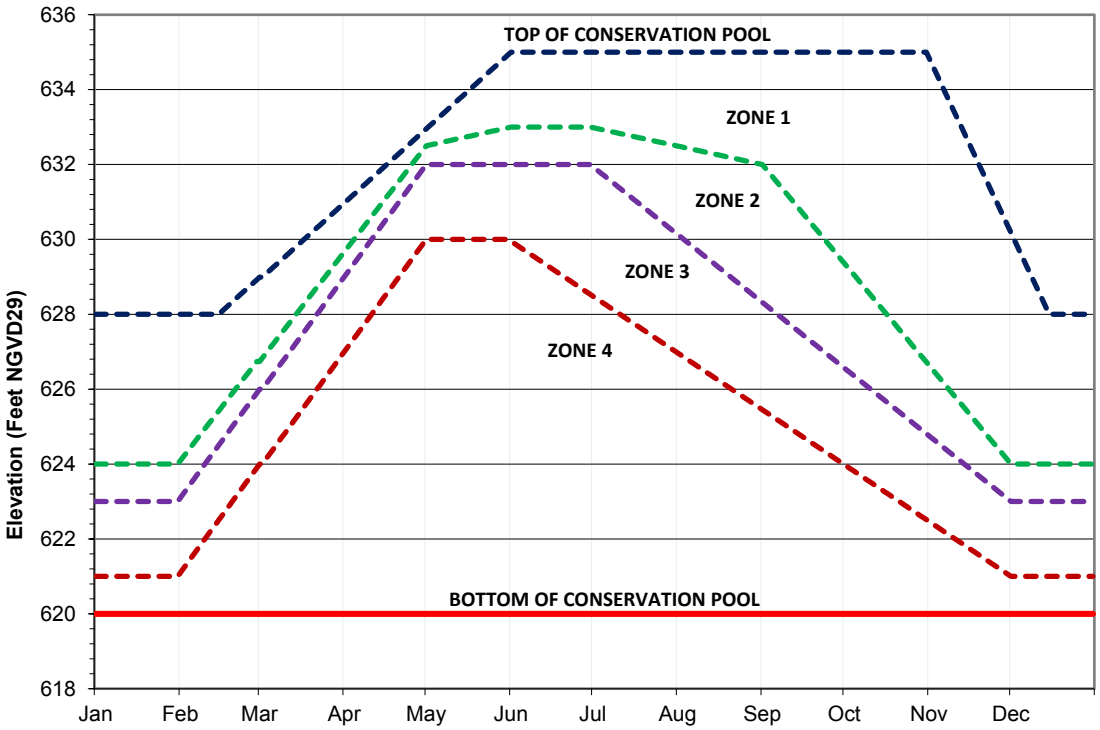


Figure 2.1-28. West Point Dam and Lake Water Control Action Zones

West Point Dam provides a continuous minimum release of 675 cfs to the Chattahoochee River. The main unit discharge is 18,100 cfs. The project is operated in a peaking mode, generating power from 2 to 6 hours during normal operations each weekday, depending on the conservation pool elevation. Weekend generation can occur if required to meet customer needs or other project purposes. Because of the peaking power operations, downstream releases and tailwater elevations can vary substantially over a 24-hour period. Figure 2.1-29 depicts a typical pattern of flows immediately downstream of the project over a 2-week period. During peak hydroelectric power generation periods, stages can increase by about 4 to 6 ft at the West Point gage (about 2 miles below the dam) above river levels during off-peak periods.

Generally, flood operations are initiated when West Point Lake pool level is at or above the top of conservation pool elevation and inflows to the project exceed the capacity of the turbines (approximately 18,100 cfs). Flood operations are conducted in accordance with a detailed schedule outlined in the WCM for the project. Spillway discharges will pass inflows in excess of the turbine capacity. Under flood operations, the discharge capacity of West Point Dam at the maximum flood pool (elevation 641 ft) is 249,500 cfs. The spillway design capacity for the project (at pool elevation 646.4 ft) is 423,900 cfs.

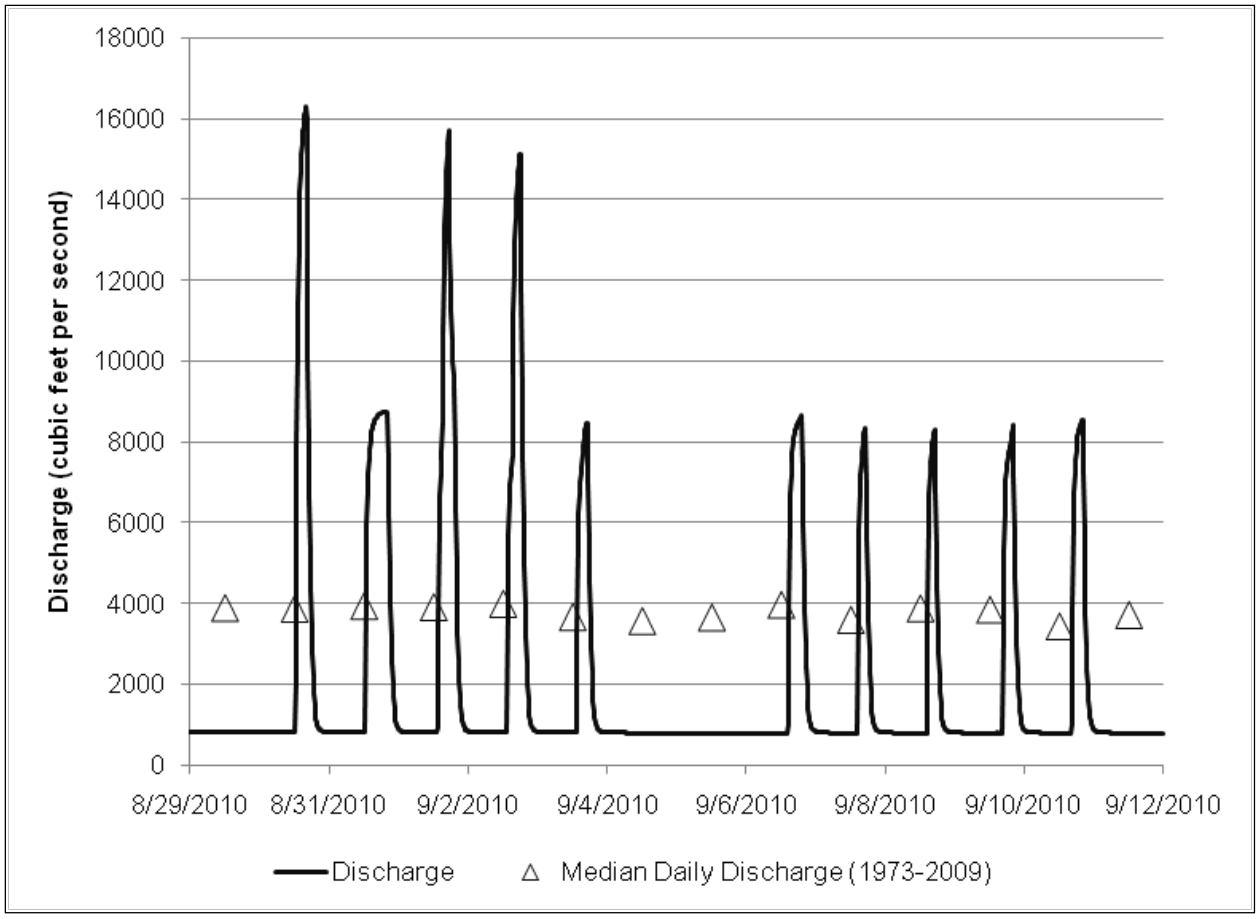
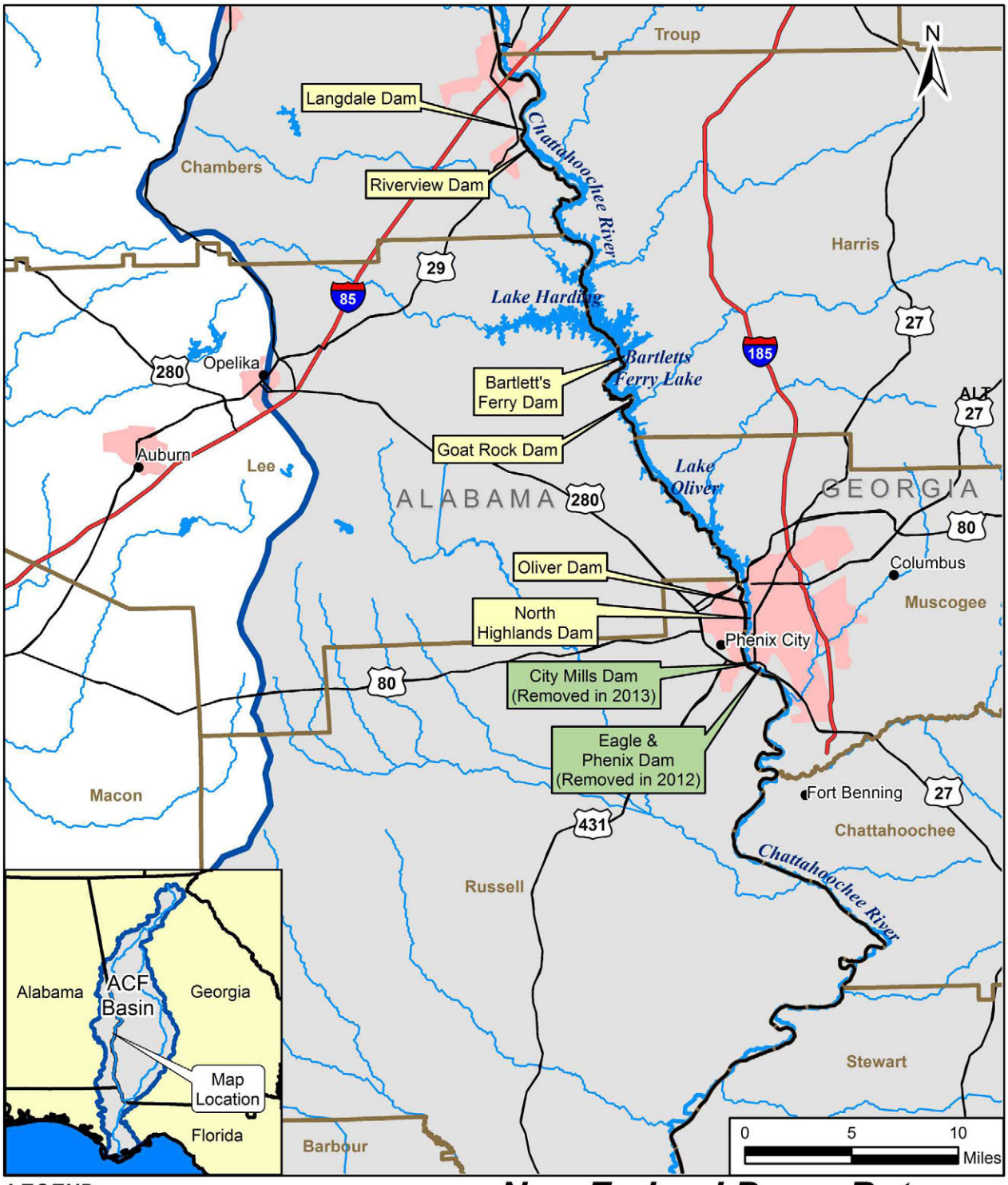


Figure 2.1-29. Chattahoochee River Discharge at USGS Gage 02339500, West Point, Georgia

2.1.1.1.6.4 Nonfederal Dams between West Point Dam (RM 201) and Walter F. George Lake Headwaters (RM 160)

Below West Point Dam, a series of six hydroelectric power generation dams are located along approximately 32 mi of river. Those projects are depicted in Figure 2.1-30. The dams are part of GPC's Middle Chattahoochee Hydro Group. They are known individually as Langdale, Riverview, Bartletts Ferry, Goat Rock, Oliver, and North Highlands dams. The first two, Langdale Dam and Riverview Dam, have small reservoirs, 152 ac and 75 ac, respectively, which are unnamed. Those two projects have a hydroelectric power capacity of 1.04 MW and 0.480 MW, respectively. The four larger projects at Bartletts Ferry, Goat Rock, Oliver, and North Highlands are described in more detail below. The Middle Chattahoochee projects operate in a run-of-river-with-pondage mode, on the basis of the outflow from the West Point Dam.

- ***Lake Harding (Bartletts Ferry Dam).*** The third hydroelectric power generation dam below West Point Lake is Bartletts Ferry Dam, which impounds Lake Harding, at RM 178.0 on the Chattahoochee River. Lake Harding is also used for water supply. The reservoir is on the Alabama-Georgia state line about 20 mi northwest of Columbus, Georgia. The normal operating pool level is elevation 521 ft. The operating pool can drop as low as elevation 510 ft. The reservoir has a surface area of 5,850 ac at 521 ft elevation. The mean depth in the reservoir is 31 ft, and the maximum depth is 111 ft. The project includes a powerhouse composed of six units, which have a total generating capacity of 173 MW. The project operates to maintain a minimum flow of 1,160 cfs at Columbus (GPC 2010a; USACE, Mobile District 1998a).



Non-Federal Dams Between West Point Dam and Walter F. George Lock and Dam

Figure 2.1-30

- ***Goat Rock Dam and Lake.*** The Goat Rock Dam impounds a small reservoir (called Goat Rock Lake) at RM 172.3 on the Chattahoochee River. The reservoir has a surface area of 1,050 ac at elevation 404 ft. It is directly downstream of the Bartletts Ferry Dam and about 10 mi above Columbus, Georgia. GPC operates this reservoir primarily for hydroelectric power generation. The powerhouse consists of six units with a total generating capacity of 38.6 MW (GPC 2010b). The project was designed for hydroelectric power generation peaking generation, with swimming, boating, and fishing as secondary benefits. The normal operating pool level is elevation 404 ft. This project is a run-of-river facility with limited pondage. The project provides an instantaneous target minimum flow release of 800 cfs, or inflow, whichever is less, downstream of the dam.
- ***Lake Oliver (Oliver Dam).*** Lake Oliver is downstream of Goat Rock Dam at RM 163.5 on the Chattahoochee River. The reservoir serves as the primary water supply source for Columbus, Georgia. GPC operates this project as a run-of-river project, with limited storage capacity. It generally passes inflow directly downstream. The reservoir has a mean summer pool elevation of 337 ft (which is the normal operating pool level and the top of the dam) and a surface area of 2,150 ac. The operating pool level can drop as low as elevation 335 ft. The powerhouse consists of three 18-MW generating units and one small 6-MW generating unit, for a total capacity of 60 MW (GPC 2010c). The project provides an instantaneous target minimum flow release of 800 cfs, or inflow, whichever is less, downstream of the dam.
- ***North Highlands Dam and Lake.*** The North Highlands project is at RM 162.5 on the Chattahoochee River downstream of Oliver Dam. The impoundment has a water surface area of 131 ac at elevation 269 ft. It has four units with a total generating capacity of 29.6 MW (GPC 2010d). The project is operated in a run-of-river-with-pondage mode, on the basis of the outflow from the West Point Dam upstream. It provides an instantaneous target minimum flow release of 800 cfs, or inflow, whichever is less, downstream of the dam; a daily average target minimum flow of 1,350 cfs, or inflow, whichever is less, downstream of the project; and a weekly average target minimum flow of 1,850 cfs, or inflow, whichever is less, downstream of the project.

The six GPC hydropower dams operate under FERC licenses. Current licenses for Langdale Dam (No. P-2350) and for Riverview Dam (No. P-2341) were issued on May 24, 1993 (FERC 2014b). The current FERC license for Bartletts Ferry Dam has an expiration date of December 14, 2014, and relicensing for the project is pending (FERC 2014b). Project operations for Goat Rock Dam, Oliver Dam, and North Highlands Dam are covered in a single FERC license issued December 27, 2004 (FERC 2014b). Minimum flow targets prescribed for these projects, as described above, are included in the FERC licenses.

In addition, two small run-of-river dams at Columbus, Georgia, located downstream of the North Highlands Dam, have recently been removed for ecosystem restoration and recreation purposes. They were the City Mills Dam (RM 161.2), built in 1863 and formerly operated by City Mills, and the Eagle-Phenix Dam (RM 160.4), built in 1834 and formerly operated by Eagle and Phenix Mill. These dams had small reservoirs (approximately 110 and 52 ac, respectively). Both dams were removed for aquatic ecosystem restoration under the USACE section 206 program in cooperation with the city of Columbus and other partners. The Eagle-Phenix Dam was removed in 2012, and the City Mills Dam was removed in 2013. Both dams had hydroelectric power generation facilities, but they were inoperative prior to the dam removals. Removal of the dams restored more than 2 mi of free-flowing “fall line” riverine habitat between the North Highlands Dam and the headwaters of Walter F. George Lake (Paine 2012).

2.1.1.1.6.5 Walter F. George Lock, Dam, and Lake

Walter F. George Lake, also locally known as Lake Eufaula, is created by the Walter F. George Lock and Dam on the Chattahoochee River. Walter F. George Lock and Dam are about 85 mi downstream of Columbus, Georgia, at Chattahoochee RM 75.0 and about 181.5 mi upstream of Apalachicola Bay. The drainage area above Walter F. George Lock and Dam is 7,460 sq mi. Walter F. George Lock and Dam and Lake is a multiple-purpose project, originally authorized by the River and Harbors Act of 1945 (under the original name of Fort Gaines) to be operated in conjunction with the other federal works of improvement in the ACF basin for the authorized system purposes. Walter F. George Lock and Dam is operated to provide benefits for authorized purposes including hydropower, navigation, fish and wildlife conservation, recreation, and water quality. The project was completed in 1963. A general map depicting Walter F. George Lock, Dam, and Lake is provided as Figure 2.1-31.

The project consists of a concrete dam, gated spillway, and single-lift lock, with earthen embankments at either side. The nonoverflow section of the dam includes a powerhouse and an intake structure. It is 200 ft long, with the deck of the powerhouse section at elevation 208 ft. The gated spillway is 708 ft long with a fixed crest at elevation 163 ft. The two earthen embankments, almost equal in length, have a total length of 12,128 ft, with crest elevation at 215 ft and a maximum height of about 68 ft. The lock, which has usable chamber dimensions of 82 ft by 450 ft, has a lift of 88 ft with the normal upper pool elevation at 190 ft over the upper sill at normal pool elevation. The power installation at the reservoir has recently been rehabilitated (project complete in 2010). The installation consists of four generating units of 42 MW, for a total of 168 MW.

At the full pool elevation of 190 ft, the reservoir provides a total storage of 934,400 ac-ft, of which 244,400 ac-ft is conservation storage and 690,000 ac-ft is inactive storage (Figure 2.1-32). There is no dedicated flood storage at this project. Walter F. George Lake is the largest reservoir in surface area in the ACF Basin, with 45,181 ac at elevation 190 ft, the top of the summer conservation pool.

The Walter F. George Lake guide curve (Figure 2.1-33) establishes the top of the conservation pool at elevation 190 ft from June through September, transitioning to elevation 188 ft from December through April. The bottom of the conservation pool is at 184 ft. The lake level may fluctuate significantly from the guide curve over time, dependent primarily upon basin inflows but also influenced by project operations and evaporation, as well as withdrawals and return flows in the basin above the dam. The record high elevation for the reservoir under flood conditions was elevation 194.7 ft (in March 1990) and the lowest level was 183.2 ft (in April 1965). Under drier conditions when basin inflows are reduced, project operations are adjusted to conserve storage in Walter F. George Lake while continuing to meet project purposes in accordance with four action zones as shown on Figure 2.1-33 and as discussed in sections 2.1.1.2.2 and 5.2.2.

USACE operates this reservoir as a peaking facility with normal 5-day operation. It also has the potential for weekend operation to coincide with customer schedules. Weekend generation can occur if required to meet customer needs or other project purposes. The number of hours of generation per day depends on the available storage, system hydroelectric power and navigation flow requirements, and other factors. The penstock capacity is 26,000 cfs with all four hydroelectric power units in operation. There is no requirement at Walter F. George Lock and Dam for a continuous minimum flow. Because of the peaking power operations, downstream releases and tailwater elevations can vary substantially over a 24-hour period. Figure 2.1-34 depicts typical river stages that may occur immediately below the lock and dam over a two-week period. During peak hydroelectric power generation periods, tailwater stages can increase from 1.2 ft (with one unit in operation) to as much as 10 ft (with all four units in operation) above the normal downstream water surface elevation of approximately 102 ft during off-peak periods.



Walter F. George Lock and Dam and Lake

Figure 2.1-31

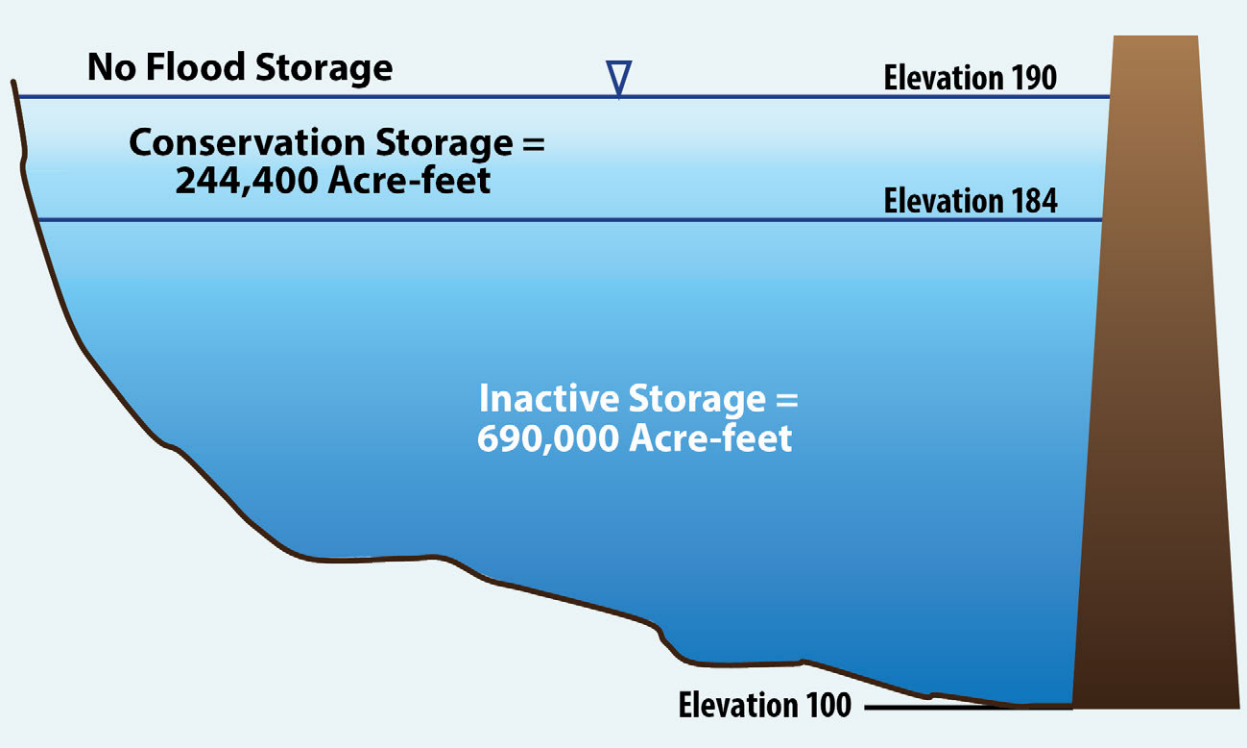


Figure 2.1-32. Storage at Walter F. George Lake

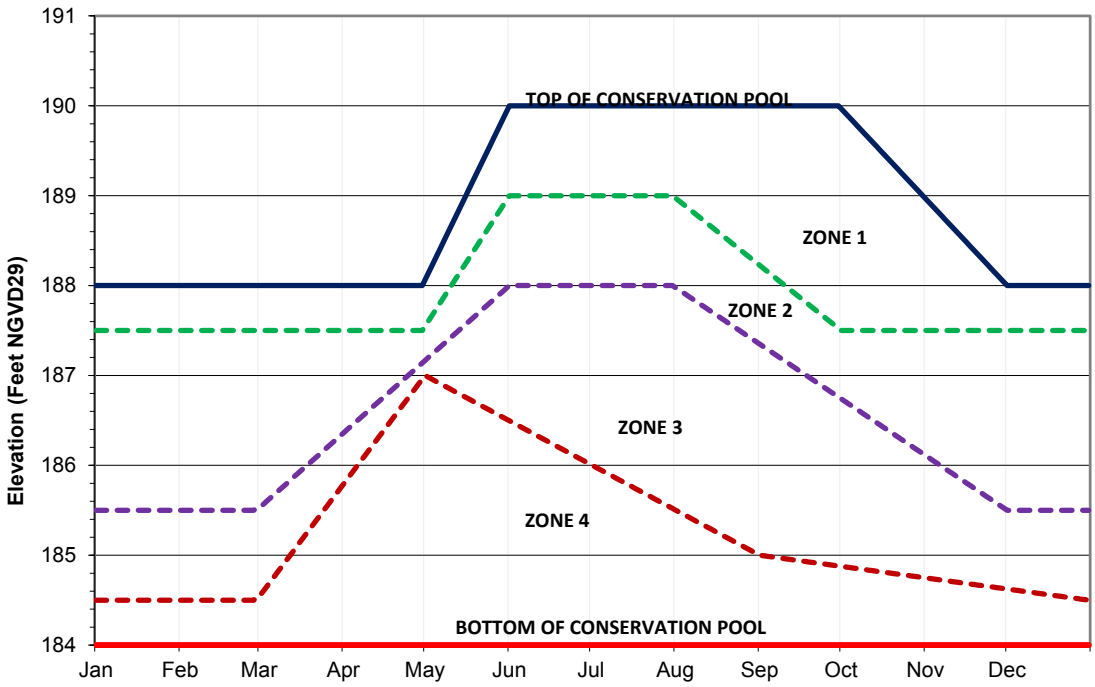


Figure 2.1-33. Walter F. George Lake Water Control Action Zones

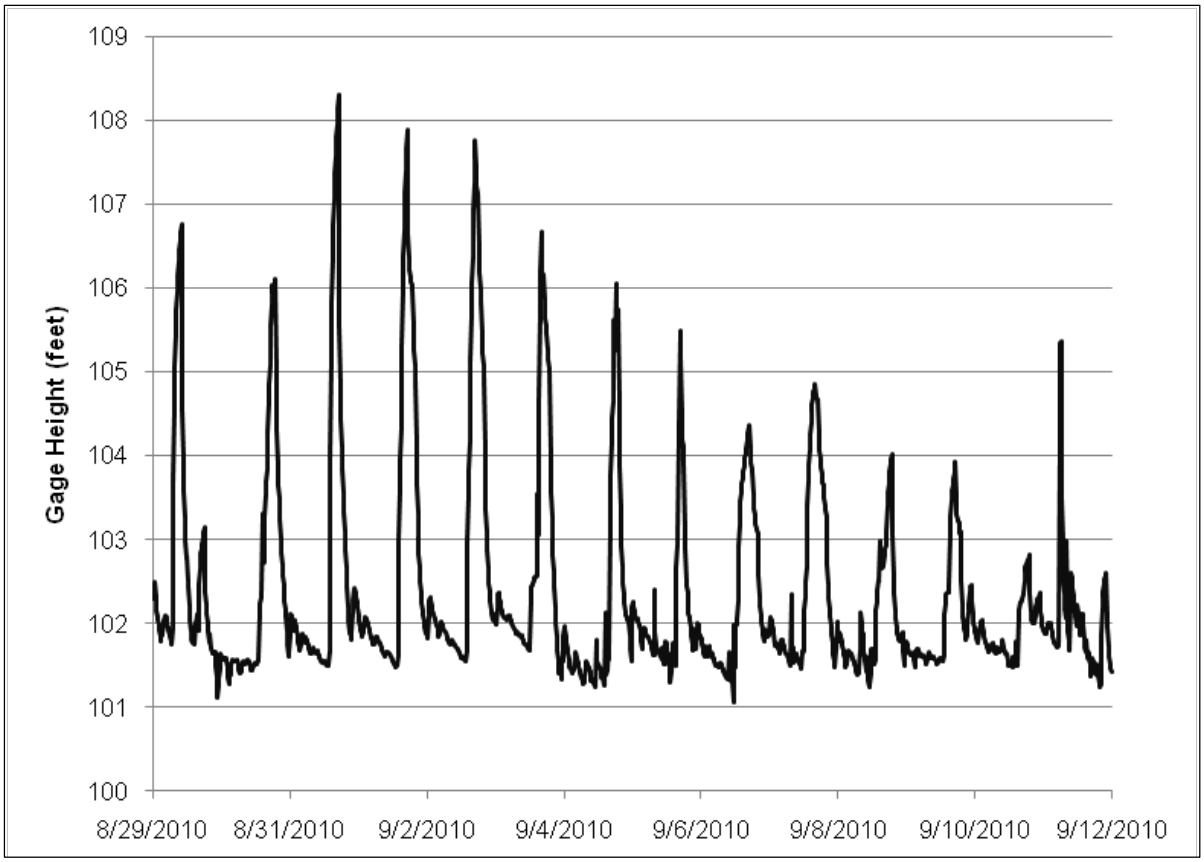


Figure 2.1-34. Chattahoochee River Stage below Walter F. George Lock and Dam at Fort Gaines, Georgia

When the Walter F. George pool level is at or above elevation 190 ft and inflows to the project exceed the capacity of the turbines (approximately 26,000 cfs), flood operations are initiated in accordance with a schedule outlined in the WCM for the project. Spillway discharges will handle inflows in excess of the turbine capacity. Under flood operations, the discharge capacity of Walter F. George Lock and Dam at the standard project flood level (elevation 200.1 ft) is 269,000 cfs. The spillway design capacity for the project (at pool elevation 206.6 ft) is 653,000 cfs.

2.1.1.1.6.6 George W. Andrews Lock, Dam, and Lake

The George W. Andrews Lock and Dam project is located at Chattahoochee RM 46.5, about 153 mi upstream of Apalachicola Bay and about 28.3 mi downstream of Walter F. George Lock and Dam. The lock and dam are about 2 mi south of Columbia, Alabama, and about 17 mi east of Dothan, Alabama. The George W. Andrews Lock and Dam project was originally authorized under the River and Harbors Acts of 1945 and 1946 (under the original name of Columbia Dam) to be operated in conjunction with the other federal works of improvement in the ACF Basin for the authorized system purposes. The project is operated to provide benefits for authorized purposes, including navigation, fish and wildlife conservation, recreation, and water quality. The project consists of a concrete fixed-crest spillway 340 ft long extending into the right bank with crest at elevation 102 ft, a concrete gate spillway adjacent to the lock 280 ft long with crest at elevation 82 ft, a single-lift lock with usable chamber dimensions of 82 ft by 450 ft, and a maximum lift of 25 ft. Depths are 13 ft over the lower sill and 19 ft over the upper sill at a normal pool elevation of 102 ft. The drainage area above the lock and dam is 8,210 sq mi, and the size of the reservoir is about 1,540 ac. A general map depicting George W. Andrews Lock and Dam is provided as Figure 2.1-35.

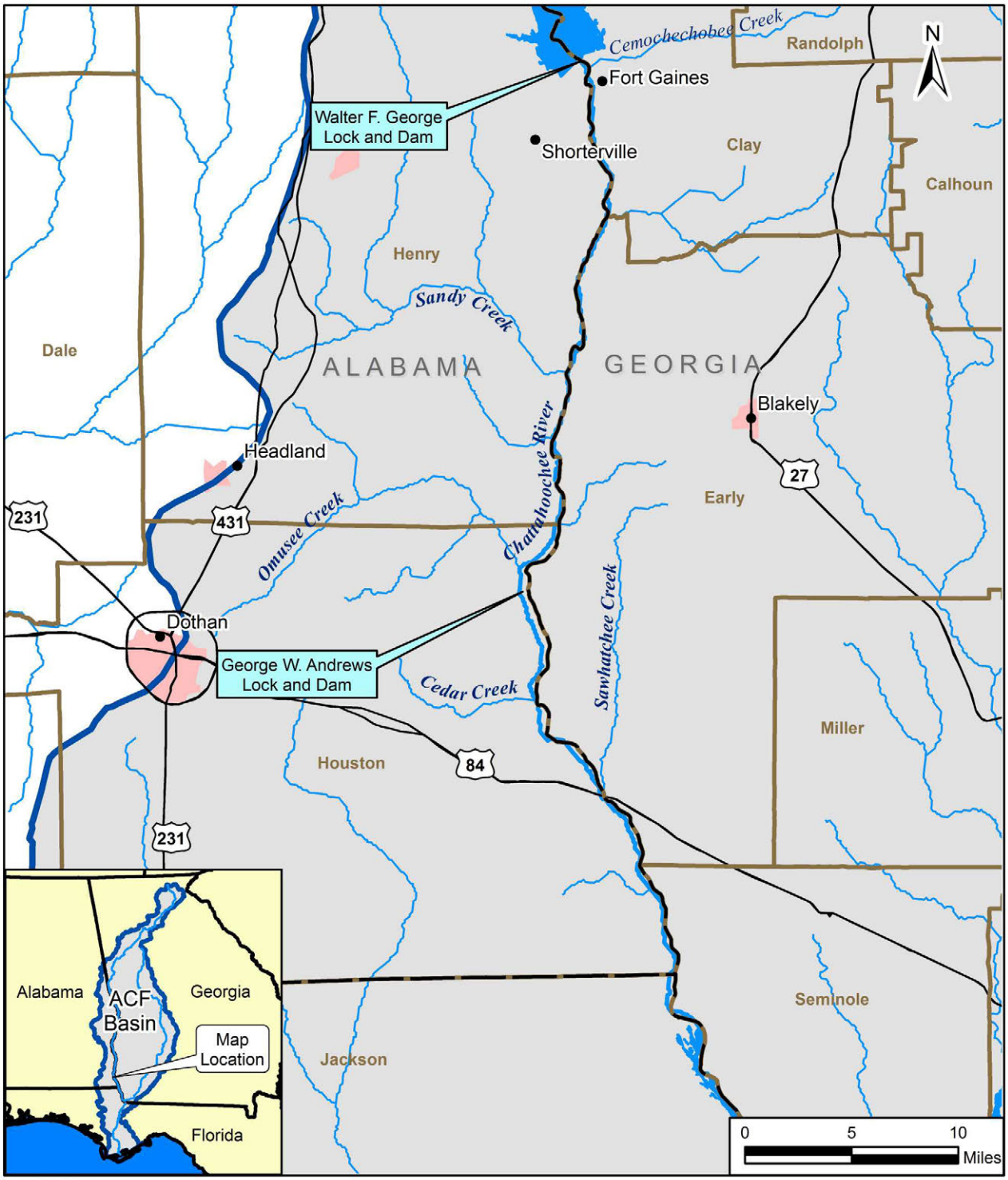

Cemochechobee Creek
Randolph
N
Fort Gaines
Walter F. George
Lock and Dam
Shorterville
Clay
Calhoun
Henry
Sandy Creek
Dale
ALABAMA
GEORGIA
Blakely
Chattahoochee River
Headland
27
Early
231
431
Omusee Creek
Sawhatchee Creek
Dothan
George W. Andrews
Lock and Dam
Cedar Creek
Miller
Houston
84
231
Alabama
ACF
Basin
Georgia
Map
Location
Seminole
Jackson
Florida
0
5
10
Miles
LEGEND
ACF Basin Boundary
County Boundary
City
Urban Area
Interstate
U.S. Route
Surface Water
USACE Dam
George W. Andrews
Lock and Dam and Lake

Figure 2.1-35

The project acts as a run-of-river project, principally for navigation, to provide navigable depths upstream to the Walter F. George Lock and Dam. The reservoir has a 9-ft-deep by 100-ft-wide navigation channel extending over its entire length. Because of its long, narrow shape, the reservoir resembles a large river more than a lake. Limited recreation facilities are also available at the project.

While the George W. Andrews Lake normal pool is at elevation 102 ft, pool elevations can temporarily increase under higher flow conditions. The lock becomes inoperable under flood conditions when the river stage at the project rises to elevation 114 ft, which occurs about 0.4 percent of the time. The reservoir has no conservation storage and no federal hydroelectric power facility. The George W. Andrews project has limited capacity to reregulate inflows from peaking power operations at the Walter F. George powerhouse.

When inflow to the Walter F. George project exceeds its full power plant capacity (26,000 cfs) and power releases are supplemented by spillway discharges into George W. Andrews Lake, the George W. Andrews Lock and Dam spillway will be operated to pass the inflow to the project. When flows at the George W. Andrews Lock and Dam reach approximately 43,600 cfs, all gates are open clear, the headwater will be about elevation 102 ft, and the tailwater elevation will be about 100 ft. For flows greater than 43,600 cfs, the pool elevation will rise with increase in flow. The gates will remain in the full open position until the headwater crests and then recedes to elevation 102.5 ft, after which the gates will be operated to slow the rate of fall and stabilize the pool at elevation 102 ft until peaking operations are resumed at the Walter F. George powerhouse. The record high elevation at the Andrews project location under flood conditions was elevation 128.3 ft (about 203,000 cfs) on March 18, 1929, which was before the project's construction. The standard project flood peak flow at the project is 293,100 cfs, and the spillway design flow is 630,000 cfs.

From May 1983 to the present, various hydroelectric power interests in the private sector have taken steps to acquire a license from FERC for nonfederal hydroelectric power development at the George W. Andrews Lock and Dam. To date, these initiatives have not led to a FERC license. In 2010, two competing preliminary permit applications for nonfederal hydroelectric power development were on file and under consideration by FERC: (1) Robertson Energy Group, LLC (FERC Project No. P-13081), initially filed on November 19, 2007 (FERC 2010a); and (2) Alabama Municipal Electric Authority (FERC Project No. P-13719), filed on April 29, 2010 (FERC 2010b). On December 21, 2010, FERC issued a preliminary permit and granted priority to file a license application to the Alabama Municipal Electric Authority (AMEA) and denied the competing application for preliminary permit by the Robertson Energy Group, LLC (FERC 2010c). The AMEA requested a 3-year extension to their preliminary permit in September 2013, which was subsequently denied by FERC on November 21, 2013 (FERC 2013). The AMEA preliminary permit expired on November 30, 2013. Subsequently, Mid-Atlantic Hydro, LLC applied for a preliminary permit from FERC. On June 19, 2014, FERC issued a preliminary permit to Mid-Atlantic Hydro, LLC, for purposes of studying the feasibility of nonfederal hydropower development at Andrews Lock and Dam (FERC 2014a). The preliminary permit is in effective for three years, expiring in June 2017.

2.1.1.1.6.7 Lake Seminole and Jim Woodruff Lock and Dam

The Jim Woodruff Lock and Dam project is located on the Apalachicola River at 106.4 mi above its mouth, about 1,000 ft below the confluence of the Chattahoochee and Flint rivers and 1.6 mi northwest of Chattahoochee, Florida. The reservoir, Lake Seminole, is the furthest downstream in the ACF Basin. It extends about 46.5 mi upstream along the Chattahoochee River to the vicinity of Columbia, Alabama, and about 47 mi upstream along the Flint River, or 17 mi above Bainbridge, Georgia. Jim Woodruff Lock and Dam was completed in 1957. The drainage area above the dam is 17,164 sq mi at the normal pool

elevation of 77 ft, and the reservoir has a surface area of 37,500 ac. A general map of Jim Woodruff Lock and Dam and Lake Seminole is provided as Figure 2.1-36.

Jim Woodruff Lock and Dam is a multipurpose project originally authorized under the River and Harbors Acts of 1945 and 1946 to be operated in conjunction with the other federal works of improvement in the ACF basin for the authorized system purposes. The project is operated to provide benefits for authorized purposes including hydropower, navigation, fish and wildlife conservation, recreation, and water quality. In addition, USACE has consulted with the U.S. Fish and Wildlife Service (USFWS) regarding effects on threatened and endangered species downstream of Jim Woodruff Lock and Dam and determines minimum releases from Jim Woodruff Lock and Dam consistent with a USFWS Biological Opinion and a 2012 Revised Interim Operating Plan (RIOP) (discussed in more detail in section 2.1.1.2.4.4).

The project consists of a concrete open-crest spillway 1,634 ft long on the right bank, with crest at elevation 79 ft; a single-lift lock with usable chamber dimensions of 82 ft by 450 ft, with a maximum lift of 33 ft and a depth over the sills of 14 ft; a gated spillway 766 ft long with the bridge at elevation 107 ft, or about 67 ft above the streambed elevation; a powerhouse with an intake section constituting a portion of the dam; a nonoverflow earthen section 506 ft long to accommodate the switchyard and substation; and an overflow dike section 2,130 ft long on the left bank, with crest at elevation 85 ft.

The power installation at the project consists of three units with a total of 43.35 MW. The reservoir level is normally maintained near elevation 77 ft. Pondage of 0.5 ft above and below that elevation is used to reregulate flows into the reservoir from upstream projects that operate as peaking hydroelectric power generation plants. The reservoir level is maintained at elevation 77 ft by passing inflows through the spillway gates or through the powerhouse. A federally authorized 9-ft-deep, 100-ft-wide navigation channel provides for commercial river transportation from the Gulf Coast through Lake Seminole upstream to Columbus, Georgia, on the Chattahoochee River and to Bainbridge, Georgia, on the Flint River.

The project has no dedicated conservation storage or flood storage. The record high elevation for the reservoir under flood conditions was elevation 78.7 ft (in April 1960) and the lowest level was 74.2 ft (in November 1978).

When the reservoir inflow exceeds the discharge capacity of the turbines (about 18,000 cfs for the three units), the excess will be released through the gated spillway up to its capacity to prevent the pool from rising above elevation 77.8 ft at the dam. When forecasts indicate expected inflows in excess of 100,000 cfs, the pool will be lowered to elevation 77.0 ft in advance of the flood peak and held at that level until all usable spillway gates are fully open. The gated spillway will discharge up to 203,600 cfs. Discharges above about 108,000 cfs will cause the power plant to be nonproductive because of the high tailwater conditions. All outflows will be through the spillway for higher flow. When the inflow exceeds 203,600 cfs, all usable gates will be fully open, and there will be no control over the outflow. The pool will rise as long as the inflow exceeds the discharge capacity of the spillway, including the free-overflow section. The gates will remain fully open until the pool drops back to elevation 77.0 ft, when they will be operated as necessary to maintain the pool at or below elevation 77.0 ft. When the flow recedes to 100,000 cfs, the gates will be gradually closed to bring the pool back to elevation 77.5 ft over a 1- to 2-day period. Operation of the lock will be discontinued during flood periods when the headwater exceeds elevation 81 ft, which is 1 ft below the top of the upstream approach walls, and the tailwater will be at elevation 79.2 ft. The estimated discharge at that time would be 260,000 cfs, which has an expected recurrence interval of once in 95 years (for approximately 20 days duration).

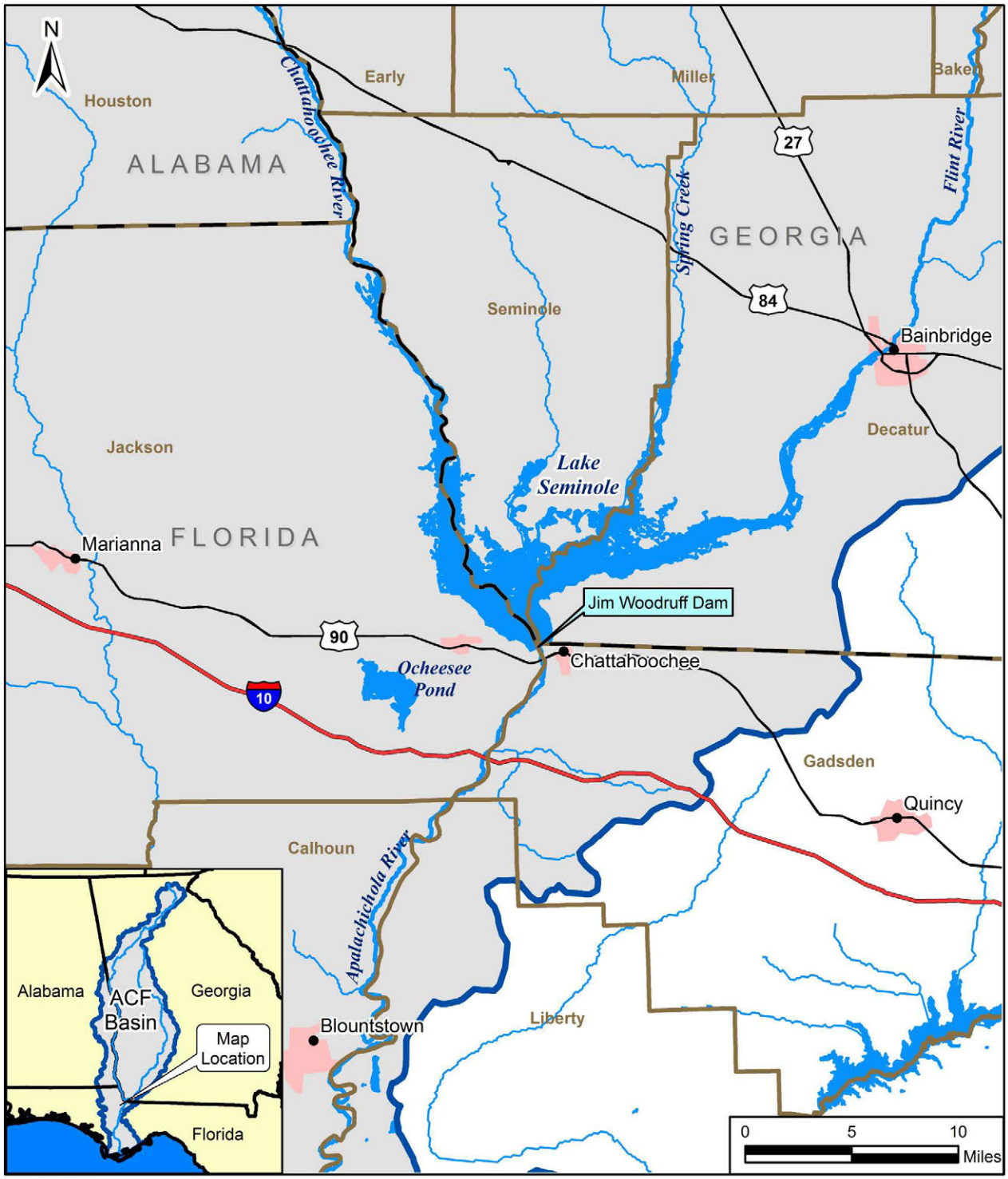

N
Houston
ALABAMA
Chattahoochee River
Early
Miller
Baker
27
Flint River
Spring Creek
GEORGIA
84
Seminole
Bainbridge
Decatur
Jackson
Lake Seminole
Marianna
FLORIDA
Jim Woodruff Dam
90
Chattahoochee
Ocheesee Pond
10
Gadsden
Quincy
Calhoun
Apalachicola River
Alabama
ACF Basin
Georgia
Map Location
Florida
Blountstown
Liberty
0
5
10
Miles
LEGEND
ACF Basin Boundary
County Boundary
City
Urban Area
Interstate
U.S. Route
Surface Water
USACE Dam
Jim Woodruff Dam/ Lake Seminole

Figure 2.1-36

2.1.1.1.6.8 Lake Blackshear and Warwick Dam

Lake Blackshear is the more upstream of the two reservoirs on the Flint River. The Warwick Dam, which is located at Flint RM 134.7 near Warwick, Georgia, impounds the Flint River to create Lake Blackshear. The dam was built in 1930 and is owned and operated by the Crisp County Power Commission for hydroelectric power generation. The general location of the reservoir is shown on Figure 2.1-37. The project consists of two earthen embankments, each about 30 ft high, on either side of a spillway and powerhouse facility. The north embankment is about 3,400 ft, and the south embankment is about 650 ft. The spillway/powerhouse facility is about 550 feet long. Lake Blackshear borders five counties, and the surface area is approximately 8,700 ac at the normal full pool elevation of 237 ft. The reservoir has 77 mi of shoreline, an average depth of 11 ft, and an average width of three-fourths of a mile. The drainage basin above the dam is approximately 3,770 sq mi and begins at Hartsfield-Jackson Atlanta International Airport just south of Atlanta, Georgia.

The project operates under FERC License No. P-659 issued on November 28, 2008 (FERC 2014b). The hydroelectric power generation project is licensed to operate in a run-of-river mode. The power plant at the dam consists of four units with a total licensed capacity of 15.2 MW. In the last 70 years, the reservoir has not only served Crisp County with power but has also become a valuable recreational and wildlife facility in southwest Georgia (CCPC 2010). The Crisp County steam plant is a major user of water from Lake Blackshear, but it also returns the thermal discharge back to the lake.

2.1.1.1.6.9 Lake Worth and Flint River Dam

GPC owns and operates the Flint River Dam (also called Lake Worth Dam or Albany Dam), which impounds a small run-of-river reservoir named Lake Worth. The project is in the vicinity of Albany, Georgia, at the Flint River's confluence with Muckalee Creek and Kinchafoonee Creek. The general location of the reservoir is shown on Figure 2.1-37. The project was constructed in 1908 for hydroelectric power generation and operates under FERC License No. P-1218, which was issued on September 30, 1999 (FERC 2014b). The hydroelectric power generation facility has three units with an installed capacity of 5.4 MW. The reservoir has a surface area of 1,400 ac and about 36 miles of shoreline at the normal elevation of 182.3 ft (GPC 2010e).

2.1.1.1.6.10 Other Reservoirs in the ACF Basin

In 2002, USACE conducted a preliminary survey of existing reservoirs in the ACF Basin in Alabama and Georgia. The survey provided information on the number, location, and approximate size of the smaller reservoirs within the basin that are off the mainstem rivers (generally reservoirs other than federal or major power company reservoirs), identifying a total of 411 reservoirs in the ACF Basin in the two states that are 20 ac or larger (USACE, Mobile District 2002a). The impoundments serve a variety of different purposes, including water supply for livestock and irrigation; fish and wildlife conservation; recreation; M&I water supply; and other localized uses. The Florida portion of the ACF Basin was not included in the survey, and it is not likely that there would be enough reservoirs of sufficient size to add appreciably to the totals from Alabama and Georgia. Hundreds of other smaller ponds and impoundments are scattered across the ACF Basin.

In the ACF Basin in Alabama, 25 reservoirs larger than 20 ac were identified during the survey. The total surface area of these reservoirs was about 1,900 ac, with an average reservoir size of about 77 ac. In the ACF Basin in Georgia, 386 reservoirs were identified. The total surface area of the reservoirs was about 23,800 ac, with an average reservoir size of about 62 ac (USACE, Mobile District 2002a). This summary does not include reservoirs on the mainstem rivers (Apalachicola, Chattahoochee, and Flint rivers) that are otherwise specifically discussed in this document. While the preliminary survey may not have identified and included every impoundment within the basin, it was detailed enough to provide a reasonably complete summary of the more noteworthy surface water impoundments in the ACF Basin.

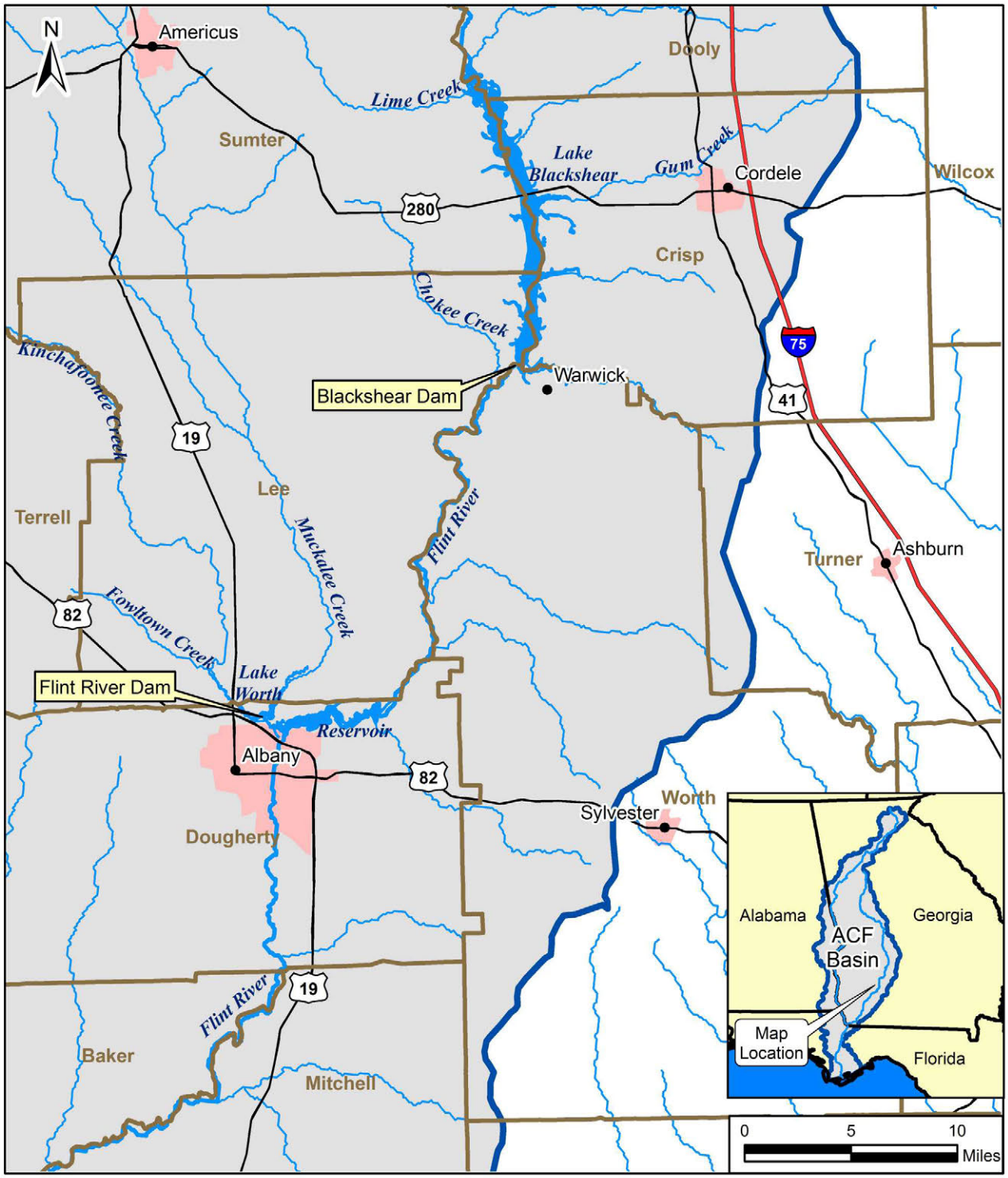

N
Americus
Dooly
Lime Creek
Sumter
Lake Blackshear
Gum Creek
Cordele
Wilcox
280
Crisp
Chokee Creek
75
Kinchafoonee Creek
Blackshear Dam
Warwick
41
19
Lee
Terrell
Muckalee Creek
Flint River
Turner
Ashburn
82
Fowltown Creek
Lake Worth
Flint River Dam
Reservoir
Albany
82
Worth
Sylvester
Dougherty
Alabama
Georgia
ACF Basin
Map Location
Florida
19
Flint River
Baker
Mitchell
0
5
10
Miles
LEGEND
ACF Basin Boundary
County Boundary
City
Urban Area
Interstate
U.S. Route
Surface Water
Non-Federal Dam
Flint River Basin

Figure 2.1-37

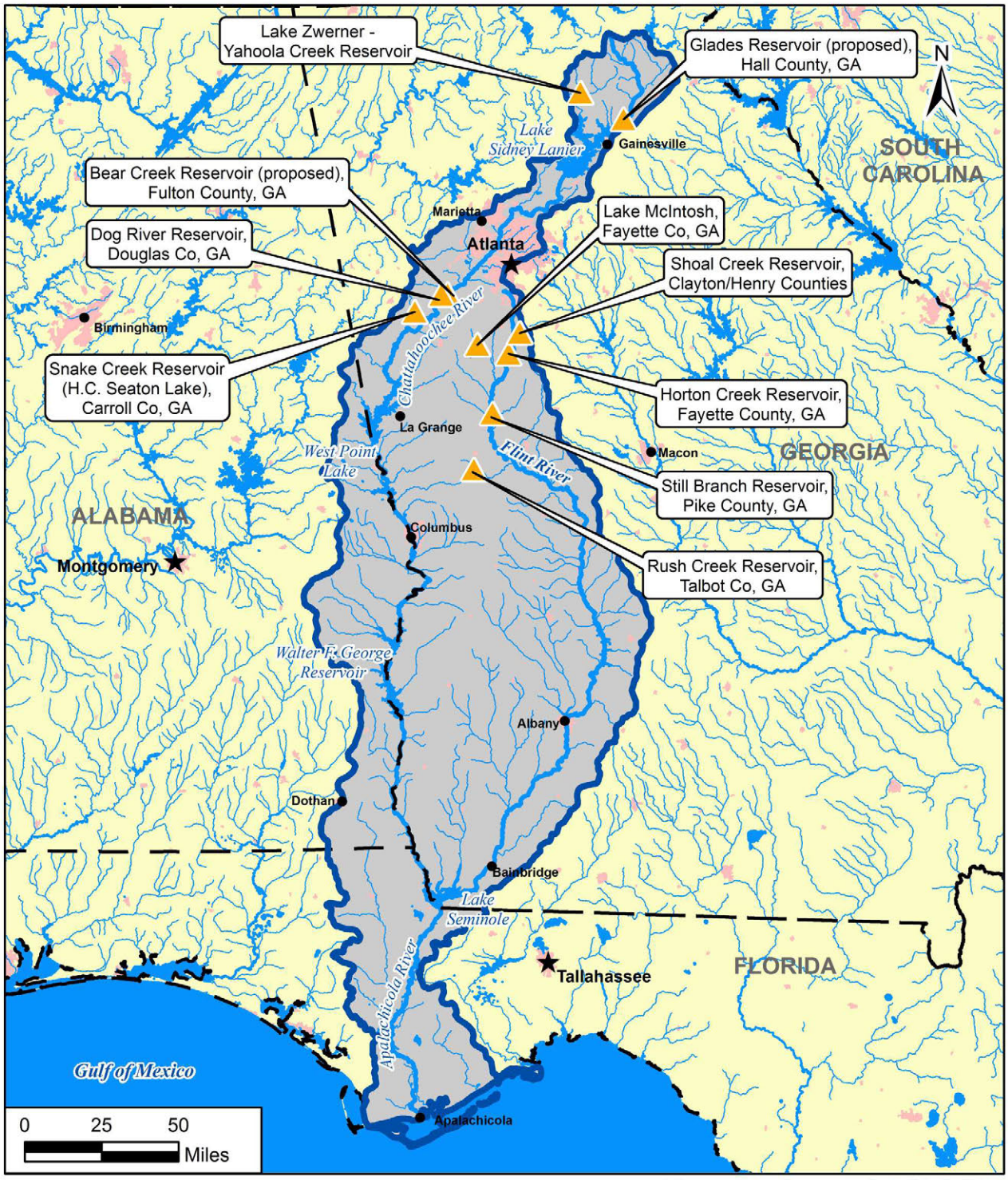
USACE issues permits under section 404 of the Water Pollution Act of 1972, as amended, and section 10 of the Rivers and Harbors Act of 1899 for potential reservoir projects. Table 2.1-4 summarizes permits (or pending permit actions) for proposed non-USACE reservoirs in the ACF Basin since 1988 (Johnson 2010). The locations of the reservoirs within the ACF Basin are shown on Figure 2.1-38. These reservoirs are in the upper Flint and upper Chattahoochee River basins in Georgia. They have generally been pursued for the primary purpose of water supply, but they may also serve other purposes, such as recreation. These projects represent the substantial reservoir projects in the basin over the last 20 years with respect to reservoir size, yield, and costs. No similar reservoir projects have recently been pursued in the Alabama or Florida portions of the ACF Basin (House 2010). Table 2.1-4 might not include all permit actions for impoundments across the ACF Basin, as a number of other smaller, minor impoundments may have been constructed for a variety of local purposes between 1990 and 2010 that, collectively, do not rise to the level of these projects.

Table 2.1-4.
Non-USACE Reservoir Projects (Permitted by USACE since 1988, or Permit Pending) in the ACF Basin not on the Mainstem Rivers

River basin	Stream	Project name	County	Yield (mgd)	Size (acres)	Status
Chattahoochee	Dog River	Dog River Reservoir	Douglas (GA)	15.89	260	Permitted 1988 Constructed 1992
Chattahoochee	Yahoola Creek	Lake Zwerner (renamed in 2009)	Lumpkin (GA)	25.5	132	Permitted 1992 Constructed 2004
Chattahoochee	Snake Creek	H.C. Seaton Reservoir	Carroll (GA)	13	650	Permitted 1994 Constructed 2001
Chattahoochee	Dog River	Dog River Reservoir Expansion	Douglas (GA)	23	256	Permitted 2004 Constructed 2009
Chattahoochee	Flat Creek	Glades Reservoir	Hall (GA)	72.5	850	Permit Pending
Chattahoochee	Bear Creek	Bear Creek Reservoir	Fulton (GA)	16.44	440	Permit Pending
Flint	Rush Creek	Rush Creek Reservoir	Talbot (GA)	2	80	Permitted 1991 Constructed 1998
Flint	Horton Creek	Horton Creek Reservoir	Fayette (GA)	18	770	Permitted 1992 Constructed 1996
Flint	Shoal Creek	Shoal Creek Reservoir	Clayton/ Henry (GA)	8.4	400	Permitted 1992 Constructed 1999
Flint	Still Branch	Still Branch Reservoir	Pike (GA)	35	476	Permitted 2001 Constructed 2008
Flint	Line Creek	Lake McIntosh	Fayette (GA)	10.4	650	Permitted 2007 Constructed 2012

Two of the reservoirs identified in Table 2.1-4 are currently proposed: Bear Creek Reservoir and Glades Reservoir. USACE permits have been requested but not yet issued and construction has not been initiated.

- **Bear Creek Reservoir.** The South Fulton Municipal Regional Water and Sewer Authority (SFMRWSA) has proposed to build a 440-ac pump-storage reservoir on Bear Creek in south Fulton County for water supply to serve the three member cities of Fairburn, Palmetto, and Union City. The proposed project would be located along Campbellton-Redwing Road (Highway 70), approximately 8 mi north of the Fulton-Coweta County line. The site is northwest of the city of Palmetto (USACE, Savannah District 2009). The general location of the proposed reservoir is shown on Figure 2.1-38.



Reservoirs with USACE Permits (or Permits Pending) in ACF Basin Since 1988

Figure 2.1-38

The proposed Bear Creek Reservoir would provide the year 2050 water demand of 16.44 mgd for the authority. Water for the reservoir would be provided by local inflow and by pump from the nearby Chattahoochee River. Water from the reservoir would be pumped to a proposed water treatment plant to be constructed adjacent to the reservoir along Highway 70. As proposed by the SFMRWSA, project construction would be phased commensurate with increasing demand over time. The phased implementation would occur as follows (SFMRWSA 2014):

- Phase 1—Construct dam and reservoir; construct 5.4-mgd water treatment plant (withdrawing 5.4 mgd from reservoir based on local inflow); no pumping from Chattahoochee River;
- Phase 2—Expand water treatment plant to 11.2 mgd; as needed, pump up to 16.4 mgd from the Chattahoochee River into Bear Creek to meet minimum in-stream flow requirements in Bear Creek; withdrawn water returned directly to Chattahoochee River;
- Phase 3—Expand water treatment plant to 16.44 mgd (the projected 2050 demand); pump maximum of 16.4 mgd from Chattahoochee River into Bear Creek to meet in-stream flow requirements (all water returned directly to Chattahoochee River); pump a maximum of 6.4 mgd from Chattahoochee River into reservoir to refill the reservoir.

In 2008, the GAEPD formally certified the need for a reservoir in south Fulton County capable of supplying the region's water needs through 2050. The project has also been endorsed by the Metropolitan North Georgia Water Planning District (MNGWPD) as one of six water-storage projects currently under way within the district. In February 2009, the SFMRWSA filed a section 10/404 permit application with USACE, Savannah District. The permit would allow the authority to move forward to construct a reservoir that will ultimately yield the projected 2050 water demand of 16.44 mgd for residents of south Fulton County. The section 10/404 permit is currently pending.

Proposed operations for the Bear Creek Reservoir were considered in the HEC-ResSim modeling for the Master WCM update and WSSA. Details on how operations were addressed in the HEC-ResSim model are provided in the HEC-ResSim Modeling Report in Appendix E.

- **Glades Reservoir.** The Hall County Board of Commissioners, Hall County, Georgia, has proposed to construct a water supply reservoir project in Hall County to operate as part of the public water supply system. The proposed Glades Reservoir would be a pumped-storage facility located on Flat Creek about 0.8 mi upstream of its confluence with the Chattahoochee River at the headwaters of Lake Lanier. The proposed Glades Reservoir would be located approximately 12 mi northeast of Gainesville, Georgia, northeast of US 23/365, near the US 23/365 and State Route (SR) 52 intersection. The general location of the Glades Reservoir project is shown on Figure 2.1-38. The drainage area for the proposed Glades Reservoir is about 17.6 sq mi. The proposed dam would impound an approximately 850-ac reservoir at a normal pool elevation of 1,180 ft mean sea level and provide 11.7 billion gallons of water storage capacity. The proposed project would also include an intake/pumping station, and 4.5-mi pipeline for withdrawing and pumping water from the Chattahoochee River to the proposed reservoir. The proposed intake/pumping station would be about 6.5 river miles upstream from the confluence of Flat Creek and the Chattahoochee River (USACE, Savannah District 2014).

  The proposed Glades Reservoir would store water pumped from the Chattahoochee River upstream of Lake Lanier, as well as natural streamflow from Flat Creek. Water would be pumped from the river to the reservoir for storage only when a minimum in-stream flow (approximately 120 cfs) could be maintained in the Chattahoochee River. As currently proposed by Hall County, reservoir operations to meet water supply demands would involve releases from Glades Reservoir to Lake Lanier, via Flat Creek, for withdrawal (at the same rate of release) from Lake Lanier at one or more of the existing water intakes in the lake. Under current USACE policy, this proposed operation would require a reallocation of conservation storage in Lake Lanier to water supply

storage. Hall County's section 10/404 permit application, prior to the June 2011 opinion of the U.S. Court of Appeals for the 11th Circuit, presumed that a water supply storage reallocation at Lake Lanier would not be forthcoming (per the July 2009 U.S. District Court order) and consequently incorporated a plan for the necessary infrastructure to transmit water from Glades Reservoir directly to existing water treatment facilities in lieu of moving water to those facilities via discharges to Lake Lanier. Absent a future reallocation of Lake Lanier storage, Hall County would presumably revert to this previous proposal. As indicated by Hall County in the USACE section 10/404 permit application for the project, the safe yield for the proposed Glades Reservoir is estimated to be 72.5 million gallons per day (mgd) on an annual average daily basis. This project is expected to meet Hall County's water supply need through 2060 (USACE, Savannah District 2014).

Implementation of the proposed Glades Reservoir project in Hall County was specifically discussed in the January 11, 2013, letter from the Governor of Georgia to the Assistant Secretary of the Army (Civil Works), subject: State of Georgia's Water Supply Request. Regarding proposed operations at Glades Reservoir for water supply, the affidavit attached to the Governor's letter states:

> Based on reasonable assumptions regarding operation of Glades Reservoir, EPD projects a 30-40 mgd yield from Glades Reservoir. EPD plans to work with the Corps and the reservoir sponsors to ensure that the Glades reservoir serves as a net benefit to the system yield, provided that the Corps will be able to meet water supply needs of 705 mgd from Lake Lanier (Office of Governor, State of Georgia 2013). (*NOTE: These statements are based on estimates of year 2040 demands per the state of Georgia.*)

Proposed operations for the Glades Reservoir, as presented in the Governor's letter, were considered in the HEC-ResSim modeling for the Master WCM update and WSSA. Details on how Glades Reservoir operations were addressed in the HEC-ResSim model are provided in the HEC-ResSim Modeling Report in Appendix E.

Calhoun Creek Reservoir. In early 2013, the city of Dawsonville, Georgia, advanced a proposal for a 590-ac water supply reservoir, which would lie within the city of Dawsonville, Dawson County, and Lumpkin County. This project is in the early stages of development. To date, no section 404 permit application for the project has been submitted to USACE, Savannah District. Therefore, the project was not included in Table 2.1-4. The proposed reservoir would store about 10.6 billion gallons of water at a full pool elevation of 1,350 ft. Because of the very small drainage area above the proposed dam site, the principal sources of water to fill the reservoir would be withdrawals from both the Etowah River (ACT Basin) and the Chestatee River (ACF Basin) to maximize the reservoir's reliable safe yield. Based on utilization of both sources, the proposed project estimated to yield 47.5 mgd.

As conceived, the reservoir would be able to release water into both the Etowah and Chestatee rivers for downstream water supply withdrawal, even though the reservoir would be located in the Etowah River basin (City of Dawsonville 2013). While the reservoir project proposal is still in the early in the stages of development, the city of Dawsonville submitted an application to GEFA in April 2013 for direct state investment funding under the Governor's Water Supply Program (GWSP) for acquisition of real property associated with the proposed reservoir (City of Dawsonville 2013). The proposed project was not selected for 2013 GWSP funding. Additionally, the Calhoun Creek Regional Reservoir Authority has a pending application with GAEPD for a surface water withdrawal permit for the proposed reservoir. The application specifically proposes withdrawals of up to 45 mgd (both daily maximum and monthly average) from the Etowah River but did not identify specific withdrawal requirements from the Chestatee River. No Section 404 permit application for the project has been submitted to date to the USACE, Savannah District.

Because of the preliminary nature of the potential Calhoun Creek Reservoir proposal, it was not considered in the HEC-ResSim model for the WCM update and WSSA.

2.1.1.1.7 Groundwater

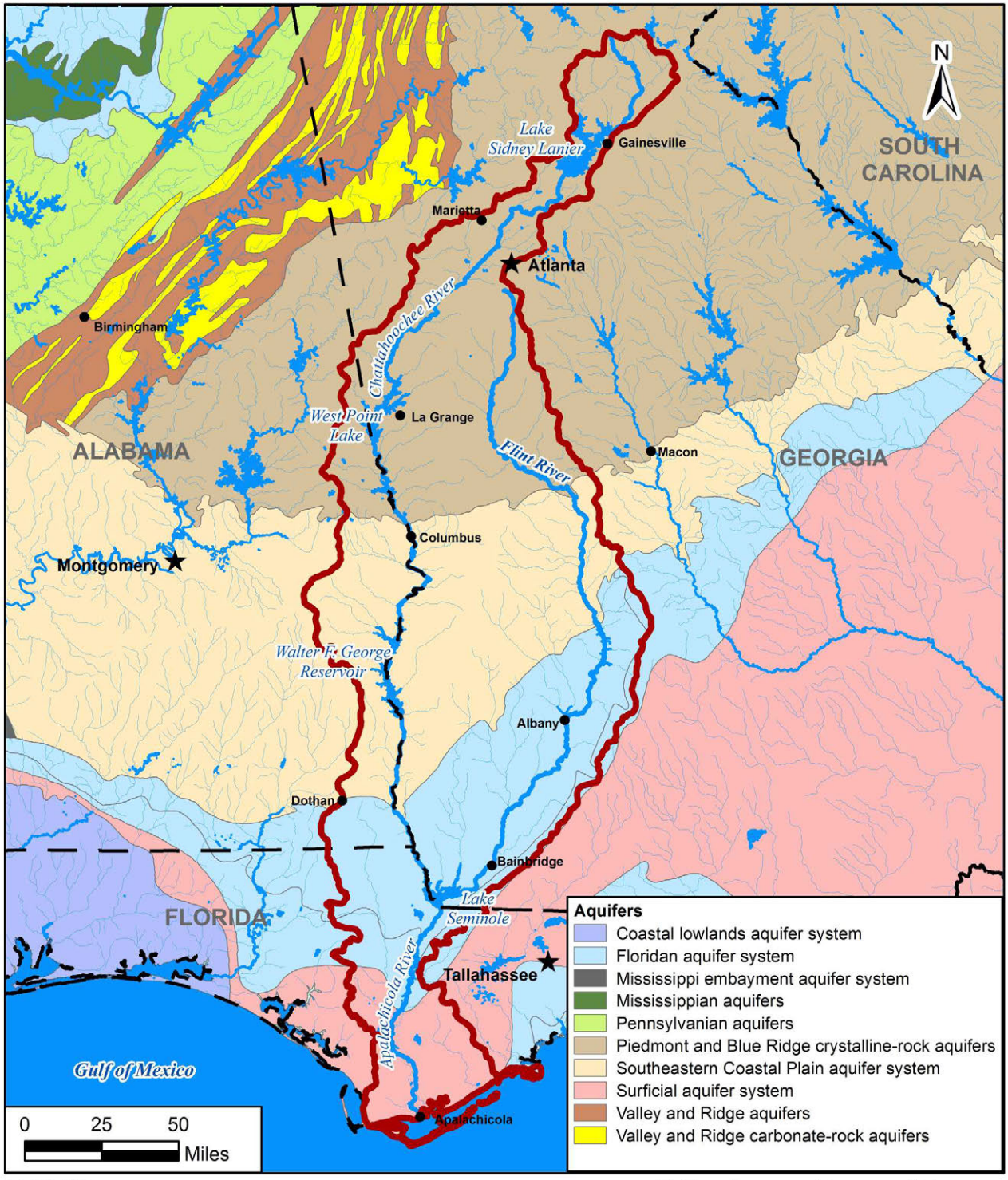
The major aquifers in the ACF Basin include the surficial aquifer system, the Upper Floridan aquifer system, the Claiborne aquifer, the Clayton aquifer, the Providence aquifer, and the crystalline rock aquifer (Figure 2.1-39).

Groundwater in the ACF Basin generally flows from northwest to southeast, with some variation in local flow. Near major stream channels, and in areas of major water withdrawals, the flow is vertically upward and downward, but is mainly perpendicular to the stream channel, which demonstrates good hydraulic connection between groundwater and surface water. Rivers and streams in the southern half of the basin are deeply incised into the underlying aquifers and can receive substantial amounts of groundwater. For example, the Upper Floridan aquifer is hydraulically connected to the Flint River and, consequently, groundwater discharge contributes more significantly to baseflow in the Flint River than in the Chattahoochee River. Groundwater discharge to the Chattahoochee River is roughly 20 percent of the amount discharged to the Flint River (Frick et al. 1996).

The Blue Ridge and Piedmont are underlain by a metamorphic and igneous crystalline rock aquifer. The crystalline aquifer is overlain by a regolith of soils and saprolite of varying thicknesses, from 10 to 150 ft. The crystalline rocks have less than 2 percent primary porosity and little permeability. Most groundwater is stored in the saprolite, which has porosities of 20 to 30 percent. Water is transmitted from the saprolite to the crystalline bedrock via fractures that have formed in the rock from differential weathering at joints, faults, and quartz veins (Chapman and Peck 1997a). The volume of water stored in the saprolite is controlled by the porosity and thickness, while the volume of water stored in the bedrock is controlled by the degree of fracturing. The surface water drainage basins directly overlay the groundwater basins, and the two are interconnected; pumping of the groundwater reduces streamflow at a 1:1 ratio (GAEPD 1997).

The crystalline rock aquifer is used for private water supplies and livestock watering and may yield quantities of water suitable for public or industrial supply. The groundwater supply in the crystalline aquifer is typically not sufficient to meet M&I supply demands (Chapman and Peck 1997a, b; GAEPD 1997). Well yields are highly variable and are dependent on the number and type of intersections of cracks and fractures in the bedrock. Wells typically yield 1 to 25 gallons per minute (gpm), but the yield can range from 0 gpm in wells with no fracture intersections to 700 gpm in wells with primary fracture intersection (Chapman and Peck 1997a,b).

Water quality in the crystalline aquifer is typically suitable for drinking. The high clay content in the saprolite prevents pollutants from migrating into the bedrock aquifer, but there can be localized elevated concentrations of iron, manganese, sulfate, and nitrates from the minerals in the weathering rocks (Chapman and Peck 1997a; GAEPD 1997). For example, a drilling experiment in Cobb County, Georgia, yielded wells with high sulfate content that were not suitable for drinking water. The weathering can also produce acidic water, which can corrode copper lines, and radon gas from the natural radioactive decay of uranium in the rocks (Chapman and Peck 1997a).



Major Aquifers

Figure 2.1-39

The Southeastern Coastal Plain aquifer system comprises numerous semiconfining to confining units. The aquifers are difficult to distinguish from each other and are often mapped as one unit. The Claiborne aquifer crops out at the Fall Line and is confined in southwestern Georgia. It is composed of sand and sandy limestone from the Eocene age, and yields are typically less than 100 gpm. The Claiborne aquifer supplies water in southwestern Georgia and is composed of Paleocene sand and limestone. Well yields range from 100 to 700 gpm. Several layers of interbedded aquifers are within the Upper Cretaceous sediments, including the Providence aquifer. The Providence aquifer is one of the most prominent aquifers in the Upper Cretaceous sediment and is the deepest of the principal aquifers in the Southeastern Plains. It serves as the major source of water in the northern section of the Southeastern Plains, and wells in the aquifer yield 100 to 300 gpm. The Upper Cretaceous aquifers are composed of sand and gravel, and the layers are contained in clay and silt, which function as confining beds (GAEPD 1997).

Long-term heavy pumping from the Claiborne, Clayton, and Upper Cretaceous aquifers has resulted in significant water-level declines in the Albany, Georgia, area. The recharge area of the Clayton aquifer is small, and pumping rates have greatly exceeded recharge rates (GAEPD 2006).

The Upper Floridan aquifer, in the lower portion of the ACF Basin, stores and transmits large quantities of water. It is unconfined and semiconfined and is composed of a sequence of carbonate rocks that vary in thickness and transmissivity. Variations in transmissivity, from 2,000 to 1,300,000 sq ft per day, are caused by the size and distribution of the limestone and its openings and proximity to streams (USACE, Mobile District 1998a). Limestone thickness can range from 100 to 1000 ft (Edmiston 2008), and the greater thicknesses have higher transmissivity. Openings are often largest at bedding planes and fractures, and near streams due to acceleration of opening development by the surface water (USACE, Mobile District 1998a). One of the thickest and most productive limestone formations, the Ocala Limestone, is found in the karst topography of the Dougherty Plains (GAEPD 1997; FLDEP 2002).

Groundwater flow in the Floridan aquifer is from north to south, but flow direction can vary locally depending on the vicinity of streams and large groundwater withdrawal pumps. Rivers and streams in the Coastal Plain and Southern Piedmont are often incised into the aquifer and receive groundwater discharge from the aquifer (Edmiston 2008). In the Upper Floridan aquifer, groundwater levels rise and fall seasonally and with precipitation levels. Groundwater levels are often the lowest in the summer due to groundwater pumping for irrigation, increased evapotranspiration, and decreased rainfall (Mayer 1997).

The Surficial aquifer system is a shallow, unconfined water-table aquifer in Florida. It is recharged through rainfall, and seasonal precipitation patterns directly affect groundwater levels. Groundwater levels are also affected by prolonged droughts, water withdrawals, and evapotranspiration (FLDEP 2002). Flows in the Apalachicola River also affect groundwater levels, but this impact is less pronounced as proximity to the river is decreased (USACE, Mobile District 1998a). The aquifer has low permeability and is not a primary source of water supply; it is typically used only for isolated domestic wells (USACE, Mobile District 1998a). Because the surficial aquifer is primarily fed by rainwater, it is susceptible to contamination (Edmiston 2008).

As part of the ACF Basin Comprehensive Study in the 1990s, USGS conducted groundwater modeling in the Upper Floridan aquifer to investigate the long-term, or steady-state, effects of groundwater pumping on streamflow (Torak and McDowell 1996). A major assumption built into the model runs was that groundwater withdrawal from the Upper Floridan aquifer was steady and continuous, and would allow steady-state conditions to be established in the stream-reservoir-aquifer flow system. Results of this modeling suggested that, under these conditions, the effect of pumping 1 gallon (gal) of groundwater from the Upper Floridan aquifer would be about a 0.6-gal reduction in the groundwater contribution to streamflow. That is, reductions in streamflow caused by groundwater withdrawal occurred in a 0.6-to-l ratio of the amount of groundwater pumped under steady-state conditions. However, it should be noted that the model assumed that groundwater withdrawals occurred under conditions in which steady state

had been reached in the flow system, and steady-state conditions could be established only after the aquifer had been given an adequate amount of time to fully respond to the long-term effects of continuous groundwater withdrawal at a constant rate. In areas of the basin north of the Fall Line, the ratio was 1 to 1 (i.e., for every 1 gal of groundwater withdrawal, there was a 1-gal reduction in river flow). In the Coastal Plain (the area below the Fall Line and north of the extent of the Upper Floridan aquifer), the ratio was found to be 0 to 1 (i.e., groundwater withdrawal had no effect on surface water flows) (USACE, Mobile District 1997).

In reality, the effects of groundwater withdrawal on surface water are transient (i.e., neither steady nor continuous) because groundwater is not pumped at a continuous rate long enough to allow the system to fully respond. Other transient effects on the flow system are caused by changes in hydrologic boundaries with time, such as lateral and vertical flows into and out of the basin by recharge, vertical leakage, and regional flow. Therefore, because groundwater withdrawals fluctuate according to time of day, seasonal variations, weather conditions (e.g., drought), and a wide variety of economic factors, the stream-reservoir-aquifer water system never actually reaches the steady-state conditions necessary to create the 0.6-to-1effect from groundwater pumping on streamflow. This is further confirmed by the actual hydrologic effects that have been observed historically. Aquifer response to groundwater withdrawal is not instantaneous. Instead, aquifer response lags in time behind changes to the pumping rate due to hydraulic storage properties in the aquifer and semiconfining units of the affected flow system. Major water-bearing units in the lower ACF Basin do not exhibit long-term declines in water levels during drought conditions. During the droughts of the early and late 1960s, 1980 to 1981, and 1986 to 1988, water levels declined to record or near-record levels, but they recovered to predrought conditions with the return of normal precipitation (Torak and McDowell 1996).

Surface water features have variable effects on groundwater levels in the lower ACF Basin. Despite the potential for hydraulic connection between the Upper Floridan aquifer and Flint River, sudden changes in river stage for short durations do not necessarily cause corresponding water level changes in the aquifers. Surface water impounded behind dams does, however, locally affect groundwater levels. For example, at Lake Seminole, the pool elevation is maintained at an elevation of about 77 ft year-round, which causes the water levels nearby in the adjacent aquifer and overlying semiconfining unit to be nearly constant. However, it should be noted that groundwater levels in the Upper Floridan aquifer near Lake Worth are influenced by regional flow from the north.

Downstream from Lake Seminole, the stage of the Apalachicola River influences groundwater levels in the floodplain. Observation wells across the floodplain near Blountstown and Sumatra, Florida, indicate that groundwater levels depend on the river stage; however, water level fluctuations in the river are dampened in the floodplain by movement of water through the floodplain soils.

2.1.1.1.8 Estuarine Conditions

The Apalachicola Bay is a wide, shallow estuary along the Gulf Coast and is oriented east to west. The Gulf of Mexico enters the bay on the east side, and the Apalachicola River enters the bay on the west side. Water movement is from east to west and velocities are typically less than 1.5 cfs, except at passes on the west side of the bay, where velocities can range from 3.3 cfs to 11.5 cfs as water leaves the bay. Salinity is heavily influenced by flow from the Apalachicola River, decreasing both north to south and east to west as freshwater input from the river increases (Edmiston 2008).

The Apalachicola Bay is in a tidal transition area in the Gulf of Mexico. Tides within the bay are a mix of semidiurnal tides and diurnal tides, and the mixing produces one to five tides daily. Larger tidal variation is found in the eastern bay near the mouth to the Gulf of Mexico due to a stronger diurnal signal. The tidal range in the bay is normally 1 to 2 ft, but it can be as high as 3 ft. Strong winds can alter water movement, obscuring tidal effects and mixing shallow water in the bay (FLDEP 1998).

Mean annual discharge from the Apalachicola River to the bay is approximately 25,000 cfs, but minimum and maximum flow average 9,300 cfs and 200,000 cfs, respectively. Low flows occur in the summer and fall, and high flows occur in the winter and spring (FLDEP 1998). Freshwater inflow to the bay is determined by water releases from Lake Seminole (Jim Woodruff Lock and Dam) and inflows from tributaries to the Apalachicola River below the dam. Releases from Jim Woodruff Lock and Dam are the dominant influence on freshwater inflows. Of the approximately 20,000 sq mi contributing to the bay, only about 2,400 (or about 12 percent) are in Florida, causing rainfall amounts in the Chattahoochee and Flint River basins to heavily influence freshwater inflow into the bay (Edmiston 2008). During normal rainfall periods, the Chattahoochee River tends to contribute twice as much flow to the Apalachicola River as the Flint River; during drought periods, the Flint River tends to contribute more flow to the Apalachicola because of groundwater contributions. Releases from Jim Woodruff Lock and Dam are highly variable but, as discussed in section 2.1.1.2.4.4, the minimum release from the lake is 5,000 cfs (except under extreme drought conditions, when it can be as low as 4,500 cfs).

Approximately 247,000 ac encompassing the Apalachicola Bay and lower portion of the Apalachicola River are designated as the Apalachicola National Estuarine Research Reserve (ANERR). ANERR is one of 25 sites designated by the National Oceanic and Atmospheric Administration (NOAA) as a research reserve. The Reserve program is a federal/state partnership with the Florida Department of Environmental Protection (DEP) as the state program administrator. The ANERR is a consortium of management entities with various state and federal agencies assigned lead role management within the reserve. National Estuarine Research Reserves (NERRs) have been established to provide opportunities for long-term estuarine research and monitoring, estuarine education and interpretation, resource management, and learning upon which to base more informed coastal management decisions.

Recreation is a critical aspect of water use in Apalachicola Bay. Within the ANERR, there are national wildlife refuges, aquatic preserves, state forests and parks, and water management areas. Many of the recreational areas within the ANERR can be accessed only by boat because the reserve has restricted vehicle traffic. Much of the non-estuarine habitat is forested floodplain and wetlands with very few roads, although some parking lots are provided at popular recreation sites. Recreational activities include boating, freshwater and saltwater fishing, camping, birding, hiking, picnicking, swimming, sailing, hunting, shelling, and canoeing and kayaking. Recreational fishing has become more important in the area with the advent and increase of the tourism industry; it contributes over $35 million annually to the local economy (Edmiston 2008).

Several navigation projects are operated within the Apalachicola Bay and River. One, the ACF navigation project, begins at the confluence of the Apalachicola and Jackson rivers and extends to Columbus, Georgia, on the Chattahoochee River and to Bainbridge, Georgia, on the Flint River. A 9-ft-deep by 100-ft-wide federal navigation channel is authorized in the Apalachicola River, and annual dredging maintained the channel through the late 1990s. Commercial navigation use of the river has declined significantly since 2000 and currently, is nearly non-existent. Issues related to providing conditions suitable for commercial navigation on the Apalachicola River are discussed in more detail in section 2.1.1.2.4.3.

The Gulf Intracoastal Waterway (GIWW) navigation project extends from the eastern part of the bay to the west. The waterway is a 12-ft-deep and 125-ft-wide channel that follows the coastline from Florida through Texas. Dredged material from this channel is principally placed in open water sites. Some dredged material placement locations are controversial due to potentially negative impacts on wildlife. Several other shallow-draft navigation channels are located within Apalachicola Bay, and they are primarily used by oyster boats and shrimp boats. Dredging occurs at these channels every 2 to 15 yr (Edmiston 2008).

2.1.1.2 Water Management and Use in the ACF Basin

USACE projects in the ACF Basin were constructed and are operated to meet federally authorized project purposes. Water control objectives and operational guidelines to meet the authorized project purposes at USACE reservoirs in the ACF Basin are recorded in WCMs. An individual project-specific WCM has been prepared for each of the reservoir projects at some point after it was constructed and placed into operation (see section 3.4), which includes specific water control plans for the project. The original Master WCM for the basin as a whole was completed in 1958. The WCMs were developed in thorough consideration of all project purposes and cover a full array of all foreseeable hydrologic conditions, from flood to drought. This section summarizes the authorized project purposes and associated current water management activities for USACE projects in the ACF Basin, as described in the draft Master Manual (USACE, Mobile District 1989), in existing individual project water control plans, and in other documents as specifically noted.

2.1.1.2.1 Authorized Project Purposes—USACE Reservoirs

The ACF project has been authorized by Congress in several legislative acts.

- *Section 2 of the River and Harbor Act (RHA) of 1945* (P.L. 79-14) approved the general plan recommended in House Document 342, 76th Congress, for development of the Apalachicola, Chattahoochee, and Flint Rivers in Georgia and Florida. The recommended plan authorized two locks and dams to provide for navigation and power: one at Fort Benning and one at the confluence of the Chattahoochee and Flint Rivers. Additionally, the plan included navigation-power dams with locks at four sites on the Chattahoochee River between Fort Benning and the junction; three storage-power dams on the upper Chattahoochee River; and three storage-power reservoirs on the Flint River.
- A modification to the 1945 general plan was authorized by *section 1 of the River and Harbor Act of 1946* (P.L. 79-525), in accordance with the report of the Chief of Engineers dated May 13, 1946 (House Document 300, 80th Congress), to include Buford multipurpose reservoir (Lake Lanier), the Fort Benning Lock and Dam, and the Upper Columbia and Jim Woodruff multipurpose developments. The project's navigation feature was to be provided by dredging, channel contraction works, construction of a series of locks and dams, and flow regulation by the upstream reservoirs. The 1946 amendment provided that, in the Apalachicola River portion of the project, "…local interests furnish free of cost to the U.S., as and when required, all rights-of-way, spoil-disposal areas, easements and other lands required for the provision and maintenance of a navigation channel in the Apalachicola River…".
- Further modifications authorized by Congress in 1953 (*House Committee Public Works Resolution adopted May 19, 1953*) substituted the George W. Andrews and Walter F. George Locks and Dams in lieu of authorized projects formerly identified in the 1945 general plan at different locations on the Chattahoochee River as the Upper Columbia multipurpose project and Fort Benning Lock and Dam.
- *Public Law 84-841*, enacted July 30, 1956 (1956 Act), granted USACE authority to enter into an agreement with Gwinnett County, Georgia, for the allocation of 11,200 ac-ft of storage for regulated water supply.
- The *Flood Control Act of October 23, 1962* (P.L. 87-874), authorized West Point Lake in accordance with House Document 570, 87th Congress, for flood risk management, hydroelectric power generation, navigation, recreation, water quality, and, fish and wildlife conservation.

- Other operational objectives for the ACF projects derive from authorities that generally apply to all USACE reservoirs, including the following:
  - Fish and wildlife conservation (Fish and Wildlife Coordination Act of 1958 [P.L. 85-624] and the Endangered Species Act (ESA) of 1973 [P.L. 93-205])
  - Recreation (Flood Control Act of 1944 [P.L. 78-534])
  - Water quality (Federal Water Pollution Control Act of 1972 and its amendments, including the Clean Water Act of 1977 and the Water Quality Act of 1987)
  - Water supply (Water Supply Act of 1958 [P.L. 85-500])

The following paragraphs describe the authorized purposes for which the ACF project is operated.

Flood Risk Management. Heavy rains produce floods, which can raise a lake level several feet overnight. When floods are over, it is important to prepare the reservoir to store floodwaters for the next flood event. When a flood event occurs, releases from the dam are curtailed or minimized until downstream conditions allow or if the reservoir reaches its capacity to hold floodwaters. When conditions allow, USACE releases water to evacuate the floodwaters as quickly as possible to prepare for the next potential flood event.

Not all USACE projects are designed to manage flood risk, and no dam can eliminate risk from every flood. Some major floods will eventually exceed the flood capacity of a dam. Typically, in a major flood, the dam will help reduce the peak flow of the flood and help reduce the amount of risk or damage that might have occurred if the dam was not there. In the ACF Basin, Buford Dam and West Point Dam were authorized specifically for flood control. Terminology used within USACE to refer to this project purpose has changed over time. USACE currently uses the term "flood risk management" rather than "flood control," recognizing that floods cannot be controlled, but the risks associated with flooding can be managed through the operation of USACE reservoir projects.

Hydroelectric Power Generation. Water power plays an important part in providing reliable and relatively inexpensive energy. Most hydroelectric power generation is peaking power. The generators are turned on when the most, or peak, demand for power occurs. Hydroelectric power generation can start quickly, making it an important safety feature of an electric system.

Under the provisions of section 5 of the Flood Control Act of 1944 (P.L. 78-534) and other acts, power generated at USACE projects, which USACE determines to be surplus to project needs, is delivered to the Secretary of Energy for marketing. Buford Dam, West Point Dam, Walter F. George Lock and Dam, and Jim Woodruff Lock and Dam are authorized for hydroelectric power generation. The Southeastern Power Administration (SEPA) sells hydroelectric power from the USACE lakes in the ACF Basin to a number of electric cooperatives and municipal retail suppliers of power, referred to as *preference customers*.

Navigation. Navigation was one of the earliest uses of the nation's southeastern rivers. Native Americans and early European settlers used the rivers for transportation and commerce. Keeping rivers clear for navigation was one of the first USACE missions. Today's commercial barge lines still use rivers to move significant quantities of bulk materials by barge. In the ACF Basin, all five federal projects (i.e., Buford Dam, West Point Dam, Walter F. George Lock and Dam, George W. Andrews Lock and Dam, and Jim Woodruff Lock and Dam) are authorized to support navigation. Locks were constructed at the Walter F. George, George W. Andrews, and Jim Woodruff projects to facilitate navigation upstream to Columbus, Georgia, on the Chattahoochee River and to Bainbridge, Georgia, on the Flint River.

As stated above, the original plan for navigation provided for a minimum flow in the Apalachicola River, which together with dredging, would ensure adequate navigation depth. In drier months, water may be taken from reservoirs to augment natural river flow. Augmentation can often result in the decline in

reservoir levels. At the present time, USACE is unable to perform dredging in the Apalachicola River for reasons described in detail in section 2.1.1.2.4.3. Accordingly, navigation on the Apalachicola River occurs only during seasonal periods, in the winter and early spring months, when adequate natural flows support the required navigable depths. Other special shipments can occur on an emergency basis, but they are scheduled and managed by coordinating with stakeholders to minimize fluctuating lake and river level effects.

Fish and Wildlife Conservation. Fish and wildlife conservation is a specifically authorized project purpose at West Point Dam and Lake. Fish and wildlife conservation is also an authorized purpose of the entire ACF Basin in accordance with the Fish and Wildlife Coordination Act (FWCA) of 1958 (P.L. 85-624), as amended. The FWCA directs that equal consideration be given to fish and wildlife resources and that measures to conserve those resources may be incorporated, along with other project features, into water resources development projects. The FWCA stipulates, however, that for projects authorized prior to the FWCA date of enactment—such as the ACF Basin project—modification of operations shall be compatible with basic project purposes. USACE recognizes the importance of keeping a healthy population of fish and sustainable terrestrial habitats. Each year, in coordination with the USFWS and state fishery agencies, USACE works to keep lake levels stable during the spring fish spawn period and to provide necessary releases to support fish spawning in downstream river reaches during designated periods. At other times of the year, USACE cooperates by manipulating releases and lake levels to improve fisheries, in both the reservoirs and the downstream river reaches. All USACE reservoirs in the ACF Basin support important fisheries and are operated accordingly, consistent with other project purposes. In addition to fishery management, operations include aquatic plant control and waterfowl management activities. The various basin projects have specific operations for fish and wildlife conservation, which are described in the individual WCMs for the projects.

Beginning in 2006, USACE has consulted with the USFWS under section 7 of the ESA on operation of ACF Basin projects. Operational parameters at Jim Woodruff Lock and Dam have been established through the ESA consultation, including minimum flow releases, as set forth in the 2012 Revised Interim Operating Plan (RIOP). Specific activities under the RIOP are described in detail in section 2.1.1.2.4.4.

Recreation. With a large economic expansion due to local and interstate tourism, recreation at USACE lakes has become a very important resource. Recreation is one of the original congressionally authorized purposes for West Point Dam and Lake. At the other four federal ACF Basin projects, recreation facilities are authorized by the Flood Control Act of 1944. This act authorizes USACE "...to construct, maintain, and operate public park and recreational facilities at water resource development projects under the control of the Secretary of the Army…" Further, the Federal Water Project Recreation Act of 1965 (P.L. 89-72), as amended, established the development of recreation potential at federal water resource projects as a full project purpose. The ACF projects do not have any reservoir storage specifically allocated for recreation. Accordingly, although recreation is an authorized project purpose, it is secondary (relative to storage operation) to project functions for which the reservoir storage was formulated (EM 1110-2-3600, p. 2-29).

Water Quality. Federal projects operate to sustain or improve water quality conditions, consistent with other specifically authorized project purposes. Three of the dams in the ACF Basin have minimum release obligations: Buford Dam, West Point Dam, and Woodruff Lock and Dam. The minimum flow requirements at Buford and West Point dams are based on the original project authorization. As noted above, the minimum flow releases at Jim Woodruff Lock and Dam are necessary to comply with USACE's ESA requirements as set forth in the 2012 RIOP. The releases from the three dams help to ensure healthy aquatic life, even when treated or used waters are added at downstream points. Project operation can influence water quality as it relates to temperature, dissolved oxygen, and nutrients and can help benefit water quality purposes on downstream lakes and river reaches.

Water Supply. Much of the M&I water supply in the ACF Basin comes from surface water in streams, rivers, and reservoirs. Even in the worst droughts in history, streams and rivers provided sufficient flow to accommodate domestic and M&I water supply needs. However, cities and industries have grown and become more dependent on reservoir storage for a dependable water supply. Federal projects in the ACF Basin do not currently include allocations of storage for water supply. Additionally, as a by-product of operating the federal projects for other purposes, downstream users may receive an incidental water supply benefit.

In connection with the initial construction of Lake Lanier and West Point Lake, USACE entered into relocation agreements authorizing direct withdrawals from those reservoirs, in compensation for the federal taking of preexisting intake facilities or lands. There are relocation agreements with the cities of Buford and Gainesville, Georgia, at Lake Lanier and with the city of LaGrange, Georgia, at West Point Lake.

The accommodation of additional water supply withdrawals from Lake Lanier and from the Chattahoochee River downstream are discussed in sections 2.1.1.2.4.6 and 3.3. The 11th Circuit Court of Appeals determined in 2011 that release of water from Buford Dam to accommodate downstream water supply withdrawals for Metro Atlanta needs is a project purpose authorized by the 1946 River and Harbor Act. In the ruling, the court also affirmed that reallocation of water supply storage withdrawals directly from Lake Lanier, except for withdrawals covered by the relocation agreements, would be addressed in accordance with the provisions of the Water Supply Act of 1958. A more complete discussion of the 11th Circuit Court of Appeals opinion can be found in section 3.5.2.8.2.

2.1.1.2.2 ACF Regulation Master Manual - Overview

The initial Master Manual for the ACF Basin was completed in February 1958, shortly after completion of the Jim Woodruff Lock and Dam and shortly before Buford Dam was fully completed and in service. Therefore, the 1958 Master Manual essentially summarized natural basin characteristics and did not include a comprehensive explanation of the interrelationships of the projects or a systemwide water control plan. However, the 1958 Master Manual stated that "full consideration will be given to all water uses, such as flood control, navigation, power and water supply" (USACE, Mobile District 1958). In discussing the interrelationship of the ACF Basin projects, the 1958 Master Manual stated that the operating plan for the existing projects together with the contemplated projects would be operated as "an integrated and mutually interrelated system that will make the most complete practical use of the water resources of the basin" (USACE, Mobile District 1958).

With the completion of the WCM for Buford Dam in 1959, the USACE interpretation of congressional intent was reflected in both the USACE Master Manual and the operating manual for Buford Dam, "ensuring an adequate water supply for the Atlanta area by releases from Buford Dam" (Stockdale 2012). The 1959 WCM for Buford Dam confirmed the intended operation of the dam for downstream water supply stating, "[t]he increased flow in dry seasons also provides for an increased water supply for [M&I] uses in the metropolitan area of Atlanta…" (USACE, Mobile District 1959). Additionally, the WCM stated, "the Buford project will be operated as a peaking plant for the production of hydroelectric power generation with minimum releases during the daily and week-end off-peak periods which will be sufficient, with local inflows added, to supply the Atlanta area with not less than 600 cfs. During low-water periods such regulation will provide increased flow downstream for navigation, water supply, pollution abatement and other purposes" (USACE, Mobile District 1959).

Since completion of all the federal projects in the ACF Basin and as operating experience has been gained, the regulation plans for the reservoirs have evolved. Operational adjustments are detailed in the WCMs for the individual projects, which have been designated as appendices to the 1989 draft update to the Master Manual for the entire ACF Basin.

Jim Woodruff Lock and Dam was completed in 1957, when the ACF Basin was entering a *normal* period of hydrometeorological conditions, during which sufficient flows were generally available to meet all basin requirements. This period lasted throughout the 1960s and 1970s. Drought episodes were experienced with uncommon frequency and severity during the 1980s. The summer of 1980 through the fall of 1981 marked the beginning of this trend, with the most severe basinwide event during the decade occurring in 1986 (see section 2.1.1.1.1.2). As that decade progressed, it became increasingly apparent that previously established operational procedures were not adequate to appropriately respond to severe drought conditions.

On the basis of those experiences, USACE, Mobile District responded to requirements for drought contingency planning as defined in ER 1110-2-1941 (September 1981). The Interim Drought Management Plan for the ACF Basin (USACE, Mobile District 1985) provided generalized guidance for drought management actions and established interagency coordination procedures. An Emergency Drought Management Strategy (USACE, Mobile District 1986) specifically addressed circumstances in the acute 1986 drought and provided useful strategies and guidelines for addressing management of USACE projects in the ACF Basin during subsequent water shortage periods. Individual project WCM updates and supplementary documentation developed since then, including experience from the significant droughts of 1998-2002 and 2006-2008, contain more detailed descriptions of water control actions invoked during droughts.

As indicated above, purposes for which the federal projects in the ACF Basin are operated include flood risk management, hydroelectric power generation, navigation, fish and wildlife conservation, recreation, water supply, and water quality. Fish and wildlife conservation, recreation, water quality, and water supply are considered purposes under general legislation, including the Flood Control Act of 1944, Federal Water Project Recreation Act of 1965, Water Pollution Act of 1972, as amended, Water Supply Act of 1958, FWCA, and ESA. The exception is West Point Lake, where fish and wildlife conservation and recreation are specifically cited purposes in the congressional authorization. USACE policy states that legally authorized purposes recognized after project construction receive appropriate consideration when making water control decisions just as the project purposes that were specified in the original project authorizations do.

ACF Basin water control operations consider all project functions and account for the full range of hydrologic conditions from flood to drought. Because actions taken at the upstream portion of the basin affect conditions downstream, the federal projects in the ACF Basin are operated as a system rather than as a series of individual, independent projects. The balancing of water control operations to meet each of these purposes varies between the individual projects and time of year. Operation of the projects is usually performed in a manner that represents a consideration of the oftentimes competing purposes and, whenever possible, reservoir operations are managed to accommodate these purposes in a complimentary fashion. For example, flood waters are evacuated to the greatest extent practicable through the powerhouse turbines to produce electricity. In addition to specific purposes for which these projects are operated, over the years a variety of activities (e.g., M&I water supply, in-stream recreation, water quality) have become dependent upon the operational patterns of the projects.

Traditionally, the federal projects in the ACF Basin have been operated to control hydroelectric power generation requirements during the summer months when energy demands are high, while navigation needs dominate during the fall, low flow months. Whenever rainfall has caused water levels to rise excessively, flood risk management operations override other project functions. During extreme drought conditions, water supply and water quality requirements have been the major operating concerns. During the extreme drought period beginning in 2006, federally listed threatened and endangered species conservation also became a priority consideration in managing the system. This water management approach recognizes that extreme droughts can produce situations where trade-offs are required. For example, in extreme droughts, project operations directed primarily at water supply, water quality, and/or

endangered species conservation might receive higher consideration than other purposes, such as hydroelectric power generation, navigation, and recreation.

2.1.1.2.3 ACF Water Control Objectives and Guidelines—General

This section summarizes current water management practices for the ACF Basin, which will remain in effect pending an updated and approved Master WCM prepared by USACE. Future specific congressional direction or an agreement among the states on a water allocation formula could dictate further revision of the Master Manual.

The water management practices for the ACF Basin described in this section are detailed in the following documents:

- Draft ACF Water Control Plan, dated 1989
- Project WCMs for Buford (1991), West Point (1984), Walter F. George (1993), George Andrews (1996), and Jim Woodruff Lock and Dam (1985) (USACE, Mobile District 2010b)
- RIOP and Environmental Assessment (EA) (June 2008), as modified by the May 2012 RIOP/EA
- South Atlantic Division Regulation (DR) PDS-O-1, *Project Operations, Lake Regulation and Coordination for Fish Management Purposes* (May 31, 2010) and draft *Reservoir Regulation and Coordination for Fish Spawn Management Purposes Standard Operating Procedure* (SOP), (USACE, Mobile District SOP 1130-2-9) February 2005
- CRMS as described in the ACF Basin Master Reservoir Regulation Manual, Appendix B, Buford Dam (Lake Sidney Lanier) Chattahoochee River, GA, February 1991

The reservoirs in the ACF Basin are managed and operated in accordance with authorized project purposes and as an integrated system of water resource projects in which each reservoir has a role to play. Operations at each project are coordinated with the other projects to best meet authorized purposes and balance frequently competing water resource requirements. The balancing of water control operations to meet each of these authorized purposes varies between the individual projects and time of year (USACE, Mobile District 2010b). Many interests and conditions must be continually considered and balanced when making water control decisions for the basin. Flexibility must be maintained to address the short-term needs of one project function without jeopardizing the long-term requirements of another.

Many factors must be evaluated in determining project or system operation, including project requirements, time of year, weather conditions and trends, downstream needs, and the amount of water remaining in storage. The guidelines are not limited to a specific hydrologic condition, and, therefore, the Master Manual differs from a flood risk management or drought management plan; however, the plan is broad enough that it can fulfill requirements for a drought management plan.

The following sections describe the water control objectives and guidelines for specific project purposes for USACE projects in the ACF Basin.

2.1.1.2.4 ACF Basin Water Control Objectives and Guidelines by Project Purpose

2.1.1.2.4.1 Flood Risk Management

The objective of flood risk management operations (formerly referred to as flood control) is to impound excess flows, thereby reducing downstream river levels below flood stage. Whenever flood conditions occur, operation for flood risk management takes precedence over all other project functions. Only Buford and West Point dams have storage allocated for flood risk management operations. During the principal flood season, December through April, the regulation plan at Walter F. George Lake provides

for lower lake levels to ensure lower peak stages throughout the reservoir during major floods. George W. Andrews and Jim Woodruff lock and dams operate to pass inflows.

The timing of flood peaks in the ACF Basin is of considerable importance in determining the effectiveness of reservoir operations for flood risk management and the degree to which such operations can be coordinated. During a flood event, excess water above the guide curve is evacuated (released) consistent with other project needs as soon as downstream waters have receded enough that releases from the reservoirs will not increase the natural maximum flood heights downstream. This timely evacuation is necessary so that consecutive flood events will not cause floodwaters to exceed allocated storage capacities and endanger the integrity of the dam. Both turbines and spillways are used, as necessary, to evacuate floodwaters.

Because flooding usually occurs in the winter and spring when rainfall and runoff are more plentiful and hydroelectric power generation demands are lower, the guide curve operation generally reflects this situation by specifying a lower elevation during this time period. Transitions between the seasonal levels are gradual to moderate increases or decreases in outflow. By drawing down the pool in late fall, either specifically for flood risk management as at West Point or coincidentally for other purposes, additional storage is gained for containing floodwaters.

For flood risk management purposes, releases are reduced or terminated at Buford Dam, except for the small hydropower unit, as soon as it appears that downstream river stages will exceed flood stage. Key gaging stations in the vicinity are closely monitored to determine when floodwaters have begun to recede so that flood storage in the reservoir can be expeditiously evacuated in a manner consistent with other project functions without exacerbating downstream flooding. Projects on the middle and lower river pass flood waters once the pool has reached the top of the conservation pool. West Point and Walter F. George dams operate according to specified flood risk management plans, as outlined in their WCMs. Spillway gates are opened if necessary to assist the turbines in passing these flows.

Even though the traditional flood season spans several months, discrete incidences of flooding should have insignificant long-duration effects if pool elevations are maintained close to guide curve elevations. No pool is allowed to remain above its guide curve for any appreciable length of time without prior approval of a temporary deviation or variance by USACE, South Atlantic Division.

2.1.1.2.4.2 Hydroelectric Power Generation

Hydroelectric power generation is a small but key feature in meeting the power demands of the region, with the plants providing a power source that meets a portion of the region's peak demands for electric power. Peaking capability on short notice is greatly valued for power grid reliability. Hydroelectric power generation is instantaneously available to meet extreme increases in power demand or to replace unexpected interruptions in thermal generation. The power generated by USACE projects in the ACF Basin is marketed by the Southeastern Power Administration (SEPA), an agency of the Department of Energy. SEPA markets power on the basis of a system that comprises a large geographical area to a number of cooperatives and municipal retail suppliers of power, referred to as *preference customers.* Projects within SEPA's Georgia-Alabama-South Carolina system include Buford, West Point, and Walter F. George on the Chattahoochee; four projects in the Alabama, Coosa, and Tallapoosa River Basin; and three projects on the Savannah River Basin. The 10 powerhouses in this system have been operated most of the time as *peaking plants* in an integrated fashion to produce an aggregate hydroelectric power generation supply for the system. As a result, power generation demands have been balanced among the projects weekly to enhance the long-term generating capability of the entire system. By integrating the operation of these projects, the total utility and marketability of power produced for the entire system is greatly increased and the adverse effects on the reservoirs are more balanced. When the system obligation cannot be met, the SEPA arranges for supplemental power or purchases from other sources, or both.

The storage projects (i.e., Buford, West Point, and Walter F. George) generally provide at least 2 hours of generation a day, 5 days a week at powerhouse capacity throughout the year, as long as sufficient conservation storage is available. The amount of generation per day is governed by a preset guide curve and action zones for each reservoir, with diminishing energy generation with declining storage. Minimum generation provides the release that would normally meet downstream water supply and water quality demands, as well as the capacity specified in SEPA's marketing arrangement. During the summer and early fall (July through October), typical operation provides minimum generation of 4 hours a day at a project if the pool level is above Zone 3, as identified in Figure 2.1-22 (Buford), Figure 2.1-28 (West Point), and Figure 2.1-33 (Walter F. George). This increase assists in meeting the high energy demands during that period. Minimum releases can also be increased if local inflows below the project are insufficient to meet water quality/water supply requirements. Additional generation solely to meet system hydroelectric power generation demands does not occur.

The Jim Woodruff (Lake Seminole) project is operated as a run-of-river plant and is dependent on releases from the upstream impoundments on the Chattahoochee River and from the Flint River. Unlike projects with appreciable conservation storage, run-of-river hydroelectric power generation facilities do not follow a guide curve, nor do they fluctuate or redistribute flows. The output of the plant varies with changes in the inflow entering Lake Seminole. The Jim Woodruff is a 1-project system, and the power it generates is marketed by SEPA to seven preference customers in the northern part of Florida to provide a specific minimum capacity and weekly energy. When that obligation cannot be met, the SEPA arranges for supplemental power or purchases from other sources, or both.

Droughts experienced over the basin in the past 35 years have revealed that, during extended low flow seasons, operation of the federal projects in the ACF Basin for hydroelectric power generation production to meet the SEPA contract requests does not provide enough flexibility to adequately meet other authorized purposes. During these times, water taken from storage during the high-energy-demand months (June through September) would draw the pools down to such an extent that recreation would be affected in the lakes and less storage would be available late in the year to meet other release requirements, such as navigation or water quality. In such instances, hydroelectric power generation has been curtailed, as necessary, to balance the entire system operation.

2.1.1.2.4.3 Navigation

The existing authorized navigation project includes a 9-ft by 100-ft navigation channel from Apalachicola, Florida, to Columbus, Georgia, on the Chattahoochee River, and to Bainbridge, Georgia, on the Flint River. Hydraulic and sedimentation characteristics of the Apalachicola River have been such that, despite maintenance dredging, the controlling channel depth has typically been less than 9 ft during a large portion of the normal low flow period of the summer and fall each year. Groundings have been frequent, and barge loadings have been reduced considerably at times in the past to avoid grounding delays. This section describes authorized and historical operations in support of navigation in the ACF Basin through 1998, followed by a brief description of current water management operations specifically related to navigation.

Historical Operations (through 1998). The following overview of historical operation for navigation is summarized from a USACE, Mobile District information paper, *Navigation on the Apalachicola River* (USACE, Mobile District n.d.). The Blountstown, Florida, gage, approximately 29 mi downstream of Jim Woodruff Lock and Dam, has been historically used as the critical point of reference for the channel depth availability. With the performance of adequate maintenance dredging and snagging, a stage reading of 5 ft generally translated to a 9-ft channel during the late spring and early summer from 1970 through 1998. With the removal of additional shoals during late summer and early fall, a 9-ft channel could be provided by lower flow conditions and a correspondingly lower stage. Because of inadequate depths,

navigation had to be suspended temporarily during extreme drought years. Over the period 1970–1998, a 9-ft channel was available only about 62 percent of the time, and a 7.5-ft channel was available 82 percent of the time. In dry years, a 7.5-ft channel might be available only 25 percent of the time.

Flow is the primary factor that influences the degree to which authorized project depths in the Apalachicola River navigation channel are achieved. The original design of the project documented that a discharge from Jim Woodruff Lock and Dam of 9,300 cfs together with dredging would provide a 9-ft channel. By the mid-1980s the required discharge with dredging to provide a 9-ft channel was estimated to be 11,000 cfs. By 1995, the predredging flow requirement to provide a 9-ft navigation channel had increased to 16,000 cfs.

The increasing flow requirements to achieve the authorized navigation channel depth and a range of navigation depths in the Apalachicola River are attributable to (1) channel degradation and (2) flow diversion through Chipola Cutoff. Degradation of the upper third of the Apalachicola River streambed has historically occurred as a result of the construction of Jim Woodruff Lock and Dam. This is a typical response of a river system following construction of a dam in that sediment is trapped upstream by the dam and, consequently, the downstream river channel erodes and gets deeper and wider, requiring increasingly more flow to achieve the same channel depth. In the lower reach of the Apalachicola River between RMs 39.0 and 42.0, a section of the river channel divides, creating an island. The navigation channel is on one side of the island while, on the other side, an opening to the adjacent Chipola River called the *Chipola Cutoff* allows Apalachicola River water to flow into the Chipola River. The Chipola Cutoff has been widening over the years and allowing more flow to enter the Chipola River, requiring greater discharges from Jim Woodruff Lock and Dam into the Apalachicola River to achieve the various navigation channel depths.

Three reaches of the Apalachicola River have historically presented major maintenance problems, in terms of high annual dredging quantities, multiple dredging events per year, and the lack of adequate disposal area capacity. They are Corley Slough, between RMs 35.0 and 37.0; Chipola Cutoff, between RMs 39.0 and 42.0; and the Blountstown Reach, which extends from RM 76.0 to RM 81.0. The quantity of dredged material removed from the three river sections has accounted for almost 40 percent of all maintenance dredging on the Apalachicola River. The navigation problems associated with shoaling in these reaches are particularly aggravated during low flow periods.

Following discussions with navigation users during and after the 1986 drought, USACE developed a technique to provide for a planned period of navigation called a *navigation window*. This technique involved temporarily storing sufficient water in West Point Lake, Walter F. George Lake, and Lake Seminole that was then released over a 10-day to 2-week period at a rate to provide for navigable depths (at least a 7.5-ft channel) in the Apalachicola River. This technique was employed beginning in 1990 and continued throughout the decade. Beginning in the mid-1990s, navigation windows were scheduled in advance, approximately one per month during the low-water months, to provide the waterway users a predictable, reliable channel. Because channel conditions were deteriorating, navigation windows were used with increasing frequency to as many as six a year, generally between May and December. While the use of navigation windows proved successful in providing for navigation on the system, the effects on downstream fisheries and other environmental resources and on recreational use in the upstream reservoirs from fluctuations of lake levels necessary to accommodate releases for navigation windows created increasing controversy over the technique.

In accordance with the Water Pollution Act of 1972, as amended, USACE obtained water quality certifications from Florida for maintenance dredging in the Apalachicola River, beginning in 1979. Over the years, conditions placed on the certification imposed increasing restrictions on the usage of dredged material disposal area, and required an extensive monitoring program and the reopening of sloughs along the river. Those actions limited dredged material disposal capacity and increased the costs of channel

maintenance. In response to the limitations, new management techniques (e.g., mechanical redistribution) were developed to provide for additional dredged material disposal capacity. Mechanical redistribution was initiated in 1987 and involved the mechanical grading of material from a within-banks disposal area into the river during high flows to facilitate transport of the dredged sediment downstream with the river bedload. Mechanical redistribution was certified in Florida's water quality certification in 1991, subject to a monitoring program.

Historically, when it became apparent that, due to diminishing inflows to the system, downstream flows and depths had to be reduced, navigation bulletins were issued to project users. These notices were issued as expeditiously as possible to give barge owners and other waterway users sufficient time to make arrangements to either light-load or remove their vessels before action was taken at Woodruff to reduce releases.

Available storage was normally used to extend some level of navigable depth throughout the year. Pondage at Lake Seminole was used hourly and daily to regulate the river. Because Walter F. George Dam is farther upstream and its releases have to travel about 75 RMs through Andrews Lake and Lake Seminole before affecting navigation, its storage provided daily and weekly regulation of flows. Still farther upstream, West Point Lake assisted weekly and monthly regulation. As the furthest upstream location, Lake Lanier storage was used on a monthly time scale. Navigation flows could often be provided by just the lower projects (West Point and Walter F. George), but in general, flow regulation for navigation required the integrated use of all the resources in the basin. Even then, flow regulation capability could not provide full navigation channel availability for all circumstances. Special releases of short duration were made to assist navigation. When making reductions in outflows, a stair-step approach was typically used so that stages dropped no more than 1 ft a week and navigators could be notified of the impending reductions.

Through most of the 1990s, the navigation channel on the ACF Basin was used consistently and frequently by commercial traffic. The authorized navigation channel downstream of Jim Woodruff Lock and Dam was maintained in reasonably reliable condition by way of maintenance dredging, snagging, and training works, combined with flows from upstream that were generally sufficient to meet navigation needs. During that period, annual tonnage ranged from 550,000 to 640,000, and annual traffic ranged from 900 to 1,200 trips (USACE, Mobile District 2006).

Current Operations for Navigation (1999–Present). Navigational use of the ACF waterway declined precipitously during 1999 and has not recovered. The navigation channel downstream of Jim Woodruff Lock and Dam was only partially dredged in 1999 due to a shortage of dredged material disposal capacity. Water quality certification for maintenance dredging of the Apalachicola River portion of the navigation channel, issued in October 1999 by the Florida DEP, placed significant conditions and constraints on the practice, including prohibiting the continued use of mechanical redistribution of dredged material. No dredging was conducted in 2000 and only minimal dredging was conducted in 2001, principally due to extreme drought and low-water conditions, coupled with the environmental constraints associated with water quality certification. The use of navigation windows for providing navigable depths was also discontinued in 2001. The navigation project was not maintained in 2002–2005, principally due to the lack of navigation traffic, environmental conditions and constraints on dredging activities, and consequently, funding constraints (USACE, Mobile District 2006).

The significant drops in both traffic and tonnage, especially between 2001 and 2005, reflected the unreliability of the Apalachicola River due to a lack of maintenance dredging. During that time, many companies began moving their cargoes by truck and rail, a more expensive, but more reliable, means of transportation (USACE, Mobile District 2006).

In March 2004, USACE, Mobile District, applied for a 5-year renewal of the section 401 water quality certification for maintenance dredging of the authorized navigation channel in the Apalachicola River. After an extended period of coordination and negotiation, the Florida DEP formally denied the Mobile District's request on October 11, 2005 (USACE, Mobile District 2006). No maintenance dredging on the Apalachicola River, or appreciable navigation use of the ACF navigation system, has occurred since that time. In June 2012, the Mobile District applied to the Florida DEP for a permit to continue to conduct routine maintenance snagging to remove tree snags from the navigation channel in the Apalachicola River portion of the project. The request did not include any proposed dredging activity. The snagging permit was issued to USACE, Mobile District on November 27, 2013, and is in effect for 10 years from the issue date, or November 27, 2023 (FLDEP 2013a). Minimal navigation dredging occurred in 2010 on the Chattahoochee River upstream of Jim Woodruff Lock and Dam to facilitate navigation on that portion of the ACF waterway, but no dredging has been conducted since that time. Currently, no water management activities are routinely being undertaken in the ACF Basin specifically to support navigation.

Although navigation is an authorized purpose of the federal projects in the ACF Basin, basin inflows are not sufficient at all times to allow those projects to provide for flows downstream of Jim Woodruff Lock and Dam to support navigation channel depths (currently estimated at 20,600 cfs for a 9-ft channel). Additional limiting factors include the lack of commercial navigation use/demand and the inability to secure the necessary water quality certification from the Florida DEP to perform the required maintenance dredging and other operational activities for the navigation channel downstream of Jim Woodruff Lock and Dam. Limited use of special releases to assist with critical navigation requirements (in the form of a brief navigation window) have been addressed on a case-by-case basis. Such special releases, when requested, are coordinated with Florida, Alabama, and Georgia; federal resource agencies; and key stakeholders.

Water management for navigation, as authorized, could be resumed at any point in the future depending on sufficient demand for a reliable navigation channel and resolution with the state of Florida of any channel maintenance issues in the Apalachicola River as necessary to provide navigable channel depths.

2.1.1.2.4.4 Fish and Wildlife Conservation

West Point Dam is the only federal project in the ACF Basin with fish and wildlife conservation specifically included in its original congressional authorization. Nonetheless, the ACF Basin USACE reservoirs (i.e., Lanier, West Point, Walter F. George, Andrews, and Seminole lakes) operate to support fish and wildlife conservation pursuant to the authority in either the FWCA or the ESA. Generally, reservoir operations for fish and wildlife conservation consist of either maintaining pool elevations during fish spawns or making special releases to minimize the possibility of fish kills. Special drawdowns for specific environmental purposes may be specified from time to time, but only after coordination with state and federal resource agencies and others, as appropriate. Although the possibility of requiring water control actions may extend throughout a season, the actual actions are usually of short duration. In addition to fishery management, operations include aquatic plant control, waterfowl, and other terrestrial habitat management. The various projects in the basin have specific operations for fish and wildlife, which are described in the individual project WCMs. Specific fish and wildlife conservation activities on USACE ACF Basin projects are addressed in more detail in the following paragraphs.

Fish Spawning. USACE South Atlantic DR 1130-2-16 (March 30, 2001) and Mobile District Draft SOP 1130-2-9 (February 2005) were developed to address reservoir regulation and coordination for fish management purposes. South Atlantic DR 1130-2-16 has been updated and renumbered as South Atlantic DR PDS-O-1 (May 31, 2010), *Project Operations, Lake Regulation and Coordination for Fish Management Purposes.* It specifically applies to operations at Lake Lanier, West Point Lake, Walter F. George Lake, and Lake Seminole in the ACF Basin as well as other reservoirs in USACE South

Atlantic Division. The draft Mobile District SOP (1) identifies designated periods of time within which operations to support fish spawning will be conducted at specific projects and on the Apalachicola River, (2) establishes protocols for coordination between the USFWS, state fisheries personnel, and USACE, and (3) provides for development of an annual plan for special water management operations by USACE (in coordination with USFWS and state fisheries agencies) that would balance impacts and benefits to both reservoir and riverine fisheries during the spring spawning period. A major goal of the SOP is not to lower lake levels more than 6 inches in elevation during the reproduction period to prevent stranding or exposing fish eggs. The protocols in these documents are consistent with the requirements for other project purposes.

Tailrace Dissolved Oxygen Levels. Reservoir stratification develops seasonally when surface water becomes warmer and less dense than deeper water, generally summer to late fall in the Southeast. This results in temperature-dependent density differences that prevent mixing and form isolated layers of water, each with their own distinct chemistry. Among the more common concerns is the depletion of oxygen in the deeper layers of lakes when stratified. Below the thermocline, dissolved oxygen is insufficient to support most aquatic life. When water is released from the lower regions of the reservoirs through hydroelectric power generation units and/or sluice gates during periods of reservoir stratification, low dissolved oxygen conditions may be experienced for a short distance downstream of dams, potentially causing stress in the tailrace fishery and occasional fish kills.

While dissolved oxygen levels downstream of Buford Dam and West Point Dam are depressed at times as a result of hydroelectric power generation when the lakes are stratified, there have been no recurring instances of fish distress or mortality in the dam tailrace areas as a result of low dissolved oxygen conditions. Section 2.1.1.2.4.6 describes measures taken over the years to improve dissolved oxygen conditions below Buford Dam. The Walter F. George Lock and Dam project has experienced recurring instances of stress in the tailrace fishery and occasional fish kills due to low dissolved oxygen. Accordingly, USACE has implemented a SOP, established in 1988 and updated in 1993, to address conditions at the Walter F. George project when low dissolved oxygen values are observed in the tailrace. The SOP calls for spillway gates to be opened in accordance with a specific protocol until dissolved oxygen readings return to an acceptable level (USACE, Mobile District 1993a). Spillage siphons have also been constructed on the dam that can be used in lieu of spillway gate discharges (Smallwood 2010).

Fish Passage. In most years since the spring of 2005, USACE has operated the lock at Jim Woodruff Lock and Dam between March and May to facilitate downstream-to-upstream passage of Alabama shad (*Alosa alabamae*) and other anadromous fishes (those that return from the sea to the rivers where they were born to breed) in cooperation with pertinent state and federal agencies. In general, two fish locking cycles are performed each day between 0800–1600 hours, one in the morning and one in the afternoon. Studies are ongoing to determine the most appropriate technique and timing for the locks, but the number of lock cycles per day will not change.

Management of Project Lands. The 11,184-ac Eufaula National Wildlife Refuge is operated by the USFWS in cooperation with USACE in the upper reaches of Walter F. George Lake within Barbour and Russell counties, Alabama, and Stewart and Quitman counties, Georgia. The refuge has an extensive system of pumps, dikes, and water control structures for water-level management in off-reservoir wetland areas. The refuge provides important habitat for migratory waterfowl and other birds, habitat for federally listed threatened and endangered species, and recreation and environmental education for the public. More detailed information on the refuge and its operation is in section 2.5.5.1.1.

USACE manages much of the project land around its ACF reservoirs for the benefit of fish and wildlife resources, consistent with other project purposes. In some cases, project lands can be managed by state agencies (i.e., wildlife management areas or state parks) or local interests through leases. Additionally,

GADNR operates a fish hatchery on the Chattahoochee River immediately below Buford Dam. USACE coordinates project operations with the fish hatchery staff. For more information, see section 2.5.5.2.

Endangered Species Conservation Downstream of Jim Woodruff Lock and Dam. Historically, no minimum flow release rate for fish and wildlife purposes was established for the Apalachicola River downstream of Jim Woodruff Lock and Dam. Reservoir releases (varying seasonally) produced from normal operations for hydroelectric power generation and navigation typically provided conditions in the river suitable for fish and wildlife purposes.

On March 7, 2006, USACE, Mobile District initiated formal consultation with USFWS, pursuant to section 7 of the ESA, regarding the effects of existing operations at Jim Woodruff Lock and Dam and releases to the Apalachicola River on federally listed threatened and endangered species and federally designated critical habitat. Specific species/critical habitat affected include the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*) and critical habitat for the Gulf sturgeon; and the endangered fat threeridge mussel (*Amblema neislerii*), the threatened purple bankclimber mussel (*Elliptoideus sloatianus*), the threatened Chipola slabshell mussel (*Eliptio chipolaensis*), and the critical habitat associated with these mussel species. The Interim Operation Plan (IOP) that resulted from the section 7 consultation process was implemented in October 2006. Minimum flow provisions for Jim Woodruff Lock and Dam were part of the overall plan established in the IOP to avoid and minimize impacts on the listed species.

On the basis of further consultation between USACE and USFWS and increasingly severe drought conditions in 2007 and 2008, the IOP was modified twice. The revised IOP (RIOP) was implemented in June 2008. The principal water management objective under the IOP (and subsequent modifications) has been to minimize adverse effects to federally listed threatened and endangered species and adverse modification of designated critical habitat in the Apalachicola River. The objective makes allowances for increased storage opportunities and/or reductions in demand for storage to provide continued support to project purposes, minimize impacts to other water users, and provide greater assurance of future sustained flows for federally listed species and other users during a severe multiyear drought.

USACE continued to coordinate with USFWS through 2009 and into 2010 regarding the implementation of the Reasonable and Prudent Measures (RPM), and formal consultation under ESA section 7 was reinitiated between USACE and USFWS in September 2010 to address new information relative to endangered mussel species. That formal consultation was completed in May 2012 when USFWS issued a new Biological Opinion for the RIOP for Jim Woodruff Lock and Dam, requiring some minor operational adjustments to the 2008 RIOP. The following summary of the RIOP is based on the description provided in the May 2012 USACE environmental assessment for the updated RIOP (USACE 2012).

The May 2012 RIOP is governed by two basic parameters applicable to daily releases from Jim Woodruff Lock and Dam: 1) a minimum discharge in relation to average basin inflows (measured as daily average in cfs) and 2) a maximum fall rate (vertical drop in river stage [ft/day]). The RIOP places limitations on refill of upstream reservoirs, but it does not require a net drawdown of composite conservation storage (discussed in more detail below) unless basin inflow is less than 5,000 cfs.

- **Minimum discharge**. The RIOP varies minimum discharges from Jim Woodruff Lock and Dam by basin inflow and by month, and the releases are measured as a daily average flow in cfs at the Chattahoochee gage. Table 2.1-5 shows minimum releases from Jim Woodruff Lock and Dam prescribed by the RIOP and shows when and how much basin inflow is available for increasing reservoir storage. Except when basin inflow is less than 5,000 cfs, the minimum releases are not required to exceed basin inflow. The RIOP defines additional basin inflow threshold levels that vary by three seasons: spawning season (March–May), nonspawning season (June–November), and winter (December–February). The RIOP incorporates composite conservation storage

thresholds that factor into minimum release decisions. Composite conservation storage is calculated by combining the conservation storage of Lake Lanier, West Point Lake, and Walter F. George Lake. Conservation storage in each of the individual reservoirs consists of four zones, which are determined by the operational guide curve for each project. The composite conservation storage also uses the 4-zone concept (i.e., Zone 1 of the composite conservation storage represents the combined storage available in Zone 1 for each of the three storage reservoirs). Figure 2.1-40 illustrates the ac-ft of storage available for composite Zones 1 through 4 throughout the year.

Table 2.1-5.
May 2012 RIOP for Jim Woodruff Lock and Dam, Apalachicola River Minimum Discharge from Woodruff Lock and Dam by Month and by Basin Inflow (BI) Rates

Months	Composite conservation storage zone	Basin inflow (BI) (cfs)	Releases from Jim Woodruff Lock and Dam (cfs)	BI available for storage[a]
March–May	Zones 1 and 2	≥ 34,000 ≥ 16,000 and < 34,000 ≥ 5,000 and < 16,000 < 5,000	≥ 25,000 ≥ 16,000+50% BI > 16,000 ≥ BI ≥ 5,000	Up to 100% BI>25,000 Up to 50% BI>16,000
	Zone 3	≥ 39,000 ≥ 11,000 and < 39,000 ≥ 5,000 and < 11,000 < 5,000	≥ 25,000 ≥ 11,000+50% BI > 11,000 ≥ BI ≥ 5,000	Up to 100% BI>25,000 Up to 50% BI>11,000
June–November	Zones 1, 2, and 3	≥ 22,000 ≥ 10,000 and < 22,000 ≥ 5,000 and < 10,000 < 5,000	≥ 16,000 ≥ 10,000+50% BI > 10,000 ≥ BI ≥ 5,000	Up to 100% BI>16,000 Up to 50% BI>10,000
December–February	Zones 1, 2, and 3	≥ 5,000 < 5,000	≥ 5,000 (Store all BI> 5,000) ≥ 5,000	Up to 100% BI > 5,000
At all times	Zone 4	NA	≥ 5,000	Up to 100% BI > 5,000
At all times	Drought Zone	NA	≥ 4,500[b]	Up to 100% BI > 4,500

Sources: USACE, Mobile District 2012; USFWS 2012

Notes:

[a.] Consistent with safety requirements, flood risk management purposes, and equipment capabilities.

[b.] Once composite conservation storage falls below top of Drought Zone, ramp-down to 4,500 cfs will occur at a rate of 0.25 ft/day.

The RIOP operations and thresholds from March through May are intended to support Gulf sturgeon spawning activities. The 16,000 cfs minimum release is also based on evaluation of spawning and rearing needs for the host fish necessary for mussel reproduction. The RIOP operations from June through February are intended to support the federally protected mussels, host fish for mussels, and young sturgeon.

During spawning season (March–May), two sets of four basin-inflow thresholds and corresponding releases exist according to the composite conservation storage (Table 2.1-5). In accordance with RPM 2008-4 of the 2008 RIOP BO (USFWS 2008a), the spawning season also includes a special fall rate provision in order to avoid take of larval Gulf sturgeon. When the composite conservation storage is in Zones 1 and 2, a less conservative operation is in place. When the composite conservation storage is in Zone 3, a more conservative operation is in place while still avoiding or minimizing impacts on federally listed species and designated critical habitat in the river. When the composite conservation storage falls below the bottom of Zone 3 into Zone 4, the drought contingency operations are triggered, representing the most conservative

operational plan. The spawning season fall rate provision is in place under normal and drought operations. Drought contingency operations are summarized below.

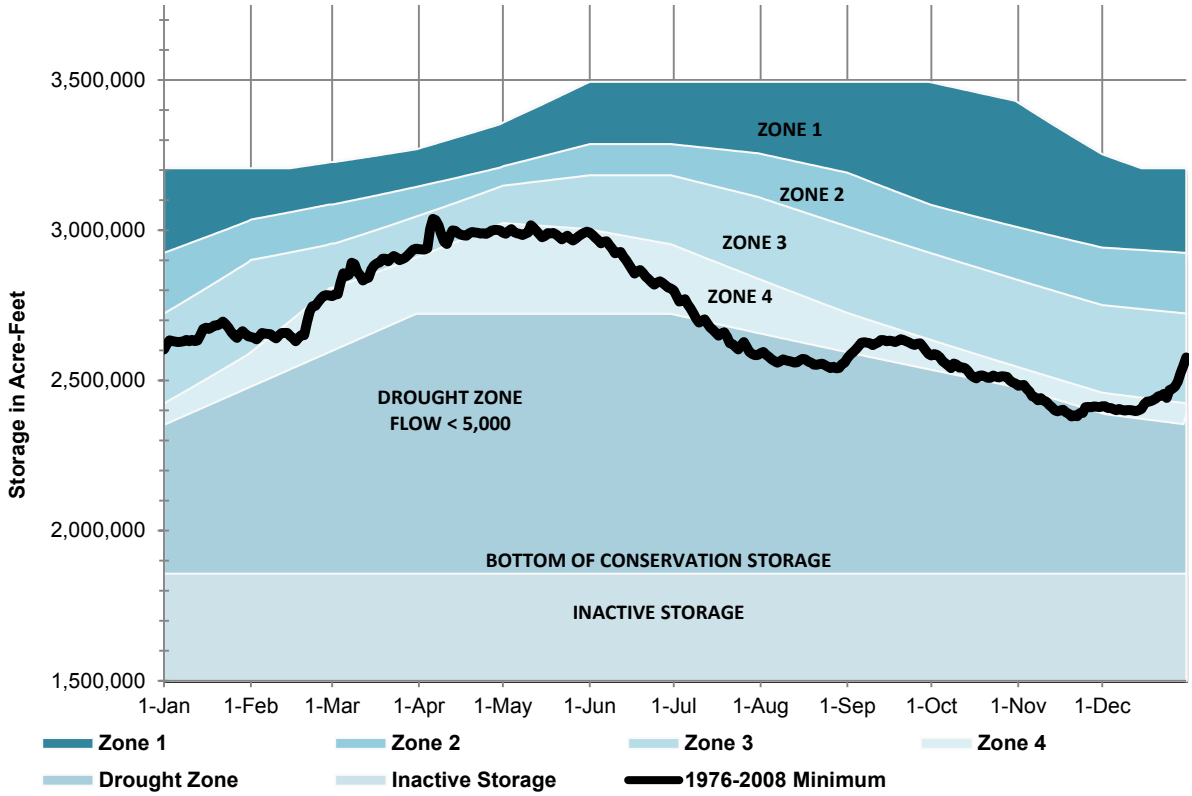


Figure 2.1-40. Basin Composite Conservation Storage and Associated Action Zones (in ac-ft)

During spawning season, the composite conservation storage is monitored daily to determine water management operations. Recently experienced climatic and hydrologic conditions and meteorological forecasts are used in addition to composite conservation storage values when determining the appropriate basin inflow thresholds in support of water management operations.

During nonspawning season (June – November), one set of four basin inflow thresholds and corresponding releases exists according to composite conservation storage in Zones 1 through 3. When composite conservation storage falls below the bottom of Zone 3 into Zone 4, the drought contingency operations are triggered.

During the winter season (December – February), there is only one basin inflow threshold and corresponding minimum release (5,000 cfs) while in composite conservation storage Zones 1 through 3. There are no basin inflow storage restrictions as long as this minimum flow is met under these conditions. When composite conservation storage falls below the bottom of Zone 3 into Zone 4, drought contingency operations are triggered.

The flow rates included in Table 2.1-5 prescribe minimum, not target, releases for Jim Woodruff Lock and Dam. During a given month and basin inflow rate, releases greater than the minimum releases in Table 2.1-5 may occur consistent with the maximum fall rate schedule, described

below, or as needed to achieve other project purposes, such as hydroelectric power generation or flood risk management.

- **Maximum Fall Rate.** The fall rate, also called the down-ramping rate, is the vertical drop in river stage (water surface elevation) that occurs over a given period. Fall rates are expressed in units of feet per day (ft/day), and they are measured at the Chattahoochee gage as the difference between the daily average river stage of consecutive calendar days. Rise rates are not addressed. Table 2.1-6 lists the maximum fall rates. The maximum fall rate schedule is suspended when composite conservation storage is in Zone 4 and drought contingency operations are implemented. Unless otherwise noted, fall rates under the drought contingency operation would be managed to match the fall rate of the one-day basin inflow. Matching the one-day basin inflow fall rate during drought operations facilitates quicker recovery and a faster return to normal operations.

  Managing fall rates to conform to Table 2.1-6 values is a challenging undertaking at Jim Woodruff Lock and Dam when flow rates exceed the release capacity of the powerhouse (about 16,000 cfs). Releases greater than 16,000 cfs require the use of the spillway gates in addition to the powerhouse and require an operator to open or close the gates using a rail-mounted crane on the crest of the dam. The water discharge openings of the gates are not fully adjustable, and inclement weather, floating debris, and other factors may complicate the procedure of opening and closing the gates. Fall rates are more manageable when releases are less than 16,000 cfs and controlled by the powerhouse, but this control is not a precise operation. For these reasons, a lower and upper maximum fall rate is provided in Table 2.1-6 for each specific release range. When conditions allow, fall rates will generally conform to the more gradual (lower) rate in each range, consistent with safety requirements, flood risk management purposes, and equipment capabilities.

Table 2.1-6.
RIOP for Jim Woodruff Lock and Dam: Apalachicola River Maximum Fall Rate for Discharge from the Lock and Dam by Release Range for Composite Conservation Storage Zones 1, 2, and 3 [a,b]

Approximate release range (cfs)	Maximum fall rate (ft/day)
> 30,000 [a]	Fall rate is not limited [c,d]
> 20,000 and ≤ 30,000 [b]	1.0 to 2.0 [d]
Exceeds Powerhouse Capacity (~ 16,000) and ≤ 20,000 [b]	0.5 to 1.0 [d]
Within Powerhouse Capacity and > 10,000 [b]	0.25 to 0.5
Within Powerhouse Capacity and ≤ 10,000 [b]	0.25 or less

Sources: USACE, Mobile District 2012; USFWS 2012
Notes:
[a.] Consistent with safety requirements, flood risk management purposes, and equipment capabilities.
[b.] The maximum fall rate schedule is suspended in composite Zone 4.
[c.] For flows greater than 30,000 cfs, it is not reasonable and prudent to attempt to control the down-ramping rate, and no ramping rate is required.
[d.] Maximum fall rates must be less than 8 ft in a consecutive 14-day period when flows are less than 40,000 cfs in March, April, and May in order to avoid take of Gulf sturgeon eggs and larvae.

- **Drought Contingency Provisions in the RIOP.** The RIOP includes a drought contingency operation (referred to as a *drought plan*). The drought plan specifies a minimum release from Jim Woodruff Lock and Dam and temporarily suspends other minimum release and maximum fall rate provisions until composite conservation storage in the basin is replenished to a level that can support them. Under the drought plan, minimum discharge is determined in relation to the composite conservation storage and not average basin inflow. The drought plan is triggered when composite conservation storage falls below the bottom of Zone 3 into Zone 4. At that time, all the

composite conservation storage Zone 1 through 3 provisions (i.e., seasonal storage limitations, maximum fall rate schedule, minimum flow thresholds) are suspended, and management decisions are based on the provisions of the drought plan. The drought plan includes the option for a temporary waiver from the existing water control plan to allow temporary storage above the winter pool guide curve at the Walter F. George and West Point projects if the opportunity presents itself and/or to begin spring refill operations at an earlier date to provide additional conservation storage for future needs as well as provide support for minimum releases at Jim Woodruff Lock and Dam.

The drought plan prescribes two minimum releases on the basis of composite conservation storage in Zone 4 and an additional zone referred to as the *Drought Zone* (Figure 2.1-40). The Drought Zone delineates a volume of water roughly equivalent to the inactive storage in lakes Lanier, West Point, and Walter F. George, plus Zone 4 storage in Lake Lanier. The Drought Zone line was adjusted in the 2012 RIOP to include a smaller volume of water at the beginning and end of the calendar year. When the composite conservation storage is within Zone 4 and above the Drought Zone, the minimum release from Jim Woodruff Lock and Dam is 5,000 cfs, and all basin inflow above 5,000 cfs that is capable of being stored may be stored.

Once the composite conservation storage falls into the Drought Zone, the minimum release from Jim Woodruff Lock and Dam is 4,500 cfs, and all basin inflow above 4,500 cfs that is capable of being stored may be stored. When transitioning from a minimum release of 5,000 to 4,500 cfs, fall rates are limited to a 0.25 ft/day drop. The 4,500 cfs minimum release is maintained until composite conservation storage returns to a level above the top of the Drought Zone, at which time the 5,000 cfs minimum release is reinstated. The drought plan provisions remain in place until conditions improve to the point that the composite conservation storage reaches a level above the top of Zone 2 (i.e., within Zone 1). At that time, the temporary drought plan provisions are suspended, and all the other provisions are reinstated. During drought contingency operations, a monthly monitoring plan that tracks composite conservation storage to determine water management operations (the first day of each month represents a decision point) is implemented to determine which operational triggers are applied. In addition, recently experienced climatic and hydrological conditions and meteorological forecasts are used when determining the set of operations in the upcoming month.

Although the drought plan provides for flows lower than 5,000 cfs in the river, provisions that allow for reduced flows during the refill period when system storage is lower and for storage conservation measures when composite conservation storage is in Zone 4 should result in fewer occasions when these low flows are triggered or in occasions where storage shortages result in flows less than 5,000 cfs.

2.1.1.2.4.5 Recreation

Lake Lanier, with about 7.5 million visitors each year, is the most visited USACE reservoir in the southeastern U.S. and one of the most visited USACE reservoirs nationwide. Walter F. George and West Point lakes also rank high among most visited USACE projects. A wide variety of recreational opportunities, dependent on or enhanced by the presence of the lakes, are provided at these sites, including boating, fishing, picnicking, sightseeing, skiing, and camping. Recreation resources and facilities at the USACE projects in the ACF Basin are discussed in more detail in sections 2.4 and 2.6.6.

To maximize the potential recreational use of all the projects, USACE operates the reservoirs in the ACF Basin as a system, keeping the drawdown levels and rates balanced among the reservoirs. USACE gives those considerations greater attention during the primary recreation season of May through early September. Reservoirs are managed to maintain a steady pool at as high a level as possible, consistent

with other authorized purposes, particularly during the primary recreation season. To sustain reasonable access to the reservoir during periods of declining inflows to the reservoirs, drawdowns are performed at as steady a rate as possible. There may be times during drought conditions when water releases are reduced to levels that satisfy only downstream water supply/water quality requirements. This conservation of storage generally allows the pools to be maintained at a higher level throughout the prime recreation season.

As other ACF water management objectives are addressed, lake levels might decline during prime recreation periods. Large reservoir drawdowns impact recreational use: access to the water for boaters and swimmers is inhibited; submerged hazards (e.g., trees, shoals, boulders) become exposed or nearly exposed, posing safety issues; and exposed banks and reservoir bottoms become unsightly and diminish the recreation experience. Consequently, for Lake Lanier, West Point Lake, and Walter F. George Lake, certain levels were identified in each impoundment at which recreation activities would be affected (Table 2.1-7).

- At the *Initial Impact level* (IIL), recreation impacts are first observed (i.e., some boat launching ramps are unusable, most beaches are unusable or minimally usable, and navigation hazards begin to surface).
- At the *Recreation Impact level* (RIL), major impacts on concessionaires and recreation are observed (i.e., more ramps are not usable, all beaches are unusable, boats begin having problems maneuvering in and out of marina basin areas, loss of retail business occurs).
- The level at which severe impacts are observed in all aspects of recreational activities is called the *Water Access Limited level* (WAL). At this point, all or almost all boat ramps are out of service, all swimming beaches are unusable, major navigation hazards occur, channels to marinas are impassable and/or wet slips must be relocated, and a majority of private boat docks are unusable.

Table 2.1-7.
Recreation Impact Levels for Federal Projects in the ACF Basin

Project	IIL	RIL	WAL
Lake Lanier	1,066 ft	1,063 ft	1,060 ft
West Point Lake	632.5 ft	629 ft	627 ft
Walter F. George	187 ft	185 ft	184 ft

Actions to be taken by resource personnel at those levels are defined in project-specific action plans prepared by each project office.

Because George W. Andrews and Jim Woodruff locks and dams are run-of-river projects, pool elevations normally follow a daily and weekly cycle of elevations. The fluctuations in these pools are generally minor with little impact on recreational use; however, small decreases in lake level at Lake Seminole can affect recreation use due to the shallow nature of the reservoir and large areas of standing timber navigation obstacles.

Water management operations at Buford Dam have a direct effect on downstream recreational and resource management activities in the Chattahoochee River National Recreation Area (CRNRA), operated by the National Park Service (NPS). CRNRA provides for river-oriented recreational pursuits between Buford Dam (Chattahoochee RM 348.3) and Peachtree Creek (RM 300.5). More specific information on the CRNRA is provided in sections 2.4 and 2.6.6. The CRNRA was established in 1978, about 20 years after Buford Dam construction was completed. The operation of Buford Dam to meet authorized project purposes is generally compatible with recreational uses of the river and adjacent lands in the CRNRA,

which include activities such as rafting, canoeing, wade and tube fishing, small boat fishing, hiking, and picnicking. The regulated flows from Buford Dam provide relatively stable and dependable flows for water-based recreational uses. Immediately below the dam, periods of peak hydroelectric power generation cause rapid rise and fall in river levels, which can present safety issues for river users. USACE, CRNRA, and Georgia have worked closely together to provide public information and to implement specific safety measures to reduce risk to river users in the area immediately downstream of Buford Dam.

2.1.1.2.4.6 Water Supply/Water Quality

Background on Buford Dam Operations for Water Supply/Water Quality. To provide for water supply and in-stream flow for water quality, House Document 300 (80th Congress, 1st Session), which serves as the basis for Buford Dam (Lake Lanier) project authorization, provided that the project release "varying flows up to a maximum of 600 second-feet … from Buford so as to insure at all times a flow at Atlanta not less than 650 second-feet" (second-feet is synonymous with cfs). The original operational scheme adopted upon completion of the Lake Lanier project in the late 1950s provided for maximum ("peak") hydropower generation on weekdays through one or both large turbines, with minimal ("off-peak") hydropower generation through the small turbine on weekends. About the time that Buford became operational, the city of Atlanta and GPC jointly financed the addition of 8-ft tainter gates to Morgan Falls Dam to raise the water surface. The addition of these gates increased storage at Morgan Falls and enabled the project to reregulate releases from Buford Dam to a limited degree. The addition of gates at Morgan Falls physically modified water control mechanisms so that USACE alone would not be responsible for operating to provide the 650 cfs at Atlanta. For many years, a minimum continuous Buford release of 400 to 600 cfs, coupled with reregulation of the Chattahoochee River at the Morgan Falls project, provided the desired flow at Atlanta (USACE, Mobile District 1991).

In the 1970s, USACE began to take steps to meet growing demands for water supply in Metro Atlanta. They adjusted the operations of Buford Dam to provide increased downstream flows to meet growing water supply demands and higher downstream water quality standards. In 1974, during the initial stages of the Metropolitan Atlanta Area Water Resources Management Study (discussed in more detail in section 3.3.1), Georgia determined that a minimum flow of 750 cfs in the Chattahoochee River downstream of Atlanta's water supply intake and just upstream of the confluence with Peachtree Creek would be necessary for the assimilation of return flows to the river. This new standard required a continuous flow of 750 cfs *after* accounting for withdrawals by Atlanta, averaging 344 cfs (222 mgd) annually at that time. The increased downstream flow target, along with increasing demand for M&I water supply in the region, raised concerns that existing operations might not continue to yield sufficient flows for downstream water quality and water supply needs.

In 1975, USACE, GPC, and the city of Atlanta agreed to an operating procedure, called the *Interim Plan*, providing for minimum flows of up to 1,256 cfs at Atlanta, enabling water supply withdrawals of up to 327 mgd, for an annual average of 230 mgd (Stockdale 2009). This plan essentially reflected existing practices at that time, without affecting project purposes or involving operational changes at Lake Lanier (Stockdale 2009).

By 1979, it became clear that the Interim Plan, which did not involve any adjustments to earlier operations, was not adequate to provide downstream flows sufficient to meet water supply and water quality needs. All parties involved agreed in 1979 to an operating procedure (the *Modified Interim Plan*) under which Georgia Power Company (GPC) would schedule a portion of weekly power generation at Morgan Falls Dam on the weekend. USACE committed to make operational changes so that certain minimum summer flows would be available from Buford Dam. These commitments allowed for increased

water supply withdrawals (327 mgd peak withdrawals and 266 mgd annual average withdrawals) while protecting the 750 cfs in-stream flow requirement (USACE, Mobile District 1991; Stockdale 2009).

Subsequently, USACE recognized that downstream withdrawals in excess of 327 mgd provided under the Modified Interim Plan might exceed the amount available incidental to operation of Buford Dam under the project authority and would require a contract under separate authority. Accordingly, under the authority of the Independent Offices Appropriations Act (IOAA) (31 U.S.C. 9701), USACE in 1986 entered into a withdrawal contract with the Atlanta Regional Commission (ARC) providing for withdrawals of up to 377 mgd from the Chattahoochee River with payment to the U.S. Government required for withdrawals exceeding 327 mgd. The contract incorporated the USACE determination that downstream withdrawals of up to 327 mgd were already available, apart from this contract, "from normal operation of the Buford project for non-water supply purposes," and "can be provided year-round with no impact on the [Lake Lanier] Project." (Contract DACW01-9-86-145 (1986), art. 1(b)). In order for USACE to provide the river flows adequate to meet the contract terms, ARC agreed to coordinate the implementation of a water management plan, referred to as the *Chattahoochee River Management System* (CRMS), in cooperation with USACE, GPC, GAEPD, and the various water utilities. The CRMS was an exhibit included in the withdrawal contract. The CRMS provided that USACE, when possible and practical, would endeavor to make only those releases specifically required for water supply and to maintain the 750 cfs minimum in-stream flow at Peachtree Creek (when not operating for peak hydroelectric power generation). GPC agreed to continue to use Morgan Falls Dam (Bull Sluice Lake) to reregulate the Buford releases to help meet that target. This 1986 contract was intended to be an interim arrangement pending development of more permanent solutions to the Atlanta water supply needs (USACE, Mobile District 1991; Stockdale 2009).

In addition to downstream withdrawals, USACE has also accommodated water supply withdrawals directly from Lake Lanier. Two cities in Georgia, Buford and Gainesville, had been withdrawing water from the Chattahoochee River before the construction of Buford Dam. As Fifth Amendment compensation for property taken for project construction, the municipalities were allowed to relocate their existing water supply intakes and continue to withdraw as they had before project construction up to 10 mgd (i.e., 2 mgd for Buford and 8 mgd[1] for Gainesville) under relocation agreements with USACE. In the 1970s, water supply needs were also increasing in areas around Lake Lanier such as Gwinnett County and Cumming, Georgia, and Gainesville. A separate authority, the IOAA (31 U.S.C. 9701), provided the legal basis for withdrawal contracts executed in 1973 with Gwinnett County for a maximum withdrawal of 40 mgd (later amended to an annual average withdrawal of 53 mgd); in 1978 with Cumming for a maximum withdrawal of 2.5 mgd (later amended to an annual average of 10 mgd; and in 1987 with Gainesville for an annual average withdrawal of 20 mgd, including the relocation contract amount of 8 mgd).

[1] Article 1f of the 1953 Gainesville relocation agreement states "The City agrees that it will not at any time remove more than 8,000,000 gallons of water from the reservoir of Buford Dam within any 24-hour period without prior written approval of the District Engineer, Mobile District…" The term "remove" has been interpreted as 8 mgd net withdrawal during any 24-hour period and specifically, to include an overall cap of 18 mgd gross withdrawals (10 mgd treated wastewater is returned to Lake Lanier), with payments from the City of Gainesville required for net withdrawals greater than 8 mgd net, up to the 18 mgd gross limit. This position, while not the only possible interpretation of the term "remove" in the 1953 agreement, is consistent with the District Engineer and Contracting Officer's determination of 1973, and the parties' apparent practice for a considerable time. This interpretation has been included in the modeling for the DEIS. Therefore, the total withdrawals under relocation contracts are 8 mgd net for Gainesville and 2 mgd gross for the City of Buford based on the pattern and practice of interpreting the relocation contracts.

Pursuant to an Army General Counsel Opinion in 1986 that the IOAA was not the preferable authority for accommodating water supply needs, USACE allowed the four contracts (with Gwinnett County, Gainesville, Cumming, and ARC) to expire in 1990 with the intention of entering into new contracts for storage space at Lake Lanier to meet existing and future water supply needs for Metro Atlanta under the authority of the Water Supply Act of 1958. Since 1990, Gwinnett County, Gainesville, and Cumming have continued to satisfy their water supply needs by withdrawing from Lake Lanier without the benefit of contracts. Water supply requirements of the suppliers downstream of Buford Dam represented by the ARC continue to be met through operation of Buford Dam per the CRMS protocols, consistent with the June 2011 opinion of the Court of Appeals for the 11th Circuit and the associated June 2012 USACE legal opinion (refer to section 3.5.2.8) and pending the update of the Master WCM.

Water Supply Objective. Even during normal or average hydrologic conditions, various portions of the basin might experience water supply problems, chiefly in the Upper Chattahoochee River, ranging from the headwaters, through Metro Atlanta, and to the region immediately below Atlanta. The water supply needs of Metro Atlanta are met almost entirely by direct withdrawals from Lake Lanier and the Chattahoochee River downstream of Buford Dam to Peachtree Creek. Flow regulation afforded by storage in Lake Lanier has provided a dependable water supply in the reach of the Chattahoochee downstream to Atlanta. However, the supply varies according to releases made for other project demands and water availability. Releases specifically for water supply are often required from Lake Lanier on summer weekends. In winter and spring, because needs for water in the lower basin are most often met with flows from that area, the releases from Lake Lanier can often be closely matched to the actual water supply needs. Reservoir releases for other purposes have generally been adequate to meet water supply needs, but chronic seasonal low flow periods, coupled with the higher demand rates associated with such periods, often stress the available supply.

Water supply functions downstream of federal projects are usually met as a by-product of normal operation of the projects for other purposes. However, minimum releases might be required at certain projects to maintain a dependable flow and adequate depths of water above the water intake structures.

Water Quality Objective. Buford Dam, West Point Dam, and Jim Woodruff Lock and Dam all provide continuous minimum releases which, in addition to meeting other project purposes and providing associated benefits, also benefits downstream water quality. Walter F. George Lock and Dam and George W. Andrews Lock and Dam have no specific minimum flow provisions.

At Buford Dam, the small turbine is operated continuously to provide a minimum flow from the dam of approximately 600 cfs. When it is necessary to have the unit out of service, the releases are made through the sluice. Under agreements between USACE and Georgia, discharges from Buford Dam, when considered in combination with the contribution of local drainage between the dam and the city of Atlanta and reregulation by GPC's Morgan Falls Dam, are to be sufficient to provide a minimum flow rate of 750 cfs at Peachtree Creek. Reregulation of streamflows at Morgan Falls Dam to provide that required flow is often not possible without weekend releases at Buford Dam.

During periods of reservoir stratification and reservoir turnover (destratification) in the fall, releases from Buford Dam hydroelectric units or sluice gates can contain high concentrations of metals, such as iron and manganese, which can cause toxicity problems at the Buford Trout Hatchery, 2 mi downstream of the dam. The release water during summer and fall is also low in dissolved oxygen except during periods of peaking generation. Because of the flow velocity and turbulence immediately downstream of the dam, substantial reaeration occurs within a relatively short distance. During a major rehabilitation of all three hydropower generation units at Buford Dam during 2003 and 2004, self-aspirating turbines were installed to improve dissolved oxygen levels immediately downstream. However, minimal benefits to downstream dissolved oxygen have been recorded since the turbines were installed. As described in more detail in the Buford Dam and Lake Sidney Lanier WCM (in Appendix A), USACE provided technical assistance to the hatchery in the

1980s, and the hatchery added the capability to add water-hardening chemicals to their Chattahoochee River withdrawals to address iron and manganese issues in support of hatchery operations. This practice has been discontinued as downstream conditions have improved over time, but there still may be an occasional need for short-term emergency releases of water from Lake Lanier for water quality purposes.

At West Point Dam, a small generating unit provides a continuous release of about 675 cfs. This flow provides low flow augmentation to benefit water quality and public health. As with Buford Dam, the release waters during reservoir stratification are low in dissolved oxygen concentration during minimum release periods.

Even though there are no specific continuous minimum flow requirements below Walter F. George Lock and Dam, USACE has an established SOP to address conditions at times when low dissolved oxygen values are observed below the dam (USACE, Mobile District 1993a). The SOP is discussed in more detail in section 2.1.1.2.4.4.

Because of the shallowness of the reservoir and the relative amount of storage when compared to inflow, Lake Seminole and George W. Andrews Lake do not stratify and water quality downstream of the dam does not fluctuate to the same degree as at other reservoirs in the basin. However, minimum releases of at least 5,000 cfs are maintained from Jim Woodruff Lock and Dam (except under extreme drought conditions). Those minimum flows are needed to meet environmental flow requirements for endangered species conservation, but as a by-product, they also meet the water supply and waste assimilation needs of downstream industrial users. Release protocols from Jim Woodruff Lock and Dam for endangered species conservation are discussed in section 2.1.1.2.4.4.

While operating to serve other federally authorized purposes, USACE reservoirs in the ACF Basin provide downstream flow conditions that collaterally support waste assimilation needs of numerous M&I wastewater dischargers in the basin. That collateral benefit of project operations is particularly valuable during annual low flow (summer/fall) periods and extended drought periods.

General Water Supply/Water Quality Operating Guidelines. Water management activities to support water supply and water quality involve taking water from storage, either directly from the pool or through releases for downstream interests. The primary concerns are ensuring that (1) sufficient drinking water will be available for urban needs and (2) agreements to provide in-stream flow for water quality will not be violated.

Minimum in-stream flow needs for water supply and water quality purposes are almost always met through normal operation of the projects for other purposes. The exception to this is at Lake Lanier, where weekend releases are required and often water supply/water quality requirements can control the volume of the weekly water release. When making water control decisions, USACE considers the water supply/water quality needs of the entire basin, as well as the needs of individual, isolated trouble spots. Water in upstream projects, notably Lake Lanier, is used when necessary for water quality needs at downstream points. The states or other governmental agencies may periodically request releases of short duration for water quality purposes.

Releases from projects in the system are the minimum (capacity) release for hydroelectric power generation or releases needed for basinwide water quality/water supply, whichever is greater. During some months of the year, particularly winter and spring, it may be appropriate to minimize releases at Buford Dam (Lake Lanier) to closely approach, without jeopardizing, the 750 cfs target water quality flow at Peachtree Creek. This plan is based on current water supply demands; increasing these demands may necessitate modifying the minimum releases.

Because the chances to replenish the lower reservoirs are greater than the chances to replenish those upstream, emphasis is given to drawing from storage at West Point and Walter F. George for providing minimum releases, historically approximately 5,000 cfs, and from Jim Woodruff Lock and Dam (Lake Seminole). However, releases from storage at Lake Lanier might be necessary to prevent the lower reservoirs from being drawn below minimum structural design limits.

2.1.1.2.4.7 Special Operations and Releases

Occasionally, a temporary deviation from the normal regulation of a reservoir is necessary to accommodate a special activity or need in the reservoir or downstream. Deviations generally fall into three categories: planned deviations, unplanned deviations, and emergency deviations.

Construction activity accounts for a major portion of the incidents requiring special releases (planned deviations) and includes utility stream crossings, bridge work, and improvements to recreation structures, tailrace surveying, and major construction contracts. Special releases are used to facilitate other planned activities, including lake shore cleanup operations and recreational activities (e.g., fishing tournaments), and to allow rapid water rescue training by emergency medical services personnel (which requires special high flow releases from the spillway). The need for unplanned deviations might be caused by unforeseen conditions that do not allow sufficient time to plan for the deviation, but do not involve an imminent threat to public health and safety, property, or the environment. Special releases also have been used in response to unplanned situations, including to help free grounded barges in the navigation channel downstream of Jim Woodruff Lock and Dam. Emergencies might require deviation from the approved water control plan to mitigate an imminent threat to public health and safety, property, or the environment, including water quality. Examples include dam safety issues, drowning and other accidents, failure of operation facilities, oil or chemical spills and drainage, bacterial contamination, harmful algal blooms, water or sewage treatment plant failures, and fish kills.

Special operations and planned deviations might be implemented during extreme drought conditions. For example, variances have been granted to allow early refilling to the summer pool at USACE reservoirs in the ACF Basin. The variances have occurred during dry springs to capture limited rainfall to ensure refilling of the project summer pool levels. To the extent that hydrologic conditions in the basin will permit during drought conditions, water control regulation can assist with critical stakeholder needs throughout the basin, including water quality considerations. Short-term special operations and deviations are typically based upon coordination with project users and interested stakeholders. For example, during the 2007–08 extreme drought period, the USACE conducted biweekly drought calls for the ACF Basin with agencies, stakeholders, and the press. Based upon feedback received during the calls, short-term water management actions were considered and, when appropriate and as reservoir conditions would allow, were conducted to alleviate critical problems, including water quality concerns.

Special operations and deviations are generally coordinated in advance with the USACE, Mobile District Water Management Section. Requests for release changes are usually for a few hours or days. Before a deviation is granted, the upstream watershed conditions, potential flood threat, conditions of downstream lakes, environmental factors, and water supply and hydropower needs are considered. Processes for deviations from "normal" reservoir regulation—as defined in the ACF Master WCM and individual project WCMs—are discussed in more detail in paragraph 7-15 of the WCM documents. Any extended temporary deviation or long-term adjustment in reservoir operations is required to be approved by the USACE, South Atlantic Division in accordance with established review and coordination procedures.

2.1.1.2.5 Water Withdrawals

2.1.1.2.5.1 Historical Water Use in the ACF Basin

Kenny et al. (2009) documented that between 1950 and 1980, there was a steady increase in water use in the U.S. During that time, the expectation was that as population increased, water use would increase proportionally. Contrary to expectation, reported water withdrawals declined in 1985 and have remained relatively stable since then in spite of a steady increase in U.S. population. Changes in technology, in state and federal laws, and in economic factors, along with increased awareness of the need for water conservation, have resulted in more efficient use of the water from the nation's rivers, lakes, reservoirs, and aquifers. Estimates of water use for 2005 indicated that about 410 billion gallons per day (gpd) were withdrawn for all uses in the U.S. That total varied less than 3 percent since 1985 as withdrawals stabilized for the two largest uses—thermoelectric power and irrigation. Water use trends in the southeast U.S. and in the ACF Basin have generally been consistent with the national trends, as reflected below.

2.1.1.2.5.1.1 Factors Affecting Water Use Patterns in the ACF Basin in 1950

When the implementation of federal water resource projects in the ACF Basin began in the 1950s, water use in the southeast U.S., including the ACF Basin, was generally consistent with the predominant socioeconomic pursuits and population distribution in the region. The region's favorable climate and generally good soil conditions were responsible for the continuing predominance of an agricultural economy. According to the 1950 agricultural census, about 70 percent of the basin was classified as farm land. About 40 percent of that area (about 3.5 million ac) was cultivated, principally in the southern portions of the basin. Principal crops were cotton and peanuts, but other agricultural pursuits included cattle and poultry production, as well as raising corn, peaches, potatoes, tobacco, and vegetables (USACE, Mobile District 1959).

Manufacturing had begun to assume a significant role in the region's economy because of favorable labor conditions, cheap hydroelectric power generation, and the proximity of raw materials. The manufacture of cotton goods and other textiles became an important component of the regional economy. Large mills at and north of Columbus, Georgia, operated by hydroelectric power generation, formed the nuclei for several small industrial centers in the basin. Forest products provided materials for numerous saw mills, planing mills, and veneer mills, principally in the southern portion of the basin, and pulpwood for paper mills in the basin and across the region. Several large meat packing plants; numerous cotton gins; canning, fertilizer, and cement plants; and turpentine stills operated in the area. Granite, fuller's earth, bauxite, clay, sand, and gravel were obtained and processed in the area. Some of the industries required large quantities of water to support their industrial processes (USACE, Mobile District 1959).

Population in the region was widely distributed and predominantly rural in nature. Few significant urban population centers were in the ACF Basin (such as Atlanta, Columbus, and Albany) having large public water supply systems. However, between 1950 and 1970, the southeast U.S. (including the ACF Basin and Metro Atlanta) became an increasingly important region for manufacturing, transportation, and commerce. Population in the urban centers began to grow at an accelerated rate, both from outside the region and from rural areas of the state, expanding the demand for water service from public water supply systems. As urban population centers and industry expanded, demand for thermoelectric power generation expanded in the region, dramatically increasing the demand for cooling water from surface water sources.

2.1.1.2.5.1.2 Water Use in the ACF Basin between 1970 and 1990

Marella et al. (1993) examined water use in the ACF Basin between 1970 and 1990, a period of significant economic and population growth in the region. This section provides a summary of the basinwide assessment presented in that report and a brief state-by-state summary.

Total water use in the ACF Basin increased by 42 percent, from 1,475 mgd in 1970 to 2,098 mgd in 1990. That increase, for the most part, can be attributed to (1) the increase in public supply water use, primarily in Metro Atlanta, and to (2) the increase in agricultural water use in the Dougherty Plain area in southwestern Georgia. All categories of water use, except for thermoelectric power generation, increased between 1970 and 1990. Public supply steadily increased over the 20-year period from about 140 mgd in 1970 to 480 mgd in 1990. Domestic self-supply remained relatively level, fluctuating between about 20 and 50 mgd over the 20-year period. Total commercial-industrial self-supply sharply increased from about 162 mgd to about 261 mgd during the 1970s, but the demand leveled off during the 1980s (249 mgd in 1990). Total agricultural water use in the basin dramatically increased from about 21 mgd in 1970 to about 365 mgd in 1980, then declining to about 255 mgd in 1990. Water use for thermoelectric power generation ranged from about 1,122 mgd (1970) to a peak of 1,581 mgd (1980), thereafter declining dramatically to about 1,076 mgd in 1990. During the period from 1980 to 1990, overall water use in the ACF Basin decreased by 19 percent from 2,586 mgd to 2,098 mgd, primarily because of the decrease in water used for thermoelectric power generation and agriculture irrigation. Reasons for those declines are discussed further below. Specific surface water and groundwater withdrawals in the basin between 1970 and 1990 are summarized (by water use category and on 5-year intervals) in Table 2.1-8.

Total groundwater withdrawals in the ACF Basin increased between 1970 and 1990 by nearly 214 mgd (243 percent), largely as a result of an increase in groundwater use for agriculture and principally in southwestern Georgia. Major changes to irrigation techniques/practices during the latter half of the 1970s resulted in substantial increases in agricultural water use in southwestern Georgia. Withdrawals of groundwater from the principal aquifers (primarily the Floridan aquifer system) increased by nearly 80 mgd in the Dougherty Plain area in Georgia between 1977 and 1980. However, between 1980 and 1990, the amount of groundwater withdrawn for irrigation purposes decreased because of a decline in irrigated acreage and an increase in irrigation efficiencies.

Table 2.1-8.
ACF Basin Water Withdrawals by Principal Water Use Categories (1970–1990) (in mgd)

		Year				
Water use	**Source**	**1970**	**1975**	**1980**	**1985**	**1990**
Public Supply	Groundwater	39.84	43.86	69.05	54.14	64.54
	Surface water	99.66	233.47	261.48	370.93	421.20
Self-supplied domestic	Groundwater	30.37	20.47	48.10	33.95	32.96
	Surface water	0.00	0.01	0.00	0.00	0.00
Self-supplied commercial-industrial	Groundwater	10.44	25.52	21.88	26.63	27.93
	Surface water	151.80	208.15	239.57	226.54	220.50
Agricultural	Groundwater	7.14	16.81	256.06	190.12	177.25
	Surface water	13.38	17.46	108.91	83.42	77.75
Thermoelectric power generation	Groundwater	1.40	0.30	0.00	0.74	0.37
	Surface water	1,120.80	1,569.10	1,580.94	1,232.44	1,075.27
Total Withdrawals (by year)	Groundwater	89.19	106.96	395.09	305.58	303.05
	Surface water	1,385.64	2,028.19	2,190.90	1,913.33	1,794.72
	Total	1,474.83	2,135.15	2,585.99	2,218.91	2,097.77

Source: Marella et al. 1993

Surface water withdrawals increased 805 mgd (58 percent) between 1970 and 1980, primarily because of increased public supply demands in the northern part of the basin and the operation of several new thermoelectric power plants. However, surface water withdrawals decreased 396 mgd (18 percent)

between 1980 and 1990, primarily because of more efficient uses of water for industrial and thermoelectric power generation purposes. Surface water withdrawals for thermoelectric power generation decreased from 1,581 mgd in 1980 to 1,075 mgd in 1990. Use of more water-efficient machinery, reuse or recirculation of water, and use of cooling ponds were some of the reasons for the decreases in water withdrawals for these categories. More information on closed-cycle recirculation cooling at thermoelectric power plants in the ACF Basin is provided section 2.1.1.2.6. Despite the year-by-year ups and downs in surface water withdrawals, there was an overall increase of about 29 percent for the 20-year period from 1970 to 1990.

Georgia. The Chattahoochee and Flint rivers and their tributaries have served as the primary source of water for many public supply systems, industries, and power plants in Georgia, whereas groundwater has been the primary source of water for irrigation purposes.

From 1970 to 1990, total water withdrawn in the ACF Basin in Georgia increased nearly 38 percent from 1,262 mgd to 1,727 mgd. Total withdrawals for public supply continually increased during that period. Surface water withdrawals for public supply, in particular, increased nearly 350 percent (321 mgd) between 1970 and 1990, and groundwater withdrawals for public supply increased nearly 32 percent (11 mgd). The largest decrease in water withdrawals between 1970 and 1990 were for self-supplied commercial-industrial and thermoelectric power generation uses. Use of more water-efficient commercial-industrial processes, recirculation of water, and use of cooling ponds are some of the reasons for decreases in water withdrawals for these categories. While overall water withdrawals increased overall from 1970 to 1990, total withdrawals actually increased dramatically in the 1970s, peaked, and decreased in the 1980s. Total withdrawals in 1980 had reached 2,253 mgd and had declined to the 1,727 mgd level by 1990.

Total agricultural water withdrawals in the ACF Basin in Georgia increased 1,320 percent between 1970 and 1990. Groundwater withdrawals for agricultural use increased more than 3,070 percent (138 mgd) during this period. Most of the increase occurred during the 1970s and peaked around 1980. The introduction of the center pivot and other self-propelled irrigation equipment led to the rapid expansion of irrigated acreage and water use between 1970 and 1980. The need for water for irrigation purposes was greater than normal in 1980 (1980 was considered a dry year). Irrigation system efficiencies increased considerably after 1980, and harvested cropland declined throughout Georgia between 1980 and 1990 (including a reduction in irrigated acreage). Those factors resulted in a decrease in irrigation water use during the period.

Alabama. Total water use in the ACF Basin in Alabama increased nearly 230 percent from 55 mgd (1970) to 183 mgd (1990). Nearly 78 percent of this increase was related to the opening of the Farley Nuclear Power Plant during the late 1970s. Discounting withdrawals by the Farley Plant, surface water withdrawals increased 23 percent. Groundwater withdrawals between 1970 and 1990 increased nearly 244 percent, due mostly to increased crop irrigation and public-supply use.

Florida. Total water use in the ACF Basin in Florida increased 19 percent from 157 mgd (1970) to 188 mgd (1990). The dominant use of water in the ACF Basin in Florida was cooling water for thermoelectric power generation at the Sholtz Power Plant. Water withdrawals for this plant actually declined gradually from about 145 mgd (1970) to 108 mgd (1990). Despite a 20-percent increase in the power generated, surface water withdrawals decreased as a result of the more efficient use of water for thermoelectric power generation. The overall increase in total water withdrawals between 1970 and 1990, for the most part, was attributed to the withdrawal and interbasin transfer of water from the Chipola River to the St. Joe Paper Company in Port St. Joe, Florida (the paper company closed in 1999). All categories of water use, except thermoelectric power generation, increased moderately in the basin in Florida between 1970 and 1990.

Groundwater withdrawals in the Apalachicola River Basin in Florida increased between 1970 and 1990. That was consistent with the statewide trend of increasing reliance on groundwater and the decreasing use of surface water.

2.1.1.2.5.1.3 Recent Water Use Trends from 1990 to 2010

Between 1990 and 2010, the region continued to experience rapid population growth, particularly in the metropolitan Atlanta area and in other urban areas within the ACF Basin, although the rate of growth leveled off somewhat beginning in 2008 due to poor economic conditions in the region. Additionally, acreage of irrigated agriculture has increased in southwestern Georgia. Both factors tend to indicate a continued upward trend in both surface water and groundwater withdrawal and use. However, a number of technological and economic factors have, in large part, offset increased water demands in the ACF Basin. Some of those factors include the following:

- Increased agricultural irrigation efficiencies.
- Improved cooling water technologies for thermoelectric power plants.
- Reduced water demands in the commercial-industrial water use category due to the changing economy of the region. The industrial sector of the economy in the region (which frequently requires significant quantities of water to support manufacturing processes) has significantly declined as business has shifted more to a service-based economy.
- Numerous water conservation/water efficiency technologies and programs instituted by the states and public water supply providers.
- Concerted regional water planning initiatives.

Georgia. Fanning and Trent (2009) evaluated water use trends in Georgia from 1980 through 2005. Statewide, total water use in 2005 (about 5,353 mgd) was about the same as in 1990 (5,471 mgd). Statewide public-supply water use steadily increased from 1980 to 2000, corresponding to an increase in population (from 4,189,000 to 8,186,450) during the same period; however, water use leveled off and slightly decreased from 2000 to 2005. Commercial, domestic, and livestock uses remained about the same for the period from 1980 to 2005. Industrial water use fluctuated during the period from 1980 to 2005, mostly because of improved water efficiency, water recycling, and conservation measures at industrial plants and changes in the number and type of industrial facilities. The statewide statistics are considered to be generally indicative of water use trends in the ACF Basin in Georgia.

Irrigation water use declined from 1980 to 1990, increased from 1995 to 2000, and decreased markedly from 2000 to 2005. Estimated irrigation withdrawal was 30 percent lower in 2005 than in 2000 because of decreased irrigation demands resulting from the greater amount of rainfall in 2005, which relieved the prolonged drought that began in 1998 and continued through 2002. The total number of acres irrigated in the state increased by nearly 32 percent between 1995 and 2005.

Water for thermoelectric power generation has continued to be the largest of any off-stream use category in Georgia. Thermoelectric power withdrawal peaked in 1980, dropped sharply in 1985, and declined again in 1990 before increasing in 1995 and 2000. The rising trend was reversed in 2005, after thermoelectric power decreased by 24 percent from 2000 because of the decommissioning of three power plants and retrofitting cooling towers at several other plants, including some in the ACF Basin.

Specifically, for the ACF Basin in Georgia, surface water withdrawals between 1990 and 2005 compare as follows (Fanning and Trent 2009; Marella et al. 1993):

- Total withdrawals—decreased by 10.8 percent (1,327 mgd as of 2005)
- Public water supply withdrawals—increased by 27.4 percent (526 mgd as of 2005)
- Self-supplied domestic-commercial-industrial withdrawals—decreased by 9.2 percent (129 mgd as of 2005)
- Irrigation withdrawals—increased by 46.0 percent (92 mgd as of 2005)
- Thermoelectric power generation withdrawals—decreased by 33.2 percent (580 mgd as of 2005)

Alabama. Hutson et al. (2009) evaluated recent water use trends in Alabama as of 2005. On a statewide basis, total water use in 2005 in Alabama varied little from total use in 2000. Total water withdrawals decreased less than 1 percent in 2005 compared to 2000. Surface water withdrawals in 2005 decreased less than 5 percent from 2000 levels. In contrast, groundwater withdrawals in 2005 increased about 12 percent over 2000 levels.

Total public-supply water withdrawals decreased 4 percent from 834 mgd in 2000 to 802 mgd in 2005. Water withdrawals for irrigation statewide increased about 274 percent from 2000 (43.1 mgd) to 2005 (161.2 mgd). Groundwater withdrawals for irrigation increased at a faster rate than surface water withdrawals. Part of this increase in irrigation numbers was due to a more complete inventory of golf courses, nurseries, and sod farms. Primarily as a result of this inclusion, total irrigated acreage from 2000 to 2005 increased about 94 percent from 70,010 ac to 135,800 ac. In 2000, 57 self-supplied industries reported withdrawals compared with 66 industries in 2005. Although the number of reporting industries increased in 2005, water withdrawals decreased 34 percent from 2000 (833 mgd) to 2005 (550 mgd). Groundwater withdrawals were 51 percent less in 2005 than in 2000. Surface water withdrawals were 33 percent less in 2005 than in 2000. Reasons for reduced water withdrawals include reduced production, increased water conservation, or improved metering and reporting. Water withdrawals to support thermoelectric power generation (almost exclusively from surface water sources) have remained level in recent years.

Specifically, for the ACF Basin in Alabama, surface water withdrawals between 1990 and 2005 compare as follows (Marella et al. 1993; Hutson et al. 2009):

- Total withdrawals—increased by 4.4 percent (166 mgd as of 2005)
- Public water supply withdrawals—increased by 142.6 percent (19 mgd as of 2005)
- Self-supplied domestic-commercial-industrial withdrawals—decreased by 34.2 percent (30 mgd as of 2005)
- Irrigation withdrawals—increased by 76.3 percent (12 mgd as of 2005)
- Thermoelectric power generation withdrawals—decreased by 6.6 percent (105 mgd as of 2005)

Florida. NWFWMD (1998, 2008) provided an assessment of water use in 1995 and 2005 in the 8-county area adjacent to the Apalachicola River (Regions IV, V, and VI in the Northwest Florida Water Management District's area of operation), which generally, but not precisely, aligns with the ACF Basin. Overall, total consumptive water use in the Apalachicola River Basin in Florida decreased slightly between 1995 and 2005, despite moderate increases in various water use categories such as public supply, domestic self-supply, and agricultural irrigation. These increases have been offset by the termination of industrial surface water withdrawals from the Chipola River by the St. Joe Paper Company in Port St. Joe, Florida, which closed in 1999.

Metropolitan Atlanta Water Use Trends. The Metropolitan Atlanta Area Water Resources Management Study (MAAWRMS) (USACE Savannah District 1978) summarized 1975 water withdrawals by the city of Atlanta and several surrounding metropolitan counties from the Chattahoochee and Flint River basins. The study also included projections of year 2000 water withdrawals from those same governmental entities. The quantities are depicted in Table 2.1-9, along with average water withdrawals by the water providers in 2006, 2007, and 2008 (USACE, Mobile District 2009a). Other metropolitan Atlanta counties, such as Forsyth County and Hall County, were not specifically included in the 1978 study and are not included in Table 2.1-9 because the intent of the table is to compare water use and water use projections over time.

Table 2.1-9.
Water Withdrawals (average) by Selected Metropolitan Atlanta M&I Water Suppliers Compared to Projected 2000 Water Withdrawals from MAAWRMS

M&I water supplier	Withdrawal source (basin)	MAAWRMS report (Oct 1978)		2006[a] Withdrawals (mgd)	2007[a] Withdrawals (mgd)	2008[a] Withdrawals (mgd)
		1975 Withdrawals (mgd)	Projected 2000 withdrawals (mgd)			
Atlanta	Chattahoochee	86.8	116.4	102.5	100.9	87.8
Fulton	Chattahoochee	21.1	67.3	43.8	44.1	36.1
DeKalb	Chattahoochee	59.0	110.8	82.8	78.4	72.6
Cobb	Chattahoochee	29.7	74.1	51.0	52.1	43.7
Gwinnett	Chattahoochee	14.5	50.7	92.6	88.2	73.6
Douglas	Chattahoochee	4.3	17.7	13.2	9.6	11.0
Clayton	Flint	15.6	40.6	13.9	12.3	10.6
Totals		231.0	477.6	399.8	385.6	335.4

Source: USACE, Mobile District 2009a

For the water providers summarized in Table 2.1-9, water withdrawals between 1975 and 2006 increased by 73 percent. However, with the exception of Gwinnett County, 2006 average withdrawals for each water provider was substantially lower than year 2000 water withdrawal projections from the MAAWRMS. Their overall total was lower as well. Cumulative withdrawals in these metropolitan Atlanta counties peaked in 2006–2007. Thereafter, total withdrawals abruptly declined in 2008 (by about 13 percent) and have not returned to those peak levels. Year 2008 water use in north Georgia was reduced due to restrictions associated with drought conditions, including a mandate from the Governor of Georgia for public water suppliers to reduce water use by at least 10 percent during the balance of the drought period. Consequently, 2006–2007 withdrawal levels provide a reasonably conservative representation of present withdrawals in the metropolitan Atlanta counties included in Table 2.1-9.

The 2010 Water Metrics Report (covering the years from 2000 through 2009), prepared for the Metropolitan North Georgia Water Planning District (ARC 2011), substantiates that M&I water withdrawals from the Chattahoochee River and Flint River basins within the 15-county MNGWPD area remained relatively steady from 2000 through 2007. During this period, average annual withdrawals ranged from 395 to 447 mgd in the Chattahoochee River Basin and from 19 to 22 mgd in the Flint basin. Withdrawals declined about 15 percent in 2008 and 2009 due to conservation and water use restrictions associated with drought conditions and, subsequently, reduced economic activity in the region associated with the 2009 recession. Reduced economic activity and the associated effects on water use in the region have extended over several years but are expected to be temporary.

2.1.1.2.5.2 Current Water Use—Georgia

Surface Water. According to a USGS report of water use withdrawals in Georgia in 2005 (Fanning and Trent 2009), surface water use in the ACF Basin (Georgia) totaled 1,326.51 mgd, consisting of the water use categories shown in Table 2.1-10. The 2005 water use report is the most recent available comprehensive assessment of water use in the state of Georgia, including the Georgia portion of the ACF Basin. As stated in the previous section, additional water use data available since 2005 (particularly data relative to Metro Atlanta) indicates that overall surface water withdrawals in the basin declined during the 2007–2008 drought period and the subsequent economic recession and have not yet returned to levels observed from 2005 through 2007. Consequently, water use values from the 2005 report are considered to reasonably represent, or slightly exceed, current water use across the ACF Basin for purposes of this analysis.

Preparer's note: A comprehensive report on water use in Georgia as of 2010 was expected from USGS by mid-2015. The 2010 water use report was not available in sufficient time to include the information in the draft EIS for public review. Appropriate updates to this section will be included in the final EIS so that the most current and relevant information can be presented. Preliminary information indicates that water use in most categories declined slightly between 2005 and 2010.

Table 2.1-10.
Surface Water Use: ACF (Georgia)

Water use category	Quantity (mgd)	% of Total
Total Use	*1, 326.51*	*100%*
Public Supply	525.75	39.6%
Domestic and Commercial	6.90	0.5%
Industrial and Mining	121.84	9.2%
Irrigation	75.92	5.7%
Livestock	16.06	1.3%
Thermoelectric Power Generation	580.04	43.7%

Source: Fanning and Trent 2009

Georgia law—the Georgia Groundwater Use Act (O.C.G.A sections 12-5-90 *et seq.*) and the Georgia Water Quality Control Act (O.C.G.A. 12-5-31)—requires any surface water user who withdraws more than 100,000 gpd on a monthly average to obtain a withdrawal permit from the GAEPD. The basic provisions, requirements and procedures associated with the permit program are summarized in section 2.1.1.2.10.1.1.

Table 2.1-11 provides a summary of permitted surface water withdrawals for M&I uses in the ACF Basin in Georgia (GAEPD 2011). The information is provided beginning with the most upstream counties in the Chattahoochee River and Flint River watersheds working downstream. The numbers in the table do not necessarily reflect actual quantities of water withdrawn or whether a withdrawal could even be occurring at any time by those who hold surface water withdrawal permits from Georgia. They do reflect the allowable limits placed on each user. Actual quantities withdrawn from surface waters in Georgia are used in modeling the ACF Basin for the purpose of updating the Master Manual and project WCMs.

On the basis of studies conducted by Dr. James E. Hook et al. (2009) for use in conjunction with development of the Georgia statewide water plan, estimates for surface water pumping rates (projections for year 2011) in the Chattahoochee and Flint River basins for agricultural irrigation are presented in Table 2.1-12 and Table 2.1-13 In the tables, the *wet year* equals the wettest 25th percentile (1 in 4 years)

and *dry year* equals the driest 25th percentile (1 in 4 years). The results of the studies are being used to characterize and quantify surface water withdrawals for agricultural irrigation to support the statewide water planning process. Surface water withdrawal for agricultural irrigation across the entire ACF Basin is relatively minor compared to other uses.

Table 2.1-11.
Georgia Permitted M&I Surface Water Withdrawals within the ACF Basin

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Upper Chattahoochee River Basin – headwaters to Whitesburg, GA						
Chattahoochee	Baldwin, City of	068-1201-04	Habersham	Chattahoochee River	4.000	3.000
Chattahoochee	Clarkesville, City Of	068-1201-03	Habersham	Soque River	1.500	1.000
Chattahoochee	Cornelia, City Of	068-1201-01	Habersham	Hazel Creek, Camp Creek Reservoir, Emergency Camp Cr.	4.000	4.000
Chattahoochee	HaBest, Inc.[a]	068-1201-06	Habersham	Soque River	223.000	128.000
Chattahoochee	White County Water & Sewer Authority	154-1202-02	White	Turner Creek	2.000	1.800
Chattahoochee	Birchriver Chestatee Company, LLC	093-1202-03	Lumpkin	Chestatee River	0.430	0.430
Chattahoochee	Dahlonega, City of	093-1204-03	Lumpkin	Yahoola Creek Reservoir	9.100	6.800
Chattahoochee	Dahlonega, City Of New Plant	093-1204-01	Lumpkin	Yahoola Creek	1.500	1.250
Chattahoochee	McRae and Stolz, Inc.	042-1202-01	Dawson	Lake Lanier	0.780	0.500
Chattahoochee	Buford, City Of	069-1290-04	Hall	Lake Lanier	2.500	2.000
Chattahoochee	Gainesville, City Of	069-1290-05	Hall	Lake Lanier	35.000	30.000
Chattahoochee	LLI Management Company, LLC	069-1205-01	Hall	Lake Lanier	0.600	0.600
Chattahoochee	LLI Management Company, LLC (Pineisle)	069-1205-02	Hall	Lake Lanier	0.600	0.600
Chattahoochee	Gwinnett County Water & Sewerage Auth	069-1290-06	Hall	Lake Lanier		150.000
Chattahoochee	Cumming, City Of	058-1290-07	Forsyth	Lake Lanier	21.000	18.000
Chattahoochee	Forsyth County Board Of Commissioners	058-1207-06	Forsyth	Lake Lanier	16.000	14.000
Chattahoochee	Lanier Golf Club	058-1207-05	Forsyth	Golf Course Pond #1	0.290	0.210
Chattahoochee	Sequoia Golf Olde Atlanta LLC	058-1207-03	Forsyth	ManMade Lakes	0.340	0.200
Chattahoochee	Sequoia Golf Windermere, LLC	058-1207-09	Forsyth	James Creek	0.400	0.400
Chattahoochee	Southeast Investments, L.L.C.	058-1207-08	Forsyth	Dick Creek	0.200	0.080
Chattahoochee	Dekalb Co Public Works Water & Sewer	044-1290-03	Dekalb	Chattahoochee River	140.000	140.000
Chattahoochee	Atlanta Athletic Club	060-1209-02	Fulton	Chattahoochee River	0.860	0.430
Chattahoochee	Atlanta, City of	060-1291-01	Fulton	Chattahoochee River	180.000	180.000

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Chattahoochee	Atlanta-Fulton Co. Water Res Commission	060-1207-02	Fulton	Chattahoochee River	90.000	90.000
Chattahoochee	Cherokee Town & Country Club	060-1290-09	Fulton	Bull Sluice Lake	0.720	0.430
Chattahoochee	GCG Members' Purchasing Committee, Inc.	060-1209-04	Fulton	Big Creek	2.000	1.000
Chattahoochee	Palmetto, City Of	060-1218-01	Fulton	Cedar Creek	0.600	0.450
Chattahoochee	Riverfarm Enterprises, Inc.(RiverPines Golf)	060-1207-04	Fulton	Johns Creek	1.150	0.500
Chattahoochee	Roswell, City Of Big Creek	060-1209-01	Fulton	Big Creek	1.200	1.200
Chattahoochee	Standard Golf Club	060-1209-03	Fulton	Unnamed tributary to Johns Creek	0.750	0.600
Chattahoochee	Perimeter Terminal LLC	060-1290-08	Fulton	Chattahoochee River	0.250	0.250
Chattahoochee	Caraustar Mill Group, Inc. - Mill 2	033-1214-02	Cobb	Sweetwater Creek	0.864	0.864
Chattahoochee	Caraustar Mill Group, Inc. - Sweetwater	033-1214-01	Cobb	Sweetwater Creek	0.560	0.490
Chattahoochee	Cobb Co Marietta Water Authority	033-1290-01	Cobb	Chattahoochee River	87.000	87.000
Chattahoochee	GPC Plant McDonough	033-1291-03	Cobb	Chattahoochee River	394.000	394.000
Chattahoochee	Douglasville Douglas County W & S A	048-1216-03	Douglas	Bear Creek	6.400	6.000
Chattahoochee	Douglasville Douglas County W & S A	048-1217-03	Douglas	Dog River Reservoir	23.000	23.000
Chattahoochee	East Point, City Of	048-1214-03	Douglas	Sweetwater Creek	13.200	11.500
Chattahoochee	Carroll County Water Authority	022-1217-01	Carroll	HC Seaton Reservoir (Snake Cr)	8.000	8.000
Chattahoochee	Coweta County Water & Sewerage Authority	038-1218-02	Coweta	BT Brown Reservoir	10.000	6.700
Chattahoochee River - Whitesburg to Jim Woodruff Lock and Dam (Lake Seminole)						
Chattahoochee	GPC Plant Yates	038-1291-02	Coweta	Chattahoochee River	720.000	700.000
Chattahoochee	Newnan Utilities	038-1221-01	Coweta	Sandy/Browns Creek	8.000	8.000
Chattahoochee	Newnan Utilities	038-1221-02	Coweta	Raw Water Reservoirs	14.000	14.000
Chattahoochee	GPC Plant Wansley	074-1291-06	Heard	Chattahoochee River	116.000	116.000
Chattahoochee	GPC Plant Wansley	074-1291-07	Heard	Service Water Reservoir	110.000	110.000
Chattahoochee	Heard County Water Authority	074-1220-02	Heard	Centralhatchee Creek	4.000	3.100
Chattahoochee	Heard County Water Authority	074-1220-03	Heard	Hillabahatchee Creek	4.000	3.100
Chattahoochee	Heard County Water Authority	074-1291-08	Heard	Chattahoochee River	0.550	0.550
Chattahoochee	Hogansville, City Of	141-1222-01	Troup	Blue Creek Res	1.000	1.000
Chattahoochee	LaGrange, City Of	141-1292-01	Troup	West Point Lake	22.000	20.000

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Chattahoochee	West Point, City Of	141-1292-02	Troup	Chattahoochee River	2.100	1.800
Chattahoochee	Chat Valley Water Supply District	072-1291-04	Harris	Chattahoochee River	8.000	5.800
Chattahoochee	Harris County Water Dept	072-1224-01	Harris	Bartletts Ferry Res	3.000	3.000
Chattahoochee	Southern Power Co Plant Franklin	106-1225-08	Muscogee	Chattahoochee River	31.500	31.500
Chattahoochee	Columbus, City Of	106-1293-05	Muscogee	Lake Oliver	90.000	90.000
Chattahoochee	Continental Carbon	106-1225-07	Muscogee	Chattahoochee River	0.900	0.660
Chattahoochee	Eagle-Phenix Hydro-electric Project, Inc.[b]	106-1225-04	Muscogee	Chattahoochee River	1,694.000	1,694.000
Chattahoochee	Eagle-Phenix Mills, LLC	106-1293-07	Muscogee	Chattahoochee River	1.400	1.300
Chattahoochee	Smiths Water Authority	106-1225-05	Muscogee	Lake Oliver (Chattahoochee River)	8.000	8.000
Chattahoochee	Fort Benning	026-1225-01	Muscogee	Chattahoochee River	12.000	10.000
Chattahoochee	Unimin Georgia Company, L.P.	096-1225-09	Marion	Duck pond on tributary to Black Cr	1.152	0.768
Chattahoochee	Yellow Pine Energy Company	030-1295-04	Clay	Chattahoochee River	2.650	2.650
Chattahoochee	Georgia. Pacific Cedar Springs, LLC	049-1295-01	Early	Chattahoochee River	144.000	115.000
Chattahoochee	Homestead Energy Resources, LLC[c]	049-1295-02	Early	Chattahoochee River	16,130.000	16,130.000
Chattahoochee	Longleaf Energy Associates, LLC	049-1295-03	Early	Chattahoochee River	27.000	25.000
Flint River Basin – headwaters to Jim Woodruff Lock and Dam (Lake Seminole)						
Flint	Clayton County Water Authority - Flint	031-1102-07	Clayton	Flint River	40.000	40.000
Flint	Clayton County Water Authority - Shoal	031-1101-01	Clayton	J.W. Smith Res./ Shoal Cr.	17.000	17.000
Flint	Stephens MDS, LP	031-1101-02	Clayton	Pond No. 1	0.250	0.250
Flint	Stephens MDS, LP	031-1101-03	Clayton	Pond No. 5	0.250	0.250
Flint	Board of Commissioners of Fayette County	056-1102-03	Fayette	Lake Peachtree	0.550	0.500
Flint	Board of Commissioners of Fayette County	056-1102-06	Fayette	Flat Creek Reservoir	4.500	4.000
Flint	Board of Commissioners of Fayette County	056-1102-09	Fayette	Line Cr (McIntosh Site)	17.000	12.500
Flint	Board of Commissioners of Fayette County	056-1102-10	Fayette	Whitewater Creek	2.000	2.000
Flint	Board of Commissioners of Fayette County	056-1102-12	Fayette	Horton Creek Reservoir	14.000	14.000
Flint	Board of Commissioners of Fayette County	056-1102-13	Fayette	Flint River	16.000	16.000
Flint	Fayetteville, City Of	056-1102-14	Fayette	Whitewater Creek	3.000	3.000
Flint	Newnan Utilities	038-110211	Coweta	Line Creek	12.000	12.000

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Flint	Newnan Utilities	038-110302	Coweta	White Oak Creek	7.000	7.000
Flint	Senoia, City Of	038-110205	Coweta	Hutchins Lake	0.300	0.300
Flint	Griffin, City Of	126-119001	Spalding	Flint River	13.200	12.000
Flint	Griffin, City of	114-1104-03	Pike	Still Branch Reservoir	48.000	42.000
Flint	Griffin, City of	114-119102	Pike	Flint River	50.000	50.000
Flint	Zebulon, City Of	114-110401	Pike	Elkins Creek	0.400	0.300
Flint	Roosevelt Warm Springs Institute	099-110604	Meriwether	Cascade Creek	0.144	0.144
Flint	Woodbury, City Of	099-110602	Meriwether	Cain Cr Res On Pond Cr	0.750	0.500
Flint	Southern Mills, Inc.	145-110402	Upson	Upper Boy Scout's Lake discharge or Boy Scout's lower	0.650	0.500
Flint	Thomaston, City Of	145-110501	Upson	Potato Creek	4.400	3.400
Flint	Thomaston, City Of	145-110502	Upson	Potato Creek	1.440	0.400
Flint	Thomaston, City Of	145-110503	Upson	Raw Water Cr Res	4.300	4.300
Flint	Manchester, City of	130-110605	Talbot	Rush Creek Reservoir	2.000	1.440
Flint	Manchester, City of	130-110606	Talbot	Lazer Creek	4.300	3.700
Flint	Unimin Georgia Company, L.P.	133-110901	Taylor	Remote Pond on Black Creek	2.592	1.728
Flint	Unimin Georgia Company, L.P.	133-110902	Taylor	Black Creek (Remote Jr.)	0.576	0.384
Flint	Weyerhaeuser Company	094-119101	Macon	Flint River	13.500	11.500
Flint	Crisp County Power Comm Hydro[d]	159-1112-02	Worth	Lake Blackshear	4,847.300	4,847.300
Flint	Crisp County Power Comm Steam	159-1112-01	Worth	Lake Blackshear	15.000	15.000
Flint	GPC Plant Mitchell	047-1192-01	Dougherty	Flint River	232.000	232.000

Notes:

[a.] Georgia withdrawal permit issued in 2007 for proposed flow through non-USACE hydroelectric power generation project at existing dam in Habersham County.

[b.] Georgia withdrawal permit (active as of 2009) for proposed non-USACE hydroelectric power generation at Eagle-Phenix Dam. Request submitted to FERC on 10/21/2010 to surrender license (75 FR 209, October 29, 2010).

[c.] Georgia withdrawal permit (active as of 2009) for proposed non-USACE hydroelectric power generation at George W. Andrews Lock and Dam. FERC terminated the license for project on 11/15/2007.

[d.] Georgia withdrawal permit (active as of 2009) for flow through non-USACE hydroelectric power generation at Lake Blackshear.

Table 2.1-12.
Chattahoochee River Basin: Agricultural Irrigation (Surface Water)
Annualized Pumping Rates (in mgd) Projected for Year 2011

Basin/subbasin	Wet year	Median year	Dry year
Basin Total	*4.06*	*6.23*	*8.35*
Upper Chattahoochee	0.15	0.27	0.46
Middle Chattahoochee – Lake Harding	0.02	0.02	0.03
Middle Chattahoochee – W.F. George Res.	1.41	2.09	2.82
Lower Chattahoochee	2.48	3.85	5.04

Table 2.1-13.
Flint River Basin: Agricultural Irrigation (Surface Water)
Annualized Pumping Rates (in mgd) Projected for Year 2011

Basin/subbasin	Wet year	Median year	Dry year
Basin Total	*64.07*	*95.09*	*126.52*
Upper Flint	2.75	3.90	5.31
Spring Creek	4.27	6.46	8.41
Middle Flint	16.20	24.80	33.40
Lower Flint	6.75	9.53	12.60
Kinchafoonee-Muckalee Creeks	13.00	19.40	25.90
Ichawaynochaway Creek	21.10	31.00	40.90

Groundwater. The GAEPD requires permits for all wells withdrawing greater than 100,000 gpd. Numerous private wells throughout the state withdraw less than 100,000 gpd, but location, density, and withdrawal rates can only be estimated. The basic provisions, requirements, and procedures associated with the GAEPD permit program are summarized in section 2.1.1.2.10.1.1.

In the Chattahoochee River Basin, 26 M&I water users are permitted to withdraw 14.89 mgd (on a monthly average). In the Flint River Basin in Georgia, 72 M&I water users are permitted by the state to withdraw 121.95 mgd (on a monthly average). Use of groundwater for M&I water needs is much more prevalent in the Flint River Basin, and over 40 percent of the permitted use (about 50 mgd) occurs in Dougherty County, principally by the city of Albany, Merck & Company, Proctor and Gamble, and Miller-Coors (GAEPD 2009b).

In the Southeastern Plains, stream and groundwater flow are highly connected and agricultural irrigation impacts streamflow during drought conditions. Low flows in streams were greater and occurred sooner in the recent droughts compared to previous droughts. Groundwater withdrawals are highest in the lower Chattahoochee River and middle and lower Flint River basins. The heaviest usage of groundwater occurs below the Fall Line in the high-yield aquifers of the Floridan, Clayton, Claiborne, and Providence aquifers, with the highest density occurring near Spring Creek. There, the close connection between surface water and the Floridan aquifer cause groundwater withdrawals to lower surface water levels in droughts, causing the basin to exceed the safe yield for freshwater mussels (Hook et al. 2005).

A 5-year study (2000–2004) by the University of Georgia examined agricultural groundwater use throughout the state. Data collected in the study are used for modeling by the state and municipalities to determine groundwater withdrawal use and its impacts on aquifers. Data from the study revealed that most agricultural irrigation occurs during the growing season, April to September, and peaks in June, July, and August when evapotranspiration is typically highest and stream and groundwater levels are

approaching their seasonal low levels. Irrigation was nearly twice as high during the drought years of 2000 and 2001 as it was in normal and wet years. The timing and volume of irrigation is also dependent on seasonal rainfall distribution, crop type and planting date, soil conditions, and growers experience and preferences (Hook et al. 2005).

Estimates of pumping rates (projected for year 2011) contained in the Georgia statewide water plan for the Chattahoochee and Flint River basins for agricultural irrigation are presented in Table 2.1-14 and Table 2.1-15. In the tables, the *wet year* equals the wettest 25th percentile (1 in 4 yr) and *dry year* equals the driest 25th percentile (1 in 4 yr). The results of the studies are being used to characterize and quantify groundwater withdrawals for agricultural irrigation associated with development of the Georgia statewide water plan.

Table 2.1-14.
Chattahoochee River Basin: Agricultural Irrigation (Groundwater)
Annualized Pumping Rates (in mgd) Projected for Year 2011

Basin/subbasin	Wet year	Median year	Dry year
Basin Total	*11.4*	*16.9*	*21.7*
Upper Chattahoochee	0	0	0
Middle Chattahoochee – Lake Harding	0	0	0
Middle Chattahoochee – W.F. George Res.	0.4	0.50	0.7
Lower Chattahoochee	11.00	16.40	21.0

Table 2.1-15.
Flint River Basin: Agricultural Irrigation (Groundwater)
Annualized Pumping Rates (in mgd) Projected for Year 2011

Basin/subbasin	Wet year	Median year	Dry year
Basin Total	*223.3*	*328.8*	*435.8*
Upper Flint	4.0	5.7	7.6
Spring Creek	53.3	79.8	106.0
Middle Flint	37.4	56.6	76.4
Lower Flint	82.7	119.0	157.0
Kinchafoonee-Muckalee Creeks	19.6	29.3	38.4
Ichawaynochaway Creek	26.3	38.4	50.4

2.1.1.2.5.3 Current Water Use—Alabama

Surface Water. Surface water withdrawals for all use categories, including agricultural irrigation and livestock, from the ACF Basin in Alabama in 2005 are summarized in Table 2.1-16. Only about 7 percent of surface water use in the Alabama portion of the Chattahoochee River Basin is for agricultural irrigation and livestock (Hutson et al. 2009). The 2005 water use report is the most recent available comprehensive assessment of water use in the state of Alabama, including the Alabama portion of the ACF Basin. As stated in the previous section, limited additional water use data available in the basin since 2005 indicate that overall surface water withdrawals in the basin declined during the 2007–2008 drought period and the subsequent economic recession and have not completely returned to levels observed in 2005–2007. Consequently, water use values from the 2005 report are considered to reasonably represent, or slightly exceed, current water use across the ACF Basin for purposes of this analysis.

Preparer's note: A comprehensive report on water use in Alabama as of 2010 was expected from USGS/ALOWR by mid-2015. The 2010 water use report was not available in sufficient time to include the information in the draft EIS for public review. Appropriate updates to this section will be included in the final EIS so that the most current and relevant information can be presented. Preliminary information indicates that water use in most categories declined slightly between 2005 and 2010.

Table 2.1-17 provides a summary of the important M&I surface water withdrawals in Alabama from the Chattahoochee River (between West Point Dam and Jim Woodruff Lock and Dam) in 2005. Over 80 percent of the Chattahoochee River withdrawals from within Alabama come from two sources, Mead Westvaco and Southern Nuclear Company (Farley Nuclear Plant) (Hutson et al. 2009).

Table 2.1-16.
Alabama Surface Water Use: ACF Basin

Water use category	Quantity (mgd)	% of total
Total Use	*165.95*	*100%*
Public Supply	18.92	11.4%
Industrial and Mining	29.76	17.9%
Thermoelectric Power Generation	105.36	63.5%
Irrigation	11.33	6.8%
Livestock	0.58	0.4%

Source: Hutson et al. 2009

Table 2.1-17.
Alabama M&I Surface Water Withdrawals in the ACF Basin

Withdrawal by	County	Withdrawal (mgd)
WestPoint Home Inc. - Fairfax Finishing Plant (Westpoint Stevens Inc.)	Chambers	2.16
Chattahoochee Valley Water Supply District	Chambers	4.72
Smiths Water and Sewer Authority (Smiths Station Water System)	Lee	2.29
Opelika Water Works Board	Lee	7.48
Phenix City Utilities	Russell	7.04
Mead Westvaco Corporation	Russell	27.60
Southern Nuclear Company - Farley Nuclear Plant	Houston	105.36

Source: Hutson et al. 2009

Groundwater. Table 2.1-18 provides a summary of the groundwater withdrawals in Alabama in 2005 lying within the extent of the Chattahoochee River Basin (between West Point Dam and Jim Woodruff Lock and Dam). The most significant uses of groundwater in this area are public water supply and agricultural irrigation, which constitute about 90 percent of the total groundwater use (Hutson et al. 2009).

Alabama does not have a formal water withdrawal permitting program for surface water and groundwater. Water use information is acquired through a water use reporting system administered by the Alabama Office of Water Resources (OWR) (see section 2.1.1.2.10.2.3).

Table 2.1-18.
Alabama Groundwater Use: ACF Basin

Water use category	Quantity (mgd)	% of total
Total Use	*23.77*	*100%*
Public Supply	13.48	56.7%
Industrial and Mining	2.34	9.8%
Thermoelectric Power Generation	0.17	0.8%
Irrigation	7.38	31.0%
Livestock	0.40	1.7%

Source: Hutson et al. 2009

2.1.1.2.5.4 Current Water Use—Florida

Table 2.1-19 presents information on M&I surface water withdrawals from the Apalachicola River Basin. By far, the most significant surface water withdrawal from the Apalachicola River over much of the period of analysis for this WCM update occurred at the Gulf Power Company's Scholz Electric Generating Plant in Jackson County, Florida, 3.5 miles below Jim Woodruff Lock and Dam. While the average daily withdrawal for Plant Scholz was 96.10 mgd (over 19 yr of data), a 2008 Water Supply Assessment Update prepared by the Northwest Florida Water Management District (NWFWMD 2008) indicates that the net consumptive water use at Plant Scholz in 2005 was approximately 4.1 mgd. In 2013, Gulf Power Company announced that it planned to cease operations at Plant Scholz in April 2015. In April 2015, the Company ceased water withdrawals and completed closure of Plant Scholz (Jackson County Floridan 2015).

Table 2.1-19.
Florida M&I Surface Water Withdrawals within the ACF Basin

Withdrawal by	Avg daily withdrawal (monthly avg mgd)	Max daily withdrawal (monthly avg mgd)	Min daily withdrawal (monthly avg mgd)	Years for which data are available
Apalachicola River – Jim Woodruff Dam (Lake Seminole) to Apalachicola Bay				
Gulf Power (Scholz Electric)	96.10	129.60	0.06	1990–2008
St. Joe Timberland (Prudential Ins.)	0.95	10.75	0.00	1999–2008
City of Port St. Joe	0.52	4.51	0.00	2002–2008

Source: Withdrawal data compiled by USACE, Mobile District, for use in modeling the ACF Basin with HEC-ResSim.

Available St. Joe Timberland (Prudential Insurance) water use statistics represent intermittent withdrawals (three to four months each year, generally between August and January) from 1999 through 2006. These withdrawals provide for the seasonal filling of waterfowl management impoundments on the property. These waters are generally returned to the river when the waterfowl management impoundments are drained in the early spring (March/April) (Chelette 2011). No withdrawals were made in 2007 or 2008 because river levels were too low to meet NWFWMD withdrawal permit conditions due to drought conditions in the basin (Chelette 2011).

Available data indicates relatively minor and highly variable surface water withdrawals for the city of Port St. Joe between 2002 and 2008 (last year of available data). The predominant source of water supply for the city has historically been groundwater. Due to depression of the Floridan aquifer in the vicinity of Port St. Joe from pumping to supply the St. Joe Paper Company, an 18.5-mile long freshwater canal was built in 1953 between the Chipola River and Port St. Joe to serve as a freshwater supply for the paper

mill, with a capacity to provide about 51.5 mgd. The mill closed in 1998, and the ownership of the canal (called the Gulf County Fresh Water Supply Canal) was transferred the city of Port St. Joe in 2001 (NWFWMD 2008). A regional water supply plan developed in 2007 for Franklin and Gulf counties NWFWMD 2007) includes provisions to develop the surface water system, using the existing canal in lieu of groundwater resources, to meet the water supply needs of Port St. Joe up to an estimated quantity of 6.0 mgd. The city of Port St. Joe completed the conversion to surface water supply in 2009 and is currently withdrawing about 2 mgd (Chellette 2011), representing a net transfer of water out of the Apalachicola River Basin.

In an 8-county area adjacent to the Apalachicola River (Regions IV, V, and VI in the Northwest Florida Water Management District's 2008 Water Supply Assessment Update (NWFWMD 2008)), about 70 mgd (including both surface water and groundwater) is withdrawn and consumptively used. Agricultural and other irrigation (about 54 percent of the total water use) are considered virtually 100 percent consumptive. Most public supply and domestic self-supply of water in the area use septic systems, which are highly consumptive. This NWFWMD assessment also considered only the net, or consumptive, use of water at Plant Scholz—the difference between that withdrawn from, and returned to, the Apalachicola River, or about 4.1 mgd (NWFWMD 2008). On the basis of those assumptions, only about 14 percent of water use in this 8-county area comes from surface waters. With the closure of Plant Scholz in April 2015, the percentage of water use from surface water has declined further from the 2008 estimate. The remaining water withdrawn and consumptively used is groundwater. Irrigation (over 60 percent of the total) and public supply/domestic self-supply are the predominant uses of this water.

Florida regulates water withdrawals in the Apalachicola River Basin by way of surface water and groundwater permit programs administered by the Northwest Florida Water Management District (NWFWMD). Those programs are described in more detail in section 2.1.1.2.10.3.4.

2.1.1.2.5.5 Incidental Water Withdrawals Permitted at USACE Reservoir Projects

Historically, at USACE reservoir projects with shoreline management plans that allow for permitting of docks and other facilities (including Lake Lanier, West Point Lake, Walter F. George Lake, George W. Andrews Lake, and Lake Seminole in the ACF Basin), water pumps of 2 horsepower or less have been authorized in conjunction with a permitted facility for incidental cleaning purposes or watering of lawns and gardens. On the basis of a 2008 USACE, Mobile District review of the above projects, the following numbers of permits (issued under USACE's Title 36 shoreline management authority) allow such incidental water withdrawals: Lake Lanier–1,495; West Point Lake–31; Walter F. George Lake–104; George W. Andrews Lake–0; and Lake Seminole–44. Collectively, those minor and intermittent withdrawals are considered to have a negligible effect on the projects and water availability in the system (Day 2010).

2.1.1.2.6 Consumptive Water Use and Return Flows

Consumptive use is defined as the part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the environment. Consumptive use is also referred to as *water consumed* (Hutson et al. 2009).

General observations on how much water is consumptively used for various categories of water use in the region (consumptive-use coefficients) are summarized in Fanning and Trent (2009). Consumptive-use coefficients vary for each of the water-use categories. Because public supplies deliver water to domestic, commercial, industrial, and thermoelectric-power users, consumptive use is estimated for those use categories and not for public supply. For domestic water use, consumptive use is estimated at about 18 percent of the total use (Hutson et al. 2009). The consumptive-use coefficient for commercial use was developed by the Georgia Water Use Program and supported by calculations using withdrawal and

discharge data for some commercial users, and it is estimated to be 18 percent (Hutson et al. 2009). For industrial and mining use, consumptive-use coefficients were determined by industry type and type of mining activity. For example, in 2005 the consumptive-use coefficient was estimated at 7 percent for the pulp and paper industry and 13 percent for the textile industry. Irrigation and livestock water uses are considered to be 100 percent consumed; that is, all the water withdrawn was evaporated or transpired, incorporated into crops, or consumed by livestock. Crops in the region are irrigated using sprinkler and micro-irrigation methods, which do not have the large nonconsumptive amounts of water of flood irrigation methods. Consumptive-use coefficients for thermoelectric power ranged from zero to nearly 70 percent. The percentage is determined by the type of plant cooling (once-through cooling or cooling towers or ponds). Consumptive use is negligible for in-stream hydroelectric power generation. In 2005, total consumptive use across Georgia was estimated to be about 24 percent of total withdrawals in the state (Hutson et al. 2009).

Table 2.1-20 below depicts the cooling system types and consumptive water use characteristics of the thermoelectric power plants in the ACF Basin. The information in the table was compiled from Blalock (2010, personal communication), DOE EIA (2006), Hutson et al. (2009), and USACE, Mobile District (2009). Other than the conversion of Plant McDonough from once-through cooling system to a closed-cycle cooling system in 2008 (as noted in Table 2.1-20), the existing thermoelectric power plants in the ACF Basin have not substantially changed operations with respect to water withdrawals and returns. The water withdrawal and return data from 2009 in Table 2.1-20 (except as noted) is considered to be representative of current withdrawal/return levels (and associated consumptive use) at thermoelectric plants in the ACF Basin.

Surface water that is not *consumed* when used is discharged (returned), with appropriate treatment, to the surface water system, which is generally at or near the point of withdrawal. Return flows from permitted M&I facilities in the ACF Basin are summarized in section 2.1.2.5 (Table 2.1-20). Return flows to other watersheds as interbasin transfers are addressed in section 2.1.1.2.10.1.9.

Table 2.1-20.
Consumptive Water Use at Thermoelectric Power Plants in the ACF Basin

Plant Name	Company	Location	River	Cooling system	Water Quantity (2009) (mgd, average annual)		
					Withdrawn	Returned	Consumed
McDonough	GA Power	Fulton Co, GA	Chattahoochee	Closed cycle[a]	6.4	1.2	5.2
Yates	GA Power	Coweta Co, GA	Chattahoochee	Closed cycle	47.0	36.5	10.5
Wansley	GA Power	Heard Co, GA	Chattahoochee	Closed cycle	59.0	42.0	17.0
Franklin	Southern Power Co.	Lee Co, AL	Chattahoochee	Closed cycle	4.8	0.5	4.3
Farley	Southern Nuclear	Houston Co, AL	Chattahoochee	Closed cycle	91.5[b]	79.2[b]	12.3[b]
Mitchell	GA Power	Dougherty	Flint	Once-through	22.0	22.0	0.0
Scholz[c]	Gulf Power	Jackson Co, FL	Apalachicola	Once-through	94.9[b]	91.8[b]	3.1[b]

Notes:
[a.] Plant McDonough was converted to a closed-cycle cooling system in April 2008 (Blalock 2010, personal communication).
[b.] These figures represent average annual quantities in year 2008.
[c.] Plant Scholz ceased operations and was closed effective April 2015.

In 2010, a Water Metrics Report was developed for the MNGWPD (ARC 2011) that analyzed the net use of water within the district from 2000 through 2009, accounting for all withdrawals and returns of treated wastewater. The percent return of water withdrawals in the MNGWPD was calculated by dividing the total wastewater returns by total water withdrawals within the district and converting to a percentage.

Figures for net water use for the overall MNGWPD account for all withdrawals and wastewater returns in the district, including any interbasin transfers of water that may be occurring. For the overall MNGWPD, the "total percent returned" figures provide an accurate approximation of consumptive water use that occurred in the district during those years. In year 2000, the percent of water withdrawals returned to the rivers and streams within the MNGWPD was about 60 percent. Between 2001 and 2008, the percent returned varied between 65 percent and 78 percent. By 2009, the percent of surface water withdrawn within the district for M&I water supply returned to the natural system increased to 82 percent (ARC 2011).

Over the 10-year period analyzed for the MNGWPD in the ARC report, between 75 and 80 percent of the total withdrawals within the district area occurred in the Chattahoochee and Flint River basins. Table 2.1-21 provides data on water withdrawals, wastewater returns, and percent returned for the Chattahoochee and Flint River basins within the MNGWPD area. As presented in this section, net water use does not equate to consumptive use. The net losses to these basins reflected in these percentages include both consumptive use of water in the river basins as well as gains or losses to the basins that occur by way of interbasin transfers of water. Interbasin transfers between river basins in the MNGWPD occur when water withdrawn in one basin for water supply is used, treated, and discharged into an adjacent river basin. Table 2.1-21 simply presents an overall summary of water withdrawals and treated wastewater returns for the Chattahoochee and Flint River basins that occurred in the MNGWPD over the 2000–2009 period.

Table 2.1-21.
Water Withdrawals, Wastewater Returns, and Percent Returned for Chattahoochee and Flint River Basins within the MNGWPD Area from 2000 to 2009 (ARC 2011)

River basin	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Withdrawals										
Chattahoochee	447.4	433.1	424.4	395.3	415.0	422.2	443.8	432.4	374.1	370.6
Flint	19.1	18.5	20.1	20.2	21.5	20.4	21.0	20.1	17.8	16.0
Returns										
Chattahoochee	248.4	267.8	270.8	293.9	285.4	303.5	283.7	262.2	253.9	292.2
Flint	5.4	5.6	5.7	6.8	8.8	9.27	8.2	7.4	7.1	8.0
Percent Returned										
Chattahoochee	56%	62%	64%	74%	69%	72%	64%	61%	68%	79%
Flint	28%	31%	28%	34%	41%	46%	39%	37%	40%	50%

In 2000, about 56 percent of all water withdrawn from the Chattahoochee River Basin within the MNGWPD area was returned as treated wastewater. Between 2001 and 2008 in the district, the percent return of water withdrawals from the Chattahoochee Basin ranged between 62 percent and 74 percent. In 2009, the percent return of withdrawals was 79 percent.

About 28 percent of the Flint River Basin withdrawals within the MNGWPD were returned in the year 2000. Between 2001 and 2008, the percent return of water withdrawals from the Flint River Basin in the in the district ranged between 28 percent and 46 percent. In 2009, the percent return of withdrawal was 50 percent.

During the 10-year period covered by in the MNGWPD Water Metrics Report (ARC 2011), water withdrawals within the district from the Chattahoochee River and Flint River basins held relatively steady (actually declined in 2008 and 2009) while the percentage of withdrawals returned to the river basins dramatically increased.

2.1.1.2.7 Interbasin Transfers

Interbasin transfers of water and wastewater occur among municipalities, counties, and basins in the MNGWPD. Transfers among basins are particularly common within counties that straddle the ridges between two or more basins. Interbasin transfers are a key and necessary element in supplying water throughout the district; there are water supply and wastewater transfers into and out of every basin. Table 2.1-22 summarizes the existing water and wastewater interbasin transfers in the MNGWPD (MNGWPD 2009). The large net transfer from the Chattahoochee River Basin to the Ocmulgee River Basin is principally because of water withdrawals and returns in Gwinnett and DeKalb counties. While Lake Lanier (Gwinnett) and the Chattahoochee River (DeKalb) serve as primary water supply sources for the counties, only about one-third of their service areas are in the Chattahoochee River Basin. Consequently, a disproportionate share of the water supply withdrawals from the Chattahoochee River Basin for those counties is discharged into the Ocmulgee River Basin as treated wastewater.

Table 2.1-22.
Summary of Existing Net Interbasin Transfers

Source basin	Receiving basin	Net transfer (aad-mgd)[a,b]
Chattahoochee	Ocmulgee	100
Chattahoochee	Oconee	7
Coosa	Chattahoochee	14
Flint	Chattahoochee	2
Flint	Ocmulgee	5

Notes:
[a.] Transfers estimated based on 2006 actual withdrawals and discharges (MNGWPD 2009).
[b.] aad-mgd (average annual day-million gallons per day).

2.1.1.2.8 Per Capita Water Use

A popular metric for comparing the average rate of water demand within a service area is per capita use in gallons per capita per day. Commonly, per capita water use is defined as the total annual volume of water demand divided by the population served within the service area.

The per capita use metric has limitations, and caution should be used when comparing water systems with different socioeconomic characteristics and in different climates. There are a number of variables that cause legitimate differences in per capita use among communities. Even when reviewing per capita water use changes within one water system, care should be taken to understand temporary fluctuations due to weather, drought restrictions, and economic recession. Reasons for variability in per capita use include climate; commercial and industrial activity; housing type and density; water conservation and drought restrictions; age of structures and the water supply infrastructure; income level; and the cost of water and sewer services (ARC 2011).

USGS water use data for Georgia indicate public water supply per capita use averaged 185 gpd in 2000 (USGS 2004). USGS 2005 data indicate that per capita use in Georgia had declined to an average of 158 gpd (Fanning and Trent 2009). In Alabama, public water supply per capita use averaged 233 gpd in 2000 (USGS 2004) and likewise declined to 199 gpd in 2005 (Hutson et al. 2009). Per capita public water supply use is determined by dividing the total amount of water provided by public suppliers by the total population served. While those are statewide averages, per capita use in the Georgia and Alabama portions of the ACF Basin is likely to be similar. A USGS report estimated that per capita public water supply use in the adjacent ACF Basin in 1990 was about 173 gpd (Marella et al. 1993).

Maddaus and CH2M Hill (2011) summarized per capita water use based upon a national survey of 41 metropolitan water agencies in 22 different states from 2004 and 2007. This period was relatively free of external factors that could significantly affect water use, including abnormal weather, droughts, and unusual economic conditions. Agencies surveyed represented metropolitan areas geographically distributed across the U.S. The surveyed communities had a total population of almost 46 million and total water use of over 7.7 billion gpd, yielding an average per capita water use of 174 gpd. Some key statistical results from the survey of the 41 water agencies include the following:

- The lowest per capita use was 104 gpd (Seattle Public Utilities, Seattle, Washington)
- Four agencies had per capita use less than 130 gpd
- Twenty of 41 agencies were in the range of 130 to 170 gpd
- Seventeen agencies had per capita water use of 170 gpd or higher
- The highest per capita water use of the agencies surveyed was 293 gpd (Savannah, Georgia)
- The median per capita water use was 162 gpd and the average was 174 gpd

The MNGWPD, or "Metro Water District", was one of the 41 agencies surveyed in Maddaus and CH2M Hill (2011). Background on the MNGWPD and its mission are provided in section 2.1.1.2.10.1.10. The per capita water use for the district in the survey was 128 gpd, which was the fourth lowest number of the 41 surveyed metropolitan water agencies. Per capita water use for other agencies in the study in the Southeast region included the following figures:

- Columbus, Georgia (143 gpd)
- Greenville, South Carolina (150 gpd)
- West Point, Georgia (153 gpd)
- Mobile, Alabama (159 gpd)
- Montgomery, Alabama (162 gpd)
- Birmingham, Alabama (167 gpd)
- LaGrange, Georgia (172 gpd)
- Phenix City, Alabama (173 gpd)
- Tallahassee, Florida (176 gpd)
- Augusta-Richmond County, Georgia (212 gpd)

The ARC developed a water metrics report in 2011 focusing on water use within the MNGWPD (15 counties and 91 municipalities in Metro Atlanta) between 2000 and 2009. The MNGWPD overlaps portions of the Chattahoochee, Flint, Coosa, Tallapoosa, Ocmulgee, and Oconee river basins, but a majority of the district lies in the Chattahoochee and Flint river basins. In 2000 (the year before the MNGWPD was created by the Georgia legislature), the average per capita use across the 15-county area was 147 gpd. By 2003, average per capita use with the MNGWPD had declined to 127 gpd, and it remained relatively steady at that level through 2007. Average per capita use for the MNGWPD for 2008 and 2009 dropped to 104 gpd and 102 gpd, respectively (ARC 2011). Increased water use restrictions and conservation measures associated with the 2007-2008 drought as well as the effect of the economic recession (beginning in 2008) on water use are likely to be primarily responsible for the decline in the 2008 and 2009 numbers, although it is not possible to determine the degree to which each factor might have contributed to the decline.

Single-family residential customers represent a relatively uniform group of water users. A single-family account typically includes one dwelling connected to city water supply through a single water meter. The MNGWPD evaluated available single-family residential water use data between 2007 and 2009. Per capita use for single-family residential customers across the MNGWPD counties generally ranged from about 55–85 gpd in 2007 to a range of about 53–70 gpd in 2009. The less densely populated outlying counties in the MNGWPD tended to have higher per capita use (ARC 2011).

2.1.1.2.9 Critical Yield for Federal Projects in the ACF Basin

Critical yield is defined as the maximum flow rate that can be continuously removed from a reservoir through releases from the dam and/or withdrawals from the reservoir, even during the most severe drought in the period of record, while completely depleting the reservoir conservation storage. *Conservation storage* is the amount of water available in a reservoir to meet project purposes other than flood risk management.

In early 2010, USACE, Mobile District developed updated critical yields for the federal projects in the ACF Basin in response to congressional direction in reports accompanying the Energy and Water Development and Related Agencies Appropriations Act, 2010 H.R. 3183; Public Law 111-85), which includes the following language (USACE Mobile District 2010c):

> "Alabama-Coosa-Tallapoosa [ACT], Apalachicola-Chattahoochee-Flint [ACF] Rivers, Alabama, Florida, and Georgia.—The Secretary of the Army, acting through the Chief of Engineers, is directed to provide an updated calculation of the critical yield of all federal projects in the ACF River Basin and an updated calculation of the critical yield of all federal projects in the ACT River Basin within 120 days of enactment of this Act."

In July 2014, USACE, Mobile District updated the ACF critical yield analysis for the purposes of the Master WCM update and the WSSA for Lake Lanier. The following sections provide a summary of the 2014 updated critical yield analysis (USACE, Mobile District 2014). The complete 2014 critical yield update analysis report is included as Appendix F.

Federal reservoirs in the ACF Basin that are included in this analysis are Lake Lanier, West Point Lake, and Walter F. George Lake because they hold the majority of water storage on the ACF System. George Andrews Lock and Dam and Jim Woodruff Lock and Dam (Lake Seminole) are federal projects on the ACF system that are excluded from the critical yield analysis because these projects are run-of-river impoundments with little or no usable water storage and cannot significantly contribute to critical yield. Similarly, the GPC reservoir projects on the Chattahoochee River have no appreciable storage and, therefore, do not contribute to the yield of the system. In addition, two proposed nonfederal water storage reservoirs, Glades and Bear Creek, have been analyzed for their individual expected yield and potential impact on existing projects. Those projects are described in section 2.1.1.1.6.10.

Critical yield provides the basis from which water stored in a reservoir is allocated to various project purposes. The volume of water stored in a reservoir can be allocated to a specific project purpose (e.g., hydroelectric power generation or water supply) on the basis of a percentage of critical yield. A change in critical yield might result in modification of the allocation of storage for a project purpose.

Critical yield is typically expressed in cubic feet per second (cfs), but it can also be expressed in other flow rate units, such as mgd or ac-ft per year (ac-ft/yr). The conversions between the various rates are 1 cfs = 0.6464 mgd = 722.7 ac-ft/yr.

2.1.1.2.9.1 Unimpaired Flow Data Set

The unimpaired flow data set is historically observed flows, adjusted for some of the human influence within river basins. Man-made changes in river basins influence water flow characteristics and are reflected in measured flow records. Determining critical yield requires removing from the observed flow measurements any identifiable and quantifiable man-made changes, such as M&I water withdrawals and returns, agricultural water use, and increased evaporation and runoff due to the construction of federal surface water reservoirs.

These quantities are used to extrapolate diversions, defined as the difference between water withdrawn and water returned to the system. A *diversion* is a net volume or quantity assumed to be permanently lost from the water system. The unimpaired flow data set is not a perfectly replicated flow data set representing conditions that would exist without the influence of human activities or a precise measure of natural flow conditions. Not all human influences, such as land use changes, can be accounted for, and many flow set adjustments are estimates based on assumptions, not direct measurements of the human influences. The unimpaired flow data set for the ACF Basin in the updated 2014 analysis includes data for the period from 1939 through 2012.

2.1.1.2.9.2 Droughts

Several drought periods were identified from the historic record and from previous yield analyses. Critical drought periods analyzed for the 2014 critical yield update included 1939–1943, 1954–1958, 1984–1989, 1998–2003, and 2006–2008. The critical yield was computed for each drought period, and the lowest value was selected as the critical yield for the 2014 update report.

2.1.1.2.9.3 Diversions

For purposes of the critical yield analysis, ACF diversions include municipal, industrial, and agricultural withdrawals and returns from the Chattahoochee River and its tributaries upstream of Lake Lanier, West Point Lake, and Walter F. George Lake. Critical yield calculations were made without diversions and with diversions, so that the impact of river withdrawals on critical yield could be determined. The maximum net river withdrawals occurred in 2007, and they are reflected in the critical yield calculation for each drought period.

2.1.1.2.9.4 Models

The USACE HEC-ResSim model, run on a daily time step, was used to simulate reservoir operations. The HEC-ResSim model has a Firm Yield subroutine that calculates the largest continuous release that can be reliably supplied during the flow record. The HEC-ResSim ACF yield models include a net precipitation-evaporation rate for each reservoir. These rates are based on evaporation values developed for NOAA Technical Reports, monthly pan evaporation rates, and NWS rainfall reports. The net evaporation losses (evaporation minus precipitation) were computed in inches at the projects. The NOAA values were used because historical monthly evaporation data are not available at the projects. Historical monthly precipitation data were obtained from the NWS.

The most severe drought event at one reservoir might not be the most severe drought event at another reservoir in the same river system. These methods use the most severe drought events documented during the hydrologic period of record (1939–2012). For the purposes of computing critical yield on the ACF system, the lowest critical yield value (typically associated with the most severe drought event) at an upstream reservoir was used to calculate a downstream reservoir's critical yield. In the ACF Basin, the amount of water exiting an upstream reservoir influences the amount of water available in a downstream reservoir. This consideration applies to critical yield computations for each reservoir by both Methods A and B.

> ***Method A (Without Diversions).*** Method A assumes that there are no withdrawals from or returns to the reservoir and no withdrawals from or returns to the river as it flows between projects. This condition results in the maximum yield possible from the federal projects. Critical yield from an upstream reservoir was assumed to be permanently removed from the system and does not contribute to the inflow at downstream reservoirs. Method A is depicted in Figure 2.1-41.

Method B (With Diversions). Method B assumes that net diversions (river withdrawals minus returns) are occurring. This method does not include withdrawals from the federal reservoirs. Critical yield from an upstream reservoir is assumed to be permanently diverted from the system and does not contribute to the inflow at downstream reservoirs. These conditions result in the most severe downstream impact. The results of Method B represent a conservative assessment of the critical yield available from federal projects managed by USACE. Method B used the most severe drought events documented during the period of record and the year of maximum net diversions in the ACF Basin (2007) to make the calculations. Method B is depicted in Figure 2.1-42.

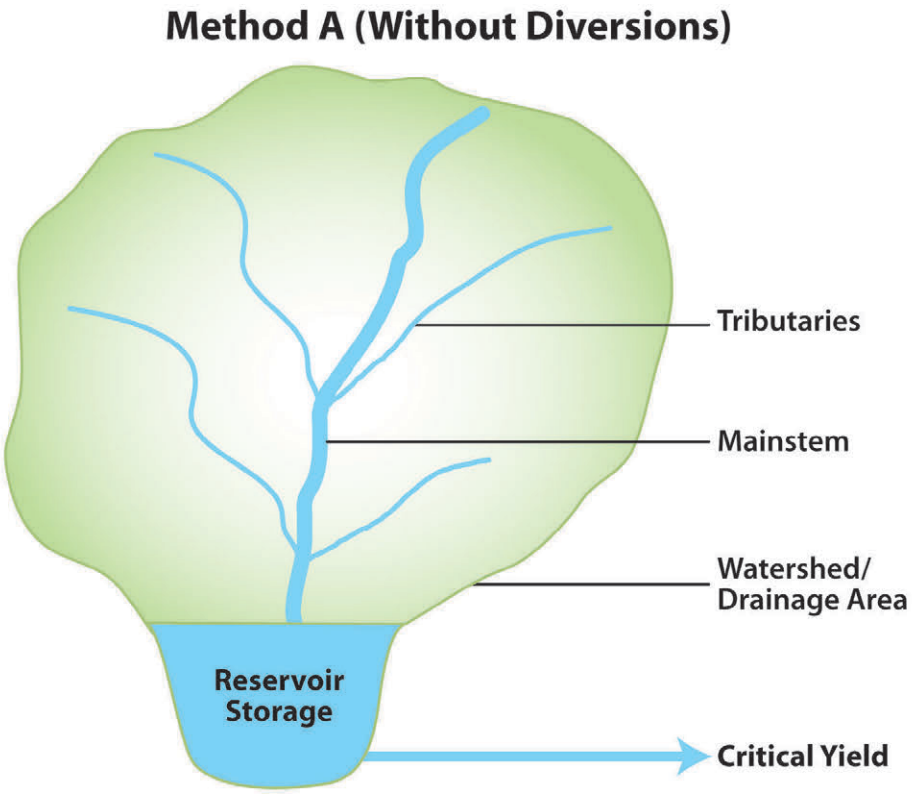


Figure 2.1-41. Critical Yield Method A

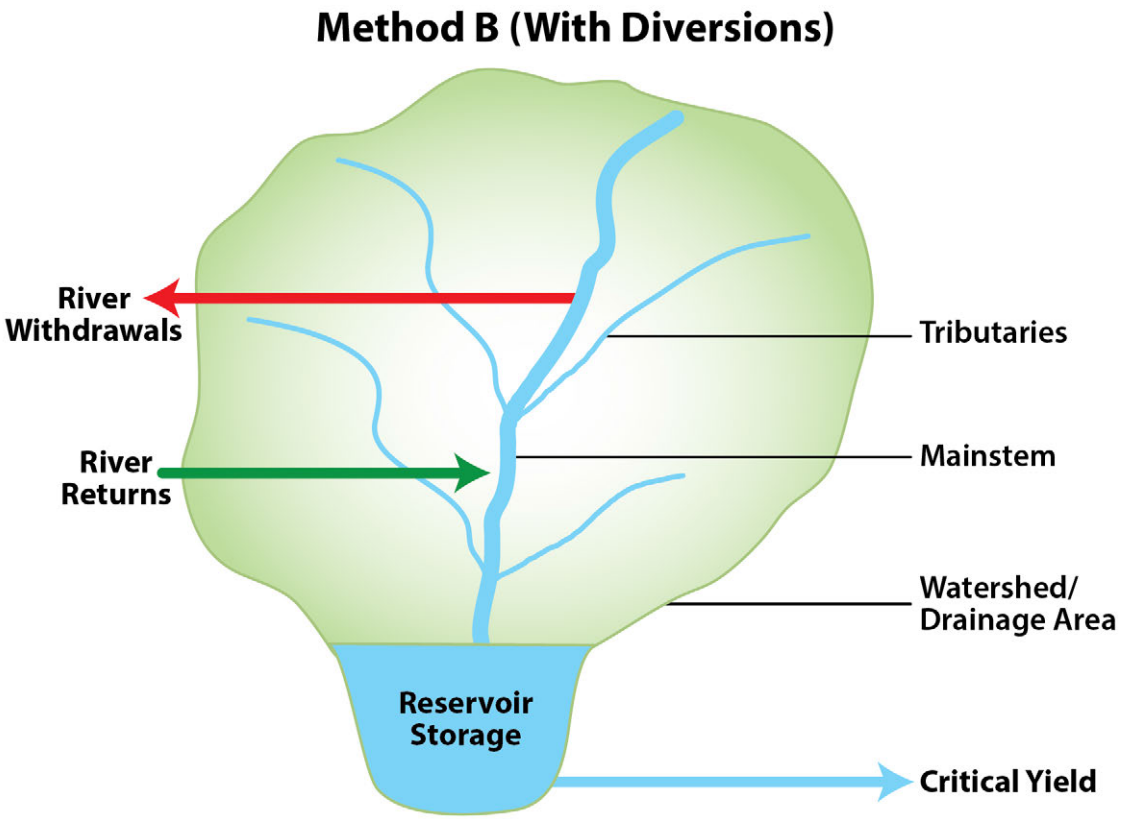


Figure 2.1-42. Critical Yield Method B

In addition to determining the critical yield from each reservoir, a *system* yield for diversion from the most downstream storage reservoir has been determined. For purposes of the 2014 critical yield update, the analysis was called *Method C (System Critical Yield)*.

Method C (System Critical Yield). Method C assumes upstream reservoirs operate in tandem to maximize the critical yield at the most downstream reservoir. Method C computes critical yield for the ACF River System, with and without net diversions. Figure 2.1-43 depicts Method C, both with and without net river withdrawals. The *with net river diversions* results represent the yield of the system essentially as USACE operates. The *without net river diversions* results represent the system's theoretical maximum yield. Method C calculates the theoretical critical yield that might be observed if the upstream projects were operated solely to maximize yield at Walter F. George Lake. In reality, these results could not be achieved because USACE must operate in a balanced manner to achieve all authorized project purposes.

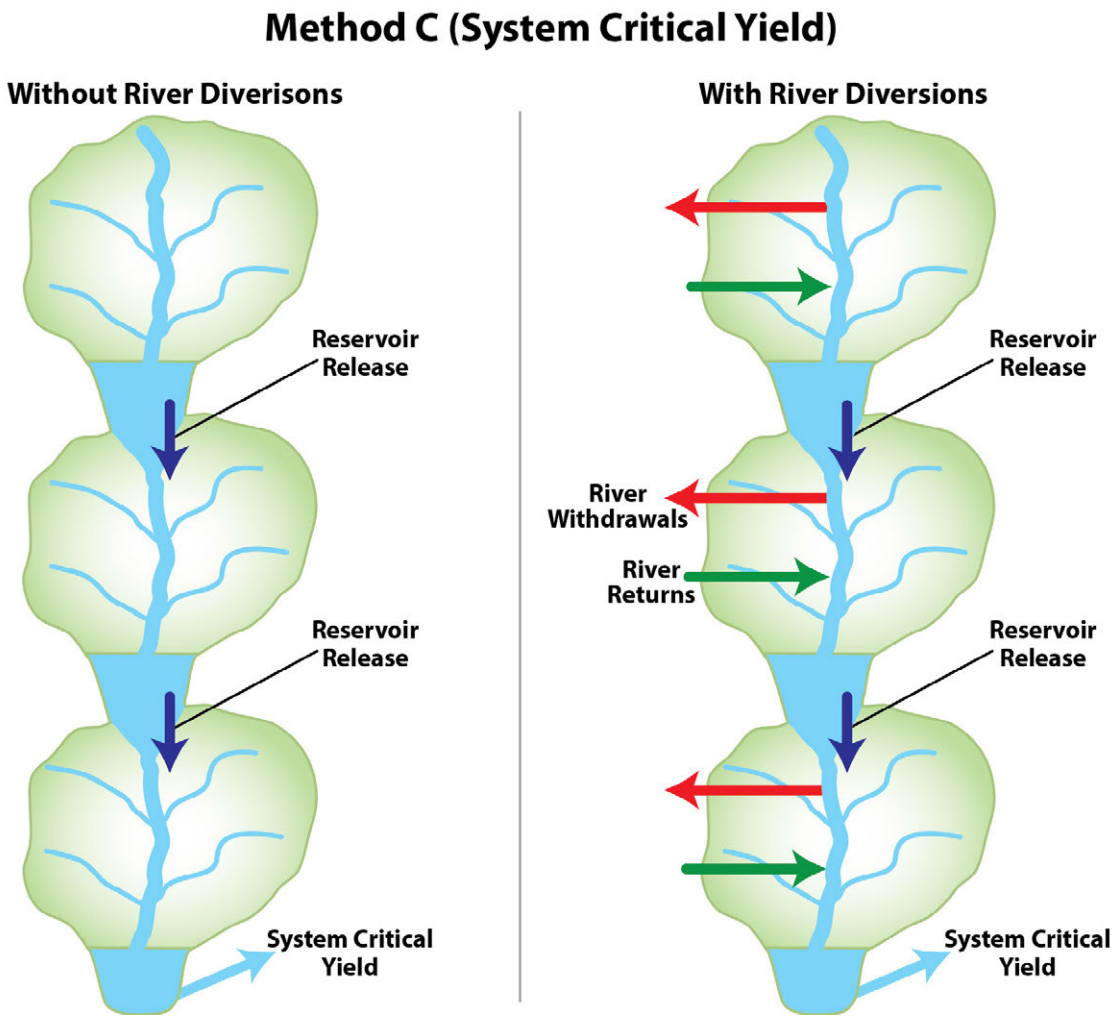


Figure 2.1-43. Critical Yield Method C

2.1.1.2.9.5 Critical Yield Modeling Assumptions

The following assumptions were used in computing the 2010 critical yield update for the ACF Basin:

- The analysis did not consider the probability of the occurrence of drought(s) more severe than those in the period of record.
- The simulation model was operated only for critical yield. The only other operating purpose included was flood risk reduction. The critical yield represents the maximum flow that could be continuously provided to meet any, or all, demands (e.g., project purposes).
- The upstream reservoir is the primary reservoir, and its yield is met (maximized) before proceeding downstream. Upstream users can consumptively divert water, precluding the availability of water yield to a downstream user. Maximizing the yield of the upstream reservoir is consistent with current state-issued water withdrawal permits. This is a significant assumption for the ACF Basin because the federal projects are operated in tandem.
- Yield analysis is based on authorized conservation storage elevations.

- Projects are full at the beginning of the drought period simulation. The pool level at the beginning of a drought simulation is important because it is a variable that directly affects the quantity or volume of water available as critical yield.
- Under model methods A and B, none of the critical yield is returned to the system. Critical yield is permanently diverted from the system and assumed to be consumptively used. This methodology determines the conservative individual project yield. The assumption is not applicable to Method C.
- The existing area capacity curves shown in the current water control manuals were used for all reservoirs in the critical yield analysis except for Lake Lanier. In 2011, a Sedimentation and Erosion Analysis for Lake Lanier was completed and a new area capacity curve was recommended (Tetra Tech 2011b). This new curve was used in the critical yield analysis model.

2.1.1.2.9.6 Critical Yield Analyses Results

Table 2.1-23 and Table 2.1-24 present the critical yield of each federal reservoir in the ACF Basin and the critical drought period used in the calculations.

Table 2.1-23.
Method A: ACF Basin Federal Project Yield (without Diversions)

Project	Critical yield (cfs)	Critical drought period
Buford Dam	1,459	1984–1989
West Point Dam	809	2006–2008
Walter F. George Lock & Dam	575	2006–2008

Table 2.1-24.
Method B: ACF Basin Federal Project Yield (with Diversions)

Project	Critical yield (cfs)	Critical drought period	Critical yield change attributable to diversions
Buford Dam	1,393	1984–1989	-4.5%
West Point Dam	960	2006–2008	18%
Walter F. George Lock & Dam	477	2006–2008	-17%

Table 2.1-24 also summarizes the change in the critical yield values at these projects that would be attributable to diversions. The 2007 net river diversion had a measurable impact, decreasing yield at Buford Dam and Walter F. George Lock and Dam, but increasing critical yield at West Point Dam. The yield at Buford Dam was reduced due to operations that ensure flow for downstream river withdrawals. However, a large portion of these diversions are returned to the river upstream of West Point Dam. As a result, the critical yield at West Point Dam with upstream river diversions would be 18% greater than the yield when there are no diversions.

The critical yields of the proposed Glades and Bear Creek reservoirs in this analysis were determined to be 72 cfs and 16 cfs, respectively. Operations for Glades Creek Reservoir would be expected to reduce the critical yield at Buford Dam by 4.6 percent. Operations for Glades and Bear Creek reservoirs would be expected to reduce the critical yield at West Point Dam by 0.34 percent.

Table 2.1-25 presents the critical yield (System Critical Yield) results based on operating the three ACF reservoirs together for a system yield at Walter F. George (Method C). When all reservoirs are operated for yield optimization at Walter F. George, the resulting yield is greater than the sum of the individual reservoir yields. Method C (River System Yield) was computed with and without river diversions. The 2007 net river diversions reduce the critical yield at Walter F. George Lock and Dam by 3.9 percent. With Glades and Bear Creek reservoirs, the critical yield reduction with 2007 river diversions at Walter F. George Lock and Dam would be 5.6 percent.

Table 2.1-25.
Method C: ACF (System Critical Yield)

Project	Critical yield (cfs)	Critical drought period
ACF (without diversions)	4,110	2006–2008
ACF (with diversions)	3,948	2006–2008
ACF with Glades and Bear Creek (with diversions)	3,881	2006–2008

The critical yield calculations for Method B (with diversions) represent a realistic assessment of the critical yield from federal projects in the ACF Basin. More detail on the 2014 critical yield analysis and results is available in Appendix F.

2.1.1.2.10 Summary of Water Planning, Management, and Conservation Activities Pursued by State, Regional, and Local Interests

This section provides a general overview of water resource planning, management, and conservation activities by state, regional, and local interests in Alabama, Florida, and Georgia that have noteworthy implications for water resources in the ACF Basin and the update of the Master Manual. This section is intended to identify and provide a brief summary of the general scope of each relevant program or activity. Appendix G provides a more specific overview on each of these programs or activities. The summary focuses on water quantity related programs in the states. Relevant state water quality management programs are discussed in section 2.1.2. This summary does not include water planning, management, and conservation programs and activities undertaken by individual counties and municipalities within the ACF Basin, unless those efforts are an integral part of one of the state or regional programs discussed below.

2.1.1.2.10.1 Georgia

2.1.1.2.10.1.1 Water Withdrawal Permit Program

Georgia laws—the Georgia Water Quality Control Act (O.C.G.A. 12-5-31) and the Georgia Groundwater Use Act (O.C.G.A 12-5-90 *et seq.*)—require any water user who withdraws more than 100,000 gpd (monthly average) from surface water or groundwater in the state to obtain a withdrawal permit from the GAEPD. Permit holders generally must report their withdrawals by month. The law does not transfer to the permit recipient any property right to the water or water permit beyond the right to reasonable use of the water. The Georgia Water-Use Program collects the reported information under the withdrawal permit system and the drinking-water permit system and stores the data in the Georgia Water-Use Data System.

Before issuing a permit, GAEPD evaluates the reasonableness of the use by applying the criteria listed in the statute, including the number of persons using the water source; the nature, severity, or duration of any impairment adversely affecting availability for other users; any injury to public health, safety or welfare; the kinds of activities proposed; the importance and necessity of the uses and the extent of any injury caused to other water uses; diversion from or reduction in flows in other watercourses or aquifers; prior investment in land; and other relevant factors (O.C.G.A. 12-5-31(e)). M&I permits are issued for a term of 10 to 50 years, after which they must be renewed. Farm use permits are issued for an unlimited term, except in the Flint River Basin, in which farm use permits issued after March 2006 have a term limit of 25 yr. M&I permits are issued for a specific quantity determined by reasonable use. Farm permits issued after 1991 also have defined quantities. Farm permits issued before 1991 are based on pump capacity as of July 1, 1988. The GAEPD can revoke M&I permits for extended periods of nonuse. Farm permits cannot be revoked after an initial use unless water was never withdrawn.

2.1.1.2.10.1.2 State Drought Management Plan

The 1998–2002 drought raised awareness in Georgia regarding drought impacts and interest in drought planning and management. The first *Georgia Drought Management Plan* was adopted by the GADNR Board in March 2003 (GAEPD 2003a). The plan was developed using a collaborative approach involving stakeholders with interest and/or expertise in water-related matters. These stakeholders represented a geographical and political cross section of the state, as well as a cross section of business, industry, environmental, and water management interests. The Georgia General Assembly and the GADNR Board have assigned the director of the GAEPD principal responsibilities for implementing the drought management plan. Numerous agencies and organizations are tasked in this plan with some level of water resource or water-related management responsibilities. The GAEPD and those agencies and organizations must coordinate closely and share information about their drought or water conservation concerns and solutions. The plan contains an array of predrought strategies, primarily oriented around water conservation as well as coordinated drought response protocols as drought conditions are encountered and persist.

2.1.1.2.10.1.3 Flint River Basin Regional Water Development and Conservation Plan

The GAEPD initiated the *Flint River Regional Water Development and Conservation Plan* in October 1999 in response to growing concern over agricultural irrigation in southwest Georgia. Computer models of stream-aquifer relationships and surface water flows indicated that, under conditions of extreme drought and greatly increased irrigation, the Flint River and some of its tributaries could virtually stop flowing. The plan included a moratorium on the issuance of new farm use permits for the Floridan aquifer in southwest Georgia; however, it also called for extensive scientific study of stream-aquifer relations and agricultural water use, and the creation of an advisory committee to assist the GAEPD in crafting the plan (McDowell 2005).

The planning process was completed in 2006. The goals of the plan, as defined by statute, are to promote conservation and reuse of water, guard against a shortage of water, promote the efficient use of water resources, and manage the water resources of the Flint River Basin so they are sustainable and consistent with the public welfare. The moratorium on new farm-use permits was lifted, but applications are closely evaluated to meet the requirements of the plan. Permitting decisions are based on the requested amount of water, the connections between groundwater and surface water as determined by computer models, the impact of water withdrawals on streamflows, and the presence of endangered or threatened species (GAEPD 2006).

2.1.1.2.10.1.4 Georgia Environmental Finance Authority Reservoir Study

In response to one of its mandates under the Georgia Water Supply Act of 2008 (O.C.G.A. 12-5-470), the GEFA conducted an inventory and survey of feasible sites for multijurisdictional drinking water supply reservoirs in Georgia. The effort also considered reservoirs under development or specifically proposed, existing reservoirs with potential expansion volumes, and possible reservoir locations extracted from prior studies. The report was intended to provide information and preliminary analysis to support decisions by local governments and regional planning councils on how best to augment local water supply. The report is summarized in the following paragraphs (GEFA 2008). The study should complement the analyses conducted under the Statewide Water Management Plan (SWP).

The analysis focused on the 78-county area in Georgia above the Fall Line because the need for drinking water supply reservoirs in Georgia is sharply divided by geology at the Fall Line. Below the Fall Line (81 counties), groundwater aquifers are the principal source of public water supply and large underground aquifers function as their own natural water supply storage reservoirs. Above the Fall Line, surface water is the principal source of public water supply and man-made reservoirs are essential for water supply storage.

The study acknowledged that reservoirs are only one tool that can be used to increase water supply. Of all options, reservoirs are the most costly, environmentally sensitive, and time-consuming. The study recommended that first consideration should be given to water conservation and efficiency measures and communities should also examine interconnectivity to other systems, as well as the potential for drilling wells.

2.1.1.2.10.1.5 Georgia Statewide Water Management Plan

The 2004 Comprehensive Statewide Water Management Planning Act authorized the development of the SWP. The act established the following goal: "Georgia manages water resources in a sustainable manner to support the state's economy, to protect public health and natural systems, and to enhance the quality of life for all citizens." The GAEPD was charged with developing a draft of the plan, with oversight by the Water Council. Created by the act, the Water Council is a coordinating committee composed of the heads of eight state agencies with water-related responsibilities, four legislators, and two citizen members (GAEPD 2008a). Between January 2006 and July 2007, GAEPD used an intensive public involvement process to develop the draft plan. As required by the act, the draft plan was submitted to the Water Council by July 1, 2008. Drawing on additional public review and comment, the Water Council revised the plan and submitted it to the Georgia General Assembly in January 2009. By the end of February 2009, the plan had been adopted by the General Assembly and signed by the Governor (Cowie and Davis 2009).

The SWP has three major components designed to address the goal for water management in Georgia: 1) resource assessments and forecasting of needs, 2) toolbox of water management practices, and 3) framework for regional water planning.

The SWP makes provisions to conduct resource assessments and generate long-range forecasts. The resource assessments focus on water quantity and water quality. The water quantity resource assessment addresses the amount of water that is available to withdraw for beneficial use, while still supporting the ability of downstream users or users from the same aquifer to benefit from that water resource. The water quality resource assessment addresses, from a watershed perspective, the wastewater treatment levels that are required to protect water quality. In addition, statewide and regional population and economic forecasts are translated in a consistent manner into water and wastewater demand forecasts over a 50-yr planning horizon (Cowie and Davis 2009).

The SWP explicitly recognizes that regional variation means that different sets of water management practices will be better suited to different parts of the state. The *toolbox* of water management practices includes demand management practices; water return practices such as onsite sewage management (septic systems) and centralized wastewater treatment; and water supply management practices such as surface water storage, interbasin and intrabasin transfers, and aquifer storage and recovery. Water conservation is highlighted as a priority practice for use across the state by all water use sectors. Water quality management practices, including stormwater and nonpoint source pollution management, are also part of the toolbox (Cowie and Davis 2009).

The SWP provides a framework for regional water planning. Through regional water planning, water management practices will be selected and defined for implementation. Ten regional water planning councils have been formed to prepare recommended water development and conservation plans (WDCPs). Each council consists of 25 members that represent the water users and the water-related interests in each region, and members are appointed by the Governor, Lieutenant Governor, and Speaker of the House. WDCPs characterize the water needs for each region as those needs relate to the needs of adjacent regions and the preferred water management practices to use in each region to close any gaps between water capacities and water needs. The councils use the resource assessments and forecasts to develop the recommended WDCPs. Recommended plans were submitted to the GAEPD for review, revision if needed, and ultimately adoption by the GAEPD director. Under the 2004 act, water withdrawal permits and state loans for infrastructure projects must be consistent with the regional plans (Cowie and Davis 2009).

Resource assessments and the forecasts of water and wastewater needs were developed in 2010. Preparation of the WDCPs was fully underway in 2010. The first set of WDCPs was adopted in 2011. The 2004 act calls for review of the SWP every 3 yr to determine whether revisions are necessary. After the GAEPD adopts the first set of WDCPs, those plans will also be reviewed and revised on a 3- to 5-yr cycle (Cowie and Davis 2009).

2.1.1.2.10.1.6 Georgia Water Conservation Implementation Plan

In May 2009, the GAEPD published a comprehensive *Water Conservation Implementation Plan* (WCIP) designed to create a culture of conservation in the state and to guide Georgians toward more efficient use of the state's finite water resources (GADNR 2009a). The WCIP is a product of the ongoing Georgia SWP process. The plan provides a multipronged strategy to achieve more efficient and sustainable water use through conservation (defined as beneficial reduction in water use, water waste, and water loss) and measures to promote more efficient use of water (maximizing benefit from each gallon used). The plan was developed in conjunction with representatives of state agencies, local governments, and a wide range of stakeholder interests.

The WCIP provides specific goals and benchmarks for Georgia's seven major water use sectors: agricultural irrigation, power generation, golf courses, industrial and commercial, landscapes, domestic and nonindustrial public uses, and state agencies. For each sector, the WCIP details water conservation goals, benchmarks, best practices, and implementation actions designed to reduce water waste, water loss, and, where necessary, water use.

The WCIP is used to guide decisions related to water use and water management by:

- Educating water users about water conservation practices and the goals they can accomplish
- Informing regional water plan preparation, which will be overseen by regional water planning councils
- Helping water use sectors collectively improve water use efficiency
- Informing Georgia DNR rule-making regarding water conservation requirements in permitting

Conserve Water Georgia (http://www.conservewatergeorgia.net/index.html) is a water conservation clearinghouse of the GAEPD (GADNR 2009b). The focus of the clearinghouse is public information, education, and awareness. The site provides tips and tools on conservation and water efficiency strategies for individuals, teachers and students, business and industry, and communities and local governments.

2.1.1.2.10.1.7 Governor's Water Contingency Planning Task Force (2009)

In response to the July 17, 2009, Federal District Court ruling that water supply was not an authorized purpose of Buford Dam/Lake Lanier, the ability to continue water supply withdrawals from the reservoir or conduct dam operations to meet downstream needs for Metro Atlanta was severely limited. The Governor of Georgia outlined a 4-part strategy. The strategy consisted of 1) appealing the ruling in court, 2) negotiating a mutually agreeable water allocation formula with Alabama and Florida, 3) pursuing congressional reauthorization of Lake Lanier for water supply, and 4) developing a contingency plan to be implemented if the District Court ruling were to take effect. The Water Contingency Planning Task Force was created to evaluate the various options for a contingency plan and make recommendations to the Governor. The task force included several dozen leaders from business, government, and environmental organizations (GWCTF 2009).

The Task Force had two key objectives: 1) to develop a fact base to educate business and community leaders on Georgia's water situation and the implications of the District Court ruling and 2) to define a time-driven action plan that prioritized specific options and recommendations for conservation, supply enhancement, and water policy to address the potential shortfall.

Upon completing its evaluation, the task force concluded that Lake Lanier would be the best and most cost-effective water supply source for Metro Atlanta. It further concluded that the recommended contingency options, if required, would impose significant incremental economic costs and environmental impact on the region.

The task force was not optimistic about the ability of the region to meet the potential water shortfall in 2012, when the District Court ruling would take effect, even with extremely aggressive mandated conservation. Within this time frame, no new supply options could offer significant yield. By 2015, there was a potential contingency solution, consisting primarily of an indirect potable reuse project, along with a set of conservation measures and isolated groundwater options. The 2015 solution would, however, require significant up-front capital. By 2020, a broader set of more cost-effective options would exist because reservoirs and transfers could be implemented. In that regard, the task force recommended a 2020 contingency solution that would consider cost efficiency, environmental impact, and implementation feasibility criteria.

Although the supply options for 2015 and 2020 were identified as contingencies, the task force recommended that enhanced conservation, implemented through incentive-based programs, should be pursued regardless of the outcome of Lake Lanier reauthorization. This program of enhanced conservation was the basis for a set of task force recommendations on options to implement immediately, along with a supporting set of policy considerations, which are detailed in the task force report. There were three broad areas of additional conservation improvements that built on Metro Atlanta's ongoing conservation progress, as reflected in the following recommended policies:

- Institute mandatory data collection and reporting of key metrics to inform future planning efforts. For instance, utilities would have to conduct standardized water loss audits.
- Adopt higher water efficiency standards and incentive measures to increase conservation effectiveness (e.g., increasing incentives for fixture and soil meter retrofits).
- Link progress on conservation efforts to funding eligibility, low-interest loan qualifications, and permitting applications to ensure implementation of measures.

In June 2011, the 11th Circuit Court of Appeals overturned the 2009 District Court ruling and confirmed that water supply was an authorized project purpose of Lake Lanier. Thus, the recommendations by the Governor's task force did not have to be implemented as an accelerated contingency plan to address severe short-term water supply deficits. Nonetheless, much of the information developed by the task force has been utilized by state and local interests in subsequent water supply planning and management activities.

2.1.1.2.10.1.8 Georgia Water Stewardship Act of 2010 (HB-370)

In light of recent severe water resource management challenges in Georgia (e.g., frequent droughts, rapid growth, and an unfavorable court ruling that could bar most water withdrawals from Lake Lanier), the General Assembly enacted the Georgia Water Stewardship Act in the 2010 legislative session. On the basis of recommendations from the 2009 Governor's Water Contingency Task Force, the legislation initiated a process for developing alternative supply sources while also reaffirming "the imminent need to create a culture of water conservation in Georgia."

Key provisions of the Water Stewardship Act include the following:

- Requirements for state agencies with water-related programs and responsibilities to review policies and programs encouraging water conservation and enhance water supply
- Mandates for public water systems serving over 3,300 individuals to implement best practices for water efficiency and conservation and to account for and mitigate water loss leaks
- Revisions to state minimum construction standards for new buildings, including use of high-efficiency plumbing fixtures and sub-metering of multi-unit buildings for water use
- Modification of state and local authority to impose outdoor watering restrictions
- Amendments to the permitting system for agricultural water withdrawals
- Creation of a joint legislative committee on water supply to examine opportunities for enhancing the state's water supply

Implementation of these provisions will require significant action by state agencies, local governments, and public water supply utilities over the next several years (UGA 2010).

2.1.1.2.10.1.9 Governor's Water Supply Program

In January 2011, Governor Nathan Deal directed GEFA to develop and launch the Governor's Water Supply Program (GWSP) and committed $300 million to the program over 4 years. The purpose of the GWSP is to align and mobilize the resources of the state of Georgia to assist local governments with developing new sources of water supply adequate to meet future water demand forecasts. The financial assistance is available in the form of low interest loans through GEFA and state direct investment through the Georgia Department of Community Affairs (DCA).

Applications for assistance under the GWSP are solicited annually. Through 2013, about $165 million was committed to water supply projects, either in low interest loans or state direct investment. State financial assistance under the GWSP can be used for detailed planning and engineering, land acquisition, construction, and related activities associated with water supply projects.

2.1.1.2.10.1.10 Metropolitan North Georgia Water Planning District (MNGWPD)

The MNGWPD was created by the Georgia General Assembly in 2001 (O.C.G.A. 12-5-572) to serve as the water planning organization for Metro Atlanta. The district's purpose is to establish policy, create plans, and promote intergovernmental coordination of water issues in the district from a regional perspective.

The MNGWPD includes 15 counties (Bartow, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Forsyth, Gwinnett, Hall, Henry, Paulding, and Rockdale counties) as well as 92 municipalities partially or fully within these counties (Figure 2.1-44). The district also has seven authorities that provide water, sewer, and/or stormwater services. The district's plans and policies work to protect water resources in the Chattahoochee, Coosa, Flint, Ocmulgee, Oconee, and Tallapoosa river basins. The area represented by the MNGWPD includes much of the Upper Chattahoochee River watershed. It covers a total area of 4,800 sq mi, with approximately 4.8 million residents (MNGWPD 2008).

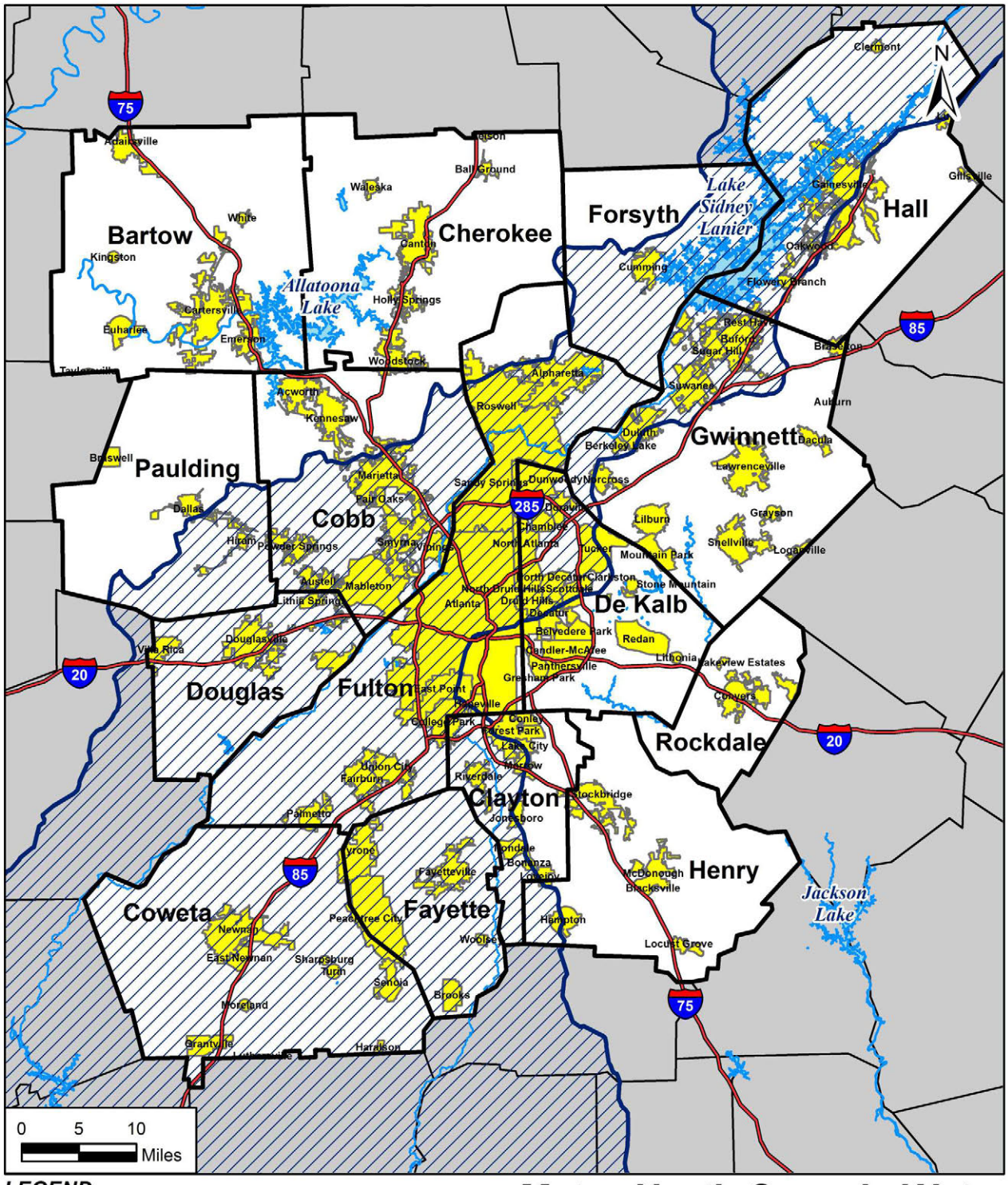
With the adoption of the SWP by the Georgia General Assembly in 2008, the MNGWPD became one of 10 regional water planning councils in the state. Accordingly, the work of the district will continue within the integrated framework of statewide water resources planning.

The district's enabling legislation mandated the development of three long-term regional plans to address the water resources challenges:

- Water Supply and Water Conservation Management Plan
- Wastewater Management Plan
- Watershed Management Plan

These three plans were developed concurrently, and they represent an integrated and holistic approach to water resources planning and management in MNGWPD (MNGWPD 2008).

The first plans were completed and adopted in 2003 and have been actively implemented by local jurisdictions. Updates to these plans were completed and published in May 2009 (MNGWPD 2008). The following paragraphs summarize the detailed strategies and recommendations for both effective water supply and water conservation as defined in the 2009 update to the *Water Supply and Water Conservation Management Plan*. The plan includes specific tasks and milestones for implementing these recommendations for local governments as well as regional and state agencies. The plan addresses pertinent water supply and conservation issues, including existing water supplies, water supply interconnections among water providers, interbasin transfers, water conservation programs, future water supply demands and sources, and water reuse. The water resources plans are the result of a collaborative effort between the district's local jurisdictions, the GAEPD, and numerous stakeholders.



LEGEND

- ACF Basin
- Surface Water
- Interstate Highway
- Metro Water District County
- Metro Water District Municipality

Metro North Georgia Water Planning District Area

Figure 2.1-44

2.1.1.2.10.2 Alabama

2.1.1.2.10.2.1 Alabama Office of Water Resources/Alabama Water Resource Commission

The Alabama Water Resources Act (Act Number 93-44, codified as Code of Alabama 1975, Article 9-10B-1, et seq.) legislatively established the Office of Water Resources (OWR), a division of the Alabama Department of Economic and Community Affairs.

The Alabama OWR plans, coordinates, develops, and manages Alabama's water resources (both groundwater and surface water) in a manner that is in the best interest of Alabama. This includes recommending policies and legislation, conducting technical studies, implementing and participating in programs and projects, and actively representing Alabama's intrastate and interstate water resource interests (ALOWR 2010).

The Alabama Water Resources Commission provides oversight to the Alabama OWR and serves in an advisory capacity to the Governor and presiding officers of the Alabama House of Representatives and Senate. The commission consists of 19 voting members selected by the Governor, the Lieutenant Governor, and the Speaker of the House. Members serve 6-yr, staggered terms. The Alabama Water Resources Act requires that commission membership include representatives from each congressional district and each major surface water region of Alabama. In addition to the geographic representation requirements, the membership must also represent a cross section of water user groups, including rural and urban public water systems, nonpublic (e.g., industrial, manufacturing) commercial navigation, conservation, and the environment or water-based recreation interests within Alabama (ALOWR 2010).

2.1.1.2.10.2.2 Alabama Drought Management Plan

Alabama has developed a *Drought Management Plan* (final) dated May 22, 2013 (ALOWR 2013). The plan is administered and coordinated by the Alabama OWR, working closely with numerous local, state, and federal agencies and other water resources professionals to pursue a statewide approach to drought planning and management. The purpose of the plan is to minimize the impact of drought, to develop action plans to be used during a drought, and to reduce the risk of drought disasters. The plan outlines both long- and short-term measures to be used to mitigate the effects of drought and to respond to drought conditions. To accomplish these goals, the plan 1) defines a process to address drought and drought-related activities, such as monitoring, vulnerability assessment, mitigation, impact assessment, and response; 2) identifies long- and short-term activities that can be implemented to reduce and prevent drought impacts; 3) identifies local, state, federal, and private-sector entities that are involved with state drought management and defines their responsibilities; and 4) acts as a catalyst for the creation and implementation of local drought response efforts.

The plan creates a statewide regional structure to identify the different areas affected by drought conditions; risks associated with drought conditions; ways to possibly avoid droughts; and, when drought emergencies cannot be avoided, ways to mitigate the impacts of droughts. These objectives are accomplished by developing drought triggers and indicators and by providing guidance on responses to drought conditions for the various sectors affected by droughts.

In the plan, the Alabama Drought Assessment and Planning Team (ADAPT) has been established to serve in an advisory capacity to Alabama OWR and the Governor's Office, as needed, and to coordinate intergovernmental drought response and management in the implementation of all drought-related activities. ADAPT is composed of members from several Alabama agencies, the U.S. Department of Agriculture (USDA), the chairman of the Monitoring Advisory Committee (MAG), and the chairman of the Drought Impact Group (DIG). The MAG provides technical support to ADAPT and is composed of representatives from federal, state, and local agencies and other water resources professionals. The DIG

provides drought impact and mitigation support to ADAPT, is responsible for identifying drought impacts on water users, and is representative of the following five drought impact sectors: domestic, agricultural, environmental, industrial, and recreational.

The state is divided into nine specific regions, and drought indicators have been determined for each region. When the drought indicators begin to show the potential onset of drought conditions, the Alabama OWR, in coordination with ADAPT and the MAG, declares appropriate drought stage determinations with increasing levels of severity (i.e., advisory, watch, warning, and emergency) as the drought deepens. Upon the inception of a new or increased drought alert phase, the ADAPT is responsible for disseminating public information concerning all aspects of the drought. The initial action in responding to drought must be public education—providing information as to existing and potential conditions and water conservation measures necessary to meet the demand presented at each drought watch phase.

Drought triggers do not automatically invoke a required response from the various categories of water users. The triggers do prompt additional monitoring and notices to the water systems and public regarding the ongoing drought conditions. The Alabama OWR, in coordination with ADAPT, notifies the local governments and water utilities regarding the severity of the drought, makes recommendations, and provides guidance on the appropriate actions to be taken during the four stages of drought.

2.1.1.2.10.2.3 Alabama Water Use Reporting Program

The Alabama OWR is mandated to administer Alabama's Water Use Reporting Program. This program requires that major nonpublic and irrigation water users that have the capacity to withdraw at least 100,000 gpd of surface water and/or groundwater, as well as all public water systems, register their use with the Alabama OWR. Users are not required to obtain water withdrawal permits (ALOWR 2010).

2.1.1.2.10.2.4 Water Conservation Program

In addition to the Alabama Drought Management Plan, which specifically supports conservation efforts during periods of drought, the state actively encourages voluntary water conservation/water efficiency initiatives on the Alabama OWR website (ALOWR 2010). The website promotes and maintains conservation tips on indoor and outdoor water use. The tips include links to assist 1) residential customers to investigate water-saving opportunities in each area of the home; 2) agricultural interests to consider adapting conservation practices that are used on agricultural land across the country to conserve and improve natural resources for use on their land; and 3) municipal water planners with step-by-step approaches and conservation measures that can be used to develop and implement plans for water conservation. The website also provides a sample water conservation ordinance for use by municipal and county government officials.

2.1.1.2.10.2.5 Alabama Water Agencies Working Group (AWAWG)

In August 2011, Governor Bentley called together four agencies of state government with water resource responsibilities to develop an overview of water issues and activities. The four agencies were Alabama Department of Community Affairs, Office of Water Resources (ALOWR); Alabama Department of Conservation and Natural Resources (ADCNR); Alabama Department of Environmental Management (ADEM); and the Geological Survey of Alabama (GSA). In April 2012, the Governor formalized the Alabama Water Agencies Working Group (AWAWG). Soon thereafter, a 5th agency, the Alabama Department of Agriculture and Industries, was added to the AWAWG.

Governor Bentley directed the AWAWG to recommend an action plan and timeline for implementing a statewide water management plan by December 1, 2013. As part of the action plan process, AWAWG was tasked to establish a comprehensive database of Alabama's water resources and conduct meetings to gather input from stakeholders interested in water resource issues. The work of the AWAWG is coordinated by a chairman appointed by the Governor. Six subcommittees were created to help carry out the group's responsibilities and provide focus on the following specific topics: legal; database; stakeholders; legislation; reporting; and public information.

AWAWG prepared and submitted an interim report to the Governor on August 1, 2012, titled *Water Management Issues in Alabama* (AWAWG 2012). The report identified and summarized a dozen key water issues for the state and associated policy options. AWAWG reaffirmed the need for a statewide water management plan so that Alabama can address these issues responsibly and effectively. The August 2012 report provided a common base of information to assist various water agencies and others interested in water resource matters to take the first steps toward resolving policy issues and creating a comprehensive water management plan for Alabama.

The December 2013 report responding to the Governor's directive summarized actions taken by AWAWG through the August 2012 *Water Management Issues in Alabama* report and subsequent steps to develop and recommend a conceptual framework for a comprehensive statewide water resource management plan. The recommendations were developed with substantial stakeholder participation. The conceptual framework included a vision statement, guiding principles, and an action plan addressing the 12 water resource issue areas identified in the August 2012 report. Recommended actions to implement a statewide water management plan included the following considerations: identification of responsible agencies; estimated costs; relative priorities; and proposed timelines for implementation (AWAWG 2013).

2.1.1.2.10.3 Florida

2.1.1.2.10.3.1 Florida Water Plan

The *Florida Water Plan* is the Florida DEP's principal planning tool for long-term protection of the state's water resources (FLDEP 2001). It was developed pursuant to section 373.036, Florida Statutes (F.S.), which requires that it specifically include:

- The programs and activities of the Department related to water supply, water quality, natural systems, flood protection, and floodplain management
- The water quality standards of the Department
- The District Water Management Plans (including regional water supply plans) of the five regional water management districts
- The Water Resource Implementation Rule (Ch. 62-40, Florida Administrative Code)

Florida has a system of five regional water management districts under the general supervision of the Florida DEP. Together, DEP and the water management districts share a broad range of responsibilities related to water supply, flood protection and floodplain management, water quality, and protection of natural systems. This system strikes a balance between the need for statewide consistency and the need for regional flexibility. Figure 2.1-45 is a graphic representation of this system.



Figure 2.1-45. Florida Water Management Plan

The plan is intended to help DEP, especially the Division of Water and the six DEP regulatory districts, to focus on the highest water resource protection priorities, organize its own water management responsibilities, and build water management partnerships. It identifies significant water resource management priorities facing the state and sets forth strategies and actions for addressing them. Specifically, the plan:

- Identifies what the DEP regards as the priority water issues
- States the DEP's main strategies for addressing the priority issues

- Focuses on accountability and performance measures
- Emphasizes the use of watershed management to achieve the DEP's water resource protection goals and aids in the statewide development and coordination of the watershed management approach
- Emphasizes the best use of current information technology to set priorities, assess effectiveness, and improve public access to data pertaining to protection activities identified in the plan
- Seeks to strengthen partnerships with the water management districts and other parties

Each year the DEP reports on the progress of the specific action steps provided in the Florida Water Plan, as well as other performance measures found in the plan. Typically the performance measures evaluate environmental health or track the accomplishment of specific tasks.

2.1.1.2.10.3.2 Water Conservation

In 2001, during one of the worst droughts in Florida's history, the DEP began an initiative to identify additional measures to increase water use efficiency. The initiative was an open process in which the DEP, in close coordination with the state's five water management districts, facilitated public meetings to develop specific water conservation recommendations. The final report (April 2002) contained 51 priority recommendations for improving water use efficiency and led to a *Joint Statement of Commitment for the Development and Implementation of a Statewide Comprehensive Water Conservation Program for Public Water Supply* (JSOC). The JSOC is a written agreement by key public water supply partners in Florida to collaborate on measures to improve water use efficiency.

Subsequent to the signing of the JSOC, and based on it, the 2004 regular session of the Florida Legislature enacted House Bill 293. Among other things, the bill creates a new section 373.227, F.S., encouraging the use of efficient, effective, and affordable water conservation measures, and it states that a goal-based, accountable, tailored water conservation program should be emphasized for public water supply utilities (FLDEP 2004).

In the legislation, the DEP was directed to "develop a comprehensive statewide water conservation program for public water supply." That is to be done "in cooperation with the water management districts and other stakeholders." The legislative action affirmed the collaborative approach used in the JSOC. The legislation was enacted to support and provide guidance to the general direction that the JSOC signatories had already embarked upon. In addition to paraphrasing portions of the JSOC and authorizing the Florida DEP and the water management districts to adopt rules needed to carry out the intended purpose, the legislation required that a written report be submitted to the Florida Legislature by December 1, 2005 (FLDEP 2004).

On the basis of the principles of the JSOC, the signatories developed a work plan (completed in December 2004). The work plan details the specific tasks, interim milestones, completion dates, estimated costs and potential funding sources, and assignment of responsibilities to 1) develop standardized definitions and performance measures for water conservation data collection and analysis; 2) establish a clearinghouse for water conservation programs and practices; 3) develop and implement a standardized process for public supply utilities to participate in the statewide water conservation program for public supply; 4) develop and maintain a Florida-specific water conservation guidance document to assist public water suppliers in designing and implementing a utility-specific water conservation program; and 5) implement pilot projects through cooperative agreements with volunteer utilities. These water conservation programs are principally implemented by the five water management districts.

2.1.1.2.10.3.3 Conserve Florida Water Clearinghouse

The Conserve Florida Water Clearinghouse is hosted by the University of Florida and supported by the water management districts, the Florida DEP, and several associations and public utilities in the state with an interest in water resource conservation. The mission of the clearinghouse is to develop collaborative relationships with related programs and to collect, analyze, and make available reliable information and technical assistance to public water supply utilities and water managers for use in developing effective and efficient water conservation programs (University of Florida 2010).

2.1.1.2.10.3.4 Northwest Florida Water Management District

The Northwest Florida Water Management District (NWFWMD) is one of five water management districts in the state created by the Water Resources Act of 1972. The water management districts are directly responsible for managing the quality and quantity of the state's waters in conjunction with the Florida DEP. The NWFWMD has worked for decades to protect and manage water resources in a sustainable manner for the continued welfare of people and natural systems across its 16-county region. The NWFWMD serves the following Florida counties: Bay, Calhoun, Escambia, Franklin, Gadsden, Gulf, Holmes, Jackson, Leon, Liberty, Okaloosa, Santa Rosa, Wakulla, Walton, Washington, and western Jefferson. The NWFWMD's area of responsibility is depicted on Figure 2.1-46. The Apalachicola River and Bay are within the NWFWMD.

2.1.1.2.10.3.5 District Water Management Plan

Pursuant to section 373.036, F.S., the NWFWMD develops a *Strategic Water Management Plan* (SWMP) every five years to define the responsibilities of the district, as well as the agency's objectives, strategies, and success criteria. This plan focuses on current strategies – those activities the district plans to undertake in the near term to accomplish its mission to protect and manage the water resources of northwest Florida in a sustainable manner for the continued welfare of its residents and natural systems. The plan defines the district's current strategic priorities, implementation activities, financial resources and performance measures. The most recent published version of the SWMP occurred in 2010.

Prior to 2006, the water management districts in Florida developed *District Water Management Plans* (DWMPs) and updated them every five years. The last update to the NWFWMD DWMP was completed in 2005. The planning processes outlined below that were part of the DWMPs are now captured in the *Strategic Water Management Annual Work Plan Report*. The SWMP integrates major programs, including regional water supply planning, water resource development, water supply development assistance, minimum flows and levels, resource regulation, wetland mitigation, special projects, the Surface Water Improvement and Management program, technical assistance, land acquisition and management, and public outreach and education. Detailed district work plans and documents guide the implementation of these programs. Collectively, the district's programs and plans, and its budget, constitute a comprehensive approach to the interrelated issues that span the four major areas of responsibility (AORs):

- **Water Supply.** Promote the availability of sufficient water for all existing and future reasonable-beneficial uses and affected natural systems.
- **Flood Protection and Floodplain Management.** Maintain natural floodplain functions and minimize harm from flooding.
- **Water Quality.** Protect and improve the quality of the district's water resources.
- **Natural Systems.** Protect and enhance natural systems.

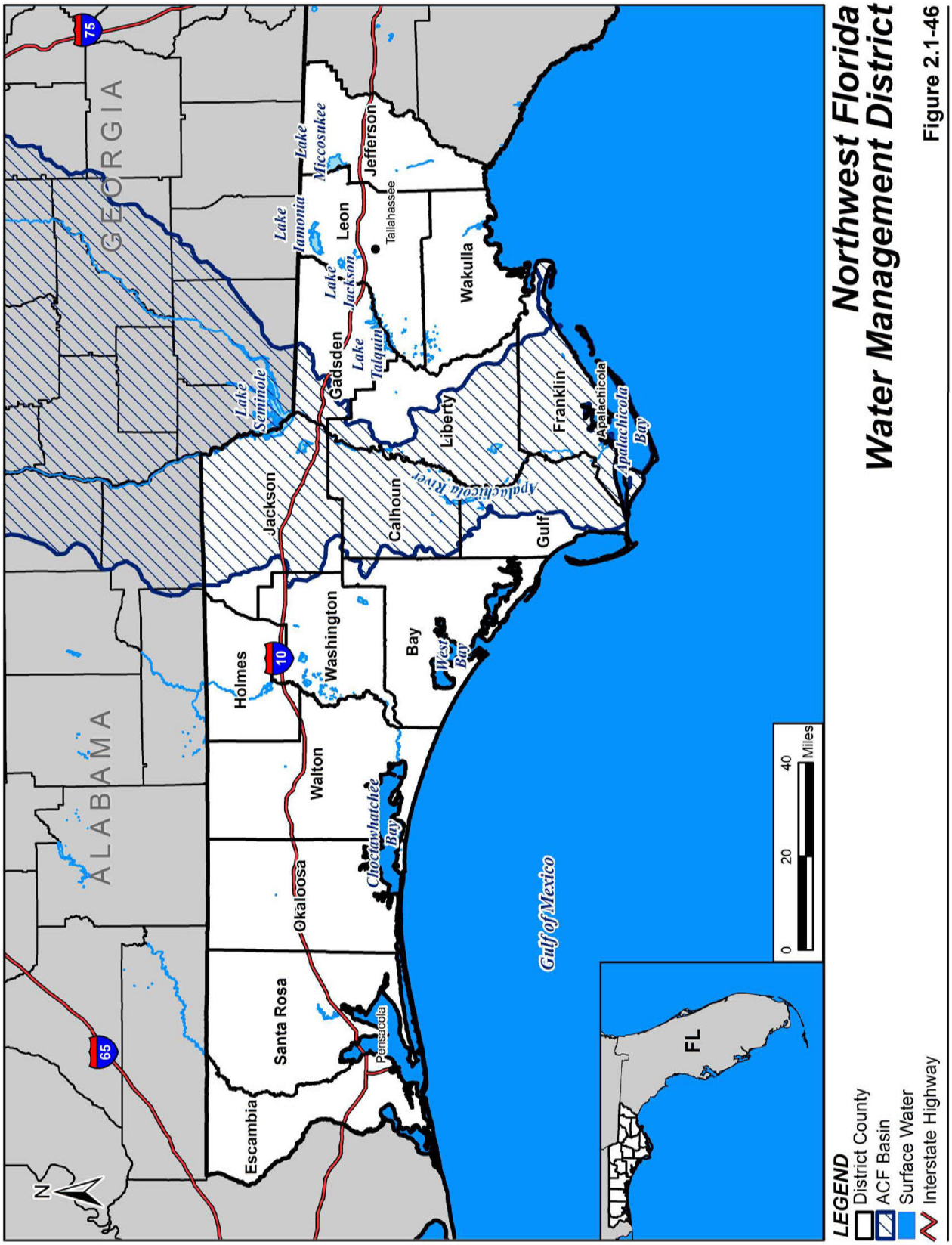

Northwest Florida
Water Management District
LEGEND
District County
ACF Basin
Surface Water
Interstate Highway
ALABAMA
GEORGIA
FL
Gulf of Mexico
Escambia
Santa Rosa
Okaloosa
Walton
Holmes
Washington
Bay
Jackson
Calhoun
Gulf
Liberty
Franklin
Gadsden
Leon
Wakulla
Jefferson
Tallahassee
Pensacola
Apalachicola
Lake Seminole
Lake Jackson
Lake Talquin
Lake Jamonia
Lake Miccosukee
Apalachicola River
West Bay
Choctawhatchee Bay
Apalachicola Bay
0
20
40
Miles
N
10
65
75

Figure 2.1-46

The SWMP communicates the district's most pressing water management issues and its key strategies to address them. Intergovernmental coordination is critical to the district in carrying out its responsibilities. The district forms partnerships with other levels of government that implement water management through planning, regulation, and acquisition, and service delivery programs. By maintaining close working ties with federal, state, regional, and local agencies, the district can draw upon and provide important resources, technical expertise, and knowledge to support effective water resource management and implementation of the plan.

2.1.1.2.10.3.6 Consumptive Use Permits

Through the Consumptive Use Program, the district's water supplies are allocated in a manner that is reasonable and beneficial, is in the public interest, and does not have a deleterious impact on existing legal users or the resource.

The NWFWMD operates regulatory programs that address, through rules, the consumptive use of water; the construction, repair, or abandonment of water wells and licensing of water well contractors; the safety of nonagricultural impoundments; agricultural and forestry surface water management facilities, including *farm ponds*; stormwater management systems; the artificial recharge of groundwater; and works of the district (NWFWMD 2010).

For consumptive use permitting purposes, the district is divided into three permitting areas within the NWFWMD boundary: Permit Areas A, B, and C. The six counties along the Apalachicola River corridor fall into the following permit categories: Gulf County (Area B, Area A for barrier islands); Franklin County (Area B, Area A for barrier islands); Calhoun County (Area C); Jackson County (Area C); Liberty County (Area B); and Gadsden County (Area A). Specific criteria and requirements for water use permitting are described at http://www.nwfwmd.state.fl.us/permits/water-use-permits/.

2.1.1.3 Monitoring Water Quantity for Management

Several federal government agencies monitor water quantity in the ACF Basin. The USGS has developed extensive water quantity monitoring networks as part of the Cooperative Water Program. The GAEPD provides support for continuous water quantity monitoring of surface water and groundwater as part of the Georgia Water Information Network (GWIN). USACE monitors inflow and discharge at all reservoirs, along with pool elevation. NOAA operates several gages in the ACF Basin to monitor changes in estuary, river, and ocean water levels. All federal water quantity monitoring data are available, in real time, online.

Both the GAEPD and Florida DEP operate several additional water quantity monitoring networks within the state. Water quantity data are taken yearly and continuously depending on the station.

The USGS operates several monitoring networks in the ACF Basin. The largest network, the Active Groundwater Network, contains information that the USGS or its cooperators measure at least once every year. At 12 wells, measurements are recorded at 15- to 60-minute intervals using data loggers that transmit the data to the USGS every 1 to 4 hours. Data collected within this network are used for statewide monitoring programs, drawdown monitoring, hydrologic research, and aquifer tests. The USGS Climate Response Network monitors the effects of droughts and climate variability on groundwater levels in seven wells in the ACF Basin. A portion of these wells are part of the Long-Term Groundwater Data Network, and measurements have been made at the wells at least once a year for at least the last two decades (USGS 2010a).

As part of the Cooperative Water Program in Georgia, the USGS monitors groundwater levels through the Georgia Ground-Water Information and Project Support (GWIPS) Unit in cooperation with the GAEPD, as well as several local municipalities (USGS 2010b). The wells are periodically observed and continuously monitored within the network of the state. Well inventory data are entered into the Ground-Water Site Inventory database.

Although the Geological Survey of Alabama monitors groundwater levels year-round at 19 well locations, none of the wells are in the ACF Basin. The agency also samples water levels in an additional 450 wells during the month of October (GSA 2010).

Florida established its Ground Water Quality Monitoring Network (GWQMN) in 1983 to monitor the chemical and physical characteristics of aquifers. The Florida DEP coordinates the monitoring, and federal and state agencies, such as Florida's water management districts, are involved. The GWQMN is composed of two networks—the Background Network of 1,700 wells and the Very Intense Study Area (VISA) Network. Water-level data for the Background Network were collected from 1994 to 1997 in a total of 40 wells installed in the Apalachicola Basin. Water-level data are continually collected in Jackson County as part of the VISA Network. The NWFWMD also maintains a small network of five monitoring wells, one of which is in the ACF Basin (FLDEP 2010).

Limited water quantity monitoring is done within Apalachicola Bay. NOAA operates a gage at the mouth of the Apalachicola River that monitors tidal changes, and both NOAA and USGS have several gages on the Apalachicola River and nearby tributaries that monitor freshwater inflow into the estuaries. USACE operates tidal gages at the mouth of the Apalachicola River and at the bay's entrance to the Gulf of Mexico.

2.1.2 Water Quality Affected Environment

This discussion addresses the quality of water in the ACF Basin by reviewing applicable standards, regulations, data, and models. Many factors can affect water quality, including M&I discharges, land use activities, and in-stream flows. This section discusses the quality of water in the ACF Basin under existing conditions.

2.1.2.1 Historic Water Quality

Water quality in the forested headwaters of the ACF Basin was very good before the 1950s. After Buford Dam was built in the 1950s, water quality in the tailrace of the dam in the Chattahoochee River was diminished. Water released from the reservoir was high in iron and manganese due to the reservoir stratification in the fall, causing several large fish kills at the Georgia Lake Lanier Trout Hatchery. In April 1987, USACE completed a study indicating that fish hatchery water quality concerns could be addressed if Georgia DNR would add water-hardening chemicals to water pumped from the river during the critical periods as a least-cost alternative (Appendix A, Appendix B - Buford Dam and Lake Sidney Lanier).

Water quality downstream of Buford Dam, in Metro Atlanta and the 70 miles immediately downstream of Metro Atlanta, was notoriously poor from the 1940s to the 1970s. Raw sewage was often directly discharged into the Chattahoochee River, along with industrial effluent. Wastewater from the R.M. Clayton Plant, the main wastewater treatment plant for Atlanta, received only primary treatment before being discharged into the river during that time (USEPA 2000a).

Discharges to the Chattahoochee River contained elevated fecal coliform counts and high concentrations of total suspended solids, ammonia, and biochemical oxygen demand in the mainstem and its tributaries. Water quality was typically worse during the summer months. River flows generally diluted the

wastewater, but low flows and warm water temperatures during summer months decreased dissolved oxygen. From 1968 to 1974, dissolved oxygen was regularly less than 1 milligram per liter (mg/L) in Metro Atlanta. Phosphorus levels were also very high in the rivers because phosphates were still being used in laundry detergent (USEPA 2000a).

Before the 1970s, water quality immediately downstream of wastewater plants was so inhospitable to fish that none were found in those locations during fish surveys. Fish kills were also common in Metro Atlanta because of raw sewage discharges into the river (Mauldin and McCollum 1992).

Several studies conducted in the 1960s that examined potential water quality solutions found the solution to be cost-prohibitive and no action was taken. In the 1970s, several laws and regulations were established at federal and local levels, including the Water Pollution Act of 1972, as amended, and the 1973 Atlanta Metropolitan River Protection Act (USEPA 2000a). The Water Pollution Act of 1972, as amended, required that all wastewater undergo secondary treatment, and, by 1974, Metro Atlanta facilities had been upgraded to provide secondary treatment. Improvement in technology also helped improve wastewater treatment plants.

Following improvements to wastewater treatment plants, dissolved oxygen concentrations increased by approximately 5–7 mg/L in the Chattahoochee River and its tributaries. There was a significant reduction in ammonia and total suspended solids being discharged, and phosphorus decreased in part because of laws passed that regulated phosphate detergent (USEPA 2000a). Biochemical oxygen demand concentrations steadily decreased after reaching a high in the late 1960s (USEPA 2000a).

Before construction of West Point Lake, there were concerns with water quality and monitoring was put in place downstream of the West Point Dam. In 1964, the U.S. Public Health Service conducted a study of water quality and water quantity that concluded a minimum of 670 cfs should be released from West Point Lake to ensure sufficient water levels for downstream intakes. In 1975, after West Point Lake was in operation, they concluded that 675 cfs was needed. USACE temporarily released additional water from West Point Dam until downstream intakes were modified in 1977 (Appendix A, Appendix E - West Point Dam and Lake).

Historically, low dissolved oxygen downstream of Walter F. George Dam had caused fish kills. A new protocol was adopted for the dam that allowed for additional water release from the reservoir during periods of fish stress and low dissolved oxygen. Today, special releases are made when monitoring indicates low dissolved oxygen or if fish below the dam appear to be in distress (Appendix A, Appendix C - Walter F. George Lock and Dam and Lake).

Relatively little data exists on water quality downstream of Atlanta before 1970. Wastewater from Columbus, Georgia, on the middle Chattahoochee River, and Albany, Georgia, on the lower Flint River, did contribute to poor water quality immediately downstream of their influence. Sources from those urban areas included septic tanks, industrial waste, and wastewater treatment plants. However, the size of their load and the relative magnitude of the rivers and associated flow conditions at those locations would have provided for better assimilation of pollutants, and water quality conditions were not likely to be as poor as in Metro Atlanta.

Despite the improvements to wastewater treatment plants and the passage of various water protection laws, water quality is threatened by population pressures and associated land use change. Nonpoint source pollution from the metropolitan areas, poultry farms, and agricultural farms contribute to high sediment loading and poor water quality following rain events, as described in section 2.1.2.6.

2.1.2.2 Existing Reservoir Quality

General water quality conditions that have been well documented in West Point Lake are typical of water quality conditions and trends that exist in reservoirs throughout the ACF Basin. Nutrient concentrations are highest in the upper arms of the tributaries to West Point Lake, specifically the Chattahoochee River arm, because of the nutrient-rich riverine inflows. Sediment and phosphorus concentrations are also highest in the upper arms and decrease toward the main pool as velocity is lowered and sediment is removed from suspension. Dissolved oxygen levels were highest in the top 15 ft of the reservoir and the reservoir is anoxic or nearly anoxic near the reservoir bottom, especially in the main pool area, during periods of seasonal (summer) stratification. Currents and mixing regimes influence the concentrations of dissolved oxygen throughout West Point Lake.

In Lake Lanier, West Point Lake, and Walter F. George Lake, summer stratification occurs because of their depths. The surfaces of these lakes heat quickly, creating a warm, less-dense epilimnion that does not mix with the cold, dense hypolimnion. The principal cause of lower dissolved oxygen concentrations in the hypolymnion is oxygen-consuming decomposition of organic matter in the water column and at the sediment surface. Thermal density differences between the warmer epilimnion and hypolymnion prevent mixing between the density layers and full water column diffusion of dissolved oxygen. In the fall, the surface layer of the reservoir cools and becomes more dense, eventually to the point where the surface water density is higher than the hypolimnion and *turnover* (or complete mixing) of the formerly distinct layers occurs. Complete mixing in the fall reestablishes a uniform dissolved oxygen concentration throughout the water column. In shallow lakes, such as Lake Seminole, mixing from currents and wind prevents strong stratification and the formation of a hypolimnion layer. Additionally, chlorophyll *a* concentrations varied both seasonally and spatially and were highest from July to October during periods of low flow (Kennedy et al. 1994).

Point and nonpoint sources from metropolitan areas such as Atlanta, Columbus, and Albany increase sediment and pollutant loads in the rivers immediately downstream. The reservoirs in the ACF Basin typically act as a sink, removing pollutant loads and sediment. Although there was a decrease in nutrient loads downstream of nearly all reservoirs, significant decreases occurred only downstream of Lake Lanier, West Point Lake, and the Flint River arm of Lake Seminole. The decreases in nutrient and sediment concentrations in the reservoirs are caused by settling of sediments and associated phosphorus and detritus, inflow from tributaries with lower nutrient concentration, and uptake of nutrients from phytoplankton in reservoirs (Frick et al. 1996).

Nutrient concentrations were lower in the Chattahoochee River during the summer because of increased nutrient uptake within the reservoirs. In the summer, the increased phytoplankton growth, along with aquatic plants, removes large amounts of nutrients. Seasonal trends in nutrient concentrations were not noticeable on the Flint or Apalachicola rivers (Frick et al. 1996).

The highest concentrations of nutrients and pollutants in the ACF Basin occur immediately downstream of Atlanta in both the Flint River and the Chattahoochee River. A large portion of the nutrient and sediment load from Atlanta in the Chattahoochee River is assimilated and deposited in West Point Lake (Frick et al. 1996). Reservoirs downstream of West Point Lake also help remove pollutants from the Chattahoochee River from Metro Atlanta point and nonpoint sources and from smaller metro areas such as Columbus. By the time the Chattahoochee River enters Lake Seminole, nutrient concentrations are similar to concentrations in Lake Seminole's tailwaters, the Apalachicola River. The Flint River, which has no reservoirs between Albany and Lake Seminole, has much higher pollutant loads upon entering Lake Seminole (Frick et al. 1996). However, poor water quality in the Flint River at Lake Seminole is not solely caused by Atlanta as water quality greatly improves between Atlanta and Albany through dilution from tributaries. The high nutrient concentrations that enter Lake Seminole from the Flint River come

from point sources in Albany and nonpoint sources from the surrounding agricultural land (Frick et al. 1996).

The influence of reservoir nutrient concentrations and use of the system are often understood from evaluating the reservoirs trophic status. Ranges of trophic state index values are often grouped into trophic state classifications. The range between 40 and 50 is usually associated with mesotrophy (moderate productivity). Index values greater than 50 are associated with eutrophy (high productivity). Values less than 40 are associated with oligotrophy (low productivity). Reservoir monitoring data collected by GAEPD indicate that Lake Lanier has moderate productivity while West Point, Walter F. George, and Seminole lakes are highly productive (GAEPD 2008b). Highly productive lakes are less likely to assimilate pollutants. Changes to reservoir inflows, outflows, or water levels at highly productive lakes would be expected to have a greater influence on the system's ability to meet water quality standards.

2.1.2.2.1 Lake Lanier Water Quality

Georgia's 2012 draft integrated 305(b)/303(d) list of impaired waters designates five of six reaches in Lake Lanier as supporting designated uses, including the area of the dam forebay. Water quality monitoring in Lake Lanier by GAEPD has indicated exceedance of the water quality standard for chlorophyll *a* at times since 2001. In the state's draft 2012 assessment, one reach was identified as impaired for chlorophyll *a*. Chlorophyll *a* standards for Lake Lanier are set as a growing season (April through October) average less than 5 micrograms per liter (µg/L) upstream of Buford Dam forebay, less than 5 µg/L upstream from Flowery Branch confluence, less than 5 µg/L at Browns Bridge Road, less than 10 µg/L at Bolling Bridge on the Chestatee River, and less than 10 µg/L at Lanier Bridge on the Chattahoochee River (GAEPD 2012a). Georgia's 305(b)/303(d) integrated list of waters refers to sections of the Water Pollution Act of 1972, as amended. Measured data at compliance points for dissolved oxygen, total nitrogen, and pH are in compliance with Georgia's standards. The state collects profile data at compliance points in the reservoir for dissolved oxygen, pH, conductivity, and water temperature during the growing season. It also collects grab samples of nitrogen, phosphorus, chlorophyll *a*, and bacteria.

Georgia has begun efforts to identify sources contributing to high chlorophyll *a* levels by developing a total maximum daily load (TMDL). As part of the state's water planning effort it has also modeled the Chattahoochee River downstream of Buford Dam.

The tailrace of Buford Dam is classified as a trout stream and requires that water quality meet stringent standards, specifically dissolved oxygen must have a daily average of 6.0 mg/L. The water released from the dam is from the deeper levels of the lake, approximately 136 ft below the water level, where, although cool, often has dissolved oxygen levels less than 3 mg/L from June to December when the reservoir is stratified and has a distinct hypolmnion layer. USACE measures basic water quality data in the tailrace. The water temperature is often 50 degrees Fahrenheit (°F), ideal to support the trout fishery, while the dissolved oxygen ranges from 1 mg/L to 13 mg/L. Re-aeration of the released water typically occurs within 5 to 6 miles of the dam because of vertical mixing in the shoals and pools within the river (Greenfield 2014, personal communication).

2.1.2.2.2 West Point Lake Water Quality

Georgia's 2012 draft integrated 305(b)/303(d) list of impaired waters designates West Point Lake as not supporting designated uses because of polychlorinated biphenyls (PCBs). A TMDL for West Point Lake was completed in 1998 for PCBs, but lists the reduction at 0 percent because PCBs are no longer being used in Georgia. The PCBs found in fish in West Point Lake are from historic contamination. A TMDL

was also completed in 2000 for low dissolved oxygen below the West Point Dam in the Chattahoochee River (USEPA 2000b).

Georgia collects profile data at compliance points in the reservoir for nutrients and additional water quality criteria. Site-specific nutrient standards have been developed for West Point Lake; monthly average chlorophyll *a* must be less than 27 µg/L at the LaGrange water intake during the growing season (April-October), total nitrogen must be less than 4 mg/L, and phosphorus loading must be less than 2.4 pounds per acre-foot (lbs/ac-ft) of lake per volume of water a year (GAEPD 2012a). All water quality samples collected by Georgia EPD have been within those ranges. In accordance with the state water plan, GAEPD developed a 3-dimensional hydrodynamic and water quality model to examine nutrient criteria in West Point Lake.

LaGrange is also actively monitoring water quality at various locations in West Point Lake. The city's monitoring efforts are being conducted to document reservoir nutrients. The city's water supply intake is in West Point Lake. In 2008, that data effort identified several violations of the state's nitrogen standard in waters entering the reservoir. Samples collected in the reservoir pool during the same period did not experience violations. Since 2008, nitrogen concentrations entering the reservoir have not violated the state's water quality standard for nitrogen (City of LaGrange 2010).

USACE monitors water quality in the tailrace of West Point Lake. Dissolved oxygen levels in the tailrace vary greatly, from 1 mg/L to 10 mg/L, with the lowest concentrations during late summer and early fall. Water temperature in the tailrace ranges from 50 °F to 80 °F (10 °C to 27 °C) and can even approach 90 °F (32 °C) in July and August.

2.1.2.2.3 Walter F. George Lake Water Quality

The pool and mid-lake behind the Walter F. George Dam are both supporting their designated water uses according to Georgia's 2012 draft integrated 305(b)/303(d) list. A TMDL was completed in 1998 for PCBs, and because PCBs are no longer used in Georgia, the reduction of contaminants was listed at 0 percent. GAEPD also collects nutrient and water quality data at compliance points in the lake, and measurements have not exceeded the standards. Walter F. George Lake has site-specific nutrient criteria, and the monthly average chlorophyll *a* during the growing season must be less than 18 µg/L at mid-river at U.S. Highway 82 or 15 µg/L at mid-river in the dam forebay (GAEPD 2012a). While the growing season average has been less than 18 µg/L, chlorophyll *a* measurements have equaled 18 µg/L. In accordance with the state water plan, GAEPD developed a 3-dimensional hydrodynamic and water quality model to further examine nutrient criteria in Walter F. George Lake.

USACE also monitors water quality in the tailrace of Walter F. George Lock and Dam. Dissolved oxygen is often less than 3 mg/L in the tailrace during the late summer and early fall months because of stratification of the lake. If during the periods of low dissolved oxygen, fish appear to be in distress, USACE releases additional water to assist fish assemblages in the tailrace (the headwaters of George W. Andrews Lake) (Appendix A, Appendix C - Walter F. George Lock and Dam and Lake).

2.1.2.2.4 George W. Andrews Lake Water Quality

George W. Andrews Lake is supporting its designated water quality use for fishing, according to GAEPD (GAEPD 2010). Because it is meeting all water quality standards, no TMDL studies have been conducted. GAEPD does not have regularly monitored compliance stations in the reservoir as it does with other reservoirs in the ACF Basin. Georgia has not developed site-specific water quality criteria for the reservoir. USACE monitors water quality in the headwaters of the reservoir and will use the data for future water quality planning purposes.

2.1.2.2.5 Lake Seminole Water Quality

According to Georgia's 2012 draft integrated 305(b)/303(d) list of impaired waters, Lake Seminole is supporting its designated recreation usage for water quality parameters other than pH. Two TMDLs were completed in 1998 for chlordane and PCBs. Reduction for both was 0 percent because neither one is used in Georgia any longer. The upper reaches of the reservoir maintain the characteristics of a river with relatively homogenous temperature and dissolved oxygen concentrations. The productive zone of the reservoir is not limited because of vertical stratification due to the homogenous dissolved oxygen concentrations and the relative shallowness of the lake. Although there is a small degree of vertical stratification, a thermocline does not exist. Interagency sampling over the 1993–1995 period does show significant areas of extremely low or zero dissolved oxygen in the aquatic plant beds in the lake.

Nonnative plant growth in the reservoir, specifically hydrilla (*Hydrilla verticillata*), has adversely affected water quality and aquatic life habitat (see section 2.5.3.2). USACE does operate Jim Woodruff Lock and Dam to help with aquatic plant control during periods when herbicides are applied to certain areas of the reservoir (Appendix A, Appendix A - Jim Woodruff Lock and Dam and Lake Seminole).

In September 1995, an interagency team directed by EPA sampled dissolved oxygen and temperature at 120 randomly selected locations within the lake. The results of this study show 44 percent of the stations sampled in aquatic vegetation (predominantly hydrilla) had dissolved oxygen levels less than 5 mg/L, compared with 8 percent of the stations in open water. On the basis of those data, a significant portion of the reservoir probably has poor water quality conditions during the hot summer and early fall months when the hydrilla has formed large surface mats. Additional field study by Georgia DNR, Wildlife Resources Division (WRD) in 1994–1995 corroborated those findings on low dissolved oxygen levels below the surface in dense hydrilla beds, compared with dissolved oxygen levels at open water stations. During 1994 and 1995, Georgia WRD sampled three stations on the Flint River and three stations on Spring Creek from June through October monthly. At each site, water quality parameters were recorded within topped-out hydrilla beds and in open water areas immediately adjacent to the dense hydrilla beds. Within the dense hydrilla beds, the dissolved oxygen levels were less than 5 mg/L at depths greater than 2 ft most of the entire June-October sampling period for both years, while stations in the open water had significantly fewer dissolved oxygen measurements of less than 5 mg/L. Average dissolved oxygen measurements on the bottom within the hydrilla beds were about 2.5 mg/L, compared with approximately 5.0 mg/L at the open water sites (Eubanks 2010, personal communication).

GAEPD regularly monitors water quality in Lake Seminole, and all water quality meets criteria. Georgia has not set site-specific nutrient criteria for Lake Seminole. USACE historically monitored water quality in the tailrace, and the data has shown that the water discharged from the dam generally has good water quality (Appendix A, Appendix A - Jim Woodruff Lock and Dam and Lake Seminole).

However, in the freshwater nutrient criteria drafted for Florida in January 2010, Florida's nutrient criteria will apply to Lake Seminole in the dam forebay, which is in Florida. The finalized standard of 0.006 mg/L (6 µg/L) of chlorophyll *a* is less than monitored concentrations. Monitored data collected in June, August, and November of 2007 range from 6.7 to 12 µg/L (GAEPD 2008b). The implications of new standards may require nutrient reductions throughout the ACF Basin from both point and nonpoint sources. GAEPD has developed a 3-dimensional hydrodynamic and water quality model for the reservoir that will establish nutrient criteria. This tool will help the state understand how nutrients entering the reservoir assimilate. Understanding how nutrients in the reservoir assimilate will be a factor in determining the need for upstream reductions.

2.1.2.3 Water Quality Standards

In 1972, Congress enacted the Water Pollution Control Act of 1972, which is now also known as the Clean Water Act. The object was "the protection and propagation of fish, shellfish, and wildlife and [to] provide for recreation in and on the water." The Water Pollution Act of 1972, as amended, established the National Pollutant Discharge Elimination System (NPDES) for the regulation of M&I water pollution control plants, the water use classification and standard process, and construction grants. In 1987, Congress made significant changes to the Water Pollution Act of 1972, as amended, which increased emphasis on toxic substances, nonpoint source pollution, and clean lakes, wetlands, and estuaries. The act requires that states evaluate their water quality standards and adopt numeric criteria for toxic substances to protect aquatic life and health. Each state was also required to evaluate nonpoint source pollution impacts and develop management plans to deal with documented problems.

Under the Water Pollution Act of 1972, as amended, 33 U.S.C. § 1313(a)(3)(A), states are required to adopt water quality standards. The standards, and any later revisions, are reviewed through public involvement and later approved by EPA. Water quality standards are based on state-assigned water use classifications, such as public water supply, recreation, and navigation. The standards consist of general narrative standards and numeric standards for water quality parameters and toxic substances.

Table 2.1-26, Table 2.1-27, and Table 2.1-28 present the water quality standards for Alabama, Florida, and Georgia, respectively, for specific stream designated uses.

In addition to the parameters presented in the three tables, Alabama, Florida, and Georgia have water quality standards for metals and other toxic substances that are based on human use and consumption rates. More information relevant to water quality standards for metals and other toxic substances can be found in the Alabama Department of Environmental Management (ADEM) Administrative Code, R. 335-6-10 (ADEM 2014); Florida Administrative Code 62-302: Surface Water Quality Standards (FLDEP 2013b); and Administrative Rule 391-3-6-.03: Water Use Classifications and Water Quality Standards (GAEPD 2012a).

Both Alabama and Georgia have developed site-specific criteria in addition to the standard water quality guidelines. Additional requirements for lakes include chlorophyll *a*, a commonly used indicator of nutrients in water bodies, and total phosphorus and total nitrogen. In 2002, EPA recommended nutrient criteria for water bodies on the basis of their ecoregion (USEPA 2008); Alabama and Georgia have not yet adopted those standards. Additional water quality standards have been set for lakes regarding hydroelectric facilities to ensure that water quality standards are met by setting tailwater dissolved oxygen targets of 4 mg/L during power generation. Table 2.1-29 provides the site-specific criteria for water bodies in the ACF Basin for Georgia and Alabama. Table 2.1-30 provides EPA's numeric nutrient criteria for Florida streams and lakes in the ACF Basin.

EPA required that states have numeric water quality nutrient standards by 2003. Although Georgia and Alabama have site-specific nutrient criteria for some lakes, they failed to establish numeric nutrient standards for all water bodies. Florida also did not establish statewide nutrient criteria, and, in July 2008, the Florida Wildlife Federation sued EPA for failure to comply with section 303(c)(4)(B) of the Water Pollution Act of 1972, as amended, which requires EPA to *promptly* propose criteria on a state's behalf if the state has failed to do so. EPA established and finalized nutrient criteria for lakes and streams by November 2010 (USEPA 2010a). EPA proposed to establish and finalize nutrient criteria for estuaries and coastal waters by October 2011. However, based on a court ruling on January 2014, EPA was allowed to discontinue its work on the inland and coastal rule. The state of Florida would implement statewide and EPA approved nutrient criteria for inland and coastal waters (USEPA 2014).

Table 2.1-26.
Alabama Water Quality Standards (ADEM 2014)

Designated use	E. Coli bacteria or Enterococci group	Dissolved oxygen	pH	Temperature
Outstanding Alabama Water	< 126 colonies/100 mL as geometric mean, no more than 235 colonies/100 mL of E. Coli for noncoastal waters < 35 colonies/100 mL as geometric mean, no more than 104 colonies/100 mL of enterococci group for coastal waters	> 5.5 mg/L at all times 4 to 5.5 mg/L under extreme conditions due to natural causes[a] Not < 4 mg/L due to hydroelectric turbine discharges[b]	Between 6.0 and 8.5 for all Between 6.5 and 8.5 for saltwater and estuarine waters	< 90 °F
Public Water Supply	< 548 colonies/100 mL as geometric mean, no more than 2,507 colonies/100 mL of E. Coli in any given sample for noncoastal waters No more than 275 colonies/100 mL of enterococci group for coastal waters Jun–Sep incidental water contact and recreation < 126 colonies/100 mL, no more than 487 colonies/100 mL of E. Coli for noncoastal waters Jun–Sep incidental water contact and recreation <35 colonies/100 mL, no more than 158 colonies/ 100 mL of enterococci group for coastal waters	> 5 mg/L at all times 4 to 5.5 mg/L under extreme conditions due to natural causes[a] Not < 4 mg/L due to hydroelectric turbine discharges[b]	Between 6.0 and 8.5	< 90 °F
Swimming and Other Whole Body Water-Contact Sports	< 126 colonies/100 mL, no more than 235 colonies/100 mL of E. Coli for noncoastal waters <35 colonies/100 mL, no more than 104 colonies/ 100 mL of enterococci group for coastal waters	> 5 mg/L at all times 4 to 5 mg/L under extreme conditions due to natural causes[a] Not < 4 mg/L due to hydroelectric turbine discharges[b]	Between 6.0 and 8.5 for all Between 6.5 and 8.5 for saltwater and estuarine waters	< 90 °F
Shellfish Harvesting	Incidental water contact and recreation < 126 colonies/100 mL, no more than 235 colonies/100 mL of E. Coli for noncoastal waters Incidental water contact and recreation <35 colonies/100 mL, no more than 104 colonies/ 100 mL of enterococci group for coastal waters	> 5 mg/L at all times 4 to 5 mg/L under extreme conditions due to natural causes[a] Not < 4 mg/L due to hydroelectric turbine discharges[b]	Between 6.5 and 8.5	< 90 °F

Designated use	E. Coli bacteria or Enterococci group	Dissolved oxygen	pH	Temperature
Fish and Wildlife	< 548 colonies/100 mL as geometric mean, no more than 2,507 colonies/100 mL of E. Coli in any given sample for noncoastal waters No more than 275 colonies/100 mL of enterococci group for coastal waters Jun–Sep incidental water contact and recreation < 126 colonies/100 mL, no more than 487 colonies/100 mL of E. Coli for non-coastal waters Jun–Sep incidental water contact and recreation <35 colonies/100 mL, no more than 158 colonies/ 100 mL of enterococci group for coastal waters	> 5 mg/L at all times 4 to 5 mg/L under extreme conditions due to natural causes[a] Not < 4 mg/L due to hydroelectric turbine discharges[b]	Between 6.0 and 8.5 for all Between 6.5 and 8.5 for saltwater and estuarine waters	< 90 °F
Limited Warmwater Fishery	< 548 colonies/100 mL as geometric mean, no more than 2,507 colonies/100 mL of E. Coli in any given sample for noncoastal waters No more than 275 colonies/100 mL of enterococci group for coastal waters	> 3 mg/L at all times	Between 6.0 and 8.5 for all Between 6.5 and 8.5 for saltwater and estuarine waters	< 90 °F
Agricultural and Industrial Water Supply	< 700 colonies/100 mL, no more than 3,200 colonies/100 mL of E. Coli for noncoastal waters No more than 500 colonies/ 100 mL of enterococci group for coastal waters	> 3 mg/L at all times	Between 6.0 and 8.5 for all Between 6.5 and 8.5 for saltwater and estuarine waters	< 90 °F

Notes:

[a.] All new hydroelectric generation impoundments, including addition of new hydroelectric generation units to existing impoundments, shall be designed so that the discharge will contain at least 5.5 mg/L dissolved oxygen where practicable and technologically possible.

[b.] All new hydroelectric generation impoundments, including addition of new hydroelectric generation units to existing impoundments, will be designed so that the discharge will contain at least 5 mg/L dissolved oxygen where practicable and technologically possible.

Table 2.1-27.
Florida Water Quality Standards (FLDEP 2013b)

Designated use	Fecal coliform bacteria	Dissolved oxygen[a]	pH	Temperature
Potable Water Supply	< 200 colonies/100 mL as monthly geometric mean Not to exceed 400 colonies/100 mL in 10% of samples Not to exceed 800 colonies on any one day	See Rule 62-302.533 Florida Administrative Code	Within 1 pH unit change of natural background given actual pH is between 6.0 and 8.5 If natural background pH < 6.0, pH will not be < natural background and will be < 1 pH unit > natural background If natural background pH > 8.5, pH will not be > natural background and will be < 1 pH unit < natural background	
Shellfish Propagation and Harvesting	14 colonies/100 mL as median value Not to exceed 43 colonies/100 mL in 10% of samples Not to exceed 800 colonies on any day	See Rule 62-302.533 Florida Administrative Code	Within 1 pH unit change of natural background given actual pH is between 6.5 and 8.5 for coastal waters, within 0.2 pH units for open waters If natural background pH < 6.5, pH will not be < natural background and will be < 1 pH unit > natural background for coastal waters, will be < 0.2 pH units for open waters If natural background pH > 8.5, pH will not be > natural background and will be < 1 pH unit < natural background for coastal waters, will be < 0.2 pH units for open waters	
Recreation and Fish & Wildlife, Fresh Waters	< 200 colonies/100 mL as monthly geometric mean Not to exceed 400 colonies/100 mL in 10% of samples Not to exceed 800 colonies on any day	See Rule 62-302.533 Florida Administrative Code	Within 1 pH unit of natural background given actual pH is between 6.0 and 8.5, within 0.2 pH units for open waters If natural background pH < 6.0, pH will not be < natural background and will be < 1 pH unit > natural background, will be < 0.2 pH units for open waters If natural background pH > 8.5, pH will not be > natural background and will be < 1 pH unit < natural background, will be < 0.2 pH units for open waters	
Recreation and Fish & Wildlife, Marine Waters	< 200 colonies/100 mL as monthly geometric mean Not to exceed 400 colonies/100 mL in 10% of samples Not to exceed 800 colonies on any day	See Rule 62-302.533 Florida Administrative Code	Within 1 pH unit of natural background given actual pH is between 6.5 and 8.5, within 0.2 pH units for open waters If natural background pH < 6.5, pH will not be < natural background and will be < 1 pH unit > natural background, will be < 0.2 pH units for open waters If natural background pH > 8.5, pH will not be > natural background and will be < 1 pH unit < natural background, will be < 0.2 pH units for open waters	
Agricultural Water Supply	No alteration of natural water quality	See Rule 62-302.533 Florida Administrative Code	Within 1 pH unit change of natural background given actual pH is between 6.0 and 8.5 If natural background pH < 6.0, pH will not be < natural background and will be < 1 pH unit > natural background If natural background pH > 8.5, pH will not be > natural background and will be < 1 pH unit < natural background	
Navigation, Utility, and Industry	No alteration of natural water quality	See Rule 62-302.533 Florida Administrative Code	Between 5.0 and 9.5 except in certain swamp water, which may be as low as 4.5	

Note:
[a] Rule 62-302.533 Florida Administrative Code reflects revisions to the dissolved oxygen standard based on percent dissolved oxygen saturation by bioregion and site-specific conditions.

Table 2.1-28.
Georgia Water Quality Standards (GAEPD 2012a)

Designated use	Fecal coliform bacteria	Dissolved oxygen	pH	Temperature
Drinking Water Supply (not treated drinking water)	May–Oct < 200 colonies/100 mL as geometric mean During occasional exceedances, allowable geometric mean 300 colonies/100 mL in lakes and reservoirs and 500 colonies /100 mL in free flowing freshwater streams Nov–Apr < 1,000 colonies/100 mL as geometric mean, no more than 4,000 colonies/100 mL	6 mg/L daily average, no less than 5 mg/L at all times for trout streams 5 mg/L daily average, no less than 4 mg/L at all times for warm water species of fish	Between 6.0 and 8.5	< 90 °F
Recreation	Coastal waters: 100 colonies/100 mL as geometric mean Recreation: 200 colonies/100 mL as geometric mean During occasional exceedances for recreation, allowable geometric mean 300 colonies/100 mL in lakes and reservoirs and 500 colonies /100 mL in free-flowing freshwater streams	6 mg/L daily average, no less than 5 mg/L at all times for trout streams 5 mg/L daily average, no less than 4 mg/L at all times for warm water species of fish	Between 6.0 and 8.5	< 90 °F
Fishing	May–Oct < 200 colonies/100 mL as geometric mean During occasional exceedances, allowable geometric mean 300 colonies/100 mL in lakes and reservoirs and 500 colonies /100 mL in free-flowing freshwater streams Nov–Apr < 1,000 colonies/100 mL as geometric mean, no more than 4,000 colonies/100 mL	6 mg/L daily average, no less than 5 mg/L at all times for trout streams 5 mg/L daily average, no less than 4 mg/L at all times for warm water species of fish	Between 6.0 and 8.5	< 90 °F
Coastal Fishing	May–Oct < 200 colonies/100 mL as geometric mean During occasional exceedances, allowable geometric mean 300 colonies/100 mL in lakes and reservoirs and 500 colonies /100 mL in free-flowing freshwater streams Nov–Apr < 1,000 colonies/100 mL as geometric mean, no more than 4,000 colonies/100 mL	Site-specific	Between 6.0 and 8.5	< 90 °F
Wild or Scenic River	No alteration of natural water quality	No alteration of natural water quality	No alteration of natural WQ	No alteration of natural water quality

Table 2.1-29.
Site-specific Standards in Georgia (GAEPD 2012a) and Alabama (ADEM 2014)

State	Basin	Water body name	Chlorophyll *a*	Other
Georgia	Chattahoochee	Lake Lanier Tributaries		Total phosphorus annual loading: Chattahoochee River at Belton Bridge Road < 178,000 lbs, Chestatee River at GA Hwy 400 < 118,000 lbs, Flat Creek at McEver Road < 14,400 lbs
Georgia	Chattahoochee	Lake Lanier	Growing season monthly average[a] < 5 µg/L upstream of Buford Dam forebay, < 5 µg/L upstream from the Flowery Branch confluence, < 5 µg/L at Browns Bridge Rd, < 10 µg/L at Boiling Bridge on the Chestatee River, < 10 µg/L at the Chattahoochee River	pH: 6.0-9.5 Total Nitrogen: < 4 mg/L Phosphorus: < 0.25 lbs/ac-ft per volume per year Dissolved Oxygen: daily average of 5 mg/L and no less than 4 mg/L at all times
Georgia	Chattahoochee	Buford Dam to I-285 West a Secondary Trout Stream		No elevation exceeding 2 °F of natural stream temperatures. A daily average dissolved oxygen of 6.0 mg/L and no less than 5.0 mg/L at all times.
Georgia	Chattahoochee	West Point Lake Tributaries		Total phosphorus loading: Yellow Jacket Creek at Hammet Road < 11,000 lbs, New River at Hwy 100 < 14,000 lbs, Chattahoochee River at U.S. 27 < 1,400,000 lbs
Georgia / Alabama	Chattahoochee	West Point Lake	Growing season monthly average[a] < 27 µg/L at the LaGrange Water Intake	pH: 6.0-9.5 Total Nitrogen: < 4 mg/L Phosphorus: < 2.4 lbs/ac-ft per volume per year Dissolved Oxygen: daily average of 5 mg/L and no less than 4 mg/L at all times
Georgia	Chattahoochee	Walter F. George Lake Tributaries		Total phosphorus loading: Chattahoochee River at Hwy 39 < 2,000,000 lbs
Georgia / Alabama	Chattahoochee	Walter F. George Lake	Growing season monthly average[a] < 18 µg/L at mid-river at U.S. Hwy 82 and < 15 µg/L at mid-river below dam forebay	pH: 6.0-9.5 Total Nitrogen: < 3 mg/L Phosphorus: < 2.4 lbs/ac-ft per volume per year Dissolved Oxygen: daily average of 5 mg/L and no less than 4 mg/L at all times

Note:
[a] Growing season is April through October as defined by GAEPD.

Table 2.1-30.
EPA's Final Numeric Nutrient Criteria for Florida Streams and Lakes in the ACF Basin

	Chlorophyll *a* (mg/L)[a,b]	TN (mg/L)[c]	TP (mg/L)[c]
Panhandle West Freshwater Streams[d]	None	0.67	0.06
Clear Lakes, Low Alkalinity[e,f]	0.006	0.51 [0.51–0.93]	0.01 [0.01–0.03]

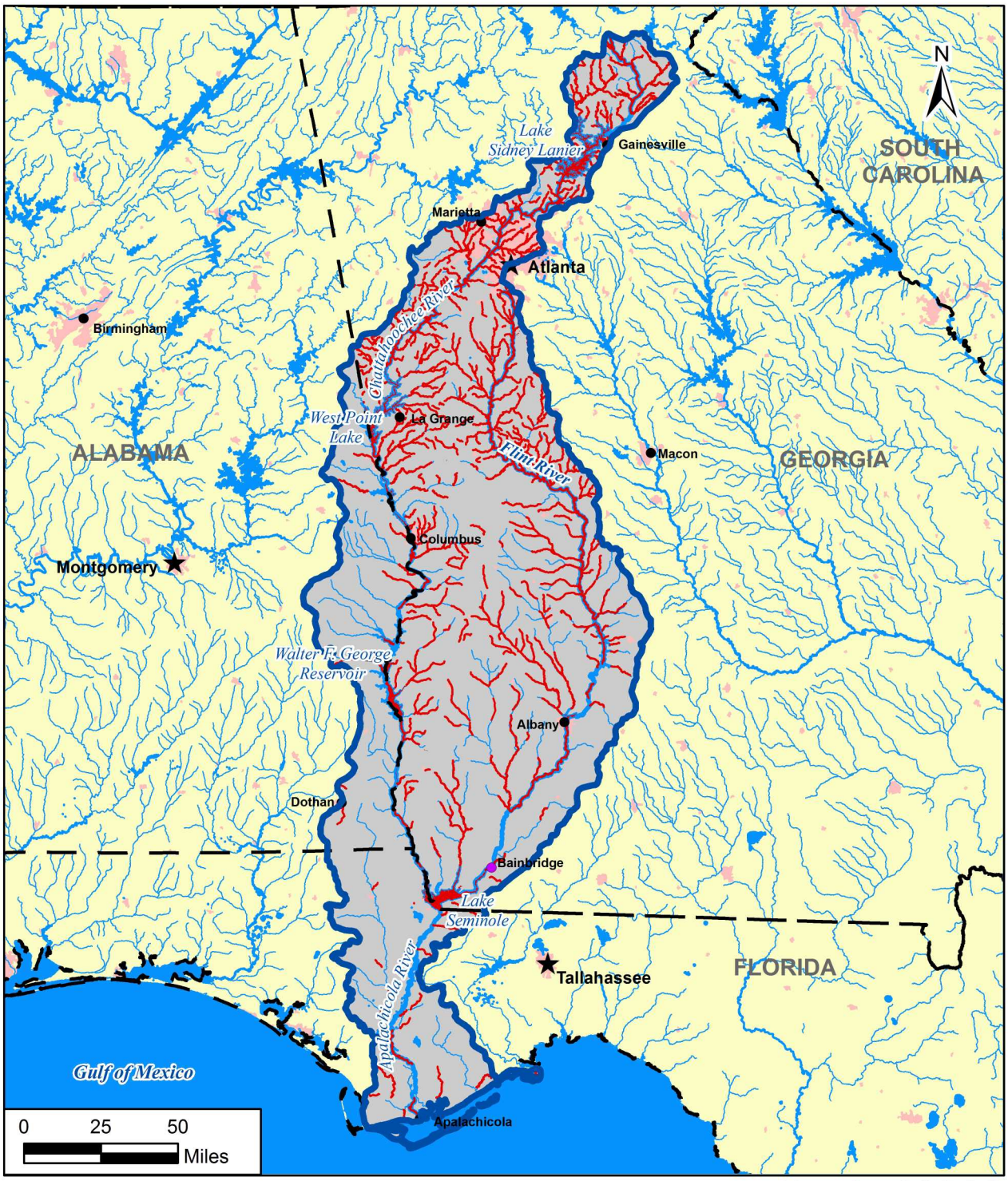
Source: USEPA 2010a
Notes:
[a.] Chlorophyll *a* is defined as corrected chlorophyll, or the concentration of chlorophyll *a* remaining after the chlorophyll degradation product, phaeophytin a, has been subtracted from the uncorrected chlorophyll *a* measurement.
[b.] For a given water body, the annual geometric mean of chlorophyll *a*, TN, or TP concentrations may not exceed the applicable criterion concentration more than once in a 3-year period.
[c.] For a given water body, the annual geometric mean of TN or TP concentrations may not exceed the applicable criterion concentration more than once in a 3-year period.
[d.] Panhandle West Region includes Perdido Bay Watershed, Pensacola Bay Watershed, Choctawhatchee Bay Watershed, St. Andrew Bay Watershed, and Apalachicola Bay Watershed. Watersheds pertaining to each Nutrient Watershed Region (NWR) were based principally on the NOAA coastal, estuarine, and fluvial drainage areas with modifications to the NOAA drainage areas in the West Central and Peninsula Regions that account for unique watershed geologies. For more detailed information on regionalization and which WBIDs pertain to each NWR, see the Technical Support Document.
[e.] Platinum Cobalt Units (PCU) assessed as true color free from turbidity.
[f.] Long-term Color ≤ 40 PCU and Alkalinity ≤ 20 mg/L $CaCO_3$.

2.1.2.3.1 Impaired Waters and Total Maximum Daily Loads

Water bodies that do not meet water quality standards on the basis of their designated use(s) are identified by states as impaired under section 305(b) of the Water Pollution Act of 1972, as amended, and by EPA under section 303(d) of the Water Pollution Act of 1972, as amended. Figure 2.1-47 shows the mainstem, major tributaries, and lakes in the ACF Basin identified as impaired on the 2012 section 303(d) list. GAEPD has developed 3-dimensional hydrodynamic and water quality models for Lake Lanier, West Point Lake, Walter F. George Lake, and Lake Seminole. These models are being used as part of the George statewide water management planning effort and the following efforts: a TMDL for Lake Lanier, comparing nutrient criteria for West Point Lake and Walter F. George Lake, and establishing nutrient criteria for Lake Seminole. Table 2.1-31 also lists the impaired water bodies. In 2010, ADEM did list Cowikee Creek from the Chattahoochee River to the end of the embayment in Walter F. George Lake as impaired for mercury in fish tissue samples from atmospheric deposition (ADEM 2010). Rivers and streams in the Chattahoochee and Flint River basins are most often impaired due to elevated fecal coliform levels, and estuaries and rivers in the Apalachicola River Basin are most often impaired due to atmospheric deposition of mercury.

TMDLs must be developed for impaired water bodies. The TMDLs identify sources of impairment, the necessary reductions to the sources, and methods to implement the reductions. Mathematical models are used to determine waste load allocation for TMDLs and recommend load reduction rates (GAEPD 2008b). Following TMDL completion, states coordinate with local governments and industries to modify NPDES permits when necessary. Historically, TMDL development in Alabama, Florida, and Georgia has been driven by lawsuits brought by environmental nonprofit organizations. Finalized TMDLs for the mainstem and major tributaries of the ACF Basin are listed in Table 2.1-32.

GAEPD and EPA have developed a number of TMDLs for legacy pollutants (PCBs) and metals (mercury), as shown in Table 2.1-32. The TMDLs were developed on the basis of human health criteria. Regulations in the 1970s stopped the use of PCBs, and current concentrations are from historical use. Sampling since the 1970s in Georgia indicates a 90 percent reduction in fish tissue concentrations of PCBs (GAEPD 2009c). The primary source of mercury in the basin is atmospheric deposition. TMDLs finalized by the GAEPD and EPA for mercury assign loads to protect public health, particularly with respect to the consumption of fish (GAEPD 2004).



LEGEND

- ACF Basin Boundary
- State Boundary
- State Capital
- City
- Urban Area
- Surface Water
- 303(d) Listed Waters

Basin 303(d) Listed Waters

Figure 2.1-47

Source: ADEM 2012a, GAEPD 2012c, USEPA OW 2014.

Table 2.1-31.
Impaired Mainstems, Major Tributaries, and Lakes in the ACF Basin (GAEPD 2012a, ADEM 2012b)

Reach name	Reach location	Violation	Potential causes	TMDL status
Upper Chattahoochee River to Whitesburg, GA				
Chattahoochee River	GA Hwy 17, Helen to SR 255	Fecal coliform, pH, affected biota (fish)	Urban runoff	Completed for fecal coliform
Chattahoochee River	SR 255 to Soquee River	Fecal coliform, pH	Nonpoint/unknown source	Completed for fecal coliform, pH deferred to EPA
Chattahoochee River	Soquee River to Mossy Creek	Fecal coliform	Nonpoint/unknown source	2007 draft
Chattahoochee River[a]	Mossy Creek to Lake Lanier	Fecal coliform	Nonpoint/unknown source	2007 draft
Chestatee River	Tate Creek to Tesnatee Creek	Fecal coliform, pH	Nonpoint/unknown source	Completed for fecal coliform, pH deferred to EPA
Chestatee River[a]	Yaholla Creek to Lake Lanier	Fecal coliform	Nonpoint/unknown source	Completed
Lake Lanier[a]	Browns Bridge Road	Chlorophyll *a*	Nonpoint/unknown source, urban runoff	
Lake Lanier[a]	Lanier Bridge Road	Chlorophyll *a*	Nonpoint/unknown source, urban runoff	
Lake Lanier[a]	Flower Branch	Chlorophyll *a*	Nonpoint/unknown source, urban runoff	
Chattahoochee River	Dick Creek to Johns Creek	pH	Nonpoint/unknown source, urban runoff	
Chattahoochee River	Johns Creek to Morgan Falls Dam	Fecal coliform, pH	Urban runoff	2007 draft for fecal coliform, pH deferred to EPA
Chattahoochee River	Morgan Falls Dam to Peachtree Creek	Fecal coliform, fish consumption (PCBs)	Urban runoff	Completed
Peachtree Creek	I-85 to Chattahoochee River	Fecal coliform	Urban runoff, combined sewer outflow	Completed
Chattahoochee River	Peachtree Creek to Utoy Creek	Temperature, fecal coliform, fish consumption (PCBs)	Combined sewer overflow, industrial facility point source, urban runoff	Completed
Sweetwater Creek	U/S Pine Valley Rd to Noses Creek	Fecal coliform	Urban runoff	Completed
Sweetwater Creek	Noses Creek to Chattahoochee River	Fecal coliform	Urban runoff	Completed
Chattahoochee River	Utoy Creek to Pea Creek	Fecal coliform, fish consumption (PCBs)	Urban runoff, combined sewer overflow	Completed
Chattahoochee River	Pea Creek to Wahoo Creek	Fecal coliform, fish consumption (PCBs)	Urban runoff	Completed
Lower Chattahoochee River to Jim Woodruff Lock and Dam				
West Point Lake[a]	Troup and Heard counties	Fish consumption (PCBs)	Nonpoint/unknown source, urban runoff	Completed
Harding Lake	Bartletts Ferry, Harris County	Fish consumption (PCBs)	Nonpoint/unknown source	Completed
Goat Rock Lake	Harris County	Fish consumption (PCBs)	Nonpoint/unknown source	Completed
Chattahoochee River	Oliver Dam to North Highlands Dam	Fish consumption (PCBs)	Urban runoff	Completed
Chattahoochee River	North Highlands Dam to Upatoi Creek	Fecal coliform, fish consumption (PCBs)	Urban runoff	Completed

Reach name	Reach location	Violation	Potential causes	TMDL status
Chattahoochee River	Upatoi Creek to Chattahoochee/ Stewart County line	Fecal coliform	Urban runoff	Completed
Chattahoochee River	Chattahoochee/ Stewart County line to Hannahatchee Creek	Fecal coliform	Nonpoint/unknown source	2007 draft
Patuala Creek	Headwaters to Clear Creek	Affected biota (fish & macroinvertebrates)	Nonpoint/unknown source	Completed for fish
Pataula Creek[a]	Hodchodkee Creek to W.F. George Lake	Fecal coliform	Nonpoint/unknown source	Completed
Mill Creek	Chattahoochee River to its source	Organic enrichment (CBOD, NBOD)	Urban development	Draft expected 2015
Uchee Creek	Chattahoochee River to County Road 39	Metals (mercury)	Atmospheric deposition	Draft expected 2020
Cowikee Creek (Walter F. George Lake)	Chattahoochee River to the end of embayment	Metals (mercury)	Atmospheric deposition	Draft expected 2020
Barbour Creek	Chattahoochee River to its source	Siltation (habitat alteration)	Agriculture	Draft expected 2015
Cedar Creek	Omusee Creek to its source	Metals (mercury)	Atmospheric deposition	Draft expected 2020
Ihagee Creek	Chattahoochee River to its source	Siltation (habitat alteration)	Land development and silviculture activities	Draft expected 2020
Moores Creek	Chattahoochee River to its source	Siltation (habitat alteration)	Land development	Draft expected 2020
Chattahoochee River	Downstream W.F. George Dam	Dissolved oxygen, fecal coliform	Dam release, nonpoint/unknown source	Completed
Flint River to Jim Woodruff Lock and Dam				
Flint River	Hartsfield Airport to Hwy 138	Fecal coliform, affected biota (macroinvertebrates)	Urban runoff	Completed for fecal coliform
Flint River	Hwy 138 to N. Hampton Road	Fecal coliform	Urban runoff	Completed
Flint River	Horse Creek to Spring Creek	Fecal coliform	Nonpoint/unknown source	
Apalachicola River Basin and Estuary				
Chipola River	Chipola River	Fish consumption (mercury)		
Apalachicola River	375 A, D-–H	Fish consumption (mercury)		
Apalachicola River	375 B	Fish consumption (mercury), bacteria (shellfish)		
Apalachicola Bay	East Bay	Fish consumption (mercury)		
Apalachicola Bay	Apalachicola Bay	Fish consumption (mercury), chlorophyll *a*, total nitrogen, total phosphorus		
Apalachicola Bay	Indian Lagoon	Fish consumption (mercury), bacteria (shellfish)		
Apalachicola Bay	Money Bayou	Fish consumption (mercury		
Apalachicola Bay	St. George Sound	Fish consumption (mercury)		
Apalachicola Bay	Gulf of Mexico	Fish consumption (mercury)		

Note:
[a] Denotes segment that directly feeds into a USACE reservoir or is in a USACE reservoir.

Table 2.1-32.
Completed TMDLs for Mainstems, Major Tributaries, and Lakes in the ACF Basin

Water body	Pollutant of concern	Percent reduction	TMDL completed
Chattahoochee River Basin, Georgia	Sediment (affecting biota)	Various (25 segments, including Lake Lanier headwater reaches), from 0 to 72%	January 2008
Chattahoochee River Basin, Georgia	Sediment (affecting biota)	Various (31 segments, including W.F. George headwater reach), from 0 to 25%	January 2003
Chattahoochee River Basin, Georgia	Copper		January 2003
Chattahoochee River Basin, Georgia	Dissolved oxygen	0% recognizing that there were no permitted sources	January 2003
Chattahoochee River Basin, Georgia	Fecal coliform	Various (79 segments, including Lake Lanier and West Point Lake headwater reaches), from 9 to 99%	November 2008
Chattahoochee River Basin, Georgia	PCBs in fish tissue	99.2%	January 2003
Upper Chattahoochee River to Whitesburg, Georgia			
Chattahoochee River at Atlanta, Georgia	Temperature	0% recognizing that wastewater temperatures do not equal or exceed allowable temperatures during July, August, and September	January 2003
Chattahoochee River Basin, Georgia	Basin sediment	Various (2 segments), 60% and 70%	February 2003
Chattahoochee River, Georgia	Mercury	Loading must be less than 2.3 kg/yr (Lake Lanier headwater)	February 2003
Chestatee River, Georgia	Fecal coliform	30% for urban areas, 99% for agricultural areas, 0% for forested areas	February 1998
Big Creek, Georgia	Fecal coliform	70% for agricultural areas, 0% for barren, urban, and forested areas	February 1998
Lower Chattahoochee River to Jim Woodruff Lock and Dam			
Flat Shoal Creek, Georgia	Fecal coliform	40% for agricultural areas, 20% for urban areas, 0% for barren and forested areas	February 1998
Hannahachee Creek, Georgia	Fecal coliform	0%	February 1998
Lake Walter F. George Lake, Georgia	PCBs	0%, no PCBs currently used in Georgia	February 1998
West Point Lake, Georgia	PCBs	0%, no PCBs currently used in Georgia	February 1998
West Point Dam, W.F. Georgia Dam	Dissolved oxygen below dams	NA, federal agencies release higher oxygenated water from dams	November 2000
Flint River to Jim Woodruff Lock and Dam			
Flint River Basin, Georgia	Sediment (biota impairment)	0%	January 2008
Flint River Basin, Georgia	Sediment (biota impairment)	Various (28 segments), 0% to 41%	January 2003
Flint River Basin, Georgia	Copper		January 2003
Flint River Basin, Georgia	DDE/DDD	99.6%	January 2003

Water body	Pollutant of concern	Percent reduction	TMDL completed
Flint River Basin, Georgia	Dissolved oxygen	Various (8 segments, including Lake Seminole headwater reaches), 0% to 67%	January 2003
Flint River Basin, Georgia	Fecal coliform	Various (6 segments), 13.5% to 73.5%	January 2008
Flint River Basin, Georgia	Fecal coliform	Various (28 segments), 1% to 96%	February 2003
Flint River Basin	Zinc		January 2003
White Oak Creek	Fecal coliform	0% baseflow, 99% storm flow	February 1998
Potato Creek	Fecal coliform	85%	February 1998
Kinchafoonee Creek	Fecal coliform	60% for agricultural areas, 0% for urban and forested areas	February 1998
Kinchafoonee Creek	Mercury	0%, from atmospheric contributions	February 2003
Chickasawakee Creek	Fecal coliform	96% baseflow, 25% agricultural areas, 50% forested, barren, and urbanized areas	February 1998
Ayocks Creek	Fecal coliform	60% for agricultural areas, 0% for barren, urban, and forested areas	February 1998
Lake Seminole	Chlordane	0%, no chlordane currently used in Georgia	February 1998
Lake Seminole	PCBs	0%, no PCBs currently used in Georgia	February 1998

When developing TMDLs for reservoirs, their tributaries, and tailwaters, the GAEPD and EPA have used dynamic mathematical models to ensure that the systems are adequately represented. The nutrient cycling in the reservoirs is dependent on point and nonpoint sources, reservoir turnover rates, and water releases from the dams. The dissolved oxygen levels and temperatures in the tailwaters of dams can also be influenced by upstream releases, and TMDLs have recommended releasing more highly oxygenated water.

2.1.2.3.2 Minimum Flow Requirements

There are state minimum flow requirements in the ACF Basin to achieve water quality standards on the Chattahoochee River at Peachtree Creek in Atlanta, Georgia, and near Phenix City, Alabama.

Five point sources discharge effluent in the Chattahoochee River near its confluence with Peachtree Creek. The combined effluent from point sources—two conventional power plants and three municipal wastewater facilities—violates Georgia water quality temperature standards (GAEPD 2003b). The temperature TMDL required that the power plants remove their discharges from the Chattahoochee River. In 2008 the facilities went to a closed current cooling system to address the TMDL (Table 2.1-20) (Blalock 2010, personal communication; PR Newswire 2008) and the two coal units were converted to natural gas in 2011 (Power Engineering 2012).

GAEPD requires an average flow of 750 cfs in the Chattahoochee River at its confluence with Peachtree Creek to maintain dissolved oxygen and temperature standards. The history of the 750 cfs minimum flow was presented in section 2.1.1.2.4.6. The normal flow target of 750 cfs is met by flows from Buford Dam as part of basin water management. Morgan Falls Dam (GPC), downstream of Buford Dam, reregulates the project inflows to ensure that the flow target at Peachtree Creek is met. GAEPD proposed that the 750 cfs flow target be removed in their 2013 triennial review. They intend to ensure water quality standards are met at all flows (GAEPD 2014).

Near Phenix City, Alabama, the MeadWestvaco Mahrt Mill facility has a discharge permit that is dependent on flows. The ADEM-issued permit requires that their discharge rate is governed by a flow formula when the flow is less than 4,000 cfs from May through October. The flow formula was set to ensure water quality standards are met in the Chattahoochee River.

2.1.2.4 Water Quality Monitoring

2.1.2.4.1 Surface Water Monitoring

Multiple federal and state laws require monitoring to ensure that water quality standards put forth by the states are being met. Most mandated water quality monitoring is conducted by local agencies and industries in accordance with NPDES permit rules and regulations. In addition to mandatory monitoring, water quality monitoring projects in the ACF Basin range in size and scope from the USGS' extensive surface water monitoring network to GAEPD's local, volunteer-staffed stream monitoring program and USACE monitoring in the tailrace of federal projects.

Several federal agencies monitor water quality within the ACF Basin. The USGS has a large network of surface water and groundwater monitoring stations through the Cooperative Water Program and coordinates its monitoring with local and state sponsors. Between 1991 and 1995, the USGS conducted intensive monitoring of groundwater chemistry and hydrology as part of the National Water Quality Assessment (NAWQA). Following completion of the intensive study, the USGS began long-term, low-intensity monitoring of the ACF NAWQA study site. USACE also monitors water quality in the tailrace of some dams (including Buford Dam, West Point Dam, and Walter F. George Dam) as a stewardship activity to monitor the fish and aquatic resource habitat downstream of reservoirs.

Georgia has several water quality sampling programs, and the data collected aids the state in making management, regulation, and water allocation decisions. Monitoring by the GAEPD includes trend monitoring, intensive surveys, reservoir and estuary monitoring, aquatic toxicity testing, and facility compliance testing (GAEPD 2008b). Georgia also requires municipalities to conduct watershed assessments when applying for NPDES permits for wastewater treatment upgrades or for construction of new wastewater treatment facilities. The watershed assessments require intense monitoring of water quality within the watershed for 1 yr to develop a watershed protection plan. Continuous, less-intense monitoring occurs in the watersheds as part of watershed protection plans.

Monitoring by other states is less extensive because the basin area within these states is 14.5 percent in Alabama and 11.5 percent in Florida. Alabama has a number of different water quality sampling programs, which focus on reservoir monitoring and trend monitoring, as well as specialty studies that address needs identified by ADEM to ensure water quality standards are met and develop wasteload allocations. The Florida DEP monitors surface water, groundwater, and trend networks on a rotating timeline. Monitoring is done to collect important information on chemical and biological parameters of the state waters and to respond to citizen concerns. More intense monitoring is conducted for regulatory issues, including the establishment of TMDLs; when developing site-specific quality criteria; and in association with regulatory permits (FLDEP 2005).

Throughout the ACF Basin, nonprofit organizations, local agencies, and industrial operations collect water quality samples to aid in management decisions and to ensure that point discharges are complying with NPDES permits. Given the size of the basin and the amount and scope of the data collected by these entities, their monitoring efforts are not detailed in this report. Information on some point sources and monitoring efforts is detailed in a number of TMDLs developed for the ACF Basin.

GAEPD monitors reservoirs in the ACF Basin to ensure compliance with water quality standards. It has developed site-specific water quality standards for chlorophyll *a*, total nitrogen, total phosphorus, and pH

for Lake Lanier, West Point Lake, and Walter F. George Lake (Table 2.1-29). The lakes are sampled by the GAEPD during the growing season, April to October, when primary productivity is highest. In addition to the four above-mentioned parameters, the GAEPD collects data on dissolved oxygen, temperature, specific conductance, Secchi depth transparency, and turbidity. The GAEPD samples all other lakes in the ACF Basin quarterly on a 3-yr rotation basis (GAEPD 2008b).

Nonprofit organizations and universities also monitor lakes within the ACF Basin. The Upper Chattahoochee Riverkeeper works in conjunction with the GAEPD to monitor Lake Lanier and samples at 10 locations during the growing season for chlorophyll *a* and other standard water quality parameters. The Lake Blackshear Watershed Association released a report in 2002 detailing water quality and the trophic state of Lake Blackshear. Regular monitoring of temperature and dissolved oxygen at 21 stations has been conducted by Weyerhaeuser, a paper company, since the mid-1980s. Nutrient concentrations are also occasionally collected. Researchers at Auburn University in Auburn, Alabama, monitored fisheries, phytoplankton, and physical and chemical characteristics in a detailed study of West Point Lake from 1976 to 1985.

2.1.2.4.2 Groundwater Monitoring

In Alabama, Florida, and Georgia, groundwater quality monitoring occurs as part of required monitoring at potential contamination sites and as part of Safe Drinking Water Act requirements. Each state has a groundwater monitoring network.

Several national laws and programs require continuous groundwater quality monitoring. Such monitoring is required for NPDES permittees that have the potential to degrade groundwater, such as land application systems, underground storage tanks, and concentrated animal feeding operation lagoons. Permittees self-monitor the groundwater and report the findings to the states, and the states review the data and periodically sample the wells themselves. As part of the Safe Drinking Water Act, public drinking water wells are monitored, along with wells at permitted facilities, for pollutants such as volatile organic compounds, which come from businesses, homes, and agriculture. Public water supply systems are monitored for nitrate-nitrite, volatile organic compounds, uranium, copper and/or lead, and iron, manganese, and aluminum.

The Georgia Groundwater Monitoring Network (GGMN), managed by the GAEPD, consists of more than 130 wells, which are sampled periodically. Intensive monitoring of Georgia's groundwater occurred between 1991 and 1995, and it included sampling more than 5,000 shallow domestic wells for concentrations of nitrate-nitrite and additional standard parameters. Smaller subsets of wells within the GGMN are sampled as part of specialized projects that monitor drinking water wells for pesticides and nitrates and monitor groundwater near potential contamination sources (GAEPD 2008b).

Monitoring is focused on groundwater within the Apalachicola Basin and within the estuary. Florida established its Ground Water Quality Monitoring Network (GWQMN) in 1983 to monitor the chemical and physical characteristics of aquifers. Monitoring is coordinated by the Florida DEP, and federal and state agencies, such as Florida's water management districts, are involved. The GWQMN is composed of two networks—the Background Network of 1,700 wells and the Very Intense Study Area (VISA) Network. Data for the Background Network were collected from 1994 to 1997 and established baseline water quality data for groundwater for major ions, nutrients, and trace metals. A total of 40 wells were installed in the Apalachicola Basin (FLDEP 2010).

Along with standard chemical parameters, the VISA Network collects data on pesticides, trace metals, volatile organic compounds, and base neutral acid extractables in urban, agricultural, and forested land use areas. The resulting data are statistically compared to data from the Background Network to determine the effects of land use and site hydrogeology on the groundwater quality. On the basis of the

results of the latter analyses, predictions are made regarding the effects of comparable land uses in hydrogeologically similar areas of the state. The VISA Network study site in the Apalachicola River Basin examines the impact of cropland agriculture (FLDEP 2010).

2.1.2.4.3 Estuarine Monitoring

Water quality monitoring in Apalachicola Bay is conducted through the ANERR and Apalachicola Preserve. All levels of government are actively involved, along with private organizations and individuals. The data collected help ensure that the bay is meeting all water quality designations, including Outstanding Florida Water and Class II Shellfishing.

ANERR is one of 25 NOAA-designated research reserve sites. The 246,766 ac reserve includes estuaries, barrier islands, riverine systems, floodplains, and upland systems. In addition to routine water quality monitoring, the ANERR collects data on fecal coliform, sediment erosion and accretion rates, and fish and macroinvertebrate populations. Research and monitoring in the ANERR are conducted by multiple organizations at the federal, state, and local level, including the USFWS, NWFWMD, and several local universities.

The ANERR water quality data are collected using data loggers at four water quality stations within Apalachicola Bay since 2002. The data loggers record temperature, depth, salinity, pH, dissolved oxygen, and turbidity every 15 minutes since 1993. The data are transmitted to the NERRS Centralized Data Management Office every 2 to 3 hours for compilation and analysis. Monthly nutrient grab samples are collected at 11 stations and analyzed for concentrations of nitrate-nitrite, ammonium, total dissolved nitrogen, orthophosphate, total dissolved phosphate, and chlorophyll *a*. Nutrient samples are collected over a 24-hour period to determine the impacts of tidal cycles and diurnal variations on estuarine nutrient concentrations.

The Florida DEP manages the 80,000-ac Apalachicola Preserve, within the ANERR. Because most research and monitoring projects within the preserve are conducted by the ANERR, projects undertaken by the Florida DEP are focused on specific Apalachicola Bay management issues. Monitoring projects, which are conducted by both state and local entities, include periodic water sampling by the Florida Department of Agriculture for consumption of shellfish and data collection on toxic *red tide* algae blooms by the Apalachicola Riverkeeper. The Apalachicola Bay is classified as Class II Shellfish Propagation and Harvesting and as Class III Recreation, Propagation, and Maintenance of Wildlife. Most of the bay is listed as Class II water. Areas near the Gulf of Mexico do not meet the Class II water quality standards because of point and nonpoint source runoff from the city of Apalachicola, and they are closed to shellfishing (FLDEP 1998).

2.1.2.5 Point Sources

Point source permitting has historically identified pipe discharges from M&I sources. In the late 1990s, the NPDES began to enforce its stormwater program by regulating stormwater discharges from municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. This program has changed the traditional definition of *point source*. The change allows regulators more authority over pollutants, ultimately resulting in improved water quality. Major M&I dischargers regulated under the NPDES program and discharging to the mainstem of the ACF Basin are listed in Table 2.1-33. *Major point sources* are defined as those that discharge more than 1 mgd of wastewater to surface waters.

Table 2.1-33.
2009 M&I NPDES Facilities in the ACF Basin[a]

Permit #	Facility	Receiving waters	Design flow (mgd)	DO (mg/L)	BOD5 (mg/L)	ON (mg/L)	NH3 (mg/L)	NO3/NO2 (mg/L)	Total P = PO4 (mg/L)
Upper Chattahoochee River to Whitesburg, GA									
GA0020168	Gainesville - Linwood WPCP	Lake Lanier	3	2	30/45	2	17.4/26.1	10	0.7
GA0021156	Gainesville - Flat Creek WPCP	Lake Lanier	12	5	9.8/14.7	2	1.5/2.3	10	0.68/1.02
GA0021504	Cornelia WPCP	So Fork-Mud Cr	3	6	25/38	2	1.5/2.3	10	0.7
GA0026077	Dahlonega WPCP	Yahoola Cr to Chestatee River	1.44	2	30/45	2	8/12	10	0.7
GA0001074	Tyson Foods Inc.	Unnamed trib/Orr's Creek	1.5	5	10	2	2	10	.75
GA0001198	USAF Lockheed (Plant No. 6)	Nickajack Cr/Rottenwood Cr/ Poorhous	2	5	10	2	2.3	10	.75
GA0001198	USAF Lockheed (Plant No. 6)	Nickajack Cr/Rottenwood Cr/ Poorhous	2	5	10	2	2.3	10	.75
GA0001198	USAF Lockheed (Plant No. 6)	Nickajack Cr/Rottenwood Cr/ Poorhous	2	5	10	2	2.3	10	.75
GA0001198	USAF Lockheed (Plant No. 6)		2	5	10	2	2.3	10	.75
GA0001198	USAF Lockheed (Plant No. 6)	Nickajack Cr/Rottenwood Cr/ Poorhous	2	5	10	2	2.3	10	.75
GA0001198	USAF Lockheed (Plant No. 6)	Nickajack Cr/Rottenwood Cr/ Poorhous	2	5	10	2	2.3	10	.75
GA0021458	Atlanta - Utoy Creek WPCP		37	5	24.8/37.2	2	16.5/24.7	10	0.7
GA0021482	Atlanta - R.M. Clayton WPCP	SE/Chattahoochee	100	5	25.2/37.8	2	16.8/25.2	10	0.7
GA0023167	Buford - Southside WPCP	Suwanne Cr	2	5	18/27	2	5/7.5	10	.75/1.1
GA0024040	Atlanta - South River WPCP	Chattahoochee	41	5	25.5/38.3	2	17/25.5	10	0.7
GA0024333	Fulton County - Big Creek WPCP	Chattahoochee	24	5	9.1/13.6	2	1.4/2.1	10	.75
GA0025381	Fulton County - Camp Creek WPCP	Chattahoochee	13	7	10/15	2	2/3	10	.3
GA0026140	Cobb County - R.L. Sutton WPCP	Chattahoochee	40	5	10/15	2	9.1/13.7	10	.75
GA0026158	Cobb County - South WPCP	Chattahoochee	40	5	15/22.5	2	10.3/15.5	10	.75
GA0026433	Gwinnett County - Crooked Creek/North WPCP	Chattahoochee	36	5	3.4/5.1	2	1.1/1.65	10	.75
GA0030341	Douglasville - Southside WPCP	Anneewakee Cr/ Chattahoochee	3.75	2	30/45	2	6.6/9.9	10	.75
GA0030686	Fulton County - Johns Creek WRF	Chattahoochee	7	5	20/30	2	7.8/11.7	10	.75
GA0031721	Newnan - Wahoo Creek WPCP	Unnamed tributary to Wahoo Cr	3	2	30/45	2	5.6/8.4	10	0.7

Permit #	Facility	Receiving waters	Design flow (mgd)	DO (mg/L)	BOD5 (mg/L)	ON (mg/L)	NH3 (mg/L)	NO3/NO2 (mg/L)	Total P = PO4 (mg/L)
GA0038440	Fulton County - Cauley Creek WRF	Cauley Cr/ Chattahoochee	5	7	2.9/4.3	2	.5/.75	10	.13/.1
GA0038709	Douglasville Douglas County - South Central WPCP		6	5	10	2	5	10	0.7
GA0046019	Cumming - Bethelview Road WPCP	Big Cr	2	5	18/27	2	5/7.5	10	.75/1.12
GA0047201	Douglasville Douglas County - Sweetwater WPCP	Chattahoochee	3	5	20/30	2	17/25.5	10	0.75
Lower Chattahoochee River to Jim Woodruff Lock and Dam									
AL0000817[b]	MeadWestvaco Coated Board	Chattahoochee (WFG Lake)	29.7[c]	5	10	2	5	10	0.7
AL0022209[b]	Phenix City WWTP	Chattahoochee	7.75[c]	6	19/28.5-Summer 25/37.5-Winter	2	4/6-Summer 20/30-Winter	10	0.7
AL0022764[b]	City of Dothan (Omussee Ck WWTP)	Omussee Creek	7.12[c]	6	3.5/5.2	4/6[d]	1/1.5	10	0.7
AL0023159[b]	City of Lanett WWTP	UT to Chattahoochee River	2.5[c]	6	25/37	2	20/30	10	0.7
AL0024619[b]	Southern Nuclear Operating Company		106.8[c]	5	30/45	2	5	10	0.7
AL0024724[b]	East Alabama WWTP (Lower Valley WTP)	Chattahoochee (Lake Seminole)	4[c]	2	25/37.5	2	20/30	10	0.7
AL0059218	Opelika Eastside WWTP	Unnamed Trib to Halawaka Cr	1	6	9/13.5	2	2/3	10	0.7
AL0061671[b]	City of Eufaula WWTP	Chattahoochee	2.7[c]	5	25/37.5	2	20/30	10	0.7
AL0065641	Mount Vernon Chemical, LLC	UT Halawaka Cr	Not reported	5	10	2	5	10	0.7
AL0068837	AL-GA Wood Preserving	UT Finley Cr	Not reported	5	10	2	5	10	0.7
AL0070912	Tri-State Plant Food	Poplar Springs Branch	Not reported	5	10	2	5	10	0.7
AL0071978	Tessenderlo Kerley, Inc.	Barbour Creek	Not reported	5	10	2	10	10	0.7
AL0073555	Southern Power Company	Chattahoochee	1.68	5	10	2	5	10	0.7
AL0077259	Prince Manufacturing	UT Busseys Lake	Not reported	5	10	2	5	10	0.7
GA0000973	Columbus - Fort Benning (WPCP 1)	Chattahoochee	4.6	2	30/45	2	17.4/26.1	10	0.7
GA0000973	Columbus - Fort Benning (WPCP 2)	Chattahoochee	4.6	2	30/45	2	17.4/26.1	10	0.7
GA0020052	West Point WPCP	Chattahoochee	1	2	30/45	2	17.4/26.1	10	0.7
GA0020516	Columbus - South WPCP	Chattahoochee	42	2	10	2	5	10	0.7
GA0025585	Blakely WPCP		1.315	5	20/30	2	1.3/1.95	10	0.7
GA0036951	LaGrange - Long Cane Creek WPCP	Chattahoochee	12.5	6	10/15	2	2/3	10	1/1.5
GA0001201	Georgia Pacific - Great Southern Paper	Chattahoochee	Not reported	5	10	2	5	10	0.7

Permit #	Facility	Receiving waters	Design flow (mgd)	DO (mg/L)	BOD5 (mg/L)	ON (mg/L)	NH3 (mg/L)	NO3/NO2 (mg/L)	Total P = PO4 (mg/L)
Flint River to Jim Woodruff Lock and Dam									
GA0020079	Thomaston - Bell Creek WPCP	Bell Cr	2	2	30/45	2	5.4/8.1	10	0.7
GA0020486	Montezuma WPCP #2	Spring Cr/ Downstream of Drayton Rd.	1.95	5	20/30	2	4/6	10	0.7
GA0024503	Cordele WPCP	Cum Cr Trib to Flint River	5	6	11/16.5	2	2/3	10	0.7
GA0030121	Thomaston - Town Branch WPCP	Potato Cr Trib to Flint River	2	2	26/39	2	17.4/26.1	10	0.7
GA0030791	Griffin - Potato Creek WPCP	Potato Cr/Flint River	2	2	30/45	2	17.4/26.1	10	0.7
GA0035777	Peachtree City - Line Creek WPCP	Line Cr Trib/Flint River	2	6	8/12	2	2/3	10	0.7
GA0035807	Fayetteville - Whitewater Creek WPCP	Whitewater Cr/Line Cr	3.75	6	10/15	2	2/3	10	0.7
GA0038369	Clayton County - Shoal Creek WPCP	002-Unnamed Trib to Flint	4.4	5	10/15	2	4/6	10	2/3
GA0046655	Peachtree City - Rockaway WPCP	Line Cr Trib to/Flint River	4	6	8/12	2	2/3	10	0.7
GA0049336	Weyerhauser Company - Flint River Operations	Flint River	10	5	10	2	5	10	0.7
GA0000817	Tyson Foods Inc.	Muckalee Cr	1.15	5	10	2	5	10	0.7
GA0001619	Merck Manufacturing Division - Flint River Plant	Flint River	1.7	5	10	2	5	10	0.7
GA0001619	Merck Manufacturing Division - Flint River Plant	Flint River	1.7	5	10	2	5	10	0.7
GA0021326	Dawson WPCP	Brantley Cr	2.5	5	15/23	2	2/3	10	0.7
GA0024678	Bainbridge WPCP	Flint River	2.5	2	30/45	2	17.4/26.1	10	0.7
GA0025399	Crisp County Power Commission[e]	Lake Blackshear	4.8	5	10	2	5	10	0.7
GA0033511	Decatur County Industrial Airpark WPCP	Flint River	1.5	2	25/38	2	10/15	10	0.7
GA0037222	Albany - Joshua Street WPCP	Flint River	32	5	30/45	2	17.4/26.1	10	0.7
GA0047767	Americus - Mill Creek WPCP	Muckalee Cr Trib/Flint River	4.4	5	25/38	2	8.7/13.1	10	0.7
GA0049093	Miller Breweries East Inc.	Flint River	1.7	5	10	2	5	10	0.7
GA0049093	Miller Breweries East Inc.	Flint River	1.7	5	10	2	5	10	0.7
	= not permitted values but assumed for modeling purposes								

Notes:

[a]Includes discharges permitted at greater than 1 mgd.

[b] Includes design flows and permit limits based on personal communication with ADEM (Minton 2014, personal communication).

[c]Assumes design flow for municipal WWTPs, long-term average for industrial and municipal WTPs.

[d] Organic nitrogen permit limit was computed using the difference between total kjehldahl nitrogen and ammonia.

[e]Assumes Crisp County Power Commission discharges into Flint below Lake Blackshear.

Facilities with NPDES permits are required to submit discharge monitoring reports (DMRs) to the ADEM, the Florida DEP, and GAEPD to ensure compliance with their NPDES permits. The limits expressed in NPDES permits are determined by states through the development of wasteload allocations. Wasteload allocations are developed to ensure facilities meet the in-stream water quality standards, as described in section 2.1.2.3, *Water Quality Standards*. Standard methods are used to develop wasteload allocations for individual dischargers when the facilities request new permits or changes to their existing permits. Table 2.1-33 identifies the 2009 permit limits for facilities that discharge to streams in the ACF Basin and 2012 permit limits for six Alabama facilities.

As previously described, regulations are changing to quantify stormwater runoff under the NPDES stormwater program for MS4s, construction activities, and industrial activities. The NPDES stormwater program was implemented in two phases on the basis of population. In 1990, cities and certain counties with over 100,000 residents were defined under the Phase I program; in 1999, Phase II established regulations for smaller cities. The details of the regulatory requirements are provided online at EPA's NPDES Stormwater Basic Information Web page (USEPA 2009a).

Regulations for construction activities require construction sites with more than 1 ac of disturbed area to obtain an NPDES permit and implement best management practices to prevent erosion of the disturbed areas. Regulations for industrial facilities require an NPDES permit for activities where pollutants might be transported to storm sewers or surface water. MS4s include municipal stormwater conveyance systems and, in some cases, roadways. Areas identified under the Phase I program are covered by individual NPDES permits (Table 2.1-34). In Alabama, Phase II communities and roadway MS4s are also covered under individual permits; in Georgia, however, Phase II communities are covered under a general permit, as shown in Table 2.1-35. In Florida in the ACF Basin, as of 2010, only the Department of Transportation (FLR04E023) and a small portion of the Bay County (FLR04E054) Phase II MS4 permitted area are permitted. All of these sources have been identified as major stressors on aquatic resources causing impairment to surface waters. The regulations are decreasing the amount of pollutants entering storm sewers and surface waters, but enforcement is limited.

2.1.2.6 Nonpoint Sources

Nonpoint sources of pollution are those generally associated with and quantified by land use activities in watersheds. Water quality concerns from nonpoint sources are usually related to fecal coliform bacteria, metals, nutrients (including biochemical oxygen demand, nitrogen, and phosphorus), pesticides, and suspended solids from overland and in-stream erosion. The sources of these pollutants are associated with runoff from areas and activities not regulated by the NPDES program. These activities are usually associated with agricultural, forested, and urban land use activities. Table 2.4-1 and Figure 2.4-1 in section 2.4 present the land use activities in the ACF Basin.

Pollutant loads from agricultural, forested, and urban land use activities have been quantified though the development of TMDLs (section 2.1.2.3.1) and the Georgia state water plan in the ACF Basin. The extensive work done by a number of agencies can be consulted to quantify loads from land use activities in the basin. The variability in concentrations of a pollutant can be accounted for through understanding current and historical land use activities, along with the properties of soils and local geology.

Historically, agricultural lands have been a major source of sediment to water bodies. However, there has been a decrease in the amount of land farmed in the ACF Basin over the last century. In portions of the basin located in Georgia, a 57 percent reduction of farmland has occurred since 1950 (GAEPD 2009c). A decrease in soil erosion has been associated with the reduction in land farmed.

Table 2.1-34.
Phase I Municipal Separate Storm Sewer Systems in the ACF Basin
(GAEPD 2007a, GAEPD 2007b)

Permit number	Permittee
Upper Chattahoochee River to Whitesburg, GA	
GAS000300	Forsyth County
GAS000104	Buford
GAS000118	Gwinnett County
GAS000135	Sugar Hill
GAS000144	Suwanee
GAS000102	Alpharetta
GAS000138	Berkeley Lake
GAS000122	Lawrenceville
GAS000112	Duluth
GAS000131	Roswell
GAS000127	Norcross
GAS000111	DeKalb County
GAS000105	Chamblee
GAS000113	Doraville
GAS000117	Fulton County
GAS000100	Atlanta
GAS000108	Cobb County
GAS000125	Marietta
GAS000132	Smyrna
GAS000110	Decatur
GAS000109	College Park
GAS000114	East Point
GAS000116	Forest Park
GAS000115	Fairburn
GAS000136	Union City
GAS000128	Palmetto
Lower Chattahoochee River to Jim Woodruff Lock and Dam	
GAS000202	Columbus-Muscogee County
Flint River to Jim Woodruff Lock and Dam	
GAS000117	Fulton County
GAS000100	Atlanta
GAS000116	Forest Park
GAS000119	Hapeville
GAS000107	Clayton County
GAS000141	Lake City
GAS000126	Morrow
GAS000130	Riverdale
GAS000120	Jonesboro
GAS000142	Lovejoy

Table 2.1-35.
Phase II Municipal Separate Storm Sewer Systems in the ACF Basin
(GAEPD 2007c; Minton 2014, Personal Communication)

Permit number	Permittee
Upper Chattahoochee River to Whitesburg, GA	
GAG6100000	Hall County
GAG6100000	Flowery Branch
GAG6100000	Gainesville
GAG6100000	Oakwood
GAG6100000	Cumming (Forsyth County)
GAG6100000	Mountain Park (Fulton County)
GAG6100000	Sandy Springs (Fulton County)
GAG6100000	Paulding County
GAG6100000	Dallas
GAG6100000	Hiram
GAG6100000	Douglas County
GAG6100000	Douglasville
Lower Chattahoochee River to Jim Woodruff Lock and Dam	
ALR040002	ALDOT-Statewide
ALR040003	City of Auburn
ALR040007	City of Dothan
ALR040010	Geneva County
ALR040012	Lee County
ALR040018	City of Opelika
ALR040019	Phenix City
ALR040027	Houston County, City of Rehobeth, City of Taylor
ALR040028	Russell County
ALR040036	Smith Station
ALS000006	Alabama Department of Transportation Statewide
Flint River to Jim Woodruff Lock and Dam	
GAG6100000	Henry County
GAG6100000	Hampton
GAG6100000	McDonough
GAG6100000	Stockbridge
GAG6100000	Fayette County
GAG6100000	Fayetteville
GAG6100000	Peachtree City
GAG6100000	Tyrone
GAG6100000	Coweta County
GAG6100000	Newnan
GAG6100000	Spalding County
GAG6100000	Griffin
GAG6100000	Peach County
GAG6100000	Byron
GAG6100000	Houston County
GAG6100000	Centerville
GAG6100000	Warner Robbins
GAG6100000	Lee County
GAG6100000	Leesburg
GAG6100000	Dougherty County
GAG6100000	Albany
GAG6100000	Cordele (Crisp County)

Urban activities in the ACF Basin, however, fall under both nonpoint and point sources as MS4 areas. Characterizing urban activities as point sources rather than nonpoint sources of pollution has allowed for improved regulatory authority over surface overland runoff from parking lots, as well as improved education on land use management to decrease pollutants (such as fertilizers and pesticides) entering surface water bodies. Regulation and enforcement of best management practices on construction sites have also decreased the amount of overland erosion and siltation and, thereby, the amount of solids entering surface water bodies.

2.2 Geology and Soils

2.2.1 Geology Affected Environment

The ACF Basin is divided into four level III *ecoregions*, or areas with similar physical, chemical, and biological environmental attributes that are identifiable at a local scale such that specific environmental management strategies can be formulated. All levels of government and research organizations use the ecoregions as the spatial framework for research and policy decisions, including the development of site-specific water quality standards and stream pollutant loads. A Roman numerical classification was set up to decrease confusion about the level of detail provided, where level I is the coarsest level, dividing North America into 15 ecological regions, and level IV to further define attributes that are identifiable at a local scale. The four ecoregions in the ACF Basin are the Blue Ridge, Piedmont, Southeastern Plains, and Southern Coastal Plain (Figure 2.1-8). These ecoregions reflect a geologic history of mountain-building in the Appalachian Mountains and long periods of repeated land submergence in the Coastal Plain ecoregion.

2.2.1.1 Blue Ridge and Piedmont Ecoregions

In the ACF Basin, the Blue Ridge ecoregion is limited to the northernmost portion of the basin and composes only about 1 percent of its area. The headwaters of the Chattahoochee River originate in this area, north of Lake Lanier. The ecoregion is characterized by mountain ridges that range in altitude from 3,000 ft and to 3,500 ft (Chapman and Peck 1997a; USGS 1996). Relative to other ecoregions in the ACF Basin, the soils are shallow and poorly developed. Runoff in the Blue Ridge ecoregion is rapid because the steep terrain sheds water quickly and the shallow soils do not store large quantities of water. The average runoff ranges from 15 to 40 in/yr (GAEPD 1997).

The Piedmont ecoregion, also in the northern portion of the basin, is directly south of the Blue Ridge. A sharp change in altitude, approximately 1,700 ft, defines the boundary between the Blue Ridge and Piedmont ecoregions (GAEPD 1997). The Piedmont has a lower relief than the Blue Ridge and is dominated by highly dissected, rolling hills. The fault zones of the rocks, at the boundaries of the rock groups, run northeast to southwest and wield geologic control of the rivers and streams in the Upper Chattahoochee River basin. The Chattahoochee River runs parallel to the Brevard fault, and most streams have trellised and rectangular drainage patterns due to fault lines.

Both the Blue Ridge and Piedmont ecoregions are underlain by Precambrian and Paleozoic crystalline rocks, which include mica schist, felsic gneiss and schist, and granite and granite gneiss. Less extensive outcrops of quartzites are also present in the upper portion of the Flint River Basin, and ridges of quartzite rise 300 to 400 ft above the Piedmont relief (Chapman and Peck 1997b). The parent rock is typically covered by a layer of weathered rock and soil (regolith), which can range in thickness from a few feet to more than 150 ft. From the land surface, the regolith zone consists of a porous and permeable zone that grades downward into a clay-rich, relatively impermeable zone that overlies or grades into a porous and permeable saprolite known as a transition zone. Beneath the transition zone is impermeable unweathered bedrock, characterized by faults and fractures.

2.2.1.2 Southeastern Plain and Southern Coastal Plain Ecoregions

The northern boundary of the Southeastern Plain is marked by the Fall Line, which generally follows the contact between the crystalline rocks of the Piedmont and the unconsolidated sediments of the Southeastern Plains. The geology consists of the surficial sediments, which are predominantly sands of the Pliocene, Cretaceous, and Tertiary ages. Streams undergo abrupt changes in gradient at the Fall Line, which is marked by a series of rapids and shoals. In the Southeastern Plain, the streams typically lack the riffles and shoals common to streams in the Piedmont, and they exhibit greater floodplain development and increasing sinuosity (USGS 1996).

Within the ACF Basin, the Southeastern Plain ecoregion is divided into two main areas: a hilly region immediately below the Fall Line composed of the Fall Line Hills and Southern Red Hills ecoregions, and a region of karst topography area known as the Dougherty Plain ecoregion (Griffith et al. 2001). The Hills ecoregions are characterized by flat to moderately rolling sandy uplands dissected by deeply entrenched streams. The topographic relief ranges from 50 to 250 ft (Griffith et al. 2001). Cretaceous sediments lie in a band immediately below the Fall Line and crop out into the younger Eocene-Paleocene sediments of the low-lying Dougherty Plain ecoregion. The Dougherty Plain, directly south of the Hills, gently slopes southward; the relief rarely exceeds 20 ft. The karst topography has numerous sinkholes of varying size and is well-connected to surface water in some areas (Hicks et al. 1987).

The Southern Coastal Plains are sandy and flat, and they slope toward the sea. The area was shaped mostly by wave and current activity during the Pleistocene era (Arthur and Rupert 1989). The land surface is characterized by ancient marine bars, spits and sand-dunes, and marine terraces. Soils in the area are generally hydric and have a high capacity to hold and store water. The sediments that form the major aquifers in the lower ACF Basin occur in an overlapping sequence toward the southeast, roughly parallel to the Fall Line, and thicken toward the south and southeast. In this sequence, progressively younger sediments crop out and cover the older units.

The relationship between geology, and streams and aquifers is described in more detail in sections 2.1.1.1.3 and 2.1.1.1.7, respectively.

2.2.2 Soils Affected Environment

2.2.2.1 Soil Types

The sediments that are transported by the streams and deposited in the reservoirs of the ACF Basin originate as soils throughout the watershed. The different soils in the watershed have a variety of compositions and differing proportions of rocks, sand, silt, and clay. Within the ACF Basin, three different soil orders make up most of the soils: ultisols, entisols, and spodosols (USGS 1996).

- *Ultisols* are characterized by sandy or loamy surface horizons overlying loamy or clayey subsurface horizons. These soils are formed in place through the deep long-term weathering of parent igneous and metamorphic bedrock. Although commonly called *red clay soil,* these soils range in color from bright orange to pale yellow-brown.
- *Entisols* are characterized as sandy, deep, infertile, well-drained, and subject to active erosion. These soils show poorly developed subhorizons and are called *young* because little change is exhibited from the parent material.
- *Spodosols* in the ACF Basin are characterized as sandy, shallow, infertile, and poorly drained due to an underlying layer cemented by mineral precipitation.

The Piedmont ecoregion is dominated by ultisols, which generally lack the original topsoil due to erosion during intensive cotton farming beginning in the 18th century (USGS 1996). The soils of the Coastal Plain ecoregion are formed from marine sediments eroded from the Appalachian range and Piedmont. These soils are primarily ultisols with the exception of entisols immediately south of the Fall Line and along the lower Flint River Basin. The soils of the ACF Basin in the Southern Coastal Plain are dominated by ultisols to the west of the Apalachicola, spodosols to the east, and entisols near the coast (Collins 2009).

2.2.2.2 Hydraulic Conductivity

The portions of precipitation that either run off the landscape or infiltrate the soil are regulated by the ability of soil layers to infiltrate water. This infiltration ability is expressed as the *hydraulic conductivity* of the least pervious soil layer in a soil profile. For use in hydrologic runoff calculations, the many different soil types in a watershed are typically classified into one of four hydrologic groups—A, B, C, or D—on the basis of hydraulic conductivity, expressed in inches per hour (Table 2.2-1). Infiltration ability can also be affected by the proximity of the water table to the ground surface. If a D group soil has a higher hydraulic conductivity when drained, it is given a dual group name (Table 2.2-1). The Disturbed Soil classification is used for soils with hydraulic conductivities that might have become altered during land development; such soils need to be directly tested to determine their hydrologic soil groups (NRCS 2009).

Table 2.2-1.
Hydraulic Conductivities of the Hydrologic Soil Groups

Hydrologic soil group	Hydraulic conductivity (in/hr)	Runoff potential when thoroughly wet
A	Greater than 5.67	Low
B	1.42 to 5.67	Moderately Low
C	0.14 to 1.42	Moderately High
D	Less than 0.14	High
Disturbed Soil	N/A	N/A
A/D, B/D, C/D	D group soil, but drainable to the greater conductivity	High when undrained

Source: NRCS 2009

The soil groups can also be described qualitatively:

- *Group A soils* are typically less than 10 percent clay and more than 90 percent sand or gravel, with textures described as a sand, gravel, or loam.
- *Group B soils* are typically 10 to 20 percent clay and 50 to 90 percent sand, with textures typically described as a loamy-sand.
- *Group C soils* are typically 20 to 40 percent clay and less than 50 percent sand, with textures that include loam plus sand, silt, and/or clay.
- *Group D soils* are typically greater than 40 percent clay and less than 50 percent sand and are described as having a clayey texture.

Also, a soil is classified as group D if the water table is within 2 ft of the surface. If a sandy or loamy soil overlying a high water table can be drained, the soil is given the dual classification A/D, B/D, or C/D.

Trends in the occurrence of the soil hydrologic groups are noted among the four ecoregions of the ACF Basin (Figure 2.2-1). North of the Fall Line, within the Piedmont and Blue Ridge ecoregions, the soils are over 90 percent group B. The Coastal Plain Ecoregion is composed of about 50 percent group B soils. The remainder consists of about 27 percent group A, 19 percent group C, and the rest groups D and B/D. No A/D or C/D soils were shown in the State Soil Geographic (STATSGO) soil data set for the ACF Basin (NRCS 2014). The group A soils occur primarily in a band south of the Fall Line and in the karst uplands along the lower Flint River valley. The group D soils primarily follow the valleys of the first- and second-order tributaries draining to the Flint River. The B/D soils are primarily found in Florida in the Southern Coastal Plain Ecoregion and along the valleys of first- and second-order tributaries to the Flint River between the Fall Line and Albany.

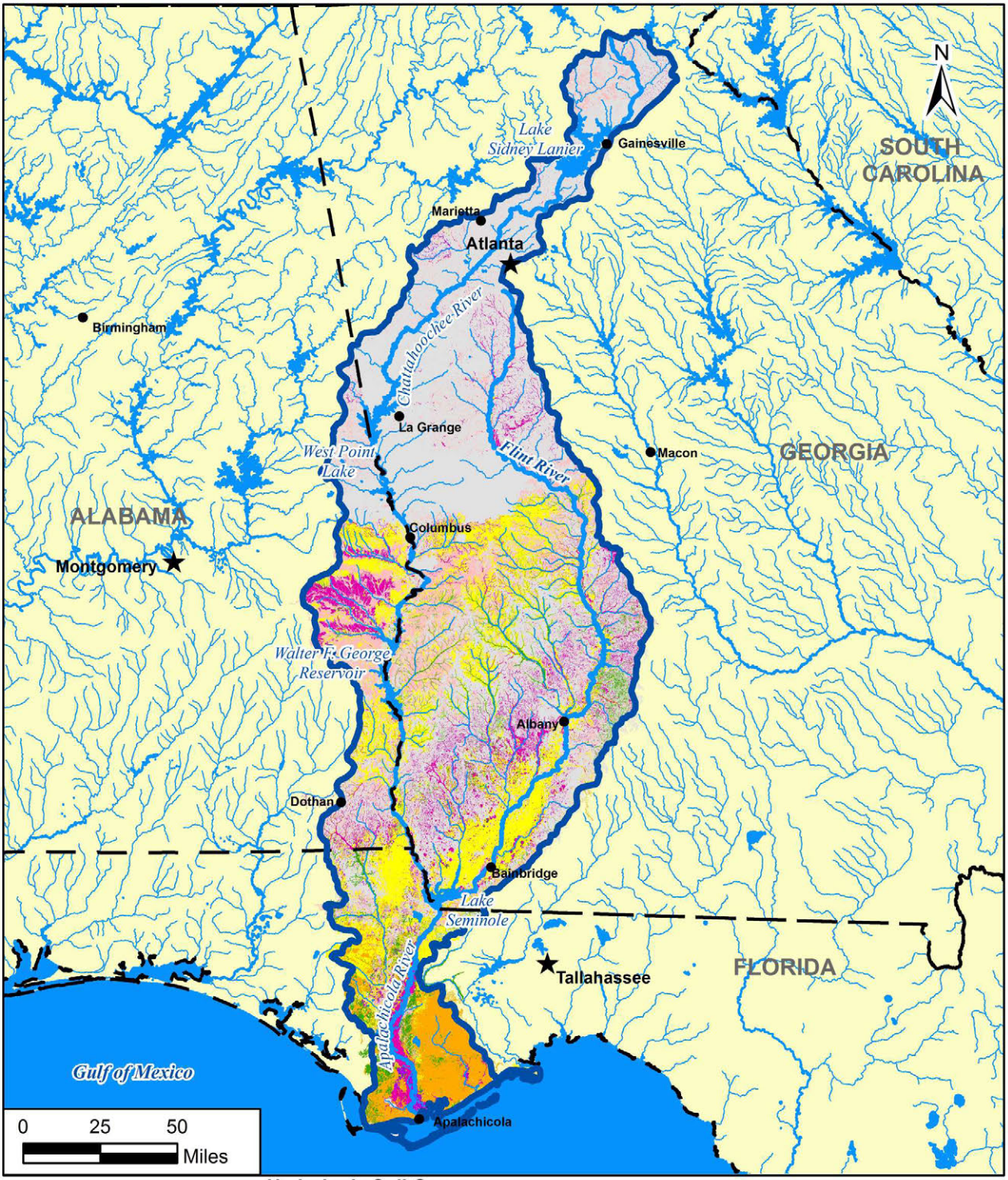
In general, regions of C and D soil groups generate the greatest amount of runoff per acre. This effect is increased in areas with steep topography, where precipitation has less time to infiltrate before running off to streams. The areas with the highest runoff potential are in the mountain areas of the Blue Ridge and northern Piedmont, the clay-rich C soils immediately south of the Fall Line, the clay-rich stream valleys in the Coastal Plain, and the areas of the Southern Coastal Plain with a high water table.

In general, regions of A and B soil groups promote the greatest amount of infiltration and groundwater recharge. This effect is increased in areas of low relief where precipitation is slow to run off and might even pond. The areas with the highest infiltration potential include the sandy A group soils south of the Fall Line and the sandy soils overlying the porous karst geology along the lower Flint River valley and lower Chattahoochee River valley.

2.2.2.3 Prime Farmland

Prime farmland is defined by the USDA as land that has "the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for long periods of time, and they either do not flood frequently or are protected from flooding. (7 CFR, Part 657.5a)"

Approximately 26 percent of the ACF Basin has been designated as prime farmland. Most of the prime farmland is in the southern third of the ACF Basin, particularly in areas along streams where surface and groundwater resources are more readily available for irrigation (Figure 2.2-2).



Hydrologic Soil Groups

Figure 2.2-1

Source: NRCS 2014.



Figure 2.2-2

Source: NRCS 2014.

2.2.2.4 Sediment

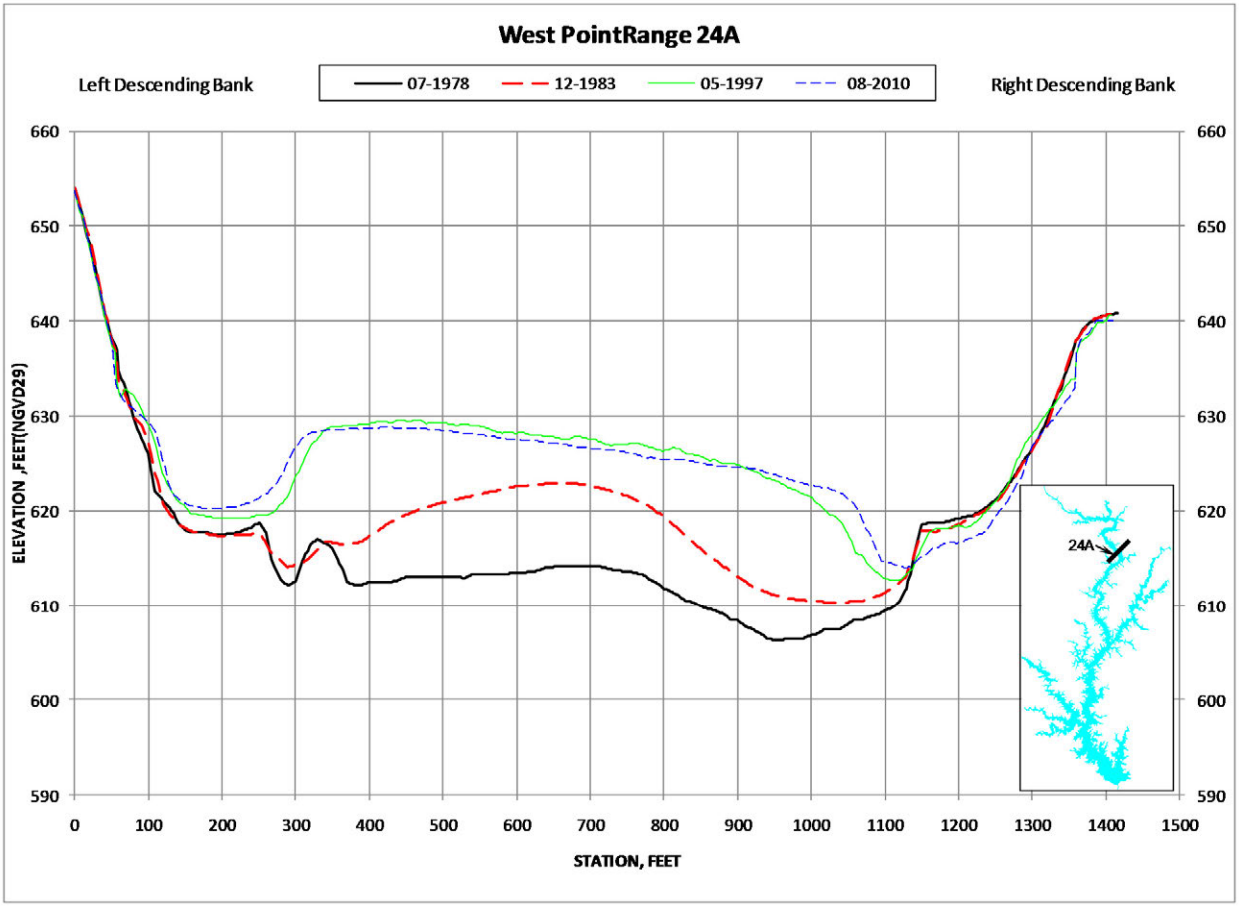
This EIS is focused on the operations of USACE reservoirs, and, therefore, it is most appropriate to focus on sediment transported by rivers rather than overland sources. In general, the quantity and size of sediment transported by rivers is related to the size and frequency of dams in the river system. Impoundments behind dams serve as sediment traps where coarse bed material particles, typically sand and larger particles, settle in the reservoir headwaters where entering flows are slowed. Fine particles, typically silts and clays, can remain in suspension and pass downstream through the reservoir. Large impoundments typically trap most of the sediment load, retaining all the sand and coarser particles plus much of the silt- and clay-sized particles. Smaller run-of-the-river impoundments tend to pass all sizes of suspended particles during low to moderate flows and coarser bed material particles during high flows. Because of this sediment trapping, impoundments can cause the stream bed to elevate in upstream channels, which reduces the channel gradient. Below dams, the river typically becomes starved for sediment. The response of a channel downstream of a dam depends on how resistant to erosion the channel bed and banks are and how quickly sediment is replenished from downstream tributaries and upland erosion sources. A typical response for channels, with bed and banks composed of easily eroded sands, silts, and/or soft clays, is for the bed to degrade to a reduced elevation; the channel might also widen through bank erosion.

The four largest projects in the system—Lake Lanier, West Point Lake, Walter F. George Lake, and Lake Seminole—act as sediment traps, retaining most of the sand and larger bed material. George W. Andrews Lake is a run-of-the-river project, which passes most of the sand and fine bed material. A detailed description of each of these impoundments is provided in section 2.1.1.1.6. Cross-sectional hydrographic surveys of reservoirs and tailraces were done periodically at the five USACE projects in the ACF Basin since the 1950s. Data were collected from three to five times at Lake Lanier, West Point Lake, George W. Andrews Lake, and Seminole Lake with the initial data being collected during the first year of impoundment and the most recent data collected in 2009. Following is a discussion of the five projects based on the hydrographic surveys.

2.2.2.4.1 Reservoir Sedimentation

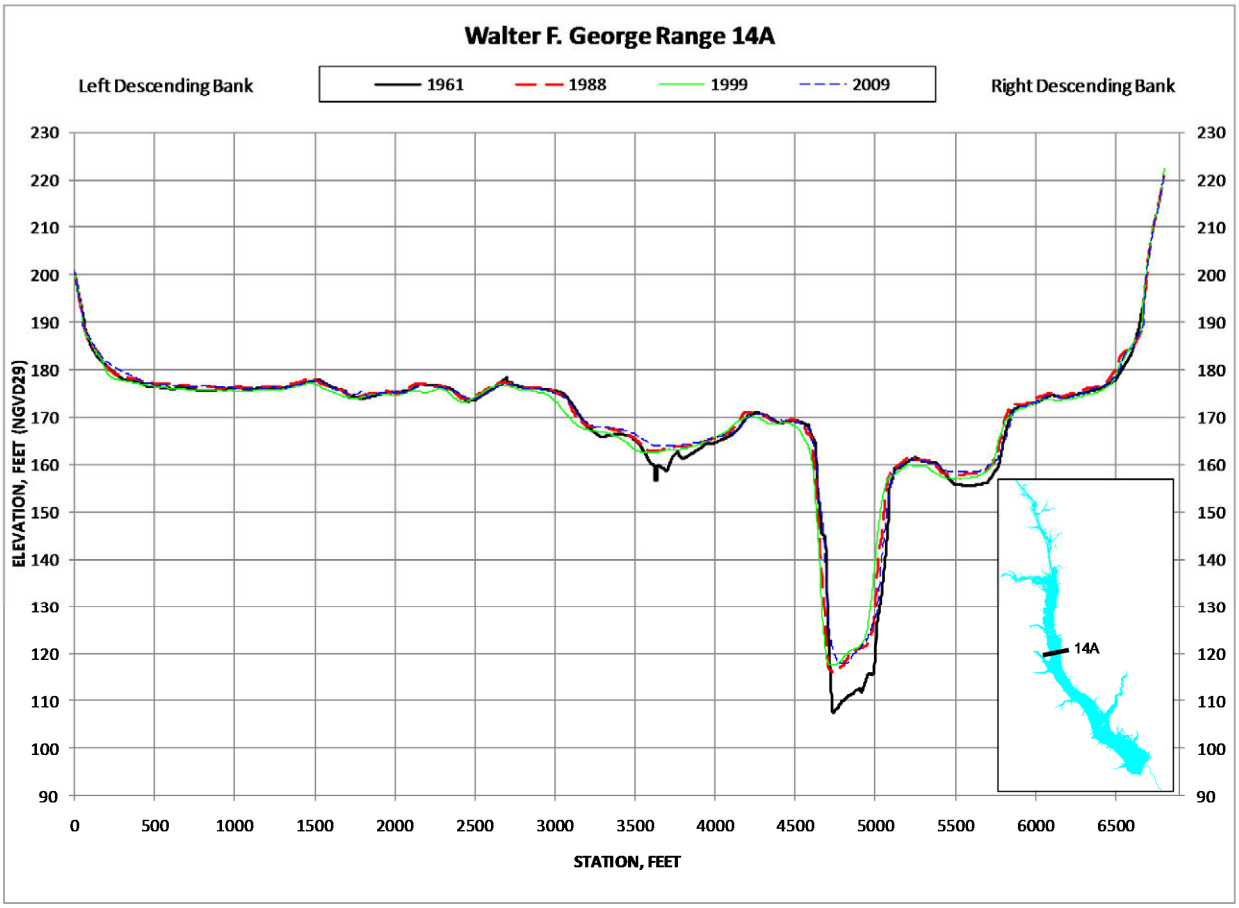
In general, four of the five projects (excluding George W. Andrews) are undergoing similar processes. Lake Lanier, West Point Lake, Walter F. George Lake, and Lake Seminole have an upper riverine region where inflows (Chestatee and Chattahoochee rivers for Lake Lanier, Chattahoochee River for West Point and Walter F. George lakes, and Chattahoochee and Flint rivers for Lake Seminole) dominate the bed and shoreline forming processes. The river beds have aggraded and widened by several feet over approximately the first 20 years since construction of the dams. Since then, the upper reaches have reached an equilibrium state where additional sediment load is transported through the reservoir without aggrading on the bed. In some upper reach locations, a portion of the sediment is being deposited overbank. Where the riverine section transitions to the main reservoir body, it is typical for sediment to be deposited in a delta. Hydrographic range surveys appear to cross delta deposits in two of the five lakes: range 24A (Figure 2.2-3) in West Point Lake, and range 4A in Lake Seminole (not depicted, see Tetra Tech 2011a). In Figure 2.2-3, the greater portion of the channel center has silted in up to the winter pool elevation of 628 ft, thus forcing flow to either channel margin. Below the deltas, the main reservoir bodies consist of a relatively flat reservoir bed several thousand feet wide (preimpoundment flood plain) cut by a 50-ft-deep by 300- to 400-ft-wide canyon (preimpoundment river channel). Sediment deposits on the flat reservoir bed are sufficiently thin to be within the depth measurement variability of the hydrographic surveys and, thus, show essentially no sedimentation through 2009. The historic river channels typically hold sediment deposits several feet thick which, in some cases, show trends of heavy deposition rates early in the life of the project, and reduced rates more recently (Figure 2.2-4). Because the historic river channels make up only a fraction of the total reservoir bed, the overall loss of storage capacity due to sedimentation for each project as of 2009 is estimated to be about 1 percent for Lanier, West Point, and

Walter F. George lakes, and 2 percent for Lake Seminole. George W. Andrews Lake is a special case in that the entire project is riverine, and the uppermost reach is within the tailwater of Walter F. George Lock and Dam. Each project is discussed in greater detail in the following sections.



Source: Tetra Tech 2011c

Figure 2.2-3. Extreme Example of Sedimentation at West Point Lake



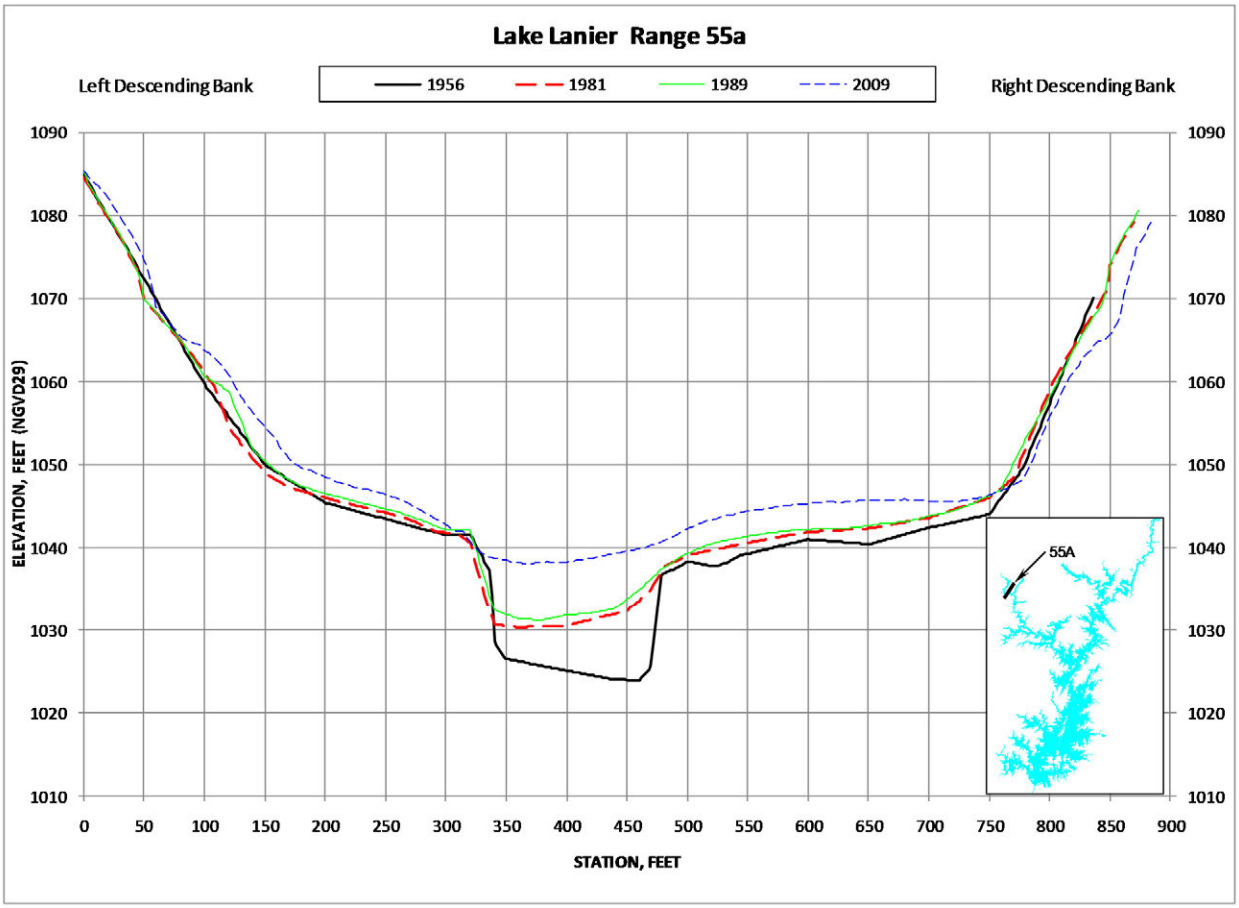
Source: Tetra Tech 2011d

Figure 2.2-4. Typical Example of Sedimentation at Walter F. George Lake

2.2.2.4.1.1 Lake Lanier

Lake Lanier has been hydrographically surveyed four times since its impoundment: 1956, 1981/1983, 1989/1990, and 2009. The form of the reservoir is dendritic with many islands and numerous small tributaries and associated embayments joining the main reservoir body. Steeply sloping shorelines are prevalent. Two main rivers drain to the lake: the Chestatee from the northwest and the Chattahoochee from the northeast. An analysis of the survey data indicates that, in general, the main body of Lake Lanier is unaffected by sedimentation. Between 1956 and 2009, less than 1 percent of the volume of the main body of the reservoir was lost to sedimentation (Tetra Tech 2011b). Measurable sedimentation is noted in the upper reaches of the two main rivers and in several of the tributaries. The general trend indicates that, where measurable sedimentation has occurred, it is has been relatively heavy and was at a constant rate from 1956 to 2009 (Figure 2.2-5). Historical aerial imagery indicates that the uppermost reaches of many of the tributaries have undergone sedimentation where they meet the lake. Because the tributary heads were not surveyed near the upper end of their embayments, the degree of sedimentation is not known.

The mainstem of the Chestatee River at the head of Lake Lanier appears to be undergoing ongoing sedimentation at about 15 ft over the past 53 years (Figure 2.2-5). Similarly, the mainstem of the Chattahoochee River at the head of Lake Lanier appears to also be undergoing continuous sedimentation. Progressing downstream toward the lake, both rivers show a much reduced sedimentation rate.



Source: Tetra Tech 2011b

Figure 2.2-5. Uniform Sedimentation on the Chestatee River at Lake Lanier

Shoreline erosion is prevalent around the reservoir with a 2- to 5-ft-high escarpment common along most shorelines between the summer and winter pool elevations. Cross-section survey data at sedimentation ranges indicate that approximately half of the ranges had undergone most of the shoreline erosion before the 1983 survey, whereas the shorelines of the remaining ranges are still actively eroding. Locations where the erosion rate has become reduced is possibly due to the exposure of the more robust underlying bedrock (Tetra Tech 2011b).

2.2.2.4.1.2 West Point Lake

West Point Lake has been hydrographically surveyed four times since its impoundment: 1978, 1983, 1997, and 2009. An analysis of the survey data indicates that, in general, the main body of West Point Lake is unaffected by sedimentation. Between 1978 and 2009, less than 1 percent of the volume of the main body of the reservoir was lost to sedimentation (Tetra Tech 2011c). However, high rates of sedimentation have occurred in the heads of bays where major tributaries enter the reservoir and in the mainstem of the Chattahoochee River where it enters the lake. Sedimentation rates at the head of the reservoir vary between about 10 to 30 percent locally, depending on where the rates are measured. The general trend indicates that sedimentation rates were highest during the first two decades following the construction of West Point Dam, while over the most recent decade, the rate has dropped off considerably (Figure 2.2-3). The shoreline and riverbed forms of the uppermost reaches of the reservoir are dominated by riverine processes. Bed and bank forms are most strongly influenced by recurring floods, which cause channel migration through the eroding

of outside riverbends and depositing eroded sediment on inside riverbends. Erosion is pervasive along shorelines surrounding the main body and major embayments of the lake. The form of erosion is related to the topographic relief and underlying geology of the shoreline. Gently sloping shorelines in unconsolidated materials are slowly eroding in the vertical direction between the summer and winter pool elevations. Steeply sloping shorelines have eroded horizontally until an escarpment has been created. The rate of shoreline erosion appears to have been highest during the first 20 years from 1978 until 1997. From 1997 to 2009, the erosion rate appears to have been greatly reduced in most locations possibly because of the exposure of the more robust underlying stiff clays and bedrock (Tetra Tech 2011c).

2.2.2.4.1.3 Walter F. George Lake

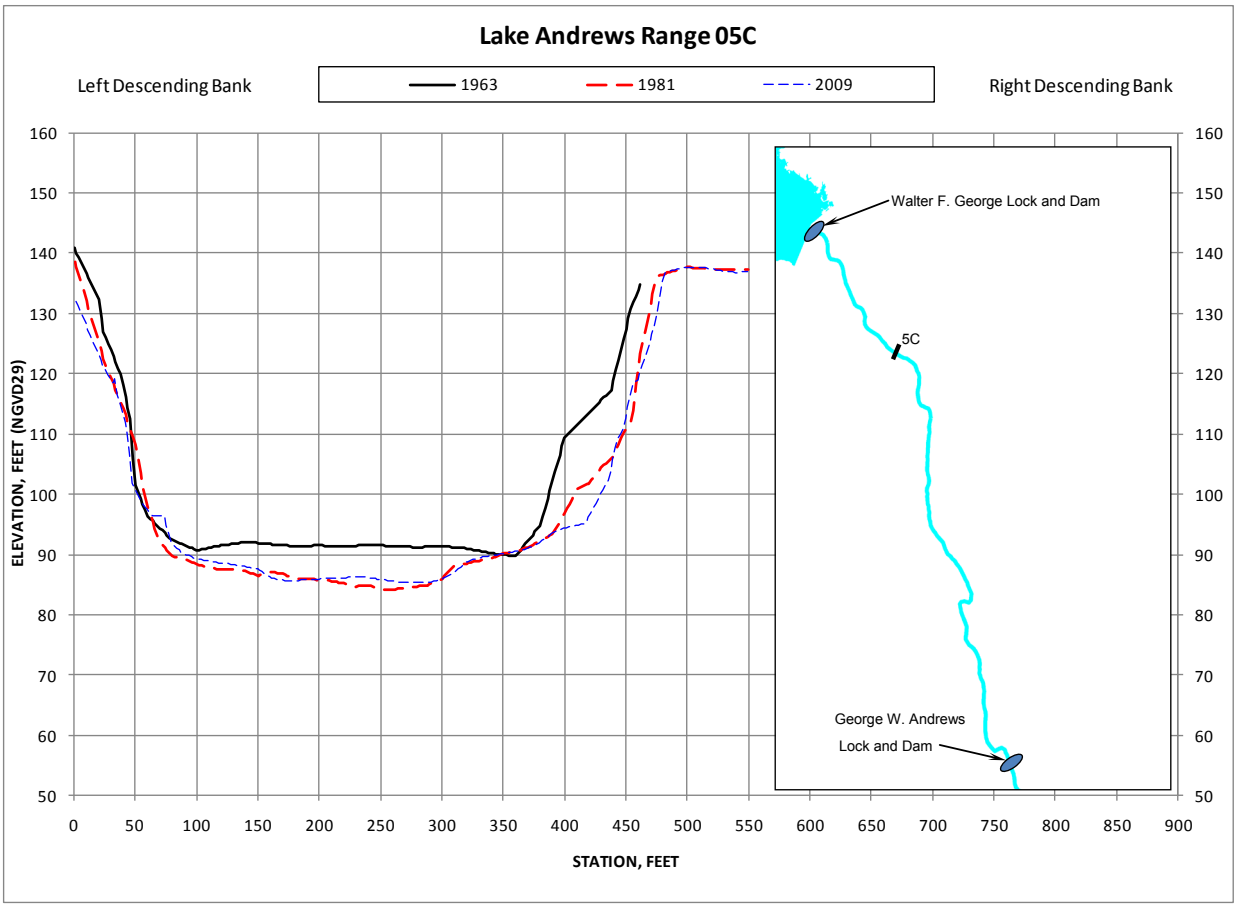
Walter F. George Lake has been hydrographically surveyed four times since its impoundment: 1960-62, 1988, 1999, and 2009. An analysis of the survey data indicates that, in general, the main body of Walter F. George Lake is unaffected by sedimentation. Between 1960 and 2009, less than 1 percent of the volume of the main body of the reservoir was lost to sedimentation (Tetra Tech 2011d). The form of the reservoir is relatively long and narrow with only four minor tributaries and associated embayments. Where surveyed, these tributaries did not appear affected by sedimentation. However, a review of historical aerial photos indicates sedimentation has been ongoing in the uppermost portions of the embayments. The general trend indicates that most of the sedimentation appears to have occurred between 1960 and 1988, continuing to the present at a reduced rate (Figure 2.2-4).

Along the uppermost portions of the lake, the impoundment is dominated by riverine channel forming process of the Chattahoochee River. Sedimentation was greatest from 1960 to 1988, with approximately 2–5 ft of deposition. Since 1988, the sedimentation rate along the riverine portion of the reservoir has been negligible.

The shoreline and riverbed forms of the uppermost reaches of the reservoir are dominated by riverine processes. Bed and bank forms are most strongly influenced by recurring floods, which cause channel migration through the eroding of outside riverbends and depositing eroded sediment on inside riverbends. Erosion is pervasive along shorelines surrounding the main body and major embayments of the lake. The form of erosion is related to the topographic relief and underlying geology of the shoreline. Gently sloping shorelines in unconsolidated materials are slowly eroding in the vertical direction between the summer and winter pool elevations. Steeply sloping shorelines have eroded horizontally until an escarpment has been created. The typical escarpment ranges from 2–5 ft high. The rate of shoreline erosion appears to have been highest during the first 20 years from 1978 until 1997. From 1997 to 2009, the erosion rate appears to have been greatly reduced in most locations, possibly because of the exposure of the more robust underlying stiff clays and bedrock (Tetra Tech 2011d).

2.2.2.4.1.4 George W. Andrews Lake

George W. Andrews Lake has been hydrographically surveyed three times since its impoundment: 1963, 1981, and 2009. The form of the reservoir is run-of-the-river joined by numerous tributaries ranging from about 1 sq mi to about 300 sq mi in drainage area. Embayments associated with the tributaries are minor in size and none contain a sedimentation range. An analysis of the sedimentation range survey data indicates that, in general, George W. Andrews Lake is unaffected by sedimentation and conversely is affected by scour. Bed erosion occurs along the entire length of the project (stream mile 46.53 to 75.17), but is most strongly exhibited along the upper half. Sedimentation range cross sections averaged an 18 percent increase in area between 1963 and 2009 (Tetra Tech 2011e). That increase was caused by both bed degradation and channel widening. The channel has widened along the entire length; however, the right bank appears to have retreated slightly more than the left. Bank elevations undergoing erosion range from about 92 ft up to 120 ft (Figure 2.2-6).

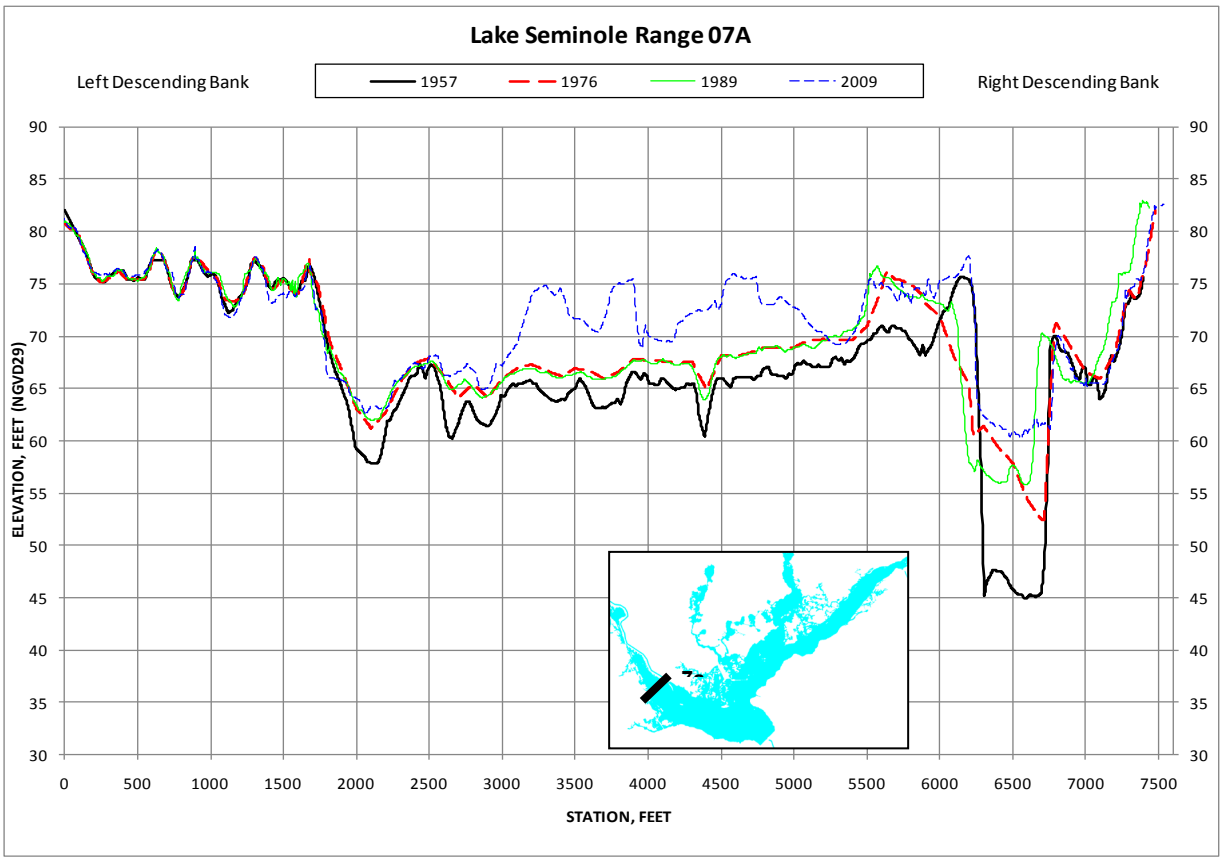


Source: Tetra Tech 2011e

Figure 2.2-6. Typical Channel Degradation and Widening at George W. Andrews Lake

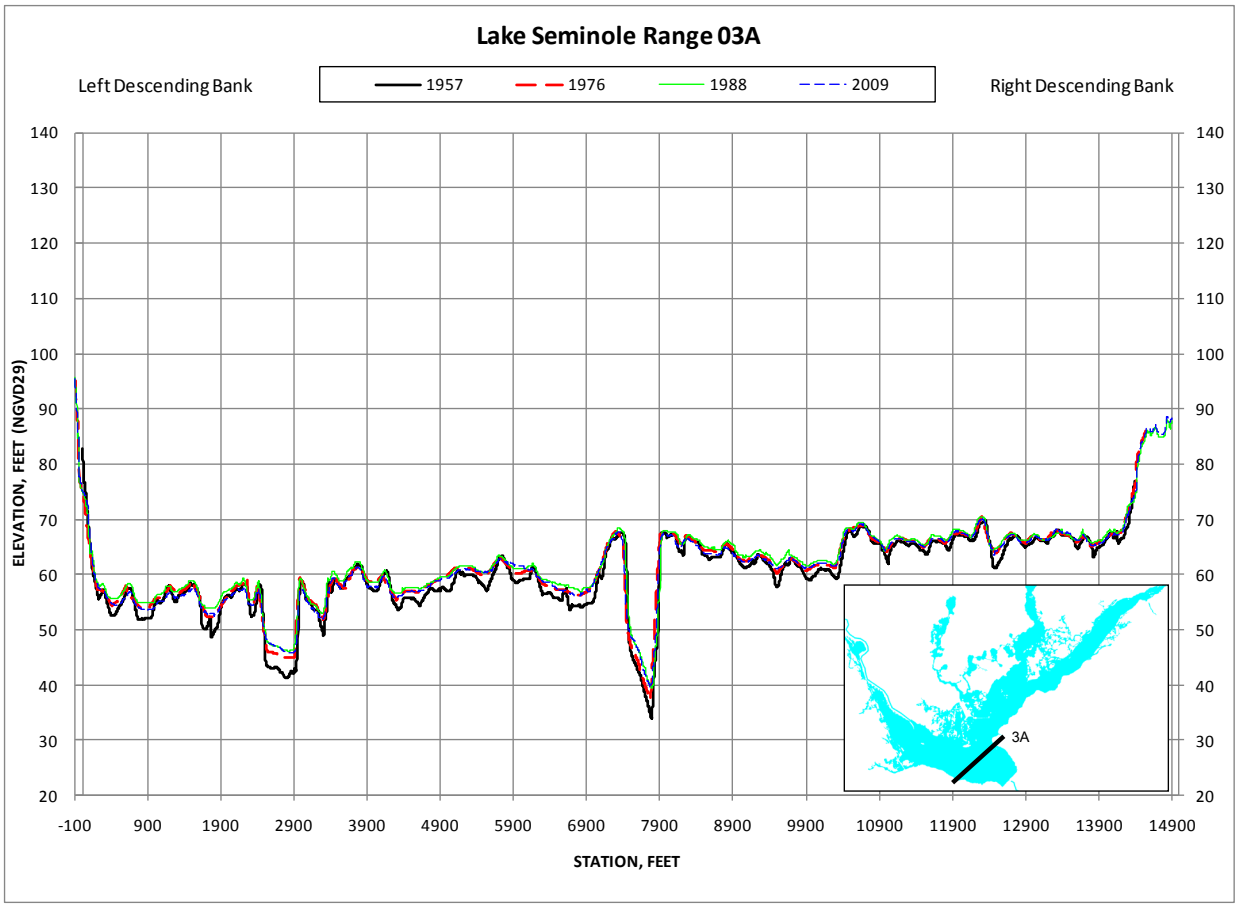
2.2.2.4.1.5 Lake Seminole

Lake Seminole has been hydrographically surveyed four times since its impoundment: 1957, 1976, 1988/1989, and 2009, plus a partial survey in 1963. The form of the reservoir is dendritic with a marshy, indefinite shoreline surrounding the main reservoir body. Two main rivers drain to the lake: the Chattahoochee River from the northwest and the Flint River from the northeast. An analysis of the survey data indicates that, in general, the main body of Lake Seminole is lightly affected by sedimentation. Between 1957 and 2009, about 2 percent of the volume of the main body of the reservoir was lost to sedimentation (Tetra Tech 2011a). However, the reach where the Chattahoochee River joins the main reservoir body is heavily affected with about 25 percent of the reservoir cross-section lost to sedimentation (Figure 2.2-7). The reach where the Flint River joins the main reservoir is essentially unaffected by sedimentation. However, that lack of impact appears to be the result of channel dredging below the town of Bainbridge. The general trend indicates that, where measurable sedimentation has occurred, it is was relatively heavy and at a constant rate from 1957 to 2009 (Figure 2.2-8).



Source: Tetra Tech 2011a

Figure 2.2-7. Heavy Delta Sediment Deposits at Range 7a in Lake Seminole



Source: Tetra Tech 2011a

Figure 2.2-8. Typical Reservoir Bed Deposition at Lake Seminole

Erosion is minor around the reservoir with some gently sloping shorelines eroding vertically downward. In general, the shorelines are well protected from wave generated erosion by their gentle slope and dense wetland and aquatic vegetation in the littoral zone. The shoreline escarpments prevalent at the northern three projects are not found at Lake Seminole. The riverine portions of the impoundment are undergoing bank erosion and channel widening, in particular on the Chattahoochee River portion (Tetra Tech 2011a).

2.2.2.4.2 Tailwater Degradation: Impact of Impoundments on Channel Stability

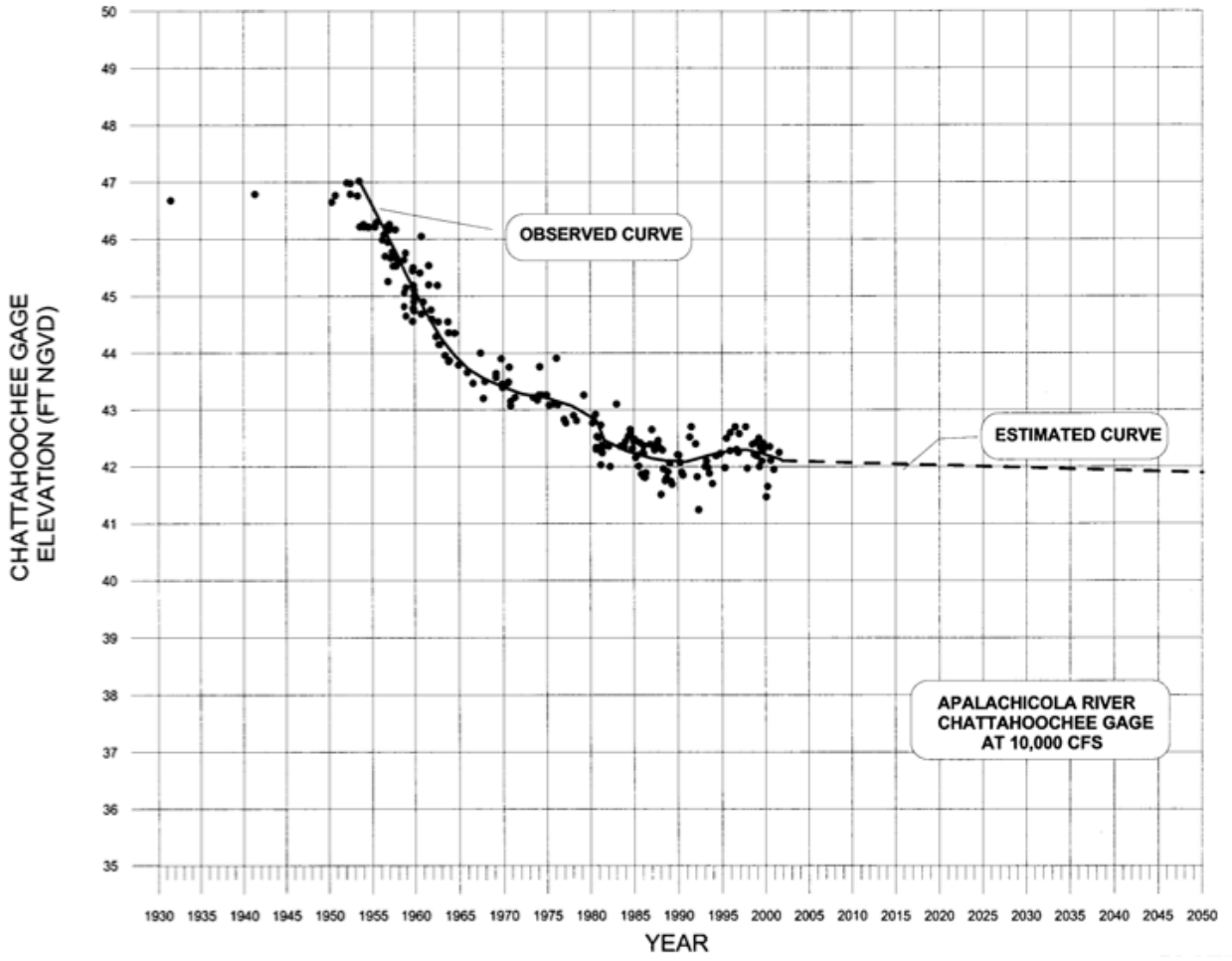
With each major reservoir functioning as a sediment trap, the potential exists for a reduced sediment load and corresponding bed degradation along the river reaches immediately below each dam. In the middle reaches of the ACF Basin, bed degradation of the river below the Walter F. George and George W. Andrews dams is attenuated to some degree by dams downstream in the system. In the upper reaches of the ACF Basin, bed degradation below Buford and West Point dams is attenuated by natural bedrock grade controls. However, below the Jim Woodruff Lock and Dam, which is the furthest downstream, there is no controlled tailwater, and erosion has occurred. Therefore, the following discussion focuses on the portion of the river system below Jim Woodruff Lock and Dam.

Since the construction of Jim Woodruff Lock and Dam, the Apalachicola River bed has degraded by about 5 ft within a mile below the dam and by about 2 ft at Blountstown (Light et al. 2006; USACE, Mobile District 2002b). The rate of this degradation can be discerned through comparisons of discharge

rating curves at the four USGS gaging stations on the river at Chattahoochee (RM 105.8), Blountstown (RM 77.4), Wewahitchka (RM 41.5), and Sumatra (RM 20.6) (USACE, Mobile District 2002b).

At Chattahoochee, a tailwater degradation curve was developed to show changes in stage for a given flow over time. All flows near 10,000 cfs were used to generate the curve (Figure 2.2-9). The curve indicates that, since the construction of Jim Woodruff Lock and Dam, the channel initially eroded at a fairly constant rate until the late 1960s, when the channel appeared to stabilize and eroded at a reduced rate through the 1970s. The drop in the stage in 1981 can be attributed to rock removal at that time. The channel remained essentially stable from 1985 until the present (USACE, Mobile District 2002b). To compare tailwater degradation for flows lower and higher than 10,000 cfs, a specific gage analysis was conducted for the Chattahoochee gage (USGS02358000). The interpretation of the tailwater curve in Figure 2.2-9 is corroborated in the trend lines on Figure 2.2-10; bed degradation took place at a high rate until about 1981. Degradation has continued at a reduced rate since 1982. The slopes of the trend lines in Figure 2.2-10 equate to a degradation rate of about 0.03 ft/yr, or 1 ft over 33 years.

The rating curve comparison from Blountstown to Wewahitchka indicates that the channel had degraded by 1 to 2 ft between completion of the Jim Woodruff Lock and Dam and the early 1980s. Since then, the bed elevations have essentially been constant, with slight fluctuations of around 1 ft, which is not unreasonable in a sand-bedded system.



Source: USACE, Mobile District 2002b

Figure 2.2-9. Tailwater Degradation Curve below Jim Woodruff Lock and Dam

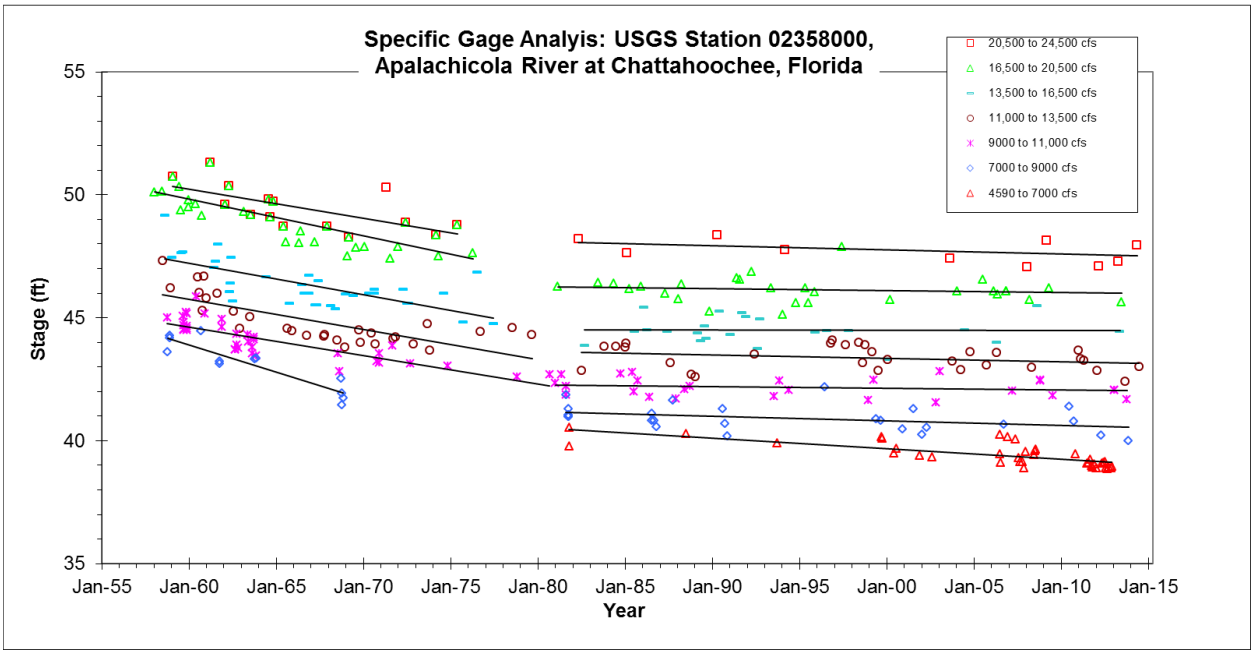


Figure 2.2-10. Streamflow Trends below Jim Woodruff Lock and Dam

At Sumatra, the rating curve comparison spanned the period from 1977 until 1994. The lack of change between the rating curves indicates that the bed was stable, undergoing no degradation or aggradation. This is expected, given the tidal influence below the Sumatra gage.

2.2.2.4.3 Impact of Existing Operations on River Channel Stability

A specific gage analysis was conducted at several USGS stream gaging stations in the Chattahoochee and Apalachicola rivers to better understand the impact of dam operations on the stability of the two rivers.

These locations were selected on the basis of two criteria: proximity to the dam and period of record. Locations nearest the dam will be most highly affected by regulated changes in discharge and by sediment starvation due to sediment being trapped in the upstream reservoir. A long period of record contains enough data points to create accurate trend lines of past and present channel stability or instability. In addition, active gages enable recent data to be included in the analysis and afford the opportunity to duplicate that analysis in the future, provided the gage remains active.

The method for conducting a specific gage analysis entails taking all historical stage measurements and plotting them over time. Stage measurements are grouped by similar discharge values. Changes in stage, for a given discharge over time, indicate that the channel depth or width has changed. A similar process can be used for the channel width. USGS discharge measurements include width, and thus the width measurements for similar discharges can be compared, over time, for changes.

2.2.2.4.3.1 Chattahoochee River (02338500) above West Point Lake (Franklin, Georgia)

The specific gage analysis results for the Chattahoochee River above West Point Lake indicate that the channel has aggraded, increasing in elevation, since the construction of West Point Dam and the impoundment of West Point Lake in 1974. Although the record is missing data from the 1950s, and the late 1970s through late 1990s, the general stage trend indicates a historical dip in channel bed elevation of about 2 ft during the 1940s (Figure 2.2-11). Insufficient low-to-moderate flow data are available for the 20-yr period following the impounding of West Point Lake. Data from 1977 to 2014 indicate that the

conditions of the channel have changed at this location. The stage is approximately 4 ft higher than before impounding, and additionally, for similar discharges, the range of stages varies by ±2.5 ft. The likely explanation is that this portion of the river is within the backwater effect of West Point Lake, and sediments are settling out of the water. However, the variation in stage for a given discharge is related to the lake level at the time of the measurement. Because the period of record of low to moderate flow data since 1975 is limited, it is not possible to determine whether bed aggradation is taking place or whether scour and fill cycles are occurring.

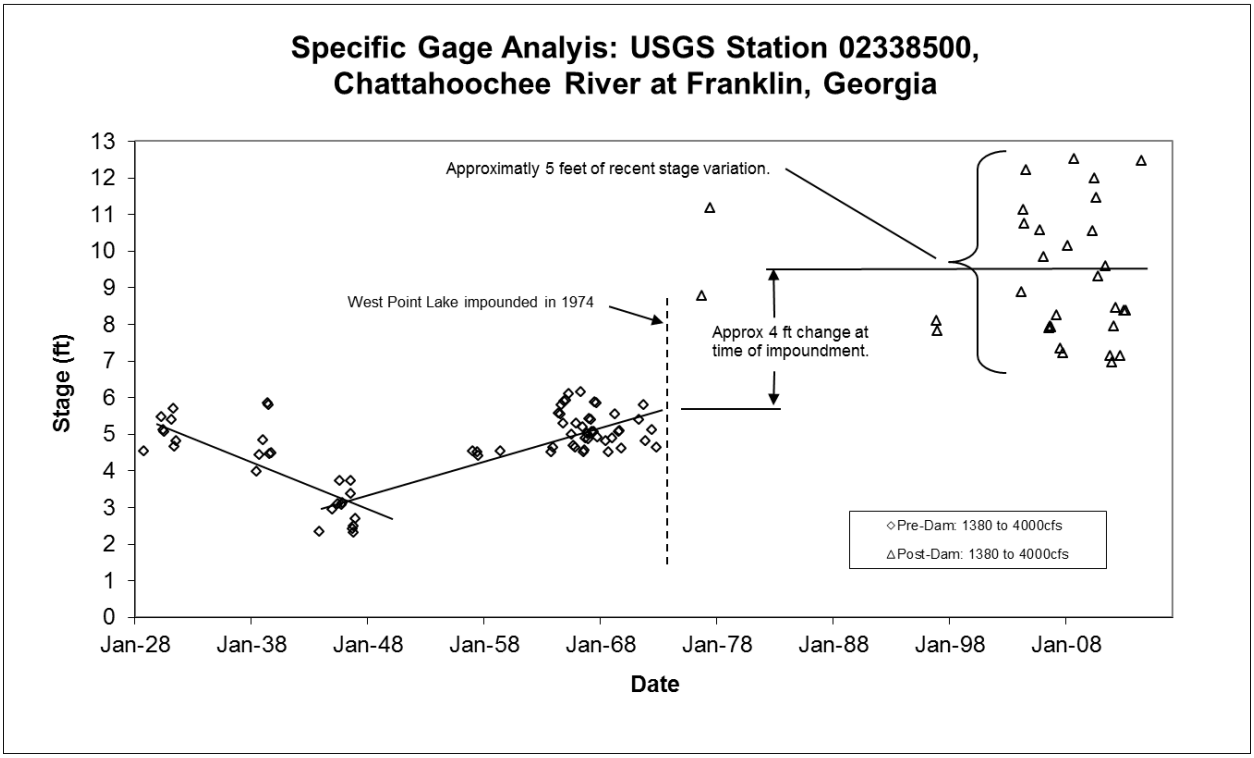


Figure 2.2-11. Specific Gage Analysis at Franklin, Georgia

2.2.2.4.3.2 Below Jim Woodruff Lock and Dam (02358000)

The USGS Chattahoochee gaging station is at approximately RM 105.8 (Figure 2.2-10). The data presented in the specific gage analysis for this location may not have been collected exactly at the gage but within perhaps 200 or 300 ft upstream or downstream, depending on the flow conditions and the field personnel.

Data for low and moderate flows are represented in Figure 2.2-10. Low flows are considered to be less than 9000 cfs, and moderate flows are 9000 to 24,000 cfs. High flows (greater than 24,000 cfs) were not included in the analysis because the data were insufficient to create reliable results.

The interpretation of Figure 2.2-10 is that from the time the dam was completed in 1957 until about 1980, give or take several years, the streambed had degraded by about 4 ft, or about 0.17 ft/yr. From about 1980 to the present, the streambed has degraded by about 0.9 ft at the low flows (less than 9,000 cfs) and 0.25 ft at the moderate flows (greater than 9,000 cfs), or about 0.03 ft/yr. The trend indicates that degradation has slowed to a near standstill, if not stopped already. One explanation for the difference in rate of change between flows less than and greater than 9,000 cfs is that the deepest part of the channel, or *thalweg*, has undergone a greater rate of degradation over the past decade than have the remainder of the

channel cross-section (Figure 2.2-12). This change in the stage will be more strongly reflected during low flows, when a larger proportion of the flow is transported through the thalweg, as compared to moderate flows, where a large proportion of the flow is transported outside the thalweg.

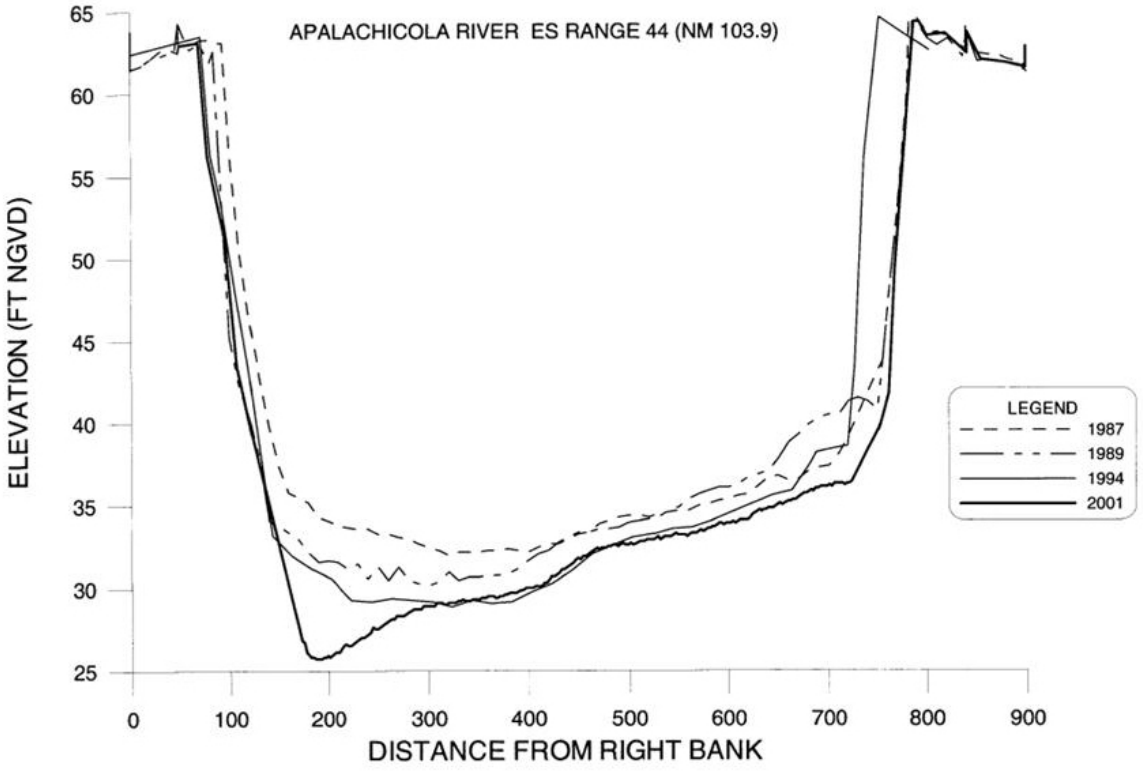
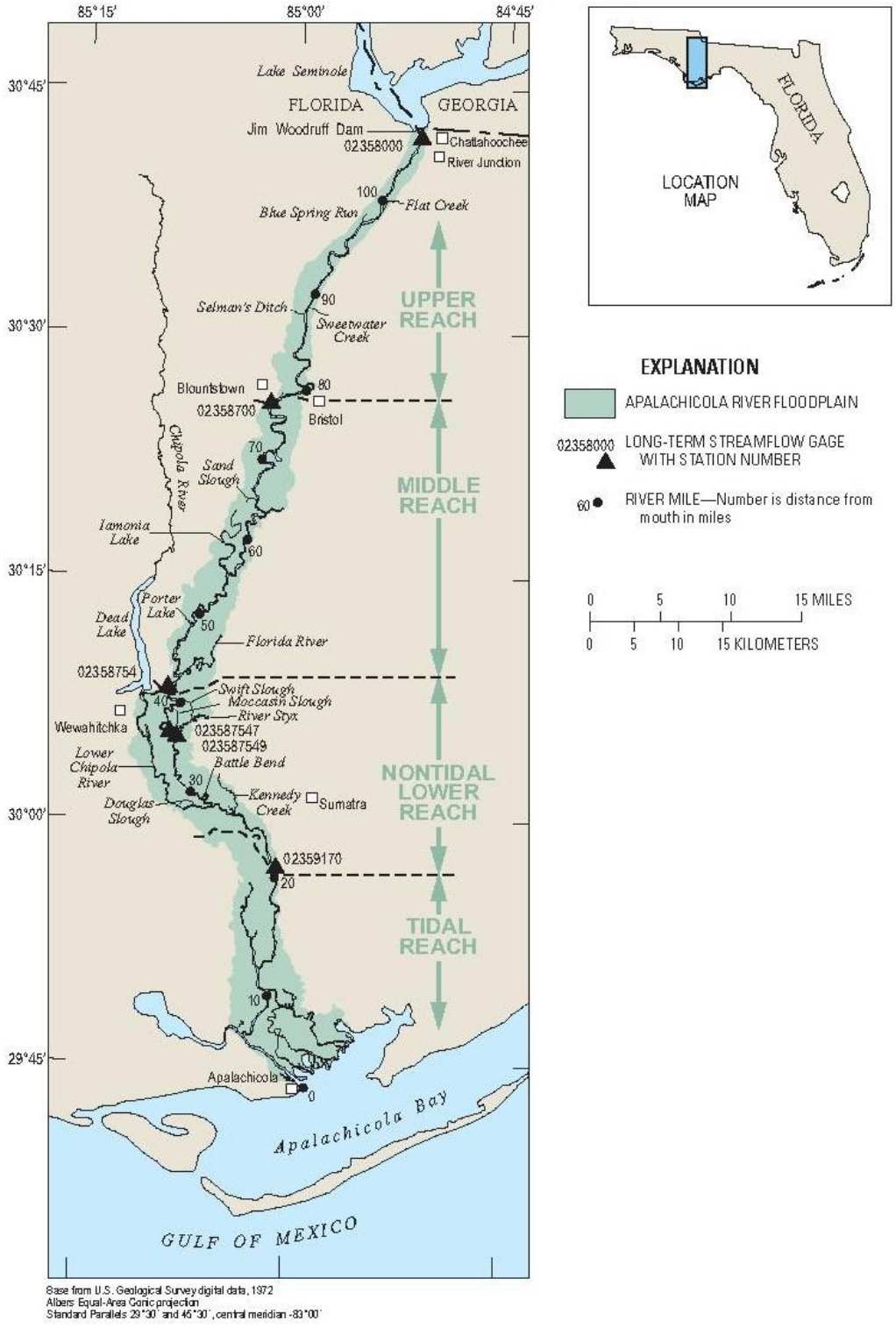


Figure 2.2-12. Cross-Section below Jim Woodruff Lock and Dam

This greater rate of degradation in the thalweg could be the result of in-channel rock removal during 1983 and 1984 (USACE, Mobile District 2002b). Between 1984 and 2007 (the latest year of data reviewed), no dredging has occurred in the reach from Jim Woodruff Lock and Dam to RM 99 whereas before 1984, minor amounts of dredging occurred upstream of RM 103.9 (154 thousand cubic yards from RM 103 to RM 106 between 1957 and 1984) and moderate amounts downstream (558 thousand cubic yards from RM 99 to RM 102 between 1957 and 1984).

The Apalachicola River below Jim Woodruff Lock and Dam can be divided into three major reaches (Figure 2.2-13): 1) the Upper Reach (Apalachicola RM 106.3 to RM 77.5) from Jim Woodruff Lock and Dam to Blountstown gage (USGS 02358700); 2) the Middle Reach (RM 77.5 to RM 41.8) from Blountstown gage to Wetwahitchka gage (USGS 02358754); and the Lower Reach (RM 41.8 to RM 20.6) from Wetwahitchka gage to Sumatra gage (USGS 02359170) (Light et al. 2006). Below the Sumatra gage, the river is considered to be influenced by tides, and, therefore, that portion of the river is not included in this discussion. Overall, the Apalachicola River has degraded and possibly widened because of the reduction in bed material from upstream following the construction of Jim Woodruff Lock and Dam. However, for the decade from 1995 to 2004, the channel has been relatively stable (Light et al 2006).



Source: Light et al. 2006

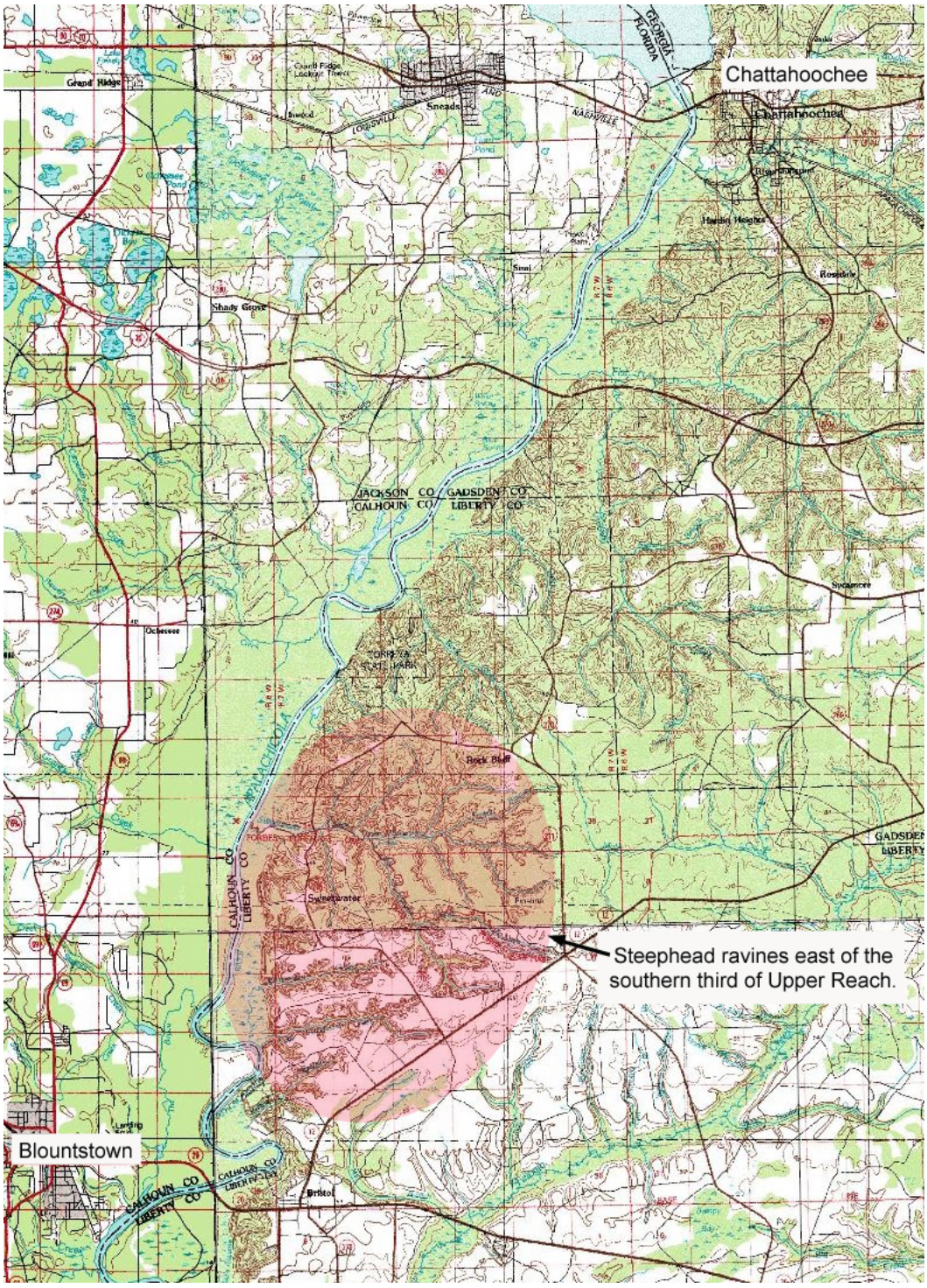
Figure 2.2-13. Major Reaches of the Apalachicola River

The stability along the relatively straight upper reach is created by the presence of limestone outcrops, coarse sand and gravel bed materials, and local sediment sources downstream of RM 84 (Harvey 2007). The geology of the upper reach greatly differs between the east and west banks. The east bank is bordered on the east by a relatively high-relief landscape consisting of poorly consolidated silty/clayey sands and gravels of the Citronelle Formation overlying the erodible sands of the Alum Bluff Group, and limestone (Harvey 2007). The Citronelle Formation is an unconsolidated yet hard, sandy-clay that is erosion-resistant enough to have formed the high-relief topography in the area (Isphording et al. 1984). The region consists of agricultural land uses on a level plateau at an elevation of about 250 ft. The plateau is highly dissected by small streams, which have incised down to about the 50- to 60-ft elevation of the Apalachicola floodplain (Figure 2.2-14). The region potentially contributes to replenishing the sediment supply of the Apalachicola River through rainsplash, rill, and sheet wash erosion of the agricultural lands, and by streambank erosion and bed incision of the tributaries.

The topographic contours in Figure 2.2-14 clearly show extensive steephead ravine morphology across the southern third of the region. Those features, reaching depths of 100 ft, are formed when groundwater seeps from the base of the sloping surface and, undercutting the sand, creates a steep-walled amphitheater that erodes headward from the valley bottom (Enge 1998). The steephead ravines could be a significant contributor of sediment to the upper end of the middle reach. Without further investigation of the area, it is not possible to tell whether the steephead ravines are actively eroding or have stabilized. The remaining near-channel regions west of the Apalachicola and south of Blountstown on both sides of the river are exceptionally low-relief, low-elevation topography, and thus are unlikely to be significant contributors of sediment. The dominant sediment source in the middle and lower reaches is most likely to be streambank erosion.

The middle reach is very sinuous with banks composed of a mixture of cohesive and noncohesive sediments that are readily eroding on the outside of bends. The channel is actively migrating because of cutbank erosion and point bar accretion. The erosion rates are low in comparison to other large alluvial rivers and are unlikely to increase over time (Harvey 2007). Bed materials (both predam and now) are composed of uniform sands averaging less than 0.15 in in diameter (Harvey 2007).

The lower reach is very sinuous with banks composed of a mixture of cohesive and noncohesive sediments that are readily eroding on the outside of bends. As in the middle reach, bed materials (both predam and now) are composed of uniform sands averaging 0.15 in in diameter (Harvey 2007). The upper portion of the lower reach from RM 42 to RM 35 appears to be net aggradational, possibly as a result of a flow diversion into the Chipola Cutoff without a commensurate proportion of bed material load. Low radius of curvature bends in both the middle and lower reaches (at RM 38, RM 40, RM 43, RM 50, and RM 62) have the potential to become natural cutoffs, which would lead to a reduced sinuosity and increased hydraulic slope.



Source: USGS 1988

Figure 2.2-14. Highly Dissected Topography East of the Upper Reach

2.3 Climate

2.3.1 Existing Climate

The climate of Alabama, North Florida, and Georgia, including all areas associated with the ACF Basin, is classified as humid subtropical and characterized by hot, humid summers and cool winters. Significant amounts of precipitation occur in all seasons in most areas. Winter rainfall (and sometimes snowfall) is associated with large storms steering from west to east. Most summer rainfall occurs during thunderstorms or an occasional tropical storm, hurricane, or tropical cyclone (Peet et al. 2007). The paragraphs below outline the existing climate in Alabama, Florida, and Georgia. Notably, detailed information about precipitation in the ACF Basin is outlined in section 2.1.1.1.1.

Summers in Alabama are among the hottest in the U.S., with high temperatures averaging above 90 °F (32 °C) in some parts of the state. The average winter minimum temperature for the entire state is 35 °F (2 °C). Alabama receives an average of 56 in of rainfall annually and enjoys a lengthy growing season—up to 300 days—in the southern part of the state (Encyclopedia Britannica 2010).

Georgia is divided into separate climatic regions along the Chattahoochee River. The mountain region to the northwest is colder than the rest of Georgia, with average temperatures in January of 39 °F (4 °C) and 78 °F (26 °C) in July. Many summer days in Georgia exceed 90 °F (32 °C). Winter is characterized by mild temperatures and little snowfall, with cold, snow, and ice most likely across northern and central Georgia (City Data 2010).

Northern Florida, near the Gulf of Mexico, is hot during the summer, when temperatures tend to be in the 80s °F (27 °C), and cool during winter, when temperatures tend to be in the 50s °F (10 °C). The warmest month of the year is July, with an average maximum temperature of 92 °F (33 °C); the coldest month of the year is January, with an average minimum temperature of 40 °F (4 °C). The annual average precipitation in northern Florida near the Gulf of Mexico is 63 in. Summer months tend to be wetter than winter months. The wettest month of the year is July, which has an average rainfall of 8.0 in (Idcide 2010).

2.3.2 Greenhouse Gases and Global Warming

Greenhouse gases (GHG) are components of the atmosphere that contribute to the greenhouse effect and global warming. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities such as the burning of fossil fuels. Federal agencies, states, and local communities address global warming by preparing GHG inventories and adopting policies that will result in a decrease of GHG emissions. According to the Kyoto Protocol and California Climate Action Registry, there are six GHGs: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (UNFCCC 2007; CARB 2007).

Although the direct GHGs (i.e., CO_2, CH_4, and N_2O) occur naturally in the atmosphere, human activities have increased their atmospheric concentrations. From the preindustrial era (ending about 1750) to 2004, concentrations of CO_2 increased globally by 35 percent. Since 1900, the earth's average surface air temperature has increased by about 1.2–1.4ºF. The warmest global average temperatures on record have all occurred within the past 10 yr. The warmest year was 2005 (USEPA 2007b).

Within the U.S., fossil fuel combustion accounted for 94 percent of all CO_2 emissions released in 2005. On a global scale, fossil fuel combustion added approximately 30 $x10^9$ tons (27 $x10^9$ metric tons) of CO_2 to the atmosphere in 2004, of which the U.S. accounted for about 22 percent (USEPA 2007a). DOE's Energy Information Administration report indicates that CO_2 emissions in the U.S. have grown by an

average of 1.2 percent annually since 1990 and that energy-related CO_2 emissions constitute as much as 83 percent of the total annual CO_2 emissions (DOE EIA 2007).

CEQ recently released draft guidance on when and how federal agencies should consider GHG emissions and climate change in NEPA analyses. The draft guidance includes a presumptive effects threshold of 27,563 tons (25,000 metric tons) of CO_2 equivalent emissions from a federal action on an annual basis (Sutley 2010).

None of the alternatives outlined in this EIS would have any direct or indirect effects on the climate. There would be no GHG emissions associated with either the No Action Alternative or the Proposed Action, and neither would contribute to global warming or changes in climate. Although regional GHG emissions are partially a function of population and land use, for the purposes of this EIS, population and land use throughout the basin are not expected to change appreciably due to the proposed updates. As a result, it is assumed that any changes in GHG emissions would have occurred under the No Action Alternative. It is for these reasons that climate change as a potentially affected resource was not carried forward for detailed analysis in this EIS. However, climate change has been carried forward in section 6.8 of this EIS to facilitate a discussion of the Proposed Action within the framework of future climate scenarios.

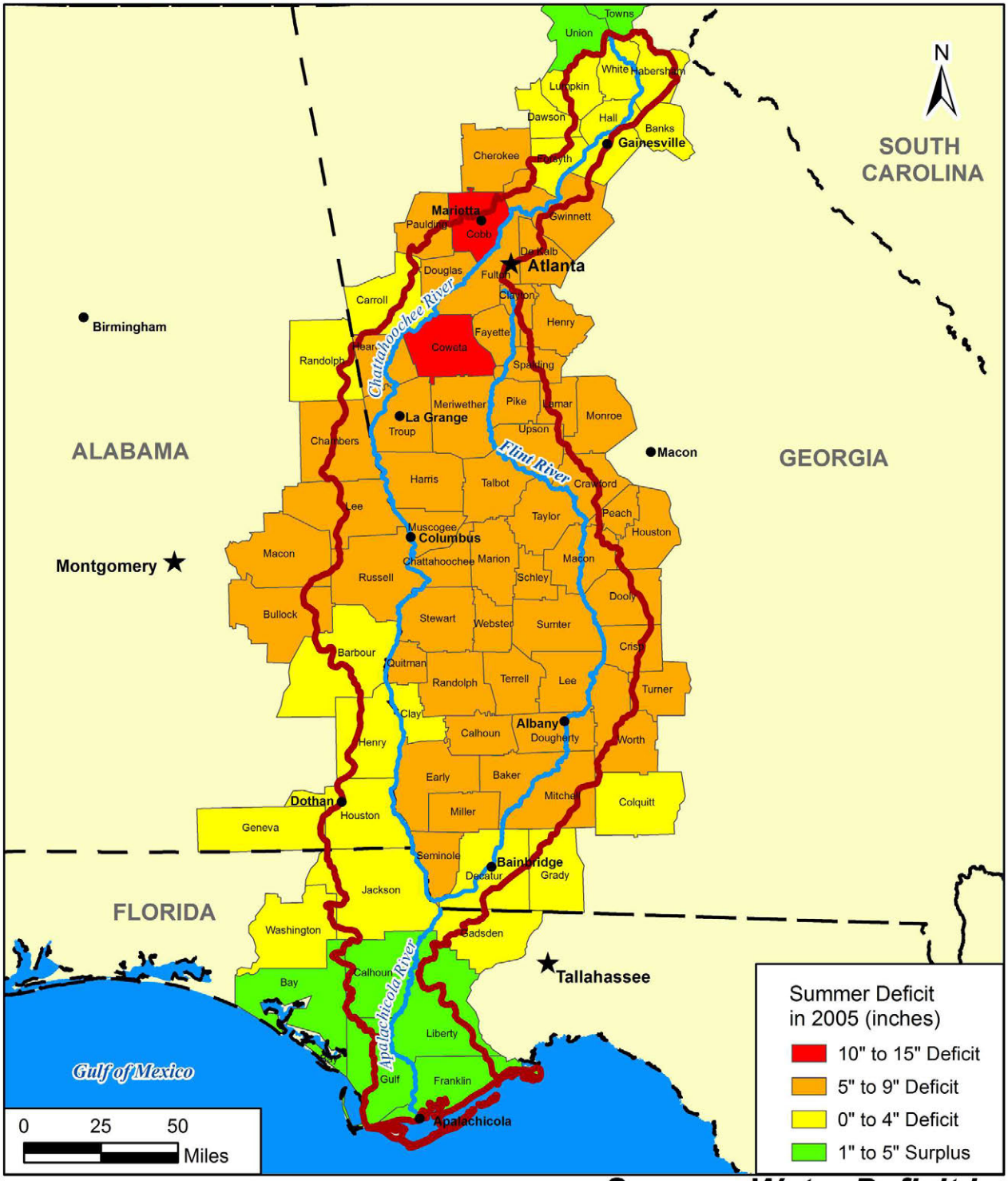
2.3.3 Historical Precipitation and Droughts

Hydrological variability over time in a river basin is influenced by variations in precipitation over daily, seasonal, annual, and decadal time scales. The frequency of low or drought flows within a river basin is affected primarily by changes in the seasonal distribution of precipitation, year-to-year variability, and the occurrence of prolonged droughts. Evaporation from the land surface includes evaporation from open water, soil, shallow groundwater, and water stored on vegetation, along with transpiration through plants. The rate of evaporation from the land surface is driven essentially by meteorological controls, mediated by the characteristics of vegetation and soils, and constrained by the amount of water available. Climate change has the potential to affect all these factors—in a combined way that is not yet clearly understood—with different components of evaporation affected differently (IPCC 2001).

The recent drought in the southeastern U.S. began in the winter of 2005/2006. It was part of a drying out that stretched from Arizona to the Atlantic Ocean, and persisted through October 2007. The recent drought was caused by a reduction in both precipitation and evaporation; it cannot be linked to man-made climate change or global warming (Seager et al. 2009). Although the exact areas of the Southeast that were affected varied, precipitation reduction has not exceeded earlier droughts, including one as recently as 1998 through 2002 (IPCC 2001).

Historically, that drought was a typical event in terms of amplitude and duration. Tree-ring records show a 21-year-long drought in the mid-16th century and a long dry period in the early- to mid-19th century, and that the Southeast was affected by medieval megadroughts centered in western North America. In general, the 20th century was moist from the perspective of the last millennium and free of long and severe droughts that were abundant in previous centuries (Seager et al. 2009).

Available precipitation is the total precipitation minus PET (potential evapotranspiration). It is a direct measure of inflows within the basin. The summer deficit is the available precipitation minus withdrawal in June, July, and August—typically the three warmest months of the year—that correspond to increased municipal, thermoelectric cooling, and irrigation demand. The summer deficit is an indicator of water shortage (in inches) on a seasonal basis that must be met through stored sources (i.e., Lake Lanier and West Point Lake) or groundwater. The historical (1934–2000) average summer deficit ranges from 5.3 in to a surplus of 3.2 in for any given county within the basin (Figure 2.3-1). Historically, the average summer deficit is 4.7 in for counties within the ACF Basin (Tetra Tech 2010).



Summer Water Deficit in 2005 for Counties in the ACF Basin (inches)

Figure 2.3-1

2.3.4 Historical Sea-Level Rise

Understanding trends in sea level and the relationship between global and local sea level provides critical information about the impacts of Earth's climate on our oceans. Changes in sea level are directly linked to a number of atmospheric and oceanic processes such as global temperatures, hydrologic cycles, coverage of glaciers and ice sheets, and storm frequency and intensity.

Ocean levels have always fluctuated with changes in global temperatures. During the ice ages, when the Earth was 9 °F (5 °C) colder than today, much of the ocean's water was frozen in glaciers and the sea level often was more than 300 ft below the present level. Conversely, during the last interglacial period (100,000 years ago) when the average temperature was about 2 °F (1 °C) warmer than today, the sea level was approximately 20 ft higher than the current sea level (Titus 1989). Sea level has risen more than 4.7 in since the peak of the last ice age (about 20,000 B.P.) and by 0.039 to 0.078 in per year during the 20th century. The rate of global sea-level rise since 1963 is estimated at 0.070 in per year. There is high confidence that the rate of observed sea-level rise was greater in the 20th century than in the 19th century.

2.3.4.1 Apalachicola Bay

A monitoring station located near Apalachicola Bay has more than 40 years of tidal data. Oceanographic and geologic conditions at the station are comparable to those of the bay. The rate of sea-level rise along the Gulf Coast near Apalachicola, Florida, was about 0.05 in per year from 1970 to 2010 (NOAA 2010).

2.4 Land Use

This section summarizes the land use in the ACF Basin and around each USACE project in the basin. A *project* is the dam and the associated reservoir (e.g., Buford Dam and Lake Lanier). The focus of the land use analysis is on the project land over which USACE has proprietary or managerial jurisdiction, and the immediately adjacent land. The Proposed Action to manage project pool levels and flow requirements could change lake levels, affecting the project shoreline and the adjacent land; therefore, the project land and the adjacent public or private land is the ROI for land use. This section presents a description of the ACF Basin as a whole followed by descriptions by project, running from north to south in the basin. Geographic information system data, maps, and shoreline management plans have been used to identify and define the land use in the ACF Basin and around each project.

2.4.1 Apalachicola-Chattahoochee-Flint River Basin

2.4.1.1 Current ACF Basin Land Use

ACF Basin land use has been compiled from the Georgia Land Use Trends 2008 data. The Georgia Land Use Trends 2008 data set addresses the entire ACF Basin, including areas in Alabama and Florida. The major land cover uses are categorized as beaches/dunes/mud, water, developed, barren land, forested land, golf courses, pasture and row crops (i.e., agricultural), and wetlands. The overall proportions of these land cover categories in the ACF Basin are illustrated in Figure 2.4-1, and the acreages associated with these land cover categories are listed in Table 2.4-1.



Basin Land Use

Figure 2.4-1

Source: GLUT 2008.

Table 2.4-1.
ACF Basin Current Land Use

Land use classification	Acres	Percent of total acreage
Beaches/Dunes/Mud	30,595	0.2%
Water	372,427	3%
Developed (urban or built-up land)	1,423,097	11%
Barren	571,492	4%
Natural forested upland (forested lands)	6,229,859	48%
Golf Courses	2,067	0.02%
Pasture and Row Crop	2,753,559	21%
Wetlands	1,712,139	13%
Total Basin	13,095,236	100%

Source: GLUT 2008

- *Beaches, dunes, and mud* account for less than 1 percent of the ACF Basin. Roughly 30,600 ac of the basin includes open sand, sandbars, sand dunes, and mud as natural environments as well as exposed sand from dredging and other activities (GLUT 2008).
- *Water* includes lakes, rivers, ponds, ocean, industrial water, and aquaculture (GLUT 2008). As shown in Table 2.4-1, water covers 372,427 ac or almost 3 percent of the ACF Basin.
- *Developed land* is urban or built-up land, which includes residential, commercial, institutional, industrial, transportation (e.g., roads, railways, airports), and recreational land uses (GLUT 2008). Developed land accounts for more than 1.4 million ac or almost 11 percent of the ACF Basin. The largest developed areas in the basin are the metropolitan area of Atlanta, Georgia, near the Chattahoochee River in the northern portion of the ACF Basin; Columbus, Georgia (the third-largest city in Georgia) along the Chattahoochee River in the central portion of the basin; and Albany, Georgia, the largest city on the Flint River in the southeastern portion of the basin.
- *Barren lands* include areas of exposed rock and soil from industrial uses, gravel pits, landfills, rock outcrops, and mountain tops (GLUT 2008). Barren lands cover approximately 571,500 ac and account for about 4 percent of land use in the ACF Basin.
- The *forested* land use category includes deciduous forest (i.e., tree species that shed foliage in response to seasonal change), evergreen forest (i.e., tree species that maintain their foliage all year), and mixed forest. Forested land is the predominant land use in the ACF Basin, accounting for more than 6.2 million ac or about 48 percent of land use.
- *Pasture and row crops*—or agricultural— is the second most predominant land use in the ACF Basin, accounting for about 2.8 million ac or 21 percent of land use. This land use category includes row crops, orchards, vineyards, groves, horticultural businesses, pasture, and nontilled grasses (GLUT 2008).
- *Wetlands* include forested, salt marsh, brackish, and freshwater marsh wetlands (GLUT 2008). Wetlands account for more than 1.7 million ac or about 13 percent of ACF Basin land use.

The ACF Basin includes nearly 1.5 million acres of national and state parks, historic parks, and national forest lands (Table 2.4-2).

Table 2.4-2.
National and State Parks in the ACF Basin

Facility Name	County, State	Area (acres)
National Park and Historic Areas		
Andersonville National Historic Site	Macon/Sumter, GA	44
Chattahoochee River National Recreation Area	Cobb/Forsyth/Fulton/Gwinnett, GA	714
Jimmy Carter National Historic Site	Sumter, GA	1
Kennesaw Mountain National Battlefield Park	Cobb, GA	267
State Parks		
Bainbridge State Park	Decatur, GA	1
Sweetwater Creek State Park	Douglas, GA	2,549
Chattahoochee State Park	Houston/Jackson/Seminole, GA/FL/AL	596
Chehaw State Park	Dougherty /Lee, GA	112
Don Carter State Park	Hall, GA	1,316
Fairchild State Park Area	Jackson/Seminole, GA/FL	168
Florence Marina State Park (Walter F. George Lake)	Stewart, GA	150
Franklin D. Roosevelt State Park	Harris/Meriweather, GA	9,049
George T. Bagby State Park & Lodge (Walter F. George Lake)	Clay, GA	700
Georgia Veterans State Park (Lake Blackshear)	Crisp, GA	1,308
John Gorrie State Museum (Apalachicola Bay)	Franklin, FL	1
Kolomoki Mounds State Park	Early, GA	1,294
Providence Canyon State Conservation Park	Stewart, GA	1,003
Florida Caverns State Park	Jackson, FL	1,306
Constitution Convention State Museum	Liberty, FL	13
Dead Lakes State Recreation Area	Gulf, FL	83
Fort Gadsden Historic Site	Franklin, FL	2,294
Seminole State Park	Seminole, GA	604
Senoia State Park	Coweta, GA	10
State Park-Forest Lands	Chambers/Jackson/Troup, AL/GA/FL	349
Smithgall Woods Conservation Area	White, GA	5,664
Sprewell Bluff State Park (on the Flint River)	Upson/Talbot, GA	1,372
Torreya State Park	Gadsden, FL	2,534
Three Rivers State Recreation Area	Jackson, FL	686
Lakepoint Resort State Park (Walter F. George Lake)	Barbour, AL	1,220
National Forest Lands		
Apalachicola National Forest	Franklin/Leon/Liberty/Wakula, FL	571,088
Chattahoochee National Forest	North Georgia	794,454

Sources: ASP 2011; Florida Park Service 2011; GSP 2011; USACE, Mobile District 1998a; USFS 2011.

2.4.1.2 Historic ACF Basin Land Use

Data on historic ACF Basin land use was available for 1992 from the USGS National Land Cover Database. Land-cover uses included categories such as water, developed, barren land, forested land, shrubland, pasture and row crop (i.e., agricultural), and wetlands. The overall proportions of these land-cover categories in the ACF River Basin as of 1992 are summarized in Table 2.4-3.

Table 2.4-3.
ACF Basin Historic Land Use (1992)

Land use classification	Acres	Percent of total acreage
Water	391,305	3%
Developed	411,427	3%
Barren	547,235	4%
Forested	7,193,632	55%
Shrubland/grassland/herbaceous	11,489	0.1%
Agricultural	3,021,904	23.%
Wetlands	1,490,838	11.%
Total Basin	13,067,830	100.%

Source: USGS NLCD 1992

Direct comparison of the 1992 land-cover data with the 2001 data is not recommended. Each data set was mapped with different methods and slightly different classes. The differences in classifications, combined with the final accuracy of the mapping, result in two distinct products. The typical result of direct comparison will result in a change map showing a difference between mapping methods rather than real change on the ground (USGS NLCD 2009).

As of 1992, forested land, which includes evergreen, deciduous, and mixed forest, accounted for the largest percentage (55 percent) of total land in the basin. Agricultural land use represented the next highest percentage of total acreage, accounting for 23 percent, and includes pasture and hay areas; row crops; and orchards, vineyards, and other planted areas. Wetlands were 11 percent of total acreage. Barren land accounted for 4 percent of total land acreage and included barren land of rock, sand, or clay; quarries, strip mines, or gravel pits; and transitional areas of sparse vegetative cover. Developed land—which includes residential, commercial, industrial, transportation, and urban/recreation grasses (e.g., parks, lawns, golf courses, and airport and industrial site grasses)—and water each accounted for 3 percent of ACF Basin land use. The smallest percent of total acreage (less than 1 percent) was shrubland, grasslands, and herbaceous land (USGS NLCD 1992).

2.4.2 Buford Dam and Lake Lanier

The Buford Dam project is on the Chattahoochee River about 48 mi northeast of Atlanta, Georgia. At a normal summer lake level of 1,071 ft, the reservoir shoreline is 692 mi (see Appendix A, Appendix B – Buford Dam and Lake Sidney Lanier for pertinent project data). The Buford Dam and Lake Lanier occupy 58,007 ac—38,542 ac of water at normal summer pool (1,071 ft) and 19,465 ac of land (Rainey 2014). Land was acquired to elevation 1,085 ft to provide an area necessary for flood storage.

The USACE *Lake Sidney Lanier Shoreline Management Plan* allocates the lake's shoreline into four categories: prohibited access areas, protected areas, public recreation, and limited development for shoreline and reservoir access. These shoreline land use allocations are described in the following paragraphs.

- *Prohibited access land* protects certain project operation areas for public safety reasons. No shoreline use permits or licenses are issued for these areas. This land is in proximity of the dam and spillway. Less than 1 percent of the lake's shoreline is categorized as prohibited access (USACE, Mobile District 2004).
- *Protected shoreline areas* are designated to preserve the scenic appeal of a reservoir that has become urban; to avoid conflict between public and private uses; to protect fish and wildlife habitat; to protect cultural, historical, and archaeological sites; to protect federally listed

threatened and endangered species; to protect navigation channels; to restrict placement of floating facilities in areas too shallow for navigation or too exposed to winds and currents; and to protect natural formations and vistas. Protected areas account for about 32 percent of Lake Lanier's shoreline. Shoreline use permits or licenses are not issued for protected shoreline areas, but passive recreational use is permitted provided that aesthetic, environmental, historical, and natural resources are not damaged (USACE, Mobile District 2004).

- *Public recreation areas* are specifically designated for public recreational development and use, such as campgrounds, day-use parks, primitive or natural areas, and marine services. No permits for private uses are issued in public recreation areas. Public recreation accounts for 21 percent of the lake's shoreline (USACE, Mobile District 2004). USACE manages a number of recreation areas around the reservoir with picnic and camping sites, playgrounds, swimming areas, hiking trails, a fishing dock, and boat ramps (USACE 2008). Hunting is permitted around the reservoir in USACE-managed areas but is generally limited to waterfowl only. At the north end of the reservoir is the Georgia DNR 1,300 ac Don Carter State Park. The park has campsites, a beach, picnic shelters, trails, and a boat dock (GADNR 2014a). Recreational facilities associated with Lake Lanier also include marinas, boat ramps, picnic areas, playgrounds, golf courses, and campgrounds operated by county, city, or other organizations through outgrant arrangements with USACE. USACE leases the land to the county or city governments or other organizations that operate the facilities (USACE 2006, 2008).
- The last shoreline allocation category, *limited development*, allows for USACE to permit specific private uses of public lands along the reservoir shoreline. Limited development accounts for 47 percent of the shoreline. Certain private uses (e.g., floating or land-based facilities such as boat docks, picnic shelters, walkways) may be authorized in these areas if a permit is obtained from USACE. These facilities provide reservoir access to private property owners who have land adjoining the project land. Such personal property is not for public use; however, pedestrian traffic and general public use of the reservoir and shoreline cannot be restricted by permit holders (USACE, Mobile District 2004). Per the *Lake Sidney Lanier Shoreline Management Plan*, the maximum number of docks allowed on the reservoir is 10,615 (USACE, Mobile District 2004). As of July 3, 2014, USACE has 10,559 permit equivalents issued with 56 permit equivalents remaining; however, if USACE has any voided permits, the remaining number of permits could increase accordingly (Noe 2010, 2014, personal communications).

The area around Lake Lanier is a popular vacation and retirement area and essentially serves as a suburb of Atlanta, Georgia. This area is heavily developed for residential use with some commercial establishments such as hotels, resorts, and golf courses. The lower lake, which is closest to Atlanta, has the highest density development; however, development around the upper reservoir is continuing and almost equals that of the lower lake.

2.4.3 The Chattahoochee River National Recreation Area

The CRNRA (which is also discussed in section 2.1.1.2.4.5) was established in 1978 by an act of Congress which states the "natural, scenic, recreation, historic, and other values of a forty-eight-mile segment of the Chattahoochee River and certain adjoining lands in Georgia from Buford Dam downstream to Peachtree Creek are of special national significance, and that such values should be preserved and protected from developments and uses which would substantially impair or destroy them." The CRNRA, under the stewardship of the NPS, runs along 48 miles of the Chattahoochee River and consists of 10,000 ac. The park is in the northern suburbs of Atlanta and is surrounded by developing communities. The original park boundary of 6,300 ac was expanded to 6,800 ac in 1984 and then expanded again to 10,000 ac in 1999. Land use in the CRNRA is protected land for the preservation of natural and cultural resources to provide for the enjoyment of the public. Recreation uses at the CRNRA include picknicking, hiking, leisure walking, bike riding, horseback riding, rock climbing, nature

watching (e.g., birdwatching, wetlands exploration), fishing, paddling, and boating. The park also has an environmental education center and an NPS park headquarters and visitor contact station (NPS 2009, 2010).

2.4.4 West Point Dam and Lake

The West Point project is on the Chattahoochee River on the Alabama-Georgia state line, about 3 mi north of West Point, Georgia. At normal summer pool elevation of 635 ft, the reservoir shoreline is 604 mi (see Appendix A, Appendix E – West Point Dam and Lake for pertinent project data). The West Point project consists of 54,748 ac of land and water at normal summer level—25,864 ac of water and 28,884 ac of land (USACE 2008). The project land was acquired to a water surface elevation of 641 ft to provide an area necessary for flood storage. In some areas around the lake, land above the flood storage elevation was purchased to provide recreational areas, natural resource protection areas, and public access areas. This land acquisition provides a continuous area of land around the reservoir and above the flood control pool to ensure public access along the shore and to accommodate project-related activities (USACE, Mobile District 1993b).

USACE's *West Point Lake Shoreline Management Plan*, like the Lake Lanier plan, allocates the lake's shoreline into four categories: prohibited access areas, protected areas, public recreation, and limited development. Prohibited access land is in the proximity of the dam and spillway. Less than 1 percent of the lake's shoreline is categorized as prohibited access for public safety and project operation purposes. About 29 percent of West Point Lake's shoreline is designated as protected areas to reduce conflicts between public and private use and to protect or restore aesthetics, fish or wildlife habitat, cultural resources, or other environmental values. Public recreation is the largest shoreline category, accounting for 46 percent of the shoreline. The last category, limited development, accounts for 25 percent of the shoreline and allows for private walkways and docks to be constructed for shoreline and reservoir access, if properly permitted (USACE, Mobile District 1993b). USACE does not have a policy limiting the number of docks on West Point Lake; there are 715 permitted docks and boat shelters on the reservoir (Scott 2014, personal communication).

USACE manages a number of recreation areas around the reservoir with picnic and camping sites, playgrounds, swimming areas, hiking trails, a fishing dock, and boat ramps (USACE 2006). In addition, other private or public organizations manage recreation areas around the reservoir (on land leased from USACE). The facilities include camping sites, picnic areas, swimming areas, boat ramps, and marinas (USACE 2008). Hunting is permitted in a 10,000-ac wildlife management area operated by the Georgia DNR at the upper end of the reservoir (USACE, Mobile District 2010d). The Georgia DNR also manages two smaller areas on the lake, the Dixie Creek and the Lakeside Wildlife Management Areas.

The land bordering the West Point project land is primarily undeveloped land used for public recreation, with the exception of the southeast end of the lake. There is light-to-moderate residential development bordering the project near the city of West Point, Georgia, just south of the lake, and the city of LaGrange, Georgia, east of the lake.

2.4.5 Walter F. George Lock and Dam and Walter F. George Lake

The Walter F. George project is on the Chattahoochee River on the Alabama-Georgia state line, about 60 mi south of Columbus, Georgia. The project consists of 96,721 ac at normal summer level of 190 ft — 45,181 ac of water and 51,540 ac of land (purchased in fee simple) (see Appendix A, Appendix C – Walter F. George Lock and Dam and Lake for pertinent project data). At normal summer lake level, the reservoir shoreline is 640 mi, 318 mi of which are in an easement estate and 47 mi of which are within the Fort Benning Military Reservation. USACE purchased easements on some portions of private land surrounding the lake. The most common easements in place give USACE the authority to perpetually or

occasionally overflow, flood, and submerge property that lies below the easement. The acquired easement estate specifically prohibits structures for human habitation on this land and requires a permit for all other structures or improvements. The Fort Benning Military Reservation is at the northern end of the reservoir (USACE, Mobile District 2001).

The USACE *Walter F. George Lake Shoreline Management Plan*, like the Lake Lanier plan, allocates the lake's shoreline into four categories: prohibited access areas, protected areas, public recreation, and limited development. Prohibited access land is in the proximity of the dam, lock, and hydroelectric power generation structure. One percent of the lake's shoreline is categorized as prohibited access for public safety and project operation purposes. About 36 percent of the shoreline is designated as protected areas to protect or restore aesthetics, fish or wildlife habitat, cultural resources, or other environmental values; to protect channels for navigation; and to restrict structures from areas too shallow for navigation or too exposed to winds and currents. Public recreation accounts for 16 percent of the shoreline. These areas are designated for present or future intensive recreational development. The last category, limited development, accounts for 47 percent of the shoreline, and it allows for private structures or activities (e.g., docks, fixed piers, steps, walkways, vegetative modifications, utility rights-of-way) to be constructed on project land or waters, if properly permitted (USACE, Mobile District 2001).

USACE manages a number of recreation areas around the reservoir with picnic and camping sites, playgrounds, swimming areas, hiking trails, fishing docks, and boat ramps. Within the Walter F. George project area, there are also state, county, or privately operated recreation areas (on land leased from USACE) with camp sites, lodging, picnic areas, hiking trails, playgrounds, swimming areas, fishing facilities, boat ramps, and marinas (USACE 2008). Alabama operates the Lakepoint State Park, and Georgia operates the George T. Bagby State Park through outgrant arrangements with USACE. The USFWS owns and operates the 11,000-ac Eufaula NWR in the northern reaches of the reservoir on the project's Alabama shoreline and some limited acreage on the Georgia side north of Soapstone Creek (USFWS 2009a).

Land use bordering the Walter F. George project land is a mix of residential, commercial, recreational, farmland, and military land (Fort Benning). The highest density development borders the central portion of the lake, where the project is bound by the cities of Eufaula, Alabama, on the west and Georgetown, Georgia, on the east. The lower portion of the reservoir is bordered primarily by residential, commercial, and recreational land use. The upper portion of the reservoir is bordered primarily by farmland.

2.4.6 George W. Andrews Lock and Dam and Lake

The George W. Andrews project is east of Columbia, Alabama, on the Alabama-Georgia state line. The reservoir extends up the Chattahoochee River about 28 mi to the Walter F. George Lock and Dam, remaining mostly within the original river banks. At normal summer lake level of 102 ft, the reservoir shoreline is 65 mi (see Appendix A, Appendix D – George W. Andrews Lock and Dam and Lake George W. Andrews for pertinent project data). The George W. Andrews project contains 2,815 ac at normal summer level—1,620 ac of water and 1,195 ac of land (USACE 2006).

USACE does not have a shoreline management plan for George W. Andrews Lake as it is a run-of-river project and most of the land around the reservoir is in easement (Jernigan 2010, personal communication).

USACE manages several recreation areas around the reservoir with picnic sites, fishing sites, and boat ramps. In addition, other private or public organizations to operate recreation areas around the reservoir with campsites, boat ramps, and picnic areas. There are no marinas on George W. Andrews Lake (USACE 2008).

The land bordering the George W. Andrews project land is primarily farmland or undeveloped forested or open land. There are a few private residences on the Alabama side, just east of Columbia, Alabama.

2.4.7 Jim Woodruff Lock and Dam and Lake Seminole

The Jim Woodruff project is on the Apalachicola River, just below the confluence of the Chattahoochee and Flint rivers, and 1.5 mi northwest of Chattahoochee, Florida. At normal summer lake level of 77 ft, the reservoir shoreline is 532 mi (see Appendix A, Appendix A – Jim Woodruff Lock and Dam and Lake Seminole for pertinent project data). The Jim Woodruff project consists of 97,572 ac at normal summer level—37,500 ac of water and 60,072 ac of land (purchased in fee simple). USACE purchased easements on some portions of private land surrounding the lake. The easements give USACE the authority to perpetually or occasionally overflow, flood, and submerge land within certain elevations (USACE, Mobile District 1995).

USACE's *Shoreline Management Plan—Lake Seminole*, like the Lake Lanier plan, allocates the lake's shoreline into prohibited access areas, protected areas, public recreation, and limited development. Prohibited access land is in the proximity of the dam, lock, and hydroelectric power generation structure. Less than 1 percent of Lake Seminole's shoreline is categorized as prohibited access for public safety and project operation purposes. The largest land use category at Lake Seminole is protected shoreline, with about 60 percent designated to protect or restore aesthetic values, fish or wildlife habitat, cultural resources, or other environmental values; to protect channels for navigation; and to restrict structures from areas too shallow for navigation or too exposed to winds and currents. No permits for new private structures or utilities are authorized in protected shoreline areas. Public recreation accounts for 19 percent of the shoreline. No permits are issued for private uses in these areas because they are specifically designated for present or future intensive public recreational development. The last category, limited development, accounts for 20 percent of the shoreline and allows for private structures to be built or activities to be conducted (e.g., docks, steps, walkways, vegetative modifications, utility rights-of-way) on Jim Woodruff project land or waters, if a permit is obtained (USACE, Mobile District 1995). USACE does not have a policy limiting the number of docks on Lake Seminole; there are 912 permitted docks on the reservoir (Timmons 2014, personal communication).

USACE manages a number of recreation areas around the reservoir with picnic and camping sites, hiking trails, fishing docks, and boat ramps (USACE 2008). Within the Jim Woodruff project land, there are also state, county, or privately operated recreation areas (on land leased from USACE). The facilities include camp sites, lodging, picnic areas, hiking trails, playgrounds, swimming areas, fishing areas, boat ramps, and marinas (USACE 2008). There are two state parks on the lake—Seminole State Park in Georgia and Three Rivers State Park in Florida. Seminole State Park, operated by Georgia DNR, is 604 ac in the northern reaches of the lake. Three Rivers State Park, operated by the Florida Park Service, is 686 ac along the western shoreline of the reservoir (Florida Park Service 2006). The Apalachee Wildlife Management Area along the western shore of the reservoir in Florida and various tracts in Georgia is managed by the respective states as game management areas (USACE, Mobile District 2010e).

The land bordering the Jim Woodruff project is characterized by a mix of residential, commercial, recreational, undeveloped forested land, farmland, and institutional (state correctional facility) land uses. The highest density residential and commercial development is in the central portion of the reservoir on the northern and southern shores near Chattahoochee, Florida.

2.4.8 Non-USACE-Owned Dams

As discussed in more detail in section 2.1.1.1.6, there are 11 dams in the ACF Basin that are not owned or operated by USACE. GPC owns and operates seven of the projects on the Chattahoochee River: Morgan Falls, Langdale, Riverview, Bartletts Ferry, Goat Rock, Oliver, and North Highlands. The City Mills Dam

and the Eagle-Phenix Dam were downriver on the Chattahoochee from the North Highlands Dam and both owned by Columbus, Georgia. The dams were removed for aquatic ecosystem restoration under the USACE section 206 program in cooperation with the city of Columbus and other partners. The Eagle-Phenix Dam was removed in 2012, and the City Mills Dam removal was completed in 2013. Lake Blackshear Dam, owned and operated by the Crisp County Power Commission, impounds the Flint River near Warwick, Georgia. GPC also operates one project, the Flint River (or Lake Worth) Dam, on the Flint River. GPC maintains shoreline management guidelines to manage all shoreline property within its project boundaries. Adjacent landowners must receive a GPC permit before conducting any construction, renovation, clearing, tree removal, or grading on GPC land. The objective of this management approach is to have a consistent position on lakeside development and to protect the environmental and aesthetic qualities of the lakes (GPC 2008).

- ***Morgan Falls and Bull Sluice Lake.*** The Morgan Falls project is in Roswell, Georgia, just north of Atlanta, on the Chattahoochee River. The project reservoir, Bull Sluice, has 580 ac of surface area at full pool and 13 mi of shoreline (see Appendix A for pertinent project data). The predominant land uses in the vicinity of the project are residential, commercial, and forest or open space. Privately owned residential homes with docks line most of the shoreline. A country club with a golf course is on the eastern shore of the reservoir just upstream from the dam. Three land units of the Chattahoochee River National Recreation Area, managed by NPS, border the reservoir. These recreation areas are used for the preservation and protection of natural, scenic, recreation, historic, and other values of special national significance (GPC 2004).
- ***Langdale Dam.*** Langdale Dam has a small reservoir (152 ac of surface area at full pool) that remains mostly within the original river banks (see Appendix A for pertinent project data). The project is in the city of Valley, Alabama, on the Chattahoochee River, downriver from the USACE West Point Dam. At this point, the river forms the boundary between Alabama and Georgia. The primary land use on the Georgia side of the project is undeveloped forested land, and on the Alabama side is the city of Valley with residential, commercial, institutional, and recreational development. The city of Valley is planning to revitalize the former Langdale Textile Mill, which is on the Alabama riverbank next to the dam, into a mixed-use facility.
- ***Riverview Dam.*** The Riverview Dam, about 1 mi downstream on the Chattahoochee River from the Langdale Dam, has a small reservoir (75 ac of surface area at full pool) contained mostly within the original riverbanks (see Appendix A for pertinent project data). As with the Langdale Dam, the predominant land use on the Georgia side of the project is undeveloped forested land, and on the Alabama side is the city of Valley with residential, commercial, institutional, and recreational development. The Riverdale Textile Mill, no longer in operation, is on the Alabama riverbank next to the Riverview Dam. The city of Valley is planning to revitalize this mill into a mixed-use facility.
- ***Bartletts Ferry Dam and Lake Harding.*** The Bartletts Ferry project is on the Chattahoochee River on the border of Alabama and Georgia. The project is about 14 mi north of Columbus, Georgia, and 20 mi south of the USACE West Point project. The reservoir has a surface area of 5,850 ac at full pool and 156 mi of shoreline (see Appendix A for pertinent project data). GPC owns and manages 3,200 ac of forest adjacent to the reservoir and leases an additional 4,800 ac in the upper reaches of the reservoir to the Georgia DNR for use as the Blanton Creek Wildlife Management Area. All project lands are available for public recreation and access and provide a reservoir buffer for aesthetics, wildlife habitat, and water quality protection. GPC leases 1,080 parcels of land adjacent to the project shoreline for private residential land use (GPC 2009).
- ***Goat Rock Dam and Lake.*** The Goat Rock project is on the Chattahoochee River on the border of Alabama and Georgia. The project is about 10 mi north of Columbus, Georgia. Goat Rock Lake has a surface area of 1,050 ac and 25 mi of shoreline (GPC 2010b; see Appendix A for pertinent project data). The predominant land use in the vicinity of the project is undeveloped

forested or open land. The Goat Rock Marina and Goat Rock Recreation Area provide public recreation access. There is some light residential development on the Alabama and Georgia shorelines, primarily in the lower portion of the reservoir near the dam.

- ***Oliver Dam and Lake.*** The Oliver project is north of the city of Columbus, Georgia, on the Chattahoochee River bordering Alabama and Georgia. Oliver Lake has a surface area of 2,150 ac and 40 mi of shoreline (GPC 2010c; see Appendix A for pertinent project data). Predominantly residential land use borders the lake's southern half, with undeveloped open or forested land bordering the lake's northern half. A country club with a golf course is on the southeast shore of the lake. The Standing Boy Creek State Park, operated by the Georgia DNR, is at the northern end of the reservoir on the eastern shore.
- ***North Highlands Dam.*** The North Highlands Dam impounds Bibb Pond, which has a surface area of 131 ac and 3 mi of shoreline (GPC 2010d; see Appendix A for pertinent project data). The project is in Bibb City, Georgia, just north of Columbus, on the Chattahoochee River. Across the river is Phenix City, Alabama. Land use bordering the project is high-density residential, commercial, and industrial.
- ***City Mills Dam and Eagle-Phenix Dam.*** The City Mills and the Eagle-Phenix dams were on the Chattahoochee River between Columbus, Georgia, and Phenix City, Alabama. USACE, in conjunction with Columbus and Phenix City, breached the Eagle-Phenix Dam in March 2012 and the City Mills Dam in March 2013 for aquatic ecosystem restoration under the USACE section 206 program, and created the opportunity for recreational use of the river such as urban kayaking and whitewater rafting. The land use adjacent to the City Mills and the Eagle-Phenix dams is high-density residential, commercial, and industrial.
- ***Lake Blackshear Dam.*** Lake Blackshear Dam is on the Flint River in southwest Georgia about 25 mi northeast of Albany, Georgia. The dam impounds an 8,700 ac reservoir with 77 mi of shoreline (see Appendix A for pertinent project data). The land use around the project is a mix of residential, farmland, and undeveloped forested land. The Crisp County Power Commission implemented a lakeshore management plan that includes a pier and dock permit program, a public information program, and recreational and wildlife conservation programs in cooperation with other state and local entities. The intent of these programs is to ensure that the scenic, environmental, and recreational aspects of Lake Blackshear are maintained and preserved for use by the public. There are a number of public recreation areas around the lake, including boat ramps, county parks, and the Georgia Veterans State Park (1,300 ac), operated by the GADNR. Recreational facilities include cottages for rent, campsites, and picnic areas, swimming beaches, boat ramps, and fishing docks (CCPC 2010).
- ***Flint River (or Lake Worth) Dam.*** The Lake Worth project is in Albany, Georgia, on the Flint River. It is operated by the GPC. The reservoir has a surface area of 1,400 ac and 36 mi of shoreline (GPC 2010e; see Appendix A for pertinent project data). Land use along the lake's shoreline is a mix of commercial development (e.g., lodging facilities), residential, and undeveloped land. Recreational facilities at the reservoir include boat ramps, fishing piers, picnic areas, and swimming beaches.

2.5 Biological Resources

This section addresses the flora and fauna of the ACF Basin with an emphasis on the vegetative communities surrounding the mainstem of the Chattahoochee and Apalachicola rivers. Current conditions of the biological resources are described for the area and include vegetation resources/wetlands, wildlife resources, fish and aquatic resources, protected species, and fish and wildlife management facilities. All of these biological resources are components of the communities and ecosystems where they survive and reproduce. It is important to recognize that divisions between and among ecosystems and ecosystem types

are artificial, and some of the most important ecological processes—from aquatic to riparian to terrestrial—operate across these boundaries (Bailey 1996; Hunter 1997). Riparian zones form the interface between the aquatic and terrestrial components of the landscape and, therefore, protect and enhance many important ecological connections. The terrestrial forests in the riparian zones of the southeastern U.S. are among the most biologically productive in the world, due largely to the temperate climate, long growing season, nutrient input from flooding, productive soils, and abundance and diversity of plant and animal communities (Dickson and Warren 1993). As these relationships become more widely recognized, so does the importance of documenting and maintaining multidimensional connectivity (i.e., longitudinal, lateral, and vertical) among the components of the ecosystems for effective watershed management (Allan 2004; Cote et al. 2009; Cloern 2007; Fausch et al. 2002; Freeman et al. 2007; Kondolf et al. 2006; Pringle 2001; Thorp et al. 2006; Ward 1989; Weins 2002).

2.5.1 Vegetation Resources Affected Environment

This section discusses the terrestrial vegetation communities in the basin, as well as freshwater and estuarine wetland communities. The descriptions of terrestrial habitats along the ACF Basin are largely based on information from Martin et al. (1993) and Jordan, Jones, & Goulding, Inc. (2000).

2.5.1.1 Terrestrial Communities

The ACF Basin contains parts of the Blue Ridge, Piedmont, and Coastal Plain ecoregions. The headwaters of the Chattahoochee River in parts of Lumpkin, White, and Habersham counties in Georgia are in the Blue Ridge ecoregion. The river passes through the Piedmont ecoregion from north of Lake Lanier to Columbus, Georgia. The Fall Line, the topographic demarcation between the Piedmont and Coastal Plain ecoregions, passes just south of Columbus. From Columbus to the Gulf of Mexico, the Chattahoochee River flows through the Coastal Plain ecoregion. By spanning these three major ecoregions, each relatively distinct from the other two and internally homogenous, the ACF Basin is rich in biological diversity.

The ACF Basin contains a variety of native terrestrial vegetative communities, from the Appalachian oak forest in the Blue Ridge ecoregion to the oak-hickory and oak-hickory-pine forests of the Piedmont and the bottomland hardwood swamp along the Apalachicola River in Florida (Jordan, Jones, & Goulding, Inc. 2000; Martin et al. 1993). In addition, areas modified for agriculture, forestry, and development contain their own distinct vegetative assemblages. The dominant terrestrial communities along the rivers are described briefly below.

2.5.1.1.1 Appalachian Oak Forests

The Appalachian oak forests in the ACF Basin are limited to the Blue Ridge ecoregion in north-central Georgia and the northernmost headwaters of the Chattahoochee River. Dominant canopy species in these forests include deciduous oaks (*Quercus* spp.), hickories (*Carya* spp.), buckeyes (*Aesculus* spp.), and magnolias (*Magnolia* spp.), as well as evergreen species. Specific species found on drier slopes and ridges in Appalachian oak forests include chestnut oak (*Quercus prinus*), northern red oak (*Q. rubra*), southern red oak (*Q. falcata*), white oak (*Q. alba*), black oak (*Q. velutina*), blackjack oak (*Q. marilandica*), pignut hickory (*Carya glabra*), sand or pale hickory (*C. pallida*), mockernut hickory (*C. tomentosa*), and tulip poplar (*Liriodendron tulipifera*). Also present are pitch pine (*Pinus rigida*) and red maple (*Acer rubrum*). The subcanopy typically includes saplings of the canopy species, as well as shrub species such as mountain laurel *(Kalmia latifolia*), various azaleas (*Rhododendron* spp.), blueberries (*Vaccinium* spp.), strawberry-bush (*Euonymus americanus*), and sweet-shrub (*Calycanthus floridus*). Wildflowers found on dry sites include asters (*Aster* spp.), violets (*Viola* spp.), trilliums (*Trillium* spp.), yellow star-grass (*Hypoxis hirsuta*), and spiderwort (*Tradescantia ohiensis*). The oak-hickory forests of the Piedmont

ecoregion are very similar in composition to the Appalachian oak forests of the Blue Ridge ecoregion, with the primary difference being the flatter topography of the Piedmont ecoregion. Many consider these oak-hickory forests the climax community for the Piedmont ecoregion (Wharton 1978).

Sites on very rich soil slopes typically have more moisture and are dominated by red maple, American beech (*Fagus grandifolia*), basswood (*Tilia herterophylla*), hickories, tulip poplar *(Liriodendron tulipifera)*, white ash (*Fraxinus americana*), and eastern hemlock (*Tsuga canadensis*). Shumard's oak (*Quercus shumardii*), yellow buckeye (*Aesculus flava*), cucumber tree (*Magnolia acuminata*), and Fraser's magnolia (*M. fraseri*) also occur on these sites. Mountain-like microclimates often form on steep slopes and ravines in the Piedmont ecoregion and support oak-hickory forests that are similar to the Appalachian oak forests of moist sites in the Blue Ridge ecoregion (Jordan, Jones, & Goulding, Inc. 2000).

The moist, rich slopes often associated with the Blue Ridge ecoregion and the steep slopes and ravines in the Piedmont ecoregion support a wide variety of wildflowers, ferns, and shrubs (Jordan, Jones, & Goulding, Inc. 2000). Rhododendrons, azaleas, and mountain laurel are common shrubs on moist sites in the Appalachian oak forest, and include the species mountain rosebay (*Rhododendron catawbiense*), rosebay rhododendron (*R. maximum*), dwarf rhododendron (*R. minus*), flame azalea (*R. calendulaceum*), and mountain laurel. Other shrubs in these forests include bush honeysuckle (*Diervilla sessilifolia*), spice bush (*Lindera benzoin*), sweet shrub (*Calycanthus floridus*), mountain pepperbush (*Clethra acuminata*), and red buckeye (*Aesculus pavia*). Some of the wildflower species occurring in this area are trout-lily (*Erythronium americanum*), violets, trilliums, bee-balm (*Monarda didyma*), blood root (*Sanguinaria canadensis*), mountain jewelweed (*Impatiens pallida*), giant chickweed (*Stellaria pubera*), fire pink (*Silene virginica*), and false Solomon's seal (*Smilacina racemosa*). Ferns in these communities include maidenhair fern (*Adiantum pedatum*), southern lady fern (*Athyrium filix-femina*), marginal shield fern (*Dryopteris marginalis*), broadbeech fern (*Phegopteris hexagonoptera*), mountain spleenwort (*Asplenium montanum*), and New York fern (*Thelypteris noveboracensis*).

2.5.1.1.2 Oak-Hickory-Pine Forests

Oak-hickory-pine forests are the most abundant native vegetative community in the ACF Basin (Martin et al. 1993). This forest type can be found throughout the area occupied by the Chattahoochee River in central and western Georgia. The community type is similar in composition to the Appalachian oak forest communities on drier sites; the major difference is the occurrence of pine species (Jordan, Jones, & Goulding, Inc. 2000). Pine species typical of the oak-hickory-pine forest include shortleaf pine (*Pinus echinata*) and loblolly pine (*P. taeda*). The dominant deciduous canopy species in the oak-hickory-pine forests of the uplands are white oak, northern red oak, post oak (*Quercus stellata*), several hickories, tulip poplar, persimmon (*Diospyros virginiana*) and eastern red cedar (*Juniperus virginiana*). In areas managed primarily for forestry products, dominant canopy species are often limited to loblolly and short-leaf pine. Subcanopy species in the upland forests typically include flowering dogwood (*Cornus florida*), sourwood (*Oxydendrum arboreum*), eastern redbud (*Cercis canadensis*), shadbush (*Amelanchier canadensis*), black gum (*Nyssa sylvatica*), American holly (*Ilex opaca*), blackberries (*Rubus* spp.), viburnums *(Viburnum* spp.), sumacs (*Rhus* spp.), greenbriars (*Smilax* spp.), grapes (*Vitis* spp.), and Japanese honeysuckle (*Lonicera japonica*).

The oak-hickory-pine community type in the Piedmont ecoregion is similar in composition to that of the Blue Ridge ecoregion; the major difference is the occurrence of pine species (Jordan, Jones, & Goulding, Inc. 2000). Pine species typical of the community type in the Piedmont ecoregion include Virginia pine (*Pinus virginiana*) and white pine (*P. strobus*), as well as the shortleaf pine and loblolly pine found in the Blue Ridge communities.

A special area referred to as the *Pine Mountain District* is on the border of the Piedmont and Coastal Plain ecoregions on Pine Mountain (Jordan, Jones, & Goulding, Inc. 2000). The area is typified by quartzite caps along ridges from Alabama east into Georgia. Stretching from the Chattahoochee River to the Flint River, Pine Mountain has been characterized as a pine-hardwood xeric ridge and slope forest. The vegetation of the district consists of shortleaf pine, blackjack oak, rock chestnut oak (*Q. montana*), Piedmont azalea (*Rhododendron canescens*), and low-bush blueberry (*Vaccinium pallidum*).

2.5.1.1.3 Rock Outcrop Communities

Rock outcrop communities are highly specialized plant communities associated with either granite or limestone outcrops (Martin et al. 1993). The ACF Basin contains small areas of both communities. These plant communities are found in areas that lack sufficient soil to support large shrubs or trees, thus maintaining communities dominated by herbaceous species. Because of the temperature and moisture extremes associated with rock outcrop areas, a number of different vegetative communities have evolved to take advantage of the varying moisture and soil conditions. Each of these communities is composed of a unique assemblage of plants, although some species can be found in more than one community type. Many of these outcrop-adapted plant species are either officially protected or considered rare where they are found, and many are classified as endemic.

2.5.1.1.4 Grass-Dominated Communities

The grass-dominated communities in the ACF Basin are limited to the middle Chattahoochee River in Alabama, in an area called the *Black Belt* (Martin et al. 1993). These communities are typically dominated by little bluestem (*Andropogon scoparius*), although 58 other herbaceous species have been documented in the remnant Black Belt grasslands in Alabama. Although occasionally invaded by sweet gum and eastern red cedar, the remnant grass-dominated communities are maintained by periodic droughts, floods, and burns that prevent most tree and shrub species from becoming established.

2.5.1.1.5 Longleaf Pine-Turkey Oak Sand Hill Community

The longleaf pine-turkey oak sand hill community is common in the lower portions of the Apalachicola River Basin. The dominant plant species in this community are typically longleaf pine (*Pinus palustris*), turkey oak (*Quercus laevis*), bluejack oak (*Q. incana*), mockernut hickory, flowering dogwood, and wiregrass (*Aristida stricta*). This community is typically maintained by periodic burns. In areas where longleaf pine has been selectively removed, turkey oak and mockernut hickory dominate the canopy. Fire-intolerant species, such as magnolia and holly, can invade areas that do not burn regularly.

2.5.1.1.6 Maritime Shrub Community

The maritime shrub community is limited to the coastal areas of Alabama and Florida. This community type is typically divided into two subcommunities—dune oak-buckthorn and oak scrub—that can be distinguished by their dominant canopy species and typical location along the coast. The dune oak-buckthorn community typically occurs on the tops and landward slopes of dunes. The canopy of this community is typically composed of live oak (*Quercus virginiana*), tough buckthorn (*Bumelia tenax*), red bay (*Persea borbonia*), slash pine (*Pinus elliotii*), and loblolly pine. Understory species include saw palmetto (*Serenoa repens*), Hercules club (*Zanthoxylum clava-herculis*), myrtle (*Myrica* spp.), yaupon (*Ilex vomitoria*), rusty lyonia (*Lyonia ferruginea*), muscadine grape (*Vitis rotundifolia*), laurelleaf briar, pepper-vine (*Ampelopsis arborea*), and juveniles of the dominant canopy species.

Evergreen maritime forests are found along the coast in Alabama. These forests are dominated by sweetbay magnolia (*Magnolia virginiana*), laurel oak, and live oak. Subcanopy species are often limited to juveniles of the dominant canopy species, red bay, cabbage palm (*Sabal palmetto*), and slash pine.

2.5.1.1.7 Ruderal Communities

People have profoundly affected the vegetation of the Piedmont region through agriculture and development. Anthropogenic (human-maintained) habitats, also referred to as *ruderal habitats*, occupy a large area along the Chattahoochee River in the Piedmont ecoregion, particularly in the Metro Atlanta (Jordan, Jones, & Goulding, Inc. 2000). Examples of ruderal habitats include residential yards, road rights-of-way, power line rights-of-way, and ballparks. Although not to the same extent as in the Piedmont ecoregion, people have also altered the vegetation in the Blue Ridge ecoregion. The development of extensive ruderal communities in the Blue Ridge ecoregion has been limited because of the steeply sloping channels characteristic of the northern extents of the Chattahoochee River.

2.5.1.2 Wetlands

Wetlands are transitional lands between terrestrial and deep-water habitats in which the water table is at or near the land surface or the land is covered by shallow water (Cowardin et al. 1979). *Palustrine wetlands* include all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens (e.g., freshwater marshes, swamps, bogs, fens, and wet prairies). *Estuarine wetlands* include deepwater tidal areas and adjacent tidal wetlands that are usually semienclosed by land but have access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land.

Estimates of the wetland acreage in the ACF Basin as a whole vary because of differences in the methods used to classify and inventory wetlands. The 2008 Georgia Land Use Trends (GLUT) indicates that 13 percent (1,711,561 ac) of the total basin is wetlands, including woody wetlands (GLUT 2008). A 1996 USGS study approximates 5 percent (633,600 ac) of the basin was wetlands in the 1970s (USGS 1996). Despite the differences in the classification methods of these two studies, the USFWS has assessed trends nationwide in wetland loss since the mid-1950s (Dahl 2000, 2006, 2011; Dahl and Johnson 1991; Frayer et al. 1983). The USFWS estimated that during that period in the U.S., 296,000 ac (5 percent) of the estuarine vegetated wetlands, 6.96 million ac (21 percent) of freshwater emergent wetlands, and 3.7 million ac (6.6 percent) of freshwater forested wetlands were lost to agriculture, urban development, and other land use and landcover conversions. Florida, including the Apalachicola Bay area, has frequently ranked high among states in loss of wetland acreage in the assessments.

Because of hilly topography, wetlands in the Blue Ridge and Piedmont ecoregions are small and scattered. Most wetlands of significant size are in the Coastal Plain ecoregion, and most of the wetland area in the ACF Basin is represented by forested palustrine wetlands in the floodplains of rivers. These riparian (river-associated) forested systems are often referred to as *bottomland hardwoods*. The riparian palustrine systems (inland wetlands without flowing water) in the ACF Basin also include small areas of nonforested wetlands such as marsh or shrub wetlands. The remaining wetland area consists of estuarine (estuary-associated) wetlands and the palustrine wetlands that occur along reservoirs (reservoir-associated). Estuarine wetlands constitute a relatively small percentage of the total wetland area within the basin; however, because of the economic value of the estuarine ecosystem to coastal communities in the basin, the potential environmental impacts on estuarine wetlands associated with reservoir operations are assessed in this EIS.

2.5.1.2.1 Freshwater Wetlands

The Piedmont ecoregion, because of its wider floodplains, has larger wetland systems along the Chattahoochee and Flint rivers than the Blue Ridge ecoregion (Jordan, Jones, & Goulding, Inc. 2000). Most of the wetlands in the Piedmont ecoregion consist of large forested, scrub-shrub, emergent, or combination floodplain wetlands. Seep wetland systems, however, still occur along slopes (Jordan, Jones, & Goulding, Inc. 2000). Seep wetland systems are often found on steep slopes where the groundwater penetrates the surface of the slope. These systems often discharge water downstream as surface water. The soil conditions in the Fall Line District produce seep wetlands that are driven by groundwater and extend to the tops of slopes (Jordan, Jones, & Goulding, Inc. 2000). They often support a variety of ferns and herbaceous species. The vegetation component often resembles that of Coastal Plain areas. Dominant species might include laurelleaf greenbrier (*Smilax laurifolia*), sweetbay magnolia, swamp tupelo (*Nyssa biflora*), red maple, titi (*Cyrilla racemiflora*), and wax-myrtle (*Myrica cerifera*). Other dominant species include swamp chestnut oak (*Quercus michauxii*), cane (*Arundanaria gigantea*), and cinnamon fern (*Osmunda cinnamomea*).

A variety of tree species can be found in the Piedmont ecoregion forested wetland systems (Jordan, Jones, & Goulding, Inc. 2000). The most common are red maple, American sweetgum (*Liquidambar styraciflua*), black willow (*Salix nigra*), overcup oak (*Quercus lyrata*), swamp chestnut oak, water oak (*Quercus nigra*), river birch (*Betula nigra*), sweetbay magnolia, and green ash (*Fraxinus pennsylvanica*).

Piedmont emergent and scrub-shrub wetlands are typically dominated by annual and perennial herbaceous species, though scrub-shrub wetlands have a shrub overstory (Jordan, Jones, & Goulding, Inc. 2000). Typical herbaceous vegetation includes broadleaf cattail (*Typha latifolia*), wool-grass (*Scirpus cyperinus*), redtop panic grass (*Panicum rigidulum*), soft rush (*Juncus effusus*), climbing hempweed (*Mikania scandens*), sallow sedge (*Carex lurida*), blunt broom sedge (*C. tribuloides*), sharp-winged monkey-flower (*Mimulus alatus*), fowl mannagrass (*Glyceria striata*), smartweeds (*Polygonum* spp.), and a variety of other sedges (*Carex* spp., *Rhynchospora* spp., *Eleocharis* spp.). The primary dominant shrub in scrub-shrub wetlands is tag-alder (*Alnus serrulata*). Other shrub species include spice bush, black willow, highbush blueberry (*Vaccinium corymbosum*), red chokeberry (*Aronia arbutifolia*), and Virginia-willow (*Itea virginica*).

The Apalachicola River floodplain is a vast wetland system of bottomland hardwood forests and tupelo-cypress swamps, the largest floodplain forest in Florida. Approximately 15 percent of the Florida portion of the Apalachicola River Basin is floodplain; the rest consists of wetland (palustrine, riverine, and lacustrine [reservoir-associated]) and terrestrial habitats (Florida State University, n.d.). The Apalachicola River of the north Florida panhandle is the state's largest river by discharge and the fourth-largest river in the southeastern U.S. (Stallins et al. 2010). The floodplain forest of the Apalachicola River is Florida's largest, and it has long been recognized for its tree species richness. Disturbances have been limited primarily to logging, which began during the lumber boom of 1870 to 1925 and has continued at a lower level to the present. The floodplain supports 47 tree species. The dominant tree species on high, infrequently flooded areas of floodplains are American sweetgum, sugarberry (*Celtis laevigata*), and American hornbeam (*Carpinus caroliniana*). Water hickory (*Carya aquatic*), overcup oak, diamond leaf oak (*Q. laurifolia*), and green ash increase in the low bottomland forest areas along the river. At the lowest elevations are the frequently inundated backswamps and their cover of water tupelo (*Nyssa aquatica*), Ogeechee tupelo (*N. ogeche*), swamp tupelo, bald cypress (*Taxodium distichum*), planer-tree (*Planera aquaticum*), and Pop or Florida ash (*Fraxinus caroliniana*) (Stallins et al. 2010).

Most of the floodplain wetland coverage of the Apalachicola River exists in the lower river delta, where the floodplain is the widest (Leitman et al. 1983). Dominant bottomland hardwood species include water tupelo, swamp tupelo, Ogeechee tupelo, bald cypress, Carolina ash, American sweetgum, and overcup oak. The upper floodplain is typically dominated by tupelo, American sweetgum, and cypress species.

The lower floodplain is characterized by coastal plain pine flatlands, coastal dunes, and freshwater and brackish marshes.

The Apalachicola River has one of the most productive floodplain forests found in warm, temperate regions (Elder and Cairns 1982). Nutrients and detritus carried from the floodplain by river floods contribute significantly to the relatively high productivity of Apalachicola Bay (Mattraw and Elder 1984). The species composition of the Apalachicola River floodplain forest is largely organized by the flood characteristics of the river, with the most flood-tolerant species dominating the most flood-prone areas. The floodplain is generally inundated annually for a period of 1 to 5 months, typically from January through April. If the flooding cycle were significantly and permanently altered, the species composition and age structure of the floodplain forest would change.

Plant species composition and wildlife use both vary along a gradient of flooding frequency and duration in the floodplain. As a habitat situated between uplands and the river, the floodplain serves as habitat for numerous wildlife species during certain life stages or certain seasons. Light et al. (1995) documented that at least 80 percent of Apalachicola River fish species use floodplain habitats, especially for spawning and foraging.

The composition of floodplain forests along the Apalachicola River has been changing during the last 30 to 40 years. The USGS found that the present-day forest composition along the river has shifted toward drier conditions compared to data collected in the 1970s (Darst and Light 2008). Although water discharge data show that the average discharge from the river from about 1930 to the present has remained steady, the seasonal distribution of flows has changed (Light et al. 2006; Stallins et al. 2010). Fall and winter discharges have increased and spring and summer discharges have decreased, with the greatest changes in February and April. Long-term changes in the monthly discharge in the Apalachicola River are a reflection of natural climatic changes and anthropogenic activities in the ACF Basin, including flow regulation, agricultural use, industrial/municipal water use, reservoir evapotranspiration, and increases in impervious surface area in the basin. With this drying trend, the hydrological connectivity between the main channel and floodplain habitats along the Apalachicola River has decreased, resulting in a shift of species composition in floodplain habitats (Stallins et al. 2010).

Consistent with Darst and Light (2008), Stallins et al. (2010) found that there was a decrease in obligate wetland tree species (such as water tupelo, Ogeechee tupelo, and Pop ash) along corridors in the Apalachicola River Basin that experience reduced frequencies of overbank flows because of large impoundments. Obligate wetland tree species, such as the overcup oak and green ash (*Fraxinus pennsylvatica*), were also found in reduced stands. Furthermore, they documented what seems to be reduced success in upland species becoming established at lower elevations when those areas are exposed to sustained high flows, often because of undersized impoundments. Maintenance of floodplain connectivity is critical not only to provide appropriate moisture regimes to vegetative communities in the surrounding landscape, but also ultimately to support the wildlife assemblages dependent on the vegetation for habitat and nutritional resources. The moisture and vegetative characteristics of terrestrial floodplains and riparian wetlands in the ACF Basin were changed by the initial hydromodification activity beginning over 50 years ago. Thus, it has been nearly the same length of time, at least, since the wildlife community could have been considered natural.

The Morgan Falls Project—a GPC project below Buford Dam and Lake Lanier on the Chattahoochee River—has a variety of wetland types that support species typical of the Piedmont region and can reasonably be expected to be typical of wetland areas in the Piedmont region of the basin (GPC 2005). The primary wetlands of the project are the vegetated palustrine wetlands, including the forested wetlands, scrub-shrub wetlands, and emergent wetlands. Dominant overstory vegetation in the forested wetlands includes black willow, river birch, red maple, black gum, and green ash. Dominant vegetation in the scrub-shrub wetlands includes black willow, button bush (*Cephalanthus occidentalis*), tag alder, and

silky dogwood (*Cornus ammomum*). Dominant species in the emergent wetlands, which occur mostly along shorelines and on islands, include sedges, common rush, seedbox (*Ludwigia* spp.), and smartweeds. The project also has areas of lacustrine wetlands and deepwater habitats, which are permanently flooded and lack persistent emergent vegetation, and riverine wetlands, which have no emergent vegetation. Surveys of the project conducted in 2002–2005 documented 35 species of aquatic macrophytes and two species of algae in the project's wetland habitats. Commonly observed aquatic macrophytes included Brazilian waterweed (*Egeria densa*), common rush, green arrow-arum (*Peltandra virginica*), hornleaf riverweed (*Podostemum ceratophyllum*), softstem bulrush (*Schoenoplectus tabernaemontani*), and broadleaf cattail. Six exotic species found in the project area included alligatorweed (*Alternanthera philoxeroides*), Brazilian waterweed, wartremoving herb (*Murdannia keisak*), parrot feather watermilfoil (*Myriophyllum aquaticum*), true forget-me-not (*Myosotis scorpioides*), and yellow flat (*Iris pseudacorus*).

The size and distribution of wetland communities associated with two reservoirs in the ACF Basin, Walter F. George Lake and Lake Seminole, were determined for the Comprehensive Study (Dove and Kress 1997). At Walter F. George Lake, 2,698 ac of wetland are supported at or below the normal pool elevation. Emergent wetlands constitute 31 percent of this total; forested wetlands, 28 percent; lacustrine littoral (reservoir edge) wetlands and various other types, 24 percent; and scrub-shrub wetlands, the remaining 17 percent. The normal pool elevation at this reservoir is 190 ft, and the top-of-dam elevation is 209 ft. There are approximately 1,653 ac of additional wetlands between the normal pool and top-of-dam elevations. A list of native vegetation typical of floodplains and wetlands for Walter F. George Lake contains species typical of the southeast Coastal Plain area: green ash, river birch, black gum, bald cypress, pond cypress (*Taxodium ascendens*), red maple, swamp chestnut oak, and black willow.

As of the September 2010 macrophyte survey in Walter F. George Lake, there are approximately 14 acres of submersed, 446 acres of emergent, and 187 acres of floating macrophytes (hydrilla, giant cutgrass, and water hyacinth, respectively) (Mortimer 2010, personal communication). A follow-up survey in 2013 has shown an increase in coverage, especially of nuisance taxa. There is an active management program in place to manage these taxa as well as Brazilian elodea (*Egeria densa*) and giant cane (*Arundo donax*) using grass carp and chemical herbicides. The relatively restricted coverage of hydrilla is a result of high and muddy water during the late spring/early summer growing period and the stocked grass carp.

At Lake Seminole, 7,418 ac of wetland are supported at or below the normal pool elevation. Lacustrine littoral aquatic bed wetlands constitute 57 percent of this total; forested wetlands, 20 percent; emergent wetlands, 15 percent; and a variety of other types, the remaining 8 percent. The normal pool elevation at this reservoir is 77 ft, and the top-of-dam elevation is 79 ft. There are approximately 3,326 ac of additional wetlands between the normal pool and top-of-dam elevations.

Aquatic plant surveys of the Spring Creek arm of Lake Seminole were conducted in 2000 and 2002 (Stewart et al. 2005). The most commonly occurring aquatic plant found at the survey sites was hydrilla, followed by several species of pondweeds (*Potamogeton* spp.), muskgrass (*Chara* sp.), naiads (*Najas* spp.), and coontail (*Ceratophyllum demersum*).

Nuisance aquatic plants other than hydrilla known to occur in Lake Seminole include water hyacinth (*Eichhornia crassipes*), giant cutgrass (*Zizaniopsis miliacea*), Asian marshweed (*Limnophila sessiliflora)*, phragmites (*Phragmites australis*), American lotus (*Nelumbo lutea*), and fanwort (*Cabomba caroliniana)* (USACE, Mobile District 2009b).

2.5.1.2.2 Estuarine Wetlands

The only estuarine wetlands in the ACF Basin are within the Apalachicola Bay estuary system, which is composed of six major subdivisions: the Apalachicola River delta, East Bay, Apalachicola Bay, St. Vincent Sound, St. George Sound, and Alligator Harbor. The Apalachicola Bay estuary covers

approximately 210 sq mi and is partially bounded seaward by four barrier islands: St. Vincent Island, St. George Island, Cape St. George Island, and Dog Island. These features form four natural openings to the Gulf of Mexico: Indian Pass, West Pass, East Pass, and the expanse between Dog Island and Alligator Point. The average depth in the estuary ranges from 3 ft in East Bay to 9 ft in Apalachicola Bay, with maximum depths up to 20 ft occurring toward the barrier islands. Florida has designated 60 percent of the estuary as the Apalachicola Aquatic Preserve. ANERR, which includes the bay, Cape St. George Island, and the Apalachicola River floodplain, is approximately 193,758 ac (Tonsmeire et al. 1996).

Muddy, soft-bottom substrates compose approximately 78 percent of the open-water areas of the Apalachicola Bay estuary system. Phytoplankton are recognized as the most important primary producers in the open waters of the estuary. The sedimentary floor of the basin is composed generally of quartz sand with a thin cover of clay (Tonsmeire et al. 1996). Certain open-water areas consist primarily of sand, whereas other areas have varying degrees of clay mixed with sand. Historically, the bay bottom was composed of silty clays, silty sands, and sand-silt-clay mixtures (Tonsmeire et al. 1996). Isphording (1985) hypothesized that the present scarcity of silt in estuarine sediments is due to upstream reservoirs altering the sediment load carried by the Apalachicola River, events in the estuary that have acted to remove or bury silt, or a combination of both.

Most of the intertidal areas around the Apalachicola Bay estuary are surrounded by freshwater, brackish, or saltwater marshes. Approximately 14 percent of the total aquatic area of the estuary is composed of marsh habitat. The primary forms of marsh habitat consist of freshwater and brackish marshes in the Apalachicola River delta above East Bay. These areas are dominated by sawgrass (*Cladium jamaicense*), bulrushes (*Scirpus* spp.), cattail (*Typha angustifolia*), brackish-water forms of cordgrass (*Spartina* spp.), and black needlerush (*Juncus roemerianus*). Mainland areas from Indian Lagoon to Alligator Point have limited marsh development; however, lagoon portions of St. George Island, Dog Island, and Alligator Point have light to moderate concentrations of fringing saltwater marshes, dominated by black needlerush and smooth cordgrass (*Spartina alterniflora*).

Seagrasses and other submersed vegetation, collectively known as *grassbeds*, account for approximately 10 percent of the total surface water area of the Apalachicola Bay estuary system. Grassbeds are highly productive and provide both food and habitat for various estuarine organisms. The naturally high rates of sedimentation in the estuary, together with the light-limiting potential of water color and turbidity resulting from river discharge, restrict the range of grassbeds in the estuary. In East Bay, the grassbeds consist primarily of brackish-water species, such as tapegrass (*Vallisneria americana*), widgeon grass (*Ruppia maritima*), and pondweeds. The introduced Eurasian watermilfoil (*Myriophyllum spicatum*) and hydrilla are also established in many of the bayous and inlets of the upper estuary. Submersed vegetation off St. George Island, Dog Island, and western portions of Alligator Point is dominated by shoal grass (*Halodule wrightii*), manatee grass (*Syringodium filiforme*), and turtle grass (*Thalassia testudium*).These species are adapted to higher salinity than occurs in East Bay, and they are usually associated with macroalgal genera such as *Gracileria*, *Caulerpa*, and *Padina*. Very little grassbed coverage occurs in St. Vincent Sound.

2.5.2 Wildlife Resources Affected Environment

This section is focused on the wildlife resources in the ACF Basin, and specifically on species known, or likely, to occur in riparian or terrestrial areas. Fish species are described separately in section 2.5.3. The capacity for all terrestrial wildlife (i.e., birds, mammals, reptiles, amphibians, and insects and other invertebrates) to survive and reproduce is controlled by characteristics of their physical and chemical habitat, and by interactions with other wildlife species, such as predators, prey, and parasites (Southwood 1977). For the many wildlife species that rely on vegetation for food and shelter, changes in the vegetative characteristics of wetlands, riparian floodplains, and upland areas also change suitability of

those areas as habitat. Some species are more sensitive to habitat changes than others, and can be loosely thought of as specialists and generalists (Stewart et al. 2010, Fahrig 2003).

2.5.2.1 General Basinwide Wildlife Assemblages

All organisms—whether aquatic, semiaquatic (i.e., spending at least a portion of their lives in water), terrestrial, or plant or animal—are dependent on immediate, local-scale habitat features, as well as broadscale environmental characteristics that influence the habitat. Different species also have different environmental and ecological requirements that control whether they can survive and reproduce in a given area (Southwood 1977). Vegetative communities provide not only shelter from severe weather events, nesting areas, and protection from predation, but also serve as food sources for plant-eating animal species. Thus, the characteristics of wildlife assemblages can strongly reflect vegetative resources. The ecological variability of the ACF Basin is acknowledged and reflected by its position within four level III ecoregions—the Blue Ridge Mountains, the Piedmont, the Southeastern Plains, and the Southern Coastal Plain—within which are nested 18 level IV ecoregions (Griffith et al. 2001; Omernik 1995) (Figure 2.1-8). The ecoregional framework represents the diversity of habitat features (i.e., soils, topography, vegetation, and climate) contained within that landscape. Such variable landscapes as these ecoregions, and the ACF Basin in particular, have the capacity for supporting a wide variety of biota.

The USFWS (1998) reviewed the historical vegetative history of the ACF Basin, including changes that have occurred in the 500+ post-European years due largely to still-accelerating human activities. Historically, the Blue Ridge Province was covered by oak-chestnut-hickory forests, with hemlock in moist coves and white pine in drier ridges. Today the vegetation of the Blue Ridge Mountains is Appalachian oak forest, mixed mesophytic vegetation, grading to shrub balds in the highest elevations (Griffith et al. 2001). Large areas of public lands (e.g., Chattahoochee National Forest) are managed for mixed uses, such as tourism, recreation, hunting, and forest products. Native forests in the Piedmont Province were dominantly deciduous hardwoods and mixed stands of pine and hardwoods (USFWS 1998). The Piedmont was heavily cultivated and is dominated today by pine plantations; pasture; agricultural production of hay, poultry, but areas have reverted to oak-hickory-pine forest (Griffith et al. 2001). As far as potential natural vegetation, throughout the Southeastern Plains there was once an abundance of southern mixed forest, oak-hickory-pine forest, longleaf pine-turkey oak, and floodplain forests (Griffith et al. 2001); however, much of the region has been altered by historical logging, currently present as pine plantations, pasture and cropland, and urban and suburban development. The potential natural vegetation in the Southern Coastal Plains is Southern mixed forest, floodplain forest, and live oak-sea oats and coastal marsh vegetation, such as cordgrass, saltgrass, and rushes (Griffith et al. 2001). Much of the land use/land cover of this ecoregion remains forested wetlands, marshes, and beaches, and there is active fish and shellfish production.

As should be apparent, the diversity of potential habitats in the ACF Basin is substantial with elevations ranging 3,000–5,000 ft in the northern Blue Ridge and Piedmont to sea level in the lower Southern Coastal Plains. The substrate of rivers and streams ranges from cobble, boulder, and bedrock in the north to sand and silt in the south. Along with the diversity of the vegetation communities that the basin supports, it is an appropriate setting for a diverse wildlife assemblage.

2.5.2.1.1 Birds

Riparian forests typically support a wide diversity of birds; however, the exact makeup of a bird assemblage depends on specific characteristics of the forest. Suitability of a forest for birds is affected by age and size of a stand; in fact, Dickson and Warren (1993) note that bird assemblages are associated with vertical foliage layers, total foliage volume, habitat patchiness, stand successional stage, moisture gradient, and hydroperiod. Forested, poorly drained wetlands are known to support higher densities and

more diverse assemblages of breeding birds, and in general, riparian zones with lower vegetative diversity support fewer birds from a less diverse assemblage (Dickson and Warren 1993). The oak-gum-cypress forest type exists throughout portions of the Southeastern Plain, in the midsection of the ACF Basin (Figure 2.1-8). Bird censuses have shown that yellow-billed cuckoos (*Coccyzus americanus*), Acadian flycatchers (*Empidonax virescens*), tufted titmice (*Baeolophus bicolor*), Carolina wrens (*Thryothorus ludovicianus*), red-eyed vireos (*Vireo olivaceous*), and Northern cardinals (*Cardinalis cardinalis*) are consistently abundant in mature forests of this type (Dickson and Warren 1993). Various raptors prefer living and hunting in riparian hardwood forests, including the Mississippi (*Ictinia mississippiensis*) and American swallow-tailed kites (*Elanoides forficatus*), bald eagles (*Haliaeetus leucocephalus*), and ospreys (*Pandion haliaetus*), whereas barred owls (*Strix varia*) and red-shouldered hawks (*Buteo lineatus*) are more frequently found in forested wetlands. Wood storks (*Mycteria americana*), purple gallinules (*Porphyrio martinicus*), and moorhens (*Gallinula chloropus*) rely on aquatic areas for habitat and for foraging zones; in addition, wood storks require tall cypress and hardwoods for nesting spots. Woodpeckers are adapted to more mature hardwood forests, and red- and white-eyed vireos live in the forest canopy and low, shrubby vegetation of riparian habitats, respectively. Bottomland hardwood forests support a diverse bird assemblage, which can include a number of warblers (i.e., prothonotary, Swainson's, Northern parula, Kentucky, and hooded), some of which nest in cavities of trees killed by floods (prothonotary warbler) or prefer bottomland understory thickets (Swainson's warbler) or Spanish moss (Northern parula warbler) (Dickson and Warren 1993).

2.5.2.1.2 Mammals

Fifty-nine species of mammals actually or potentially inhabit riparian and/or upland areas in the ACF Basin (USGS 2003) (Appendix H, Table H-1). In addition to the larger species, such as black bear (*Ursus americana*), white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), wild pig (*Sus scrofa*), red fox (*Vulpes vulpes*), and American beaver (*Castor canadensis*), there are several species each of bats, squirrels, shrews and voles, otters, skunks, and mice. The extent to which each of these species uses riparian habitat differs by specific life history traits, especially their requirements for food, cover, protection from natural enemies, and refuge from extreme weather events. The black bear is omnivorous and thus has many options for food, including carrion, herbs, small mammals, reptiles, amphibians, and the fruits of different plants such as blackberries (Dickson and Warren 1993). These animals are frequently sighted in bottomland forests in the southeastern U.S., as well as upland riparian areas. White-tailed deer exhibit an overwhelming preference for the bottomland hardwood in the Coastal Plain, and riparian zones apparently enhance the suitability of pine plantations as habitat for them.

Habitat features often present in riparian areas— such as ample forage, fruits, seeds, downed logs, debris, and stumps—have been found to be positively correlated to small mammal abundance and diversity, including for mice, rats, voles, and shrews (*Peromyscus* spp., *Mus musculus*, *Microtus* spp., *Napaeozapus insignis*, *Scalopus aquaticus*, *Sorex longirostris*, and others). The two species of squirrels, the eastern gray squirrel (*Sciurus carolinensis*) and the eastern fox squirrel (*S. niger*), have a solid association with riparian woodlands (Dickson and Warren 1993). The tricoloured bat (*Perimyotis subflavus*), formerly known by the synonym eastern pipistrelle [*Pipistrellus subflavus*]), occurs in the ACF Basin (USGS 2003) and has been documented as preferentially roosting in foliage, which is counter to the roost choice of most bats (i.e., in tree hollows) (Veilleux et al. 2003). Although mostly found in oak and maple trees in upland areas, they use those trees in riparian zones as well.

2.5.2.1.3 Reptiles

The diversity of the reptile fauna known, or likely, to occur in the ACF Basin is reflected by 68 species (USGS 2003), including the American alligator (*Alligator mississippiensis*), common and alligator snapping turtles (*Chelydra serpentine* and *Macroclemys temmincki*, respectively), 16 other turtles and

tortoises, 38 species of snakes (six of which are venomous), the green anole (*Anolis carolinensis*), six skinks, and four lizards (Appendix H, Table H-2). Many reptiles are associated with riparian areas because of their reliance on the moisture and/or on the locations of food sources, whether they are predators or herbivores. Dickson and Warren (1993, citing Wharton et al. 1981) noted that a gum-cypress forest in South Carolina had a diverse reptilian fauna including the eastern mud snake, yellow-bellied turtle, brown water snake, eastern cottonmouth, rat snake, green anole, river and Florida cooters, red-bellied water snake, banded watersnake, gray and green tree frogs, and 5-lined and brown-headed skinks. Similar habitats and forest types (tupelo-cypress) in the lower Apalachicola River Basin (Light et al. 1998) suggest a potential for substantial diversity of these organisms.

2.5.2.1.4 Amphibians

Slightly less diverse than reptiles, amphibians are represented by 58 species known, or likely, to occur in the ACF Basin (USGS 2003). Salamanders and frogs are the most diverse groups of amphibians in the basin. There are 23 species of salamanders representing eight genera (Appendix H, Table H-3). Seven species of *Desmognathus*, five species of *Ambystoma*, and three species of *Eurycea* inhabit the area. These genera include species such as the Apalachicola dusky (*Desmognathus apalachicolae*), Ocoee (*D. ocoee*), blackbelly (*D. quadramaculatus*), flatwoods (*Ambystoma cingulatum*), marbled (*A. opacum*), tiger (*A. tigrinum*), southern 3-lined (*Eurycea guttolineata*), and dwarf salamanders (*E. quadridigitata*). The 21 frog species are in the genera *Rana*, *Hyla*, *Pseudacris*, and *Acris*; other than the American bullfrog (*Rana calesbeiana*), this group includes species such as the southern leopard, wood, pickerel, and gopher frogs. There are six tree frogs of the genus *Hyla*—the bird-voiced, Cope's gray, green, pinewoods, barking, and squirrel. The five chorus frogs (*Pseudacris*) are the spring peeper, the little grass, and the upland, southern, and ornate chorus frogs. Other than the salamanders and frogs, there are six toads, three sirens, two newts, the two-toed amphiuma (*Amphiuma means*), the hellbender (*Cryptobranchus alleganiensis*), and the Alabama waterdog (*Necturus alabamensis*). Although some salamanders and frogs can be found in upland areas, most amphibians require nearly constant contact with moisture, if not for their entire life cycle, then for most of it. Wharton (1981, in Dickson and Warren 1993) reported that some upland salamander species became established in the floodplain of the Chattahoochee River after dams were constructed, the drier floodplain becoming more suitable for those particular *Plethodon* species.

2.5.2.1.5 Fish

The fish fauna of the ACF Basin is covered in subsequent sections of the EIS, although the importance of riparian function should be noted here. Lateral dimensions of rivers and streams are emphasized for their importance in maintaining and enhancing ecological integrity (Allan 2004; Thorp et al. 2006; Fausch et al. 2002; Kondolf et al. 2006). From the aspect of freshwater riverine fish, lateral dimensions of rivers and streams are directly linked to food resources, including riparian areas contributing vegetative materials and other organisms to the water as well as periodic inundation of floodplains providing access to, for example, terrestrial insects (Dickson and Warren 1993).

2.5.2.1.6 Terrestrial Macroinvertebrates

Nonaquatic insects are hyper-diverse and abundant in the humid, subtropical zone of the southeastern U.S., and even more so in riparian areas owing to nutrient-rich soils, substantial vegetative growth and productivity, and complexity of habitat structure. According to Borror et al. (1989: 1):

> "Insects are the most dominant group of animals on the earth today. They far surpass all other terrestrial animals in numbers, and they occur practically everywhere. Several hundred thousand different kinds have been described—three times as many as there are in the rest of the animal kingdom—and some authorities believe that the total number of different kinds may approach

30 million. More than a thousand kinds may occur in a fair-sized backyard, and their populations may number in the many millions per acre."

Insects feed on green vegetation, live and decaying woody materials, seeds, fungi, lichens, mosses, and algae (Slansky and Rodriguez 1987). They prey on each other and other invertebrates; they can be blood-feeders or ectoparasites on birds or mammals, scavengers feeding on dung or carrion, or parasitoids on other invertebrates. Many terrestrial insects can fly as adults, and in riparian areas they can accidently fall into water, becoming food for fish. Flooding of riparian zones gives fish immediate access to this substantial food source.

2.5.3 Fish and Aquatic Resources Affected Environment

2.5.3.1 Rivers

Riverine habitats associated with the mainstem channels of the ACF Basin were addressed under the Comprehensive Study (Freeman et al. 1997). The following description of significant river sections and riverine faunal resources in the ACF Basin is adapted from Freeman et al. (1997).

Fourteen dams in the ACF Basin impound approximate 340 mi of rivers, including roughly 275 mi in the Chattahoochee River and 65 mi in the Flint River. The remaining unimpounded river segments in the basin total about 548 RMs and differ widely in size and in the character of their natural resource values. Table 2.5-1 lists the river segments that do or could support diverse native faunal communities, protected species, or valued fisheries. These segments can be broadly categorized in three groups: unimpounded larger-river habitat, river subsystems with unregulated flow, and flow-regulated segments isolated between impoundments. The best available data were used to describe the natural resource values of these segments; however, these data remain incomplete and necessarily address the best-studied portions of the fauna (primarily fishes).

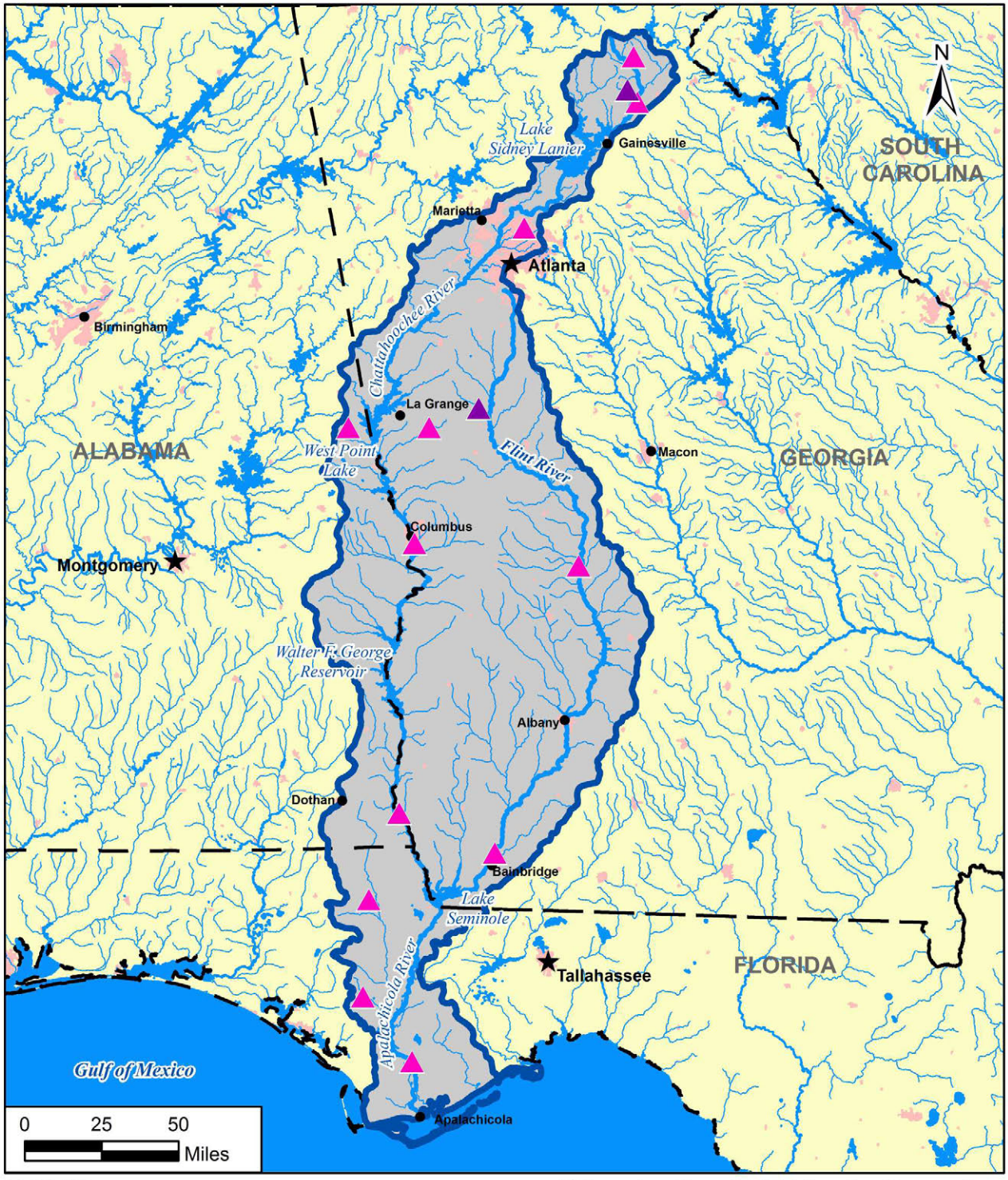
As part of the EPA National Aquatic Resources Surveys, 14 streams and rivers were sampled in the ACF Basin for benthic macroinvertebrates (Figure 2.5-1). In Alabama, Florida, and Georgia, there were, respectively, two, three, and nine locations sampled. These surveys produced a cumulative total of 50 families and 108 taxa, primarily at genus level (Appendix H, Table H-4). The larvae of non-biting midges (Insecta: Diptera: Chironomidae) were the most taxonomically diverse, with 41genera, followed by beetles (Insecta: Coleoptera) with eight genera in five families.

Riffle beetles (Elmidae) were represented by the genera *Ancyronyx*, *Optioservus, Promoresia*, and *Stenelmis*; and water pennies, by *Psephenus* (Psephenidae). Water scavenger beetles (Hydrophilidae) were also recorded. Caddisflies (Insecta: Trichoptera), typically recognized as a favorite prey item of insectivorous fish, are represented by eight genera in four families. The web-spinning caddisflies (Hydropsychidae: *Hydropsyche*, *Cheumatopsyche*, *Ceratopsyche, Diplectrona,* and *Nectopsyche*) build silken nets on substrate that filter suspended organic particles as foodstuff. The microcaddisflies (Hydroptilidae: *Hydroptila*) build sand cases that are carried around and used for refuge from predators. Another group of aquatic insects heavily fed upon by fish are mayflies (Ephemeroptera), of which there were seven genera in six families. There are several other families of mites, crustaceans, and mollusks (limpets [Ancylidae: *Ferrissia*], fingernail clams [Sphaeriidae], and basket clams [Corbiculidae]). Although Appendix H, Table H-4 is not an exhaustive list of benthic macroinvertebrates, it can be considered an example of what is present in the streams and rivers of the ACF Basin.

Table 2.5-1.
Inventory of Riverine Faunal Resources in the ACF Basin

River System Subsystem, or Segment	Aquatic Faunal Resources
Chattahoochee River system upstream of Lake Lanier	Supports populations of native species (including at least one endemic, undescribed fish species) eliminated downstream in the Chattahoochee by impoundment and water quality degradation. Headwaters support trout; lower reaches support a fishery for redeye bass and spawning habitat for walleye and white bass in Lake Lanier.
Chattahoochee River downstream of Buford Dam	Reach from Buford Dam to the confluence of Peachtree Creek supports a valued stocked trout fishery.
Chattahoochee River system between Morgan Falls Dam and West Point Lake	Extensive reach of riverine habitat including shoals in vicinity of Franklin, Georgia, provides spawning habitat for white bass migrating upstream from West Point Lake. Degraded water quality might affect faunal integrity.
Tributaries to middle Chattahoochee River	Provide habitat for species diminished in the mainstem by impoundment or degraded water quality; some tributaries, including Snake, Whooping, Centralhatchee, and Hillabahatchee creeks, retain high biotic integrity and function as refugia for Chattahoochee River fauna.
Flint River system upstream of Lake Blackshear	Supports a large fraction of the native ACF fish assemblage, including five endemic species and relict populations of imperiled mussels. Important habitat for fishes and mussels occurs in mainstem and in tributaries. Almost unique in retaining continuity of riverine habitat from Piedmont to the Coastal Plain, providing for downstream flow of energy and nutrients, exchange among populations, and natural inundation of riparian wetlands in the corridor above Lake Blackshear.
Tributaries to the Flint River	Represent potential sources of recolonizers to mainstem populations decimated by poor water quality or natural catastrophes. Ichawaynochaway Creek system supports a diverse fish assemblage of at least 55 species, including five endemic species, and summer refuge habitat for migratory striped bass (as, historically, did Spring Creek). Other tributaries (e.g., Kinchafoonee and Muckalee creek systems) support populations of mussels that have disappeared from the mainstem. Potato, Lazer, Auchumpkee, and Ulcohatchee creeks represent potential faunal fishes.
Lower Flint River system	Flow regulated by two upstream impoundments. Supports sport fisheries and contains summer refuge and spawning habitat for striped bass. Potential habitat for mussels and native nongame fishes.
Apalachicola River system	The system comprises, in addition to the mainstem, tributaries (including the Chipola River) and distributaries in a matrix of forested wetlands of exceptional extent. Historically supported diverse aquatic assemblages including abundant mussels and fishes. Flow is regulated by Woodruff Lock and Dam and upstream dams, and the channel is maintained for navigation. Diverse fish assemblages and populations of imperiled mussels persist in natural channel habitats. Anadromous Gulf sturgeon, striped bass, and Alabama shad ascend the river, with potential spawning habitat in upper portion of the river.

Source: Freeman et al. 1997



LEGEND

- ACF Basin Boundary
- State Boundary
- State Capital
- City
- Urban Area
- Surface Water
- NRSA Sample Site
- WSA Sample Site

Sites in the ACF Basin Sampled for Benthic Macroinvertebrates by USEPA during WSA and NRSA

Figure 2.5-1

2.5.3.1.1 Large River Habitat

The Apalachicola River flows freely from Jim Woodruff Lock and Dam and represents the only unimpounded large-river habitat remaining in the ACF Basin. This habitat is not pristine, however, because streamflow is regulated by upstream impoundments and dredging through the 1990s. The USFWS compared preimpoundment and postimpoundment hydrologic regimes in the Apalachicola River using the Range of Variability Approach (RVA) (Richter et al. 1997) to characterize existing altered flow conditions. The assessment showed significant postimpoundment hydrologic alterations, including increased February mean flow, decreased July mean flow, decreased duration of high flow pulses, and alterations in the rate and frequency of change in water conditions (Richter et al. 1997).

The main channel of the Apalachicola River and its tributaries provide important habitat for fish and mussels. Ninety-five species of fish are known to occur, including the anadromous Gulf sturgeon, striped bass (*Morone saxatilis*), and Alabama shad (*Alosa alabamae*) (Appendix H, Table H-5; USGS 1996). Critical habitat has been federally designated recently for Gulf sturgeon (USFWS 2003a) and four mussel species: fat threeridge, Chipola slabshell (*Elliptio chipolaensis*), Gulf moccasinshell (*Medionidus penicillatus*), and shiny-rayed pocketbook (*Hamiota subangulata*) (USFWS 2007a). Ongoing studies by the USFWS in the Apalachicola River suggest that previous estimates likely underestimated the population of fat threeridge in the middle river reaches (Zettle 2014, personal communication).

Integral habitat features of the Apalachicola River extend beyond the main channel to include tributaries, backwaters (oxbow lakes, sloughs), and the floodplain (Light et al. 1995; Sparks 1995). At least 80 percent of the fish species found in the main channel also occupy floodplain habitats, especially for spawning and foraging from April through July (Light et al. 1995; USFWS 1998). Striped bass are reported to use at least 12 tributary streams in the upper reach of the river as cool-water thermal refugia from May through November (Light et al. 1998; USFWS 1998). At least 45 species are known to use the Apalachicola River floodplain for spawning and nursery habitats based on larval trap collections from 2002 to 2007. Fish community research at the Apalachicola River indicates that floodplain connection and inundation are important for fish communities in this river system (Dutterer et al. 2012).

Entrenchment of the Apalachicola River channel, which occurred after construction of Jim Woodruff Lock and Dam up until about 1981, has lowered river stages and decreased the accessibility of tributary streams to fishes in the main channel (Light et al. 1998). As measured at the Chattahoochee gage, a flow of about 11,000 cfs is required to provide sufficient depths at tributary mouths for fish to move between the tributaries and main channel, compared to a flow of about 5,500 cfs before impoundment (Light et al. 1998). Under present conditions, the extent of connected aquatic floodplain habitat increases substantially with flows exceeding 29,000 cfs.

2.5.3.1.2 Subsystems with Unregulated Flow

A second group of river segments have unregulated flow and maintain significant portions of native species assemblages. These systems and subsystems mostly occur in the upper-most portions of the drainages, and, in some cases, represent refugia for species eliminated from downstream segments by impoundments. The upper and middle Flint River system and the uppermost Chattahoochee River system, along with some tributary systems to the Flint and Chattahoochee rivers, are known to support significant remnants of the native riverine faunal communities (Yerger 1977; Barkuloo et al. 1987; Dahlberg and Scott 1971; Gilbert 1969). Unimpeded flow from the Piedmont to the Coastal Plain ecoregion contributes significantly to natural resource value in the Flint River system because river continuity between the distinct habitats above and below the Fall Line facilitates the natural flow of water, energy, and nutrients to downstream habitats and allows the potential exchange of individuals among populations experiencing different habitat regimes. Connectivity to tributary streams is valuable for the same reasons. In all cases,

the identification of high-quality segments implicitly includes tributary streams as important system components.

The Piedmont portion of the Flint River supports a diverse assemblage of 50 fish species (Appendix H, Table H-5; Couch et al. 1996) and 20 species of mussels (Brim-Box and Williams 2000). The upper reaches of the river contain extensive shoal habitat, consisting of gravel, cobble, and bedrock substrate in areas of moderate to high gradient. Species generally found along the shoals include the rare highscale shiner (*Notropis hypsilepis*) and three endemic species: Halloween darter (*Percina crypta*), shoal bass (*Micropterus cataractae*) and bluestripe darter (*Cyprinella callitaenia*) (Freeman et al. 1997). Critical habitat units are designated for three mussel species: fat threeridge, Gulf moccasinshell, and shiny-rayed pocketbook (USFWS 2007a). In 2006, seven live specimens of the fat threeridge were found, representing a rediscovery of the species in the Flint River (USFWS 2007a). The species was previously thought to have been extirpated from the system, but subsequent surveys in 2007 found an additional three specimens.

2.5.3.1.3 Flow-Regulated, Isolated Segments

The lower Flint River system is the sole representative of the third group of river segments that are flow regulated and isolated between impoundments, and it still maintains portions of native species assemblages and supports valued fisheries. Flows are regulated by the upstream Blackshear and Flint River dams, which principally operate in run-of-river mode. RVA analysis downstream of Flint River Dam at Albany reveals typical effects of hydroelectric power generation operations associated with patterns of storage and release; however, these effects are not as pronounced as in other regulated reaches in the basin. The lower Flint River supports a warm-water fishery of approximately 81 species (Appendix H, Table H-5; USGS 1996), including sunfish, catfish, and largemouth bass, shoal bass, and striped bass. Twenty species of mussels are known to exist in this segment, including five federally listed species (Brim-Box and Williams 2000). Two federally designated critical habitat units have been established for the fat threeridge, Gulf moccasinshell, shiny-rayed pocketbook, oval pigtoe (*Pleurobema pyriforme*), and purple bank climber (*Elliptoideus sloatianus*), extending from Warwick Dam at Lake Blackshear to Jim Woodruff Lock and Dam at Lake Seminole (USFWS 2007a).

The Chattahoochee River downstream of Buford Dam includes the following flow-regulated, isolated, unimpounded reaches totaling 115 RMs:

- Buford Dam to the upstream end of Morgan Falls Lake (32 RMs)
- Morgan Falls Dam to the upstream end of West Point Lake (77 RMs)
- West Point Dam to the upstream end of Langdale Lake (6 RMs)

Cold-water hypolimnetic (bottom) releases from Buford Dam support a highly popular, urban put-and-take trout fishery in the 48-mile reach of the Chattahoochee River between Buford Dam and the bridge at I-285 west in Atlanta. The reach is classified by the Georgia DNR WRD as secondary trout waters. *Secondary trout streams* show no evidence of natural reproduction but are capable of sustaining stocked trout throughout the year. The river is stocked annually with about 250,000 adult and juvenile rainbow trout and brown trout. Formerly a warm-water stream, this reach of the Chattahoochee River now supports one of the southernmost tailwater trout fisheries (Nestler et al. 1985).

Water quality criteria for secondary trout streams in Georgia specify that elevations of natural stream temperatures must not exceed 2 °F (GAEPD 2012a). For waters designated as trout streams, dissolved oxygen concentrations must be no less than 5.0 mg/L and average at least 6.0 mg/L on a daily basis. Based on an in-stream flow study conducted by Nestler et al. (1985), habitat values for trout in the Chattahoochee River generally peak at river flows less than 2,000 cfs and decline to minimum values at flows of 12,000 cfs. The largest area of suitable trout habitat in the reach occurs below Morgan Falls Dam

in association with extensive rocky shoals. A principal factor limiting the downstream distribution of stocked trout in the Chattahoochee River is water temperature. Rainbow trout and brown trout generally require water temperatures below 77 °F (21°C) for survival and prefer temperatures below 68 °F (20 °C) for feeding, growth, and reproduction (Eaton et al. 1995; Raleigh et al. 1984, 1986).

On the basis of RVA analysis comparing preimpoundment and postimpoundment conditions downstream of Buford Dam, significant hydrologic alterations reflected in current conditions include generally higher flows in late summer and autumn and lower or more variable flows in spring (USFWS 1998). Low flow pulses and high flow pulses are both more frequent yet shorter in duration, corresponding with current hydroelectric power generation peaking operations at Buford Dam. Daily releases typically vary between about 1,000 and 8,000 cfs, resulting in substantial downstream fluctuations in stream levels. These pronounced fluctuations destabilize the day-to-day distribution and availability of aquatic habitat for native aquatic biota and trout.

The Chattahoochee River, between Morgan Falls Dam and West Point Reservoir, also contains extensive riverine habitat but with degraded water quality. The low diversity and abundance of native riverine fishes in the Chattahoochee River downstream of Atlanta might be largely attributable to decades of industrial and municipal wastewater discharge, as well as sediment and other nonpoint source pollutants in runoff from the rapidly growing metropolitan area.

Collectively, the Chattahoochee River supports 79 species of fish in the middle and upper reaches (Appendix H, Table H-5; USGS 1996). The upper reaches maintain a put-and-take trout fishery, while the middle Chattahoochee is characterized by a warm-water community dominated by sunfish, bass, and carp (Freeman et al. 1997). A 1992 survey in the vicinity of the Riverview and Langdale facilities found only one native cyprinid species, the bluestripe shiner (Freeman et al. 1997). Three native sucker species—spotted sucker (*Minytrema melanops*), greater jumprock (*Moxostoma lachneri*), and grayfin redhorse (*Moxostoma* n. sp. cf. *poecilurum*)—were also documented as part of the survey. Fifteen mussels are known to occur in the region (Brim-Box and Williams 2000). The shiny-rayed pocketbook is the only federally listed species, occurring along the mainstem of Uchee Creek in Russell County, Alabama. This segment was federally designated critical habitat in 2007 (USFWS 2007a).

A recent survey of the mussel and snail fauna in the Chattahoochee River mainstem from just upstream of Lake Oliver to downstream of Fort Benning found a total of 11 mussel and 2 snail species (Catena Group 2010). Of the 38 sites surveyed, there were no (zero) mussels found at 14, suggesting limited distributional continuity. However, the species was locally abundant and found in high numbers in the study area. Further, they indicate that historically there were 30 species of mussels recognized from this region of the Chattahoochee.

Seven dams impound nearly the entire reach of the Chattahoochee River between West Point Dam and Walter F. George Lock and Dam. Riverine habitat exists as short fragments isolated between an upstream dam and the backwaters of the next downstream impoundment. Fishes in the tailwater segments have at times suffered from scouring, the stranding effects of rapid flow fluctuations, and low dissolved oxygen levels resulting from hypolimnetic releases or from crowding of fish stranded by rapidly dropping water levels (USFWS 1998). RVA analysis shows that these segments experience substantially altered flow regimes from hydroelectric power generation operations (USFWS 1998).

Ninety species of fish are known to occur in the lower Chattahoochee River (Appendix H, Table H-5; USGS 1996). Thirteen species of mussels exist, including the shiny-rayed pocketbook, Gulf moccasinshell, and oval pigtoe (Brim-Box and Williams 2000). A federal designation of critical habitat protects these species, extending along the mainstem of Sawatchee and Kirkland creeks to the mainstem of the Chattahoochee River.

2.5.3.2 Reservoirs

The effects of damming on river biota can occur at different scales, ranging from local losses of species intolerant of reservoir and dam-tailwater habitats to basinwide reduction of migratory fauna or regional losses of fisheries (see review by Dudgeon 2000; Pringle et al. 2000). Although many stream-dependent species might persist in dam-altered basins, populations are often reduced locally and are restricted to fragments of their former ranges (Freeman et. al 2001).

Barkuloo et al. (1987) reviewed fishery resources in the ACF Basin, surveying local and regional fisheries to determine critical species, critical habitat-use guilds (e.g., littoral spawning, rearing) and their associated optimal reservoir levels, and to define *acceptability levels* for a range of water levels departing from the designated optima. Data were compiled for 10 of the 16 facilities; the remaining 6 were omitted because of their small size and limited storage capacity. Table 2.5-2 presents the critical species identified by the survey.

Table 2.5-2.
Fish Species Identified as Critical in Evaluating Operating Alternatives for Reservoirs of the ACF Basin

Reservoir	Critical species
Chattahoochee River	
Lake Lanier	Crappie, largemouth bass, spotted bass, striped bass, walleye, white bass
West Point Lake	Crappie, gizzard shad, striped bass-white bass hybrid (hybrid bass), largemouth bass, striped bass, threadfin shad, white bass
Harding Lake[a]	Bluegill, crappie, gizzard shad, hybrid bass, largemouth bass, spotted bass, striped bass, threadfin shad, white bass
Goat Rock Lake	Channel catfish, crappie, largemouth bass, threadfin shad
Oliver Lake	Bluegill, crappie, largemouth bass, threadfin shad
George Andrews Lake	Crappie, largemouth bass
Walter F. George Lake	Crappie, hybrid bass, largemouth bass, shad
Flint River:	
Lake Blackshear	Bluegill, crappie, largemouth bass, shad, sunfish
Lake Worth	Bluegill, largemouth bass
Apalachicola River	
Lake Seminole	Bluegill, crappie, largemouth bass, redear sunfish, striped bass, threadfin shad

Note:
[a.] Harding Lake is referred to as Bartletts Ferry Reservoir in Ryder et al. (1995).

Because of its proximity to Atlanta, the largest metropolitan area in the Southeast, the reservoirs, rivers, and streams of the ACF Basin are heavily used for recreation (USGS 1996). Headwaters of the basin include several extensively used reservoirs, as well as numerous national forests and national and state parks. Lake Lanier, one of the largest reservoirs of the ACF Basin, maintains the highest visitation rate of among USACE reservoirs in the southeast, receiving more than 7.5 million visitors annually (USACE 2010d). Angling opportunities are abundant, with most reservoirs supporting a quality warm-water sport fishery of bass, catfish, and sunfish. In 1991, however, EPA's *National Study of Chemical Residues in Fish* evaluated 60 chemical contaminants in fish tissue from 11 sites in the ACF Basin (USEPA 1991). Three sites on the Chattahoochee River contained chemical concentrations that were among the highest in the nation. One or more of these sites ranked in the top five for chemical concentrations, including four dioxin or furan compounds; pentachloranisole; 1,2,3 trichlorobenzene; chlordane; five chlordane congeners; chloropyrifos; and methoxychlor (USEPA 1991). Similarly, the *National Lake Fish Tissue*

Study found elevated PCB levels exceeding the federal screening value of 12 parts per billion (ppb) in two ACF Basin reservoirs (USEPA 2009b). Channel catfish (*Ictalurus punctatus*) from Walter F. George Lake and West Point Lake contained concentrations of 55 ppb and 58 ppb, respectively. Samples from Walter F. George Lake also violated the 15 parts per thousand (ppt) federal standards for total dioxans and furans, with a value of 0.45 ppt.

Uncontrolled growth of aquatic vegetation and algae is common to reservoirs, where stable water levels, shallow depths, sedimentation, and nutrient enrichment produce favorable conditions for vegetative growth. In the ACF Basin, Lake Blackshear, Walter F. George Lake, and Lake Seminole have historically experienced noxious growth of aquatic vegetation. The problem is most severe in Lake Seminole, where as much as 68 percent of the reservoir's surface area has been covered by aquatic plants. USACE has documented more than 900 species of aquatic and wetlands plants at Lake Seminole (USACE, Mobile District 1998b). Several noxious exotic species have become well-established, including Eurasian milfoil, water hyacinth, and hydrilla. Hydrilla has exhibited the most prolific growth and range expansion (Burge et al. 2007), prompting USACE to issue a hydrilla action plan (USACE, Mobile District 1998b). In addition to traditional aquatic herbicide applications, several methods, including lowdose application of herbicides, mechanical harvesting, and even biological controls (the Asian hydrilla leaf-mining fly, *Hydrellia pakistanae* [Deonier 1978] [Insecta: Diptera: Ephydridae] and the sterile grass carp [*Ctenopharygodan idella*]) have been used in an attempt to control the spread of these plants, as suggested by Burge et al. (2007). Winter drawdowns, which are so effective in controlling many submersed weeds, have not proven successful with hydrilla, and mechanical control of hydrilla provides only temporary relief and may spread the weeds to other areas of the reservoir or waterway by releasing vegetative fragments. Sterile grass carp have been used extensively in many states to control hydrilla and other submersed aquatic weeds. Grass carp may live as long as 10 years and are usually very effective in suppressing hydrilla in ponds and small lakes, particularly if the fish are stocked in the fall. Aquatic herbicides can be used for control of hydrilla, but can be toxic to fish. In large reservoir systems, it is not economically feasible to eradicate hydrilla by treating the whole reservoir with herbicides or other control methods (NCSU 1992). Due to the limited effectiveness of these control measures, hydrilla management is very challenging.

As part of EPA's National Lakes Assessment, a tributary reservoir in the ACF Basin—Mahaffey Lake in Harris County, Georgia—was sampled for phytoplankton and zooplankton (USEPA 2009b). Table 2.5-3 lists taxa identified from the plankton samples, including 20 zooplankton and 18 planktonic diatoms. Although this is not an exhaustive list of plankton, it shows some of the taxa that can be expected to be found in lakes and reservoirs of the ACF Basin.

Table 2.5-3.
List of Zooplankton and Planktonic Diatoms Collected at Mahaffey Lake (Harris County, Georgia) as Part of EPA's National Lakes Assessment (NLA06608-0207)

Zooplankton (20 taxa)		Planktonic diatoms (18 taxa)	
Family	**genus/species**	**Family**	**genus/species/variety**
Brachionidae	*Brachionus angularis*	Achnanthaceae	*Achnanthes pseudoswazi*
	Kellicottia bostonensis	Achnanthidiaceae	*Achnanthidium minutissimum*
	Kellicottia longispina	Aulacoseiraceae	*Aulacoseira ambigua*
	Keratella cochlearis		*Aulacoseira granulata angustissima*
	Keratella crassa		*Aulacoseira italica*
Hexarthridae	*Hexarthra mira*	Berkeleyaceae	*Parlibellus protracta*
Daphniidae	*Daphnia parvula*	Fragilariaceae	*Fragilaria crotonensis*
Asplanchnidae	*Asplanchna*		*Fragilaria crotonensis oregona*
Bosminidae	*Bosmina*		*Fragilaria* sp.
Collothecidae	*Collotheca*		*Synedra delicatissima*
Conochilidae			*Synedra* sp.
Cyclopidae	*Mesocyclops*		*Synedra ulna chaseana*
Daphniidae	*Ceriodaphnia*	Naviculaceae	*Navicula cryptocephala*
Diaptomidae		Stauroneidaceae	*Stauroneis tackei*
Filiniidae	*Filinia*	Stephanodiscaceae	*Cyclotella comensis*
Sididae	*Diaphanosoma*		*Cyclotella* sp.
Synchaetidae	*Polyarthra*	Tabellariaceae	*Tabellaria flocculosa*
	Ploesoma	Thalassiosiraceae	*Discostella stelligera*
	Polyarthra		
Trichocercidae	*Trichocerca*		

2.5.3.3 Apalachicola Bay and Estuary

Estuaries are semienclosed coastal water bodies with a free connection to the ocean and one or more influent rivers or streams. As a result, they contain both freshwater and marine features but generally have a range of salinities. These unique and highly productive ecosystems include a variety of habitat types, such as marine waters, brackish bays and marshes, submerged aquatic vegetation beds, and inland rivers and swamps. The formation, maintenance, and productivity of these habitats are dependent on the flow of freshwater and sediment delivery from the rivers and on the regular flushing of the marine system. Because of their habitat diversity and great productivity, estuaries provide spawning, nursery, and feeding grounds for a great number of estuary-dependent invertebrate and fish species and the food webs that depend on them. Unfortunately, due to their productivity and hydrology, estuaries provide great opportunities for human development, and of the 32 largest cities in the world, 22 are on estuaries (NSTA 2015). As a result, these systems are often affected by a variety of stressors and sources generated both locally and remotely.

The Apalachicola Bay estuary is one of the largest estuaries in the southeastern U.S. as well as one of the most important estuaries, in terms of productivity, in the entire U.S. The Apalachicola Bay estuary is part of a tri-river system that includes the Apalachicola River in Florida and the Chattahoochee and Flint rivers in Alabama and Georgia. The bay itself covers an area of approximately 210 sq mi behind a chain of barrier islands; the four principal barrier islands are St. Vincent Island, Cape St. George Island, St. George Island, and Dog Island (Gorsline 1963). The average depth across the bay is approximately

9 ft, and tidal ranges vary from 0.43 ft to 0.75 ft (Livingston 1984). As the second-largest of the 27 existing national estuarine research reserves, the Apalachicola Reserve encompasses 246,766 ac, 135,680 of which are state-owned submerged lands.

In 1969, the state of Florida designated Apalachicola Bay as one of 18 aquatic preserves, followed in 1979 by the lower river and bay system being designated by NOAA as a national estuarine research reserve (NERR). Simultaneous actions by the state designated the lower and upper Apalachicola River (1979 and 1983, respectively) as an Outstanding Florida Water. These actions provide protection and management for the system that help ensure long-term sustainability.

Of the variety of important ecological characteristics of the Apalachicola Bay estuary, the following are of particular note (Edmiston 2008; Apalachicola Riverkeeper 2010):

- The river and bay watershed is one of the most important bird habitats in the southeastern U.S.
- More than 50 species of mammals, including the threatened Florida black bear, the endangered West Indian manatee, the Indiana bat, and the gray bat, are found in the Apalachicola drainage basin.
- More than 1,300 plant species (103 federally or state listed), 40 amphibian species, and 80 species of reptiles live within the Apalachicola River Basin. This is the highest diversity of amphibians and reptiles in the U.S. and Canada.
- More than 360 marine mollusk species—many of which are federally listed as threatened and endangered—are found in the watershed.
- One hundred thirty-one species of freshwater and estuarine fish have been found in the nontidal and tidal portions of the Apalachicola and lower Chipola rivers. More than 140 species have been found within the boundary of the bay itself, and the area is a valuable spawning and nursery ground for many important commercial and sport fishes.
- The federally listed Gulf sturgeon (threatened) and blue shiner (special concern), and the state-listed (AL) shoal bass are found in the Apalachicola River Basin.

The Apalachicola Bay estuary is one of the most productive estuaries in the northern hemisphere. It provides 90 percent of Florida's commercial oysters and over 10 percent of the total U.S. production. It is a major nursery for penaeid shrimp, blue crabs, and many fish species, including striped bass, Gulf sturgeon, grouper, red fish, speckled trout, and flounder. The harvest and sale of shrimp, crab, fish, and oysters is the driving economic force for Franklin County.

The physical features of the Apalachicola Bay estuary include both common and unique features. Over a 14-year period of record (1978–1992), the Apalachicola River had the highest average discharge (25,960 cfs [Frick et al. 1996]) of any river in Florida. It is 21st in magnitude among conterminous rivers in the U.S., and its discharge accounts for 35 percent of the total freshwater runoff on Florida's west coast (from Florida Bay to Perdido Bay) (McNulty et al. 1972). Seasonal flow variation is high, with peak flows from January through April and low flows from September through November (Livingston 1984). Mean daily discharge from 1972 to 1992 at Sumatra, Florida, ranged from 5,800 cfs in 1981 to 178,000 cfs in 1990 (USGS 1996). Eighty percent of the Apalachicola River flow is contributed by the Chattahoochee and Flint rivers, 11 percent from the Chipola River, and less than 10 percent from groundwater and overland flow (Elder et al. 1988; Frick et al. 1996). The Chipola River—the Apalachicola River's largest tributary—drains one-half of the Apalachicola River Basin below Jim Woodruff Lock and Dam. The sediment load is deposited in the delta, which has been prograding approximately 6.5 ft per year since 1892 (Bedosky 1987). In-filling rates range from less than 0.04 in/yr to over 0.67 in/yr, depending on location (Bedosky 1987; Hendrickson 1997; Isphording 1985).

River flow is the primary determinant of salinity concentrations in the estuary (Livingston 1984), but other factors include local rainfall, basin configuration, wind speed and direction, and water current. The bay is divided into two main features with regard to salinity concentrations: the open gulf waters of eastern St. George Sound and the brackish portions of western St. George Sound, Apalachicola Bay, East Bay, and St. Vincent Sound. This second group is brackish because of river discharge diluting salinity concentrations. The mouth of the river and the East Bay have the lowest mean salinities. The lower reaches of the Apalachicola River compose the limnetic zone. During high river discharge and/or local precipitation events, the limnetic zone can extend to the East Bay and include considerable portions of the Apalachicola Bay.

Salinity concentrations in the limnetic zone can reach 0.5 ppt. Because of seasonal and climatic variability, salinity gradients can move through the bay area. The East Bay is typically oligohaline with salinity concentrations reaching 0.5 to 5.0 ppt. The Apalachicola Bay, St. Vincent Sound, and western portions of St. George Sound can range from mesohaline to polyhaline with salinity concentrations ranging from 5 to 18 ppt and 18 to 30 ppt, respectively. These conditions depend on river discharge, upland runoff, and local precipitation events. In the eastern sections of St. George Sound and near the passes, salinities can range from polyhaline to euhaline when salinity concentrations increase to more than 30 ppt. Vertical stratification of salinity concentrations can range from 5 to 10 ppt. Salinity is one of the major limiting factors in oyster production. Prolonged high salinities due to drought or other factors affect freshwater flow and allow for increased predation (from the southern oyster drill, *Thais haemostoma*, and the stone crab, *Menippe mercenaria*) and decreased food availability. Prolonged low salinities from flooding or other factors are similarly stressful, resulting in indirect and direct mortality such as those from the pathogen Dermo (*Perkinsus marinus* [Menzel 1983]).

Furthermore, juvenile Gulf sturgeon habitat and oyster habitat are of primary importance within the Apalachicola Bay ecosystem and depend principally on salinity regime largely driven by discharge from the Apalachicola River. Oysters thrive in salinities below 26 ppt, while juvenile Gulf sturgeon prefers regions of the estuary with salinities below 10 ppt. Three regions within Apalachicola Bay are of particular interest with regard to these requirements. Cat Point and Dry Bar sustain a vital oyster fishery and are, therefore, of economic as well as ecological importance. Optimal salinities in these areas (conducive to oyster growth from the months of May through October) should remain below the 26 ppt threshold. East Bay has been identified as important juvenile Gulf sturgeon habitat and salinity levels are optimal when below 10 ppt in this region.

There is little thermal stratification in the estuary because of its shallowness (average depth is 9 ft with up to a 1-ft tidal amplitude) and wind mixing. Water temperature is highly correlated with air temperature. Summer temperature highs usually occur in August, with similar maxima from year to year. Water temperature lows occur from December to February; the highest monthly variance occurs in winter.

Dissolved oxygen concentrations typically reach a high during winter and spring months due primarily to low water temperatures and secondarily to low salinity concentrations. Vertical stratification of dissolved oxygen concentrations can be seen in the summer and fall months. Spatial distributions of dissolved oxygen concentrations are highest in the upper reaches of East Bay, such as Round Bay; near St. George Island, such as Nick's Hole; and along the east side of St. Vincent Island.

In terms of physical habitat, wetlands compose a major part of the Apalachicola Bay ecosystem. The river floodplain regions are composed of coastal plain flatland floodplain wetlands, coastal dunes, and freshwater and brackish marshes. In the lower reaches of the river, tupelo/cypress forests are common floodplain associations (Livingston 1984). Entering the bay, marshes compose a large portion of the tidal fringe wetlands, and freshwater, brackish, and saltwater marshes are all represented, accounting for 14 percent of the total water surface area (Livingston 1984). Fresh and brackish water marshes are composed largely of bull rushes, cattails (*Typha* spp.), saw grasses (*Cladium* spp.), cordgrasses, and

needlerush. True saltmarsh habitats are typified by black needlerush, cordgrass, *Distichlis spicata*, and *Salicornia* spp. The Apalachicola marshes are important breeding and reproductive areas for a large variety of aquatic and terrestrial species, that are both ecologically and commercially important, a reflection of the high productivity of this system.

Seagrass beds account for 10 percent of the total water surface area (Livingston 1984). Seagrasses are largely light-limited over large portions of the Bay due to turbidity and color, except along the eastern portion of St. George's Sound, where they are concentrated in shallow-depth areas (< 3.5ft) along the fringe. Species in the East Bay area include freshwater and brackish taxa and are dominated by *Valisneria americana*, *Ruppia maritima*, and *Potamogeton* species. Along the mainland, east of the river, seagrass beds are dominated by *Halodule wrightii*, *Syringodium filiforme*, and *Thalassia testudinum*. *Gracilaria* species are also found in some seagrass beds (Livingston 1984). Similar to marshes, seagrasses are highly productive habitat providing organic matter and shelter for a variety of resident and migratory species of ecological and commercial importance.

The Florida DEP Apalachicola-Chipola Basin report indicates that hydrilla is in the Apalachicola River, Lake Wimico, Chipola River, and the Apalachicola Bay. The presence of submerged and floating plants fluctuates, which is largely a function of drought and salinity (FDEP 2011). Increased salinity during drought suppresses hydrilla because of its vulnerability to elevated salinities. In areas of the bay where salinities average above 12 ppt and wave action is high, likely no or little hydrilla would be present. However, in slackwater, open areas, and portions of the river with average salinities less than 12 ppt, hydrilla might be more evident. In more lentic, freshwater portions of the bay with salinities less than 7 ppt, hydrilla would be expected (Haller et al. 1974; Twilley and Barko 1990).

Oyster bars are obviously commercially important, but also ecologically important habitats. They cover approximately 1 percent of the surface area of the bay. Major beds are found in St. Vincent Sound and St. George's Sound, which compose the principal commercial beds, as well as in East Bay (Livingston 1984). Waters surrounding those beds are characterized by current and salinity conditions that are optimal for oyster development and growth (Livingston 1984). Again, more than 90 percent of the state's oyster production (and up to 10 percent nationally) comes from the Apalachicola Bay estuary.

Soft, shallow, unvegetated sediments represent the dominant habitat of the bay (78 percent of surface area) (Livingston 1984). Though not nearly as productive as marshes and seagrass beds, these habitats host a variety of resident and migratory species. The epibenthic and infaunal species are largely determined by sediment composition and water quality conditions.

The biological resources of the Apalachicola Bay estuary are abundant and diverse and range from those inhabiting freshwater, nearshore habitats to open-water bay species, and from obligate resident to migratory taxa. The organisms in nearshore areas are part of a temperate sand community (Jones et al. 1973; Smith 1974). The shallow shelf benthos (30 to 65 ft) reflects the intrusion of tropical species in both sandy areas and rocky outcrop substrates. The northeastern gulf lies in the Carolina Zoogeographic Region. The region has a warm temperate fish fauna, and the fish assemblages are characterized by a high diversity including substantial representation by native species found nowhere else, and by the presence of a number of tropical species tolerant of a wide range of temperatures (Livingston 1984).

Submerged and emergent taxa compose the highly productive vegetative habitats of the bay (Table 2.5-4). Submerged vegetation covers about 10 percent of the bay system, as mentioned earlier (Livingston 1984). This vegetation includes at least nine known species, one of which, the Eurasian water milfoil, is an invasive. The marsh habitats contribute at least six dominant taxa as well (Table 2.5-4).

Table 2.5-4.
Partial List of Submerged/Emergent Vegetation of the Apalachicola Bay and Estuary

Scientific name	Common name	East Bay	Nearshore	Shallow lagoon	Fresh/ brackish marsh	Saltwater marsh
Cladium spp.	Sawgrasses				X	
Cladium jamaicense	Sawgrass				X	
Distichlis spicata						X
Gracilaria spp.	Graceful red weed			X		
Halodule wrightii	Shoal grass		X	X		
Hydrilla verticillata	Hydrilla		X			
Juncus roemerianus	Needlerush				X	X
Myriophyllum spicatum[a]	Eurasian water milfoil	X			X	
Naias quadalupensis	Southern waternymph	X				
Potamogeton sp.	Pond weed	X				
Ruppia maritime	Widgeongrass	X				
Salicornia spp.						X
Scripus spp.	Bullrushes				X	
Spartina spp.	Cordgrasses				X	X
Syringodium filiforme	Manatee grass		X	X		
Thalassia testudinum	Turtle grass		X			
Valisneria americana	American eel grass or tape weed	X				

Sources: Livingston 1984; FLDEP 1992, 2010c (draft)
Note:
[a] Invasive.

Phytoplankton is composed of the highly productive water column algae that are important to the estuarine food web, especially oyster production. Productivity is highest beginning in spring, through summer, and into fall, when river discharge brings large nutrient loads (especially of nitrogen), temperatures are ideal for growth, and wind-driven resuspension provides important phosphorus contributions. Phytoplankton productivity and high marsh productivity combine to provide the energy that drives the productive and diverse estuarine food web. Evidence of this productivity is exhibited by the phytoplankton itself (Appendix H, Table H-6), where the taxonomic diversity reflects not only the nutrient supply but also the dynamic water quality and flow conditions created by the intersection of fresh and marine waters of this highly confined estuary.

Zooplankton species are water column consumers that link phytoplankton to higher trophic levels, including commercially important fish species. They have not been as well studied as other groups; however, not surprisingly, the same dynamic water quality, flow, morphometry, and high productivity that provide for a diversity of other taxa have contributed to similarly diverse and productive zooplankton (Livingston 1984). This group of organisms is composed largely of holoplankton (plankton for the entire life cycle) and meroplankton (temporary plankton), of which relative percentages are approximately 90 percent and 10 percent, respectively (Livingston 1984). Copepods, cladocerans, larvaceans, and chaetognaths are the dominant groups of the holoplankton. Decapod larvae, primarily crab zoeae, polychaete larvae, ostracods, amphipods, isopods, mysids, echinoderms, ctenophores, and coelenterates are the dominant groups of the meroplankton (Livingston 1984).

Fish are abundant and diverse in the Apalachicola Bay estuary (Appendix H, Table H-7). There are more than 130 species of fish, including many commercially and recreationally important species, some state- and/or federally listed species, and several introduced or nonindigenous taxa within the boundaries of the bay. The fish species of the Apalachicola Bay include taxa as diverse as the obligate estuarine bay anchovy (*Anchoa mitchilli*) and migratory striped mullet (*Mugil cephalus*), flounder (*Paralichthys lethostigma*), speckled seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), croaker (*Micropogon undulates*), spot (*Leiostomus xanthurus*), and sand seatrout (*Cynoscion arenarius*), all of which use the estuary as nursery and/or feeding grounds during part of their life cycles. Anadromous taxa, which spend a portion of their lives in the estuary before migrating upstream from the ocean to spawn, include the Gulf sturgeon, striped bass (*Morone saxatilis*), Alabama shad (*Alosa alabamae*), and skipjack herring (*Alosa chrysochloris*). Several species for which the Apalachicola Bay has essential fish habitat are covered under a fishery management plan, as required by the Magnuson-Stevens Fishery Conservation and Management Act. These species are the red drum (*S. ocellatus*), gray snapper (*Lutjanus griseus*), brown shrimp (*Penaeus aztecus*), white shrimp (*Penaeus setiferus*), pink shrimp (*P. duorarum*), and stone crab (*M. mercenaria*).

The invertebrate fauna of the Apalachicola Bay estuary are numerous and too diverse to cover adequately in this review (Appendix H, Table H-8). Many of these taxa, which play an integral part of the estuarine food web connecting plankton and detritus to higher consumers, rely on the estuary for all or part of their life cycles and may inhabit different parts of the estuary during different stages (Appendix H, Table H-8). The invertebrate fauna include crustaceans (e.g., shrimp and crabs), insects, mollusks, annelids, isopods, amphipods, coelenterates, and echinoderms, among others. Many of these species are commercially important, especially the brown, white, and pink shrimp; the blue crab (*Callinectes sapidus*); and the American oyster (*Crassostrea virginica*).

2.5.4 Protected Species Affected Environment

Sensitive species are unique plants and animals that have been observed to be declining toward extinction. Using available scientific research, state, federal, and nongovernmental organizations have assigned conservation priority to many rare or declining species. The most significant protection for sensitive species is the ESA (16 U.S.C. 1531 et seq.), passed in 1973 to address concerns about the decline in populations of many unique wildlife species. Supporters of the ESA argued that America's natural heritage was of aesthetic, ecological, educational, recreational, and scientific value to the nation and, therefore, worthy of protection. The purpose of the ESA is to rebuild populations of protected species and conserve "the ecosystems upon which endangered and threatened species depend." The law offers two classes of protection for rare species in decline: endangered and threatened.

Endangered status means a species is in danger of extinction throughout all or a significant portion of its range. *Threatened status* indicates that a species is likely to become endangered within the near future. All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened. All federal agencies are required to protect threatened and endangered species while carrying out projects and to preserve the habitats of such species on federal land (USFWS 2001).

Under the ESA, it is illegal to *take* threatened and endangered species. As defined in the ESA, the term take "means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." The Secretary of the Interior, through regulations, defined the term *harm* in this passage as "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." Because it is unlawful to hunt or collect threatened and endangered species, habitat degradation is the primary reason for population declines in listed species (USFWS 2001).

Critical habitat is defined in the ESA. Species listed as threatened or endangered under the ESA are afforded protection within specific areas of their geographic range that offer physical or biological features essential to their conservation and that might require special management considerations. Habitat not used by the species might also be included if doing so is deemed necessary for recovery. Proposed designations and the final determination of critical habitat are published in the *Federal Register*.

This section describes the federally protected species of the ACF Basin that would reasonably be expected to be affected by changes in water management. The basin supports a wide variety of wildlife and is home to approximately 166 species that are protected or included as candidate species by the states and federal government. USFWS reviewed the 37 federally protected species with presence in the ACF Basin in the May 2012 biological opinion for the RIOP for Jim Woodruff Lock and Dam (USFWS 2012) and found that only four of them would potentially be affected by changes in water management.

Figure 2.5-2 depicts the location of designated critical habitat units for federally protected fish in the basin, and Figure 2.5-3 depicts the location of designated critical habitat units for federally protected mussels in the basin. Table 2.5-5 provides the federally listed species in the ACF Basin, including the four species that would reasonably be expected to be affected by changes in water management are discussed below.

2.5.4.1 Protected Fish Species

2.5.4.1.1 Gulf Sturgeon

The Gulf sturgeon is an anadromous species, with adults ascending freshwater rivers for 8 to 9 months of the year and descending to estuarine or nearshore areas during the late fall to overwinter (Fox et al. 2002; Wooley and Crateau 1985; Huff 1975). Before the completion of the Jim Woodruff Lock and Dam, Gulf sturgeon inhabited all three rivers of the ACF Basin, migrating approximately 202 mi from the mouth of the Apalachicola River up the Flint River to Albany, Georgia (Huff 1975). Today, the species is limited to the mainstem of the Apalachicola River, downstream of Jim Woodruff Lock and Dam (USFWS 2009b; Wooley and Crateau 1985).

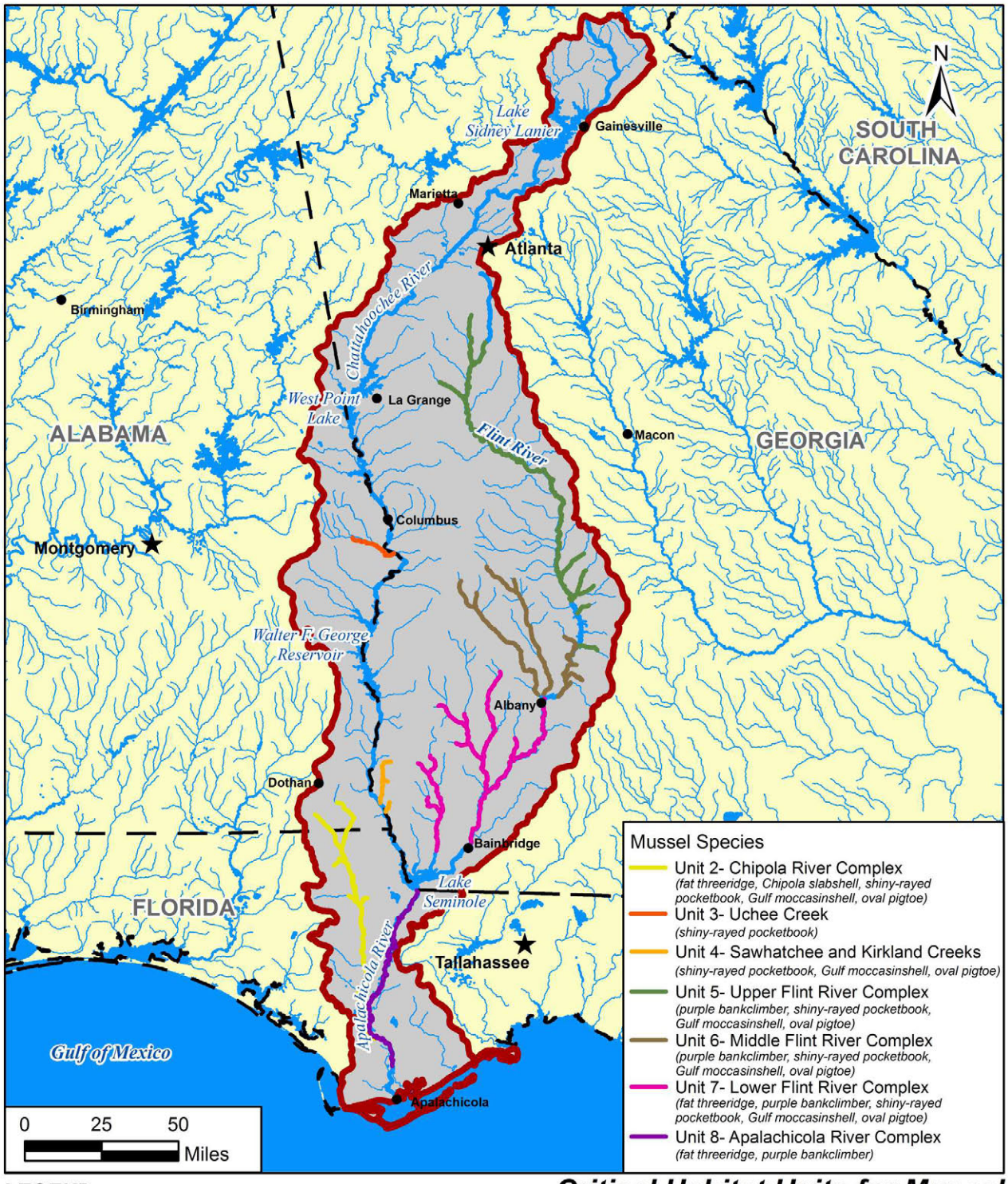
Critical habitat was established through the issuance of a final rule in March 2003, designating 14 critical habitat units comprising approximately 1,729 mi of riverine habitat and 2,333 sq mi of estuarine and marine habitat (USFWS 2003a). Within the ACF Basin, the Apalachicola River mainstem, from the Jim Woodruff Lock and Dam and downstream to its discharge at Apalachicola Bay, defines units 6 and 13 (Figure 2.5-2). All Apalachicola River distributaries, including the East River, Little St. Marks River, and St. Marks River, are included, as is the mainstem of the Brothers River.

A recent 5-year review by the USFWS concluded that reclassification of the species is not warranted (USFWS 2009b). Many factors that led to the listing of the Gulf sturgeon continue to affect its existence, including impacts on habitat by dams, dredging, point and nonpoint discharges, climate change, catch, red tide, and collisions with boats. Furthermore, the populations appear to be stabilized, the long-lived, late-maturing, and intermittent spawning of adults, coupled with a largely unknown juvenile life history, make recovery of the species tenuous.



Critical Habitat Units for Fish Species Potentially Affected by Water Management Changes in the ACF Basin

Figure 2.5-2



Critical Habitat Units for Mussel Species Potentially Affected by Water Management Changes in the ACF Basin

Figure 2.5-3

Table 2.5-5. Federally Protected Species Occurring in the ACF Basin

Scientific name	Common name	Endemic[a]	Federal status[b]	Alabama status[b]	Florida status[b]	Georgia status[b]	Subbasin[c]
Mammals							
Myotis grisescens	Gray bat		E	SP		E	AP
Myotis sodalis	Indiana bat		E	SP		E	F, UCA
Trichechus manatus	West Indian manatee		E	SP			AP
Birds							
Charadrius melodus	Piping plover		T	SP		T	AP
Mycteria americana	Wood stork		E	SP		E	LCA, AP, F
Fish							
Acipenser oxyrinchus desotoi	Gulf sturgeon		T	SP			AP
Mussels							
Amblema neislerii	Fat threeridge	Y	E			E	AP
Hamiota subangulata	Shiny-rayed pocketbook		E	SP		E	LCA, F, AP
Medionedus penicillatus	Gulf moccasinshell		E			E	AP, F
Pleurobema pyriforme	Oval pigtoe		E	SP		E	LCA, F, AP
Elliptio chipolaensis	Chipola slabshell	Y	T	SP			AP
Elliptoideus sloatianus	Purple bankclimber		T			T	AP, F
Amphibians							
Ambystoma bishopi	Reticulated flatwoods salamander		E	SP			AP, F, LCA
Ambystoma cingulatum	Frosted flatwoods salamander		T			T	AP, F, LCA
Reptiles							
Drymarchon corais couperi	Eastern indigo snake		T	SP		T	AP, LCA
Caretta caretta caretta	Loggerhead turtle		T	SP		E	AP
Lepidochelys kempii	Atlantic ridley		E	SP		E	AP
Plants							
Harperocallis flava	Harper's beauty	Y	E		E		AP
Isoetes melanospora	Black-spored quillwort		E			E	UCA, LCA, F
Lindera melissifolia	Pondberry		E				F
Oxypolis canbyi	Canby's dropwort		E			E	F
Ptilimnium nodosum	Harperella		E			E	F
Sarracenia oreophila	Green pitcherplant		E			E	F, LCA, UCA
Schwalbea americana	American chaffseed		E		E	E	LCA, AP, F
Thalictrum cooleyi	Cooley's meadowrue		E		E	E	F
Conradina glabra	Apalachicola rosemary		E		E		
Rhododendron chapmanii	Chapman rhododendron		E		E		AP, F
Torreya taxifolia	Florida torreya		E		E	E	F
Silene polypetala	Fringed campion		E		E	E	F, UCA
Spigelia gentianoides	Gentian pinkroot		E				LCA
Rhus michauxii	Michaux's sumac		E			E	F, UCA
Trillium reliquum	Relict trillium		E			E	F, LCA, UCA
Scutellaria floridana	Florida skullcap		E		E		AP
Amphianthus pusillus	Little amphianthus		T			T	UCA, LCA, F
Macbridea alba	White birds-in-a-nest		T		E		AP
Pinguicula ionantha	Godfrey's (violet) butterwort		T		E		AP
Euphorbia telephioides	Telephus spurge		T		E		AP

Sources: ALNHP 2014; FWC 2014; GADNR 2014b; CH2M Hill 2003; USFWS 2012; USFWS 2014.
Notes:
[a] Y = endemic to basin.
[b] Status. C = candidate for listing as threatened or endangered, E = listed as endangered, R = rare, no legal status, SP = species formally protected, T = listed as threatened.
[c] Subbasins (based on present known distributions): AP = Apalachicola River, F = Flint River, LCA = Lower Chattahoochee River, UCA = Upper Chattahoochee River.

2.5.4.2 Protected Mussel Species

Three federally protected mussel species found in the ACF Basin would reasonably be expected to be affected by the proposed changes in water management in the basin. Therefore, these are the only three species discussed in the EIS. These species consist of the endangered fat threeridge and the threatened Chipola slabshell and purple bankclimber.

2.5.4.2.1 Fat Threeridge

The fat threeridge was historically found in the mainstem reaches of the Flint, Apalachicola, and Chipola rivers of the ACF Basin in southwest Georgia and north Florida (Ziewitz et al 1997). There are no records of the species in the Chattahoochee Basin (USFWS 2012). It is typically found in small to large rivers of slow to moderate water velocity (Brim Box and Williams 2000). It prefers substrates ranging from gravel to cobble but is also found in a mixture of sand and sandy mud (Ziewitz et al 1997). The fat threeridge is currently known throughout much of its historical range, but it has been extirpated from localized portions of the Apalachicola and Chipola rivers. It does not occur in Lake Seminole and the population below the Jim Woodruff Lock and Dam appears to be reduced for quite some distance downstream of the dam. The species persists in the Flint River, but appears to be extremely rare in the river. Surveys in the Apalachicola and lower Chipola rivers indicate that the species is common to abundant in suitable habitat and that recruitment is occurring, demonstrating that the mussel is more abundant than previously believed.

The USFWS designated three critical habitat units in the ACF Basin, effective December 17, 2007. The units encompass approximately 489 mi in the Lower Flint River in Georgia, the Chipola River Basin in Alabama and Florida, and the Apalachicola River in Florida (Figure 2.5-3) (USWFS 2007a).

A 5-year review determined that the status of the fat threeridge should remain unchanged. Despite the discovery of several live specimens previously thought to be extirpated in the Flint River (USFWS 2007b), reclassification criteria require three viable subpopulations. The extent and viability of this subpopulation is unknown, as is the generation time of the species. The USFWS is determining the age structure of the fat threeridge to better evaluate the status of the species.

2.5.4.2.2 Chipola Slabshell

The Chipola slabshell has one of the most limited distributions of the Apalachicola region mussel species, extending throughout much of the Chipola River mainstem and into several headwater tributaries. Historically, it was thought to be endemic to the Chipola River system; however, Brim Box and Williams (2000) identified a single specimen from Howards Mill Creek, a Chattahoochee River tributary in southeastern Alabama. More recent surveys suggest that the Chipola slabshell is now extirpated from Howards Mill Creek. The species is associated with clean or silty sand substrates in slow to moderate currents along sloping banks of the stream channel (Ziewitz et al 1997).

The USFWS designated one unit as critical habitat in the ACF Basin, effective December 17, 2007. The unit encompasses the Chipola River Basin in Alabama and Florida, extending from the confluence of the Chipola River with the Apalachicola River, upstream 90 mi to the confluence of Marshall and Cowarts creeks (Figure 2.5-3) (USFWS 2007a).

A study is under way to determine the status and distribution of the Chipola slabshell in the Chipola River Basin (USFWS 2007b). Preliminary surveys have collected more than 300 specimens from 10 new subpopulations and six subpopulations that were previously documented. Final results of the study are not yet available. Note also that USFWS is conducting genetic analysis as part of an ongoing slabshell study,

and preliminary results suggest that the Chipola slabshell is not a unique subspecies but is genetically identical to another more common slabshell species (Zettle 2014, personal communication).

2.5.4.2.3 Purple Bankclimber

The purple bankclimber is endemic to the Apalachicola region. Within the ACF Basin, it was historically found along the mainstem of the Flint River and two of its larger tributaries, the Chattahoochee and Apalachicola rivers, and near Dead Lake along the mainstem of the Chipola River. The present distribution in the ACF Basin has been reduced to the Flint River and just one tributary, and the Apalachicola River (USFWS 1998, 2003b). The purple bankclimber prefers sand, fine gravel, or muddy sand in moderate currents of larger streams and rivers (Clench and Turner 1956). Brim-Box and Williams (2000) found that 80 percent of the specimens encountered in a survey of the ACF Basin inhabited sand/limestone substrates in water over 10 ft deep. The species is intolerant of impounded conditions.

The USFWS designated four critical habitat units in the ACF Basin, effective December 17, 2007. These units include approximately 771 miles of the Upper, Middle, and Lower Flint River and the Apalachicola River (Figure 2.5-3) (USFWS 2007a).

Recent surveys suggest that purple bankclimber populations are relatively stable in the Flint and Ochlockonee rivers, but the species remains the rarest mussel in the Apalachicola region (USFWS 2007b). The extent and viability of many subpopulations is unknown, and thus the species remains listed as threatened.

2.5.5 Fish and Wildlife Management Facilities Affected Environment

2.5.5.1 Fish and Wildlife Management Facilities

An inventory of fish and wildlife management facilities was completed for the Comprehensive Study (Ziewitz and Luprek 1996), and it was used as the primary source of information for this evaluation, Table 2.5-6. Table 2.4-2 presents national and state parks in the ACF Basin. The key facility in the ACF Basin is the Eufaula National Wildlife Refuge, which is managed by USFWS.

2.5.5.1.1 Eufaula National Wildlife Refuge

The Eufaula National Wildlife Refuge was established in 1964 on the Walter F. George Lake (also known as Lake Eufaula) in cooperation with USACE. The objectives of the refuge are to provide habitat for migratory waterfowl and other birds, to provide habitat and protection for federally listed threatened and endangered species, and to provide recreation and environmental education for the public. The refuge lies on the upper reaches of the reservoir from Chattahoochee RM 104 to 116 within Barbour and Russell counties, Alabama, and Stewart and Quitman counties, Georgia. The 11,184-ac refuge was once heavily forested with longleaf and slash pine ridge tops and hardwood bottoms, but past land use practices have changed the land cover and habitat. The refuge contains 4,260 ac of open water, 3,025 ac of wetlands, 2,110 ac of woodlands, and 1,814 ac of croplands and grasslands. It is managed intensively to meet the needs of migrating and wintering waterfowl, nesting wood ducks, colonial nesting birds, neotropical migrant birds, and wood storks (USFWS 2008b).

Pump systems, dikes, and water control structures are used to manage a constructed system of impoundments to create off-reservoir wetland areas. Water levels are manipulated seasonally to provide desirable food plants for wildlife. Vegetation is also manipulated by burning, mechanical, and chemical control methods.

Table 2.5-6.
Wildlife Management Facilities in the ACF Basin

Wildlife management area	County, State	Area (acres)
Apalachicola National Estuarine Research Reserve	Franklin/Liberty/Gulf, FL	240,000
Apalachicola Wildlife Management Area	Jackson, FL	7,952
St. Vincent National Wildlife Refuge	Franklin/Gulf, FL	12,489
Albany Nursery WMA	Dougherty, GA	300
Big Lazer Creek WMA	Talbot, GA	5,850
Blanton Creek WMA	Harris, GA	4,500
Chattahoochee WMA (CNF)	White, GA	250
Chestatee WMA (CNF)	Lumpkin, GA	250
Chickasawhatchee WMA	Dougherty, GA	130
ELMODEL WMA	Baker, GA	1,576
Flint River WMA	Dooley, GA	2,500
Hannahatchee Creek WMA	Stewart, GA	5,640
Joe Kurz WMA	Meriweather, GA	3,654
Mayhaw WMA	Miller, GA	4,718
Swallow Creek WMA	White, GA	190
West Point WMA	Heard, GA	9,999
Wilson Shoals WMA	Hall, GA	2,800
G.V. Perker WMA		
Apalachicola Bluffs and Ravine Preserve	Liberty, FL	6,248
Apalachicola River Water Management Area	Gulf/Liberty, FL	35,495
Apalachicola River Wildlife and Environmental Area	Franklin/Gulf, FL	55,652
Apalachicola Savannah Research Natural Area	Liberty, FL	448
Cape St. George State Reserve	Franklin, FL	2,294
St. George Island State Park	Franklin, FL	1,962
Judges Cave Wildlife and Environmental Area	Jackson, FL	37
Rock Hill Preserve	Washington, FL	373
St. Joseph Bay State Buffer Preserve	Gulf, FL	701
Tate's Hell State Forest	Frankin/Liberty, FL	131,255
Upper Chipola River Water Management Area	Jackson, FL	7,374

Source: USACE, Mobile District 1998a.

The Eufaula National Wildlife Refuge supports a diversity of flora and fauna of the Gulf Coastal Plain region. Habitat management focused on waterfowl also benefits other species. The refuge has 281 documented bird species, 36 mammal species, 95 herptile species, and roughly 30 fish species. Species that use the refuge are the protected bald eagle and peregrine falcon and the federally listed American alligator and wood stork. A complex of impounded areas, ephemeral wetlands, and reservoir backwaters constitutes a significant foraging area on the refuge for wood storks.

Forty-nine species of shorebirds, gulls, and tents have been observed along the mudflats and sandbars of the reservoir, and within the ephemeral wetlands and agricultural fields of the refuge. Ten of these—killdeer; greater and lesser yellowlegs; spotted, least and pectoral sandpiper; dunlin; common snipe; ring-billed gull; and Forster's tern—are considered common. Wood storks use the shallow and backwater areas of the reservoir, while herons and egrets consistently forage in all wetland areas. Bald eagles have been observed on the mudflats, feeding on carrion.

The refuge supports three major heron rookeries. Ideal conditions for these rookeries are high reservoir levels in spring for nest protection and lower levels in late spring and summer for foraging.

Waterfowl populations in the winter range from 10,000 to 15,000 birds. Historically, the population peaked at 35,000 ducks and geese. The refuge provides wintering waterfowl foraging and resting habitat. Croplands flooded in the fall may attract 75 percent of all waterfowl on the refuge. The river and reservoir at low water levels provide significant foraging and resting habitat.

Water management is the most important technique that the refuge uses to enhance habitats for wildlife. The refuge has eight pump sites serving five different impoundments. Over 1,800 ac-ft of water is pumped annually into the impoundments from the river during late fall and returned to the river in early spring. This pattern of water use was described in the fish and wildlife facilities report of the Comprehensive Study (Ziewitz and Luprek 1996).

The refuge has a cooperative farming program that can put up to 1,200 ac under cultivation. Crops include hay, oats, rye, corn, sorghum, millet, and peanuts. Two farmers cultivate the land and leave up to 25 percent of all crops grown in the field as part of their lease agreement. The crops are flooded for waterfowl and other wildlife. Farming on the refuge is dependent on irrigation. Approximately 500 ac is irrigated with 3 to 4 in of water during the growing season for corn and peanuts.

2.5.5.2 Fish Hatcheries

The following four fish hatcheries in the ACF Basin use an average of about 10 mgd of water annually (Ziewitz and Luprek 1996):

- Buford Trout Hatchery on the Chattahoochee River below Buford Darn in Georgia, operated by the Georgia DNR with a surface water withdrawal from the Chattahoochee River.
- Cordele Fish Hatchery in Cordele, Georgia, operated by the Georgia DNR with a groundwater withdrawal.
- Steve Cocke Fish Hatchery in Dawson, Georgia, operated by the Georgia DNR with a groundwater withdrawal.
- Warm Springs Regional Fisheries Center in Warm Springs, Georgia, operated by USFWS with a groundwater withdrawal.

Buford Trout Hatchery is the only fish hatchery in the ACF Basin that relies on surface flows for its operations, and it is the largest user of water.

2.6 Socioeconomic Resources

This section describes the affected environment, or the baseline conditions, for the economic resources in the ACF Basin. M&I water demands, navigation, power generation, agriculture, recreation, and flood risk management are discussed.

2.6.1 Municipal and Industrial Water Demands

The Chattahoochee River and the existing federal reservoirs are important sources of M&I water supply for a number of municipalities and industries within the basin. Municipalities draw water from the rivers and reservoir pools for their water supplies. Industrial plants such as pulp and paper mills and poultry processing operations use water in their production processes. Recreation-related businesses, such as country clubs, use water to irrigate golf courses. Various state and county parks use water for irrigation and water supply. In many ways, these water uses support local jobs and contribute to the economy.

Lake Lanier is the most heavily used USACE reservoir in the ACF Basin for M&I water supply and is the primary water supply source for Metro Atlanta. Lake Lanier, along with its Buford Dam operations, has been at the center of a longstanding water allocation controversy among Alabama, Florida, and Georgia as described in section 3.1. Lake Lanier has been used for M&I water supply since the project construction was completed in 1957. Two Georgia cities, Buford and Gainesville, originally withdrew water from the Chattahoochee River and both had existing intake structures and water treatment plants on riparian lands before and at the time of project construction. Consequently, contracts for the relocation, rearrangement, or alteration of municipal water works facilities (relocation contracts) were finalized for Gainesville on June 22, 1953, and for Buford on December 19, 1955.

As part of the compensation for the municipal property acquired for the Buford Dam project and under the resulting relocation contracts terms, each city was granted the right to withdraw, free of charge, specified maximum amounts of water from the reservoir. Buford was granted a maximum withdrawal amount of 2.0 mgd, and Gainesville, 8.0 mgd, as described in section 2.1.1.2.4.6.

2.6.1.1 Interim Water Withdrawal Contracts

The majority of the M&I water supply use in the ACF Basin occurs in Metro Atlanta, withdrawn either directly from Lake Lanier or immediately downstream of Buford Dam. However, several major water supply users are downstream of Metro Atlanta and withdraw directly from the Chattahoochee River, the federal reservoirs, or both.

2.6.1.1.1 Contracts for Direct Water Withdrawals from Lake Lanier

Beginning in 1973, USACE executed interim water supply withdrawal contracts with Gwinnett County and subsequently with Cumming and Gainesville—1978 and 1987, respectively—to further accommodate growing water supply needs by providing for additional direct withdrawals from Lake Lanier. The authority used to implement these contracts was the IOAA, 31 U.S.C. 9701, a statute that authorizes USACE to accept payment for services rendered, to include providing for water withdrawals. It does not provide for the reallocation of water supply storage space. These withdrawal contracts are discussed in more detail in section 2.1.1.2.4.6. USACE treated its accommodation of water supply withdrawals from Lake Lanier as services apart from the Lake Lanier project authority and collected payment pursuant to the IOAA. Table 2.6-1 provides a summary of the existing relocation contracts and prior interim water withdrawal contracts for the municipalities withdrawing water directly from Lake Lanier.

Table 2.6-1.
Water Supply Contracts Direct Withdrawals from Lake Lanier

Contract type	Contract party	Original contract amount (mgd)	Original contract date
Relocation	Gainesville	8[a]	June 22, 1953
Relocation	Buford	2	December 19, 1955
Interim Withdrawal[b]	Gwinnett County	53	July 2, 1973
Interim Withdrawal[b]	Cumming	10	June 27, 1978
Interim Withdrawal[b]	Gainesville	12	May 28, 1987

Notes:
[a] The terms of the 1953 relocation agreement with the City of Gainesville have been interpreted as 8 mgd net during any 24-hr period. 10 mgd treated wastewater is returned to Lake Lanier.
[b] The interim withdrawal contracts for Gwinnett County, Cumming, and Gainesville expired on January 1, 1990.

2.6.1.1.2 Operational Adjustments for Flows Downstream of Buford Dam

In 1974, the GAEPD established a minimum flow standard of 750 cfs downstream of Atlanta's water supply intake and just upstream of Peachtree Creek. Unlike earlier flow targets of 600, 650, or 750 cfs at Atlanta—which were minimum flows from which Atlanta was able to withdraw its water supply upstream of Peachtree Creek—the new standard required a continuous flow of 750 cfs after accounting for withdrawals by Atlanta and upstream water supply providers. This increased downstream flow target, along with increasing demand for M&I water supply in the region, and raised concerns that existing operations might not continue to yield sufficient flows for downstream water quality and water supply needs. These needs were accommodated by operational adjustments for flows downstream of Buford Dam, which are discussed in detail in section 2.1.1.2.4.6.

2.6.1.2 Lake Lanier—Direct Water Withdrawals

The existing M&I water supply withdrawals made directly from Lake Lanier by the municipalities listed in Table 2.6-2 totaled 132 mgd in 2006 and, according to a water use rate of 151 gallons per capita per day (gpcd), serve an estimated population of approximately 875,000 (MNGWPD 2009). The year 2006 best represents the existing water supply demand for Metro Atlanta because during the drought years of 2007–2009, severe water use restrictions were imposed by the water utilities to maximize water conservation. Withdrawals at the 2007 level were used in the HEC-ResSim modeling because that was the year of greatest consumption basinwide. Of the total water supply withdrawals shown in Table 2.6-2, 20 mgd are covered by the previously described relocation contracts between USACE and the cities of Buford (2 mgd) and Gainesville (18 mgd). Current withdrawals, other than those stated for Buford and Gainesville, are not currently under an authorized storage agreement.

Table 2.6-2.
Direct Water Supply Withdrawals from Lake Lanier

Municipality	2006 Direct water withdrawals (mgd)	2007 Direct water withdrawals (mgd)	2008 Direct water withdrawals (mgd)
Buford[a]	1.53	1.47	1.31
Cumming[b]	11.95	11.65	10.93
Forsyth County	6.83	8.44	4.90
Gainesville[c]	19.00	18.76	16.37
Gwinnett County	92.67	88.27	73.59
Total	131.98	128.58	107.09

Notes:
[a.] A total withdrawal amount of 2.0 mgd gross withdrawal is authorized by the relocation contract.
[b.] Cumming also furnishes water to Forsyth County, Georgia but Forsyth County's portion is reported separately
[c.] Includes 8.0 mgd net withdrawal (18 mgd gross withdrawal) authorized by the relocation contract.

2.6.1.3 Future Demand of Current and Potential Future Lake Lanier Users

Currently, 3.3 million users benefit from water withdrawals from Lake Lanier. Georgia EPD projects that, by 2040, more than 6 million users will rely on water supply storage from Lake Lanier. In 2011, the average water withdrawal directly from Lake Lanier was 115.3 mgd. Other than the entities listed above that currently withdrawal from Lake Lanier, Georgia EPD has stated that Habersham, White, Lumpkin, and Dawson counties also are likely future users.

Water supply demand was projected for Metro Atlanta in the MNGWPD Water Supply and Conservation Management Plan. Projections are forecasted through 2035 and 2050. Future withdrawals needed directly

from Lake Lanier are projected to reach 297 mgd around 2040. River withdrawals in the Atlanta reach are expected to increase to 408 mgd by 2040. While conservation measures are currently in place to reduce current and future demand, Metro Atlanta will continue to grow and see their water supply needs increase.

2.6.1.4 Downstream of Buford Dam—Existing Metro Atlanta Water Withdrawals

Metro Atlanta has four water utilities, represented by the ARC, downstream of Buford Dam (Table 2.6-3). Those utilities withdrew a combined average annual 280 mgd from the Chattahoochee River in 2006 (275 mgd in 2007) (according to withdrawal records provided by the states and compiled by USACE, Mobile District). The utilities are DeKalb County, Atlanta, Cobb County/Marietta Water Authority, and Fulton County. The residential water supply needs of a total estimated population of 2.1 million are served by those utilities, plus numerous commercial, industrial, and institutional enterprises. According to the 1975 Interim Plan, 327 mgd of water is supplied through incidental flows resulting from Buford Dam hydroelectric power generation operations. Those incidental flows are sufficient to satisfy the existing downstream water supply demand below Buford Dam.

Table 2.6-3.
Direct Water Supply Withdrawals from Chattahoochee River

	Withdrawals from Chattahoochee River (mgd)		
Municipality	**2006**	**2007**	**2008**
City of Atlanta	102.54	100.90	87.78
Atlanta-Fulton Co. Water Res. Commission	43.76	44.07	36.07
Dekalb County Public Works	82.81	78.36	72.58
Cobb County Marrietta Water Authority	51.00	52.14	43.69
Total	280.12	275.46[a]	240.13

Note:
[a.] In the RESSIM model, 277MGD was used as the gross river withdrawal value for 2007. 277 MGD was a carryover value from when modeling originally began and is representative of current river withdrawals.

In general, Buford Dam's weekly water supply/quality release decisions are based on the CRMS. Under the system, USACE, in coordination with GPC and the ARC, determines weekly the daily amounts of water to release from Buford Dam to accommodate the anticipated downstream river withdrawals for M&I water supply by DeKalb County, Atlanta, Cobb County/Marietta Water Authority, and Fulton County, and to assure water quality at the confluence of the Chattahoochee River and Peachtree Creek. The weekly schedule of Buford Dam water releases is to ensure that sufficient water is available for Chattahoochee River water supply withdrawals, water quality flows at Peachtree Creek, hydroelectric power generation, and fish and wildlife conservation needs. During the winter and spring, releases from Lake Lanier can be reduced because of sufficient downstream tributary flows to meet the GAEPD's target water quality flow at Peachtree Creek. To the extent possible, the releases are in conjunction with peaking power operations and minimize effects on hydroelectric power generation.

2.6.1.5 Other Major M&I Water Supply Users

The majority of the M&I water supply use in the ACF Basin occurs in Metro Atlanta either directly from Lake Lanier or immediately downstream of Buford Dam. However, several major water supply users downstream of Metro Atlanta withdraw directly from the Chattahoochee River or the federal reservoirs or both. They are described in the sections to follow. Details of their water withdrawals are provided in section 2.1.1.2.5.

2.6.1.5.1 LaGrange, Georgia

The city of LaGrange withdraws water directly from West Point Lake in an average amount of 20.96 mgd pursuant to a relocation contract. The city has an intake structure within the reservoir that houses a series of intakes at the following elevations: 628, 623, 618, and 600 ft. An inoperable intake that existed prior to the construction of West Point Lake is located at elevation 582 ft. The city has a water withdrawal permit from Georgia for 20 mgd (monthly average) and 22 mgd (maximum daily).

2.6.1.5.2 Columbus, Georgia

The city of Columbus withdraws water directly from Lake Oliver, one of the run-of-the-river GPC hydroelectric projects on the Chattahoochee River at Columbus. The city's intake is below the Lake Oliver permanent pool elevation of 337 ft. Columbus has a Georgia water withdrawal permit for 90 mgd.

2.6.1.5.3 Mead Westvaco (Mahrt Mill—River Intake)

The Mead Westvaco plant is near Pittsview, Alabama. The plant's water intake is in Walter F. George Lake at elevation 178.8 ft and is permitted to withdrawal 27.6 mgd. When the water surface elevation reaches 184.75 ft, the pumping capacity reduces to 75 percent. Mead Westvaco has installed emergency pumps at the intake to operate at or below pool elevation 178.8 ft to maintain pumping capacity. The plant is a flow-through facility where its discharge is generally assumed equal to the amount of water withdrawn from the river.

2.6.1.5.4 Georgia Pacific Corporation

The Georgia Pacific Corporation plant is on the Chattahoochee River near Jakin, Georgia. The plant uses six pumps with an intake elevation of 72.67 ft. Pumping capacity is reduced at pool elevations below 75 ft. The plant is a flow-through facility where its discharge is generally assumed equal to the amount of water withdrawn from the river.

2.6.1.5.5 Farley Nuclear Power Plant

The Farley Nuclear Power Plant is on the west bank of the Chattahoochee River near Columbia, Alabama. The plant becomes severely affected when the pool elevation at Lake Seminole drops below elevation 75.0 ft. Southern Nuclear defines 2,000 cfs and 74.5 ft as minimum conditions for operation.

2.6.1.5.6 Plant Scholz, Florida

The Scholz Electric Generating Plant is a coal-fired power station owned and operated by Gulf Power Company. The plant is 4 mi downstream of Jim Woodruff Lock and Dam near Sneads, Florida. The plant operated over much of the hydrologic period of analysis for the WCM update. In April 2015, Gulf Power Company ceased water withdrawals and permanently closed Plant Scholz, as discussed in section 2.1.1.2.5.4 above.

2.6.2 Navigation

The federal navigation project for the Apalachicola, Chattahoochee, and Flint rivers was originally authorized in section 2 of the River and Harbor Act of 1945, and it was further modified by the Water Resources Development Act of 1986 (Public Law [P.L.] 99-662). This legislation provides for a 9-ft by 100-ft navigation channel from Apalachicola, Florida, to the Phenix City, Alabama/Columbus, Georgia, area on the Chattahoochee River and to Bainbridge, Georgia, on the Flint River. Channel dimensions are

provided by dredging, cutoffs, training works, or other open-river methods; a series of locks and dams; and flow regulation from upstream storage projects.

The project authorization for navigation required local interests—consisting of six Florida counties bordering the Apalachicola River—to provide public port facilities and all lands, easements, rights-of-way, and disposal areas for construction and maintenance of the navigation channel in the Apalachicola River. Local interests were reluctant to provide perpetual easements for disposal of maintenance dredged material because of the potential financial liability for the counties. Accordingly, USACE approved 5-year disposal easements for the initial construction of the waterway project. After those easements expired, subsequent attempts to obtain further easements were unsuccessful. In 1988, the counties formally rescinded their commitments to provide local sponsorship for the project. Subsequently, USACE efforts to maintain the navigation channel in the Apalachicola River was largely conducted by using within-bank disposal areas subject to federal navigation servitude, which required no easements from local sponsors. Maintenance of the navigation channel in the Apalachicola River has not been performed since 2001, as discussed in section 2.1.1.2.4.3.

2.6.2.1 Port Facilities

There are two public ports in the lower Apalachicola-Chattahoochee-Flint river system. The Port of Columbus is located on the Chattahoochee River, and the Port of Bainbridge is located on the Flint River. Currently, there is no commercial barge traffic on the ACF system.

2.6.2.1.1 Port of Columbus

The Port of Columbus is owned by Georgia Ports Authority and operated by Nustart Energy LP. The terminal area is located on 14 acres with 402 ft of berthing space. The warehouse provides 27,280 sq ft of storage. The terminal processes liquid bulk commodities. Figure 2.6-1 provides an aerial view of the Port of Columbus.



Figure 2.6-1. Port of Columbus, Georgia

2.6.2.1.2 Port of Bainbridge

The Port of Bainbridge also is owned and operated by Georgia Ports Authority. The facilities are located on 107 acres on the Flint River. The port has 421 ft of berthing area for liquid bulk and 529 ft of berthing space for dry bulk. The facilities include four warehouses that provide a total of 93,000 sq ft. The facility is equipped to handle a variety of barge traffic including nitrogen solution, gypsum, ammonium sulfate, urea, cottonseed and cypress bark mulch. Figure 2.6-2 provides an aerial view of the Port of Bainbridge.



Figure 2.6-2. Port of Bainbridge, Georgia

2.6.2.2 Commercial Navigation

As much as 1.2 million tons of cargo moved on the ACF waterway as recently as 1985. The principal commodity was sand and gravel, which can move economically at shallower depths than can some other commodities. The next most important products were petroleum products and fertilizers. Presently, only sporadic commercial navigation use occurs on the ACF waterway.

Commercial waterborne traffic has continually declined in recent years as difficulties in maintaining the project and providing a reliable channel have increased. Repeated drought conditions since the 1980s have resulted in dramatic reductions in commercial traffic on the waterway. During sustained, low flow conditions when navigation on the system was restricted or eliminated, alternative contractual agreements were negotiated by the waterway users switching to truck or rail transportation. Commercial traffic is slow to return to barge transportation because of the alternative contractual agreements and unpredictable flow conditions in the basin. Because of the sustained drought conditions, dredging was not conducted in 2000, only limited dredging was completed in 2001 on the Apalachicola River, and no dredging has been conducted since then because of a combination of flow conditions, funding restrictions and, as of October 2005, the lack of water quality certification from Florida. Minor dredging occurred in 2010 on the

Chattahoochee River portion of the waterway for intrasystem navigation movements. Therefore, since 2000, a reliable channel has not been provided, and channel availability has been dependent on available flows. As a result, commercial barge commodity shipments have fallen from near 600,000 tons before the start of drought conditions in 1998 to none in 2006 and later. Table 2.6-4 contains historic tonnage by commodity on the ACF waterway for the period 1995–2011.

In addition to the commodities listed in Table 2.6-4, periodic, unscheduled shipments occur from certain users who must have waterborne transport for their large and usually oversized shipments, which cannot be transported by other modes. For example, Steward Machine of Bainbridge, Georgia, shipped two lock gates to USACE, New Orleans District, in February 2004. Also, in 2007, 480 tons of manufactured equipment and machinery were locked through Jim Woodruff Lock and Dam, which included two nuclear reactor vessel heads for Farley Nuclear Plant. It is also necessary for the Mobile District to use the navigation channel for project maintenance and rehabilitation purposes.

Table 2.6-4.
Historic Tonnage by Commodity on the ACF Waterway (1,000 Tons) 1995–2011

Commodity	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008-2011
Petroleum products	108	54	130	65	34	35	0	0	6	0	0	0	0	0
Fertilizers	166	181	138	91	60	22	0	0	2	0	0	0	0	0
Chemicals	28	25	14	10	13	3	0	0	0	0	0	0	0	0
Forest products	2	4	2	2	1	0	0	0	0	0	0	0	0	0
Sand and gravel	261	294	249	263	245	216	220	18	28	0	0	0	0	0
Farm products	21	9	7	0	3	0	0	0	0	0	0	0	0	0
Nonmetallic	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All others	2	0	1	0	2	0	1	0	0	3.1	0.1	0	0.48	0
Totals	588	567	541	431	358	276	221	18	36	3.1	0.1	0	0.48	0

Source: USACE 2013.

The majority of traffic currently operating on the lower ACF system consists of recreation vessels. Many users of recreational vessels pass though one or more of the three locks on the lower ACF system while on the river. General boating, fishing, and rafting are popular activities on this part of the system. Lock data are provided in Table 2.6-5, Table 2.6-6, and Table 2.6-7 for the years 2000–2013.

Recreational traffic has fluctuated during the last decade with no discernible trends as to number of recreational vessels using the locks. The number of vessels is often double the number of actual lockages as several recreational vessels can lock through together.

Table 2.6-5.
Jim Woodruff Lock

Lock 21	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Type of vessel														
Dredge vessel	0	16	0	0	0	0	0	0	0	0	0	0	0	0
Passenger boat or ferry	0	0	1	2	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	1	2	0	0	0	0	0	0	0	0
Nonfederal vessel	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Federal with barges	3	2	1	1	0	0	0	0	0	0	0	0	0	0
Federal without barges	19	23	16	17	8	11	4	4	6	9	11	4	2	3
Recreational vessel	555	768	705	727	602	427	430	313	171	355	392	197	262	130
Towboats with barges	405	306	2	21	6	1	0	2	1	0	0	0	0	0
Towboats without barges	12	23	17	6	4	3	2	0	1	2	2	0	0	0
Total vessels	994	1138	744	774	629	444	436	319	179	366	405	201	264	133
Total nonvessel lockages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total assists	0	0	0	0	0	0	0	0	0	0	0	0	11	0
Total lockages	715	745	431	479	423	229	256	190	146	188	196	113	116	55

Source: USACE, IWR 2014

Table 2.6-6.
George W. Andrews Lock

Lock 22	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Type of vessel														
Dredge vessel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Passenger boat or ferry	0	0	11	6	9	5	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonfederal vessel	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Federal with barges	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Federal without barges	0	9	18	13	8	9	6	9	14	21	29	10	8	8
Recreational vessel	0	47	390	237	437	604	392	420	307	446	533	427	383	261
Towboats with barges	0	12	1	3	1	0	0	0	1	0	0	0	0	0
Towboats without barges	0	2	47	28	6	1	2	1	7	16	0	0	0	2
Total vessels	0	70	467	287	461	624	401	430	329	483	562	437	391	271
Total nonvessel lockages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total assists	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Total lockages	0	53	283	206	262	390	262	192	174	215	268	183	151	125

Source: USACE, IWR 2014

Table 2.6-7.
Walter F. George Lock

Lock 23	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Type of vessel														
Dredge vessel	0	13	0	0	0	0	0	0	0	0	0	0	0	0
Passenger boat or ferry	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Other	0	0	2	2	0	0	0	0	0	0	0	0	0	0
Nonfederal vessel	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Federal with barges	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Federal without barges	0	24	24	25	9	13	13	10	24	20	20	10	11	7
Recreational vessel	0	423	321	209	368	294	593	486	321	611	648	531	359	335
Towboats with barges	0	30	1	2	2	0	0	0	1	0	0	0	0	0
Towboats without barges	0	1	2	12	3	4	1	96	2	0	0	0	0	1
Total vessels	0	491	350	250	384	311	607	592	348	632	668	541	370	343
Total nonvessel lockages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total assists	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total lockages	0	344	318	221	311	267	292	256	252	299	333	241	194	180

Sources: USACE, IWR 2014

2.6.3 Power Generation

The ACF Basin is heavily developed for hydroelectric power generation. The power resources serve residential, commercial, agricultural, and industrial users. Some of the agricultural and industrial users are dependent on economic power sources for continued operations. Hydroelectric power generation facilities in the basin are operated by private power companies, municipalities, and USACE. The water withdrawals for thermoelectric power generation are presented in section 2.1.1.2.5. GPC is the primary private operator in the ACF Basin.

The ACF Basin lies within the Southern subregion of the Southeastern Electrical Reliability Council (SERC) and the larger North American Electrical Reliability Council (NERC). The Southern subregion of the SERC consists of five smaller control areas, and Alabama Electric Cooperative, Oglethorpe Power Corporation, South Mississippi Electrical Power Association, Walton Electric Membership Corporation, and the Southern Company each manage one of the smaller areas (Figure 2.6-3).

According to the release of 2008 data from Platts, an industry leader in providing price assessments in energy markets, SERC's electrical power resources are dominated by thermal generation, a process of heating water into steam and using the steam to move turbines. Coal accounts for 59 percent of the region's total electrical power generation. Nuclear power also plays an important role, accounting for 27 percent of all generation in the area. Hydroelectric power generation makes up a smaller share of regional energy production, generating only 2 percent of the total energy. Total estimated 2008 generation for the SERC region was 1,065,368 gigawatt-hours (GWh). All thermal energy production in the region occurs at plants owned by private entities, while 50 percent of the hydroelectric power energy is generated at federal plants (Platts 2008).

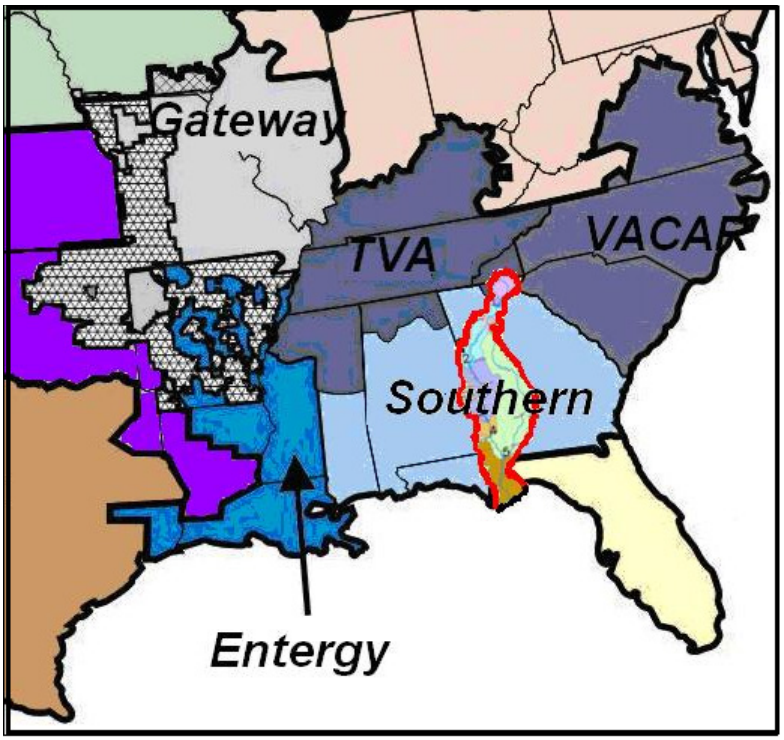


Figure 2.6-3. Southern Subregion of the Southeastern Electrical Reliability Council

Platts projects that SERC's energy and peak demand will have an annual average increase of 1.5 percent over the next 20 yr. This projected increase reflects both a shift in the SERC region and an increase in current consumption. To meet this demand, 7,100 MW of energy are projected to be added to the region's capacity, 4,800 MW of which will be from coal. With the additional increase in capacity, the region's energy generation is still projected to be thermal-driven, with coal and nuclear energy making up almost 81 percent and hydroelectric power generation still providing 2 percent of the total generation (Platts 2008). Projections and data available during initial information gathering did not recognize the expansion of liquefied natural gas or its potential to displace coal as a power generation source.

USACE operates four dams with hydroelectric power capabilities in the ACF River Basin: Buford Dam, West Point Dam, Walter F. George Lock and Dam, and Jim Woodruff Lock and Dam. The Buford, West Point, and Walter F. George projects are operated as peaking plants with an installed capacity of 382 MW, while Jim Woodruff Lock and Dam, near the confluence of the Chattahoochee and Flint rivers, is operated as a run-of-river plant with limited hydropower peaking operation and an installed capacity of 43.35 MW.

Seven non-USACE plants owned by GPC are also considered in this analysis. Morgan Falls, Bartletts Ferry, Goat Rock, Langdale, Riverview, Oliver, and North Highlands (listed in downstream order) all act as modified run-of-river plants. The GPC plants use small amounts of storage to help reregulate the variable releases of the upstream USACE reservoirs. These plants have a combined installed capacity of 307 MW. Their individual capacity is presented in Table 2.6-8.

In the Flint River Basin, the Albany Dam and Crisp County Dam both contain GPC hydroelectric power plants. However, those facilities were not included in the hydroelectric power analysis because any changes to the ACF water control operations would not affect those facilities.

Table 2.6-8.
Plant Characteristics for USACE and Non-USACE Hydroelectric Power Plants

Plant	Owner	No. of units	Power capacity (MW)	Type
Buford Dam	USACE	3	127.00	Peaking
Morgan Falls	GPC	7	16.80	Modified run-of-river
West Point Dam	USACE	3	87.00	Peaking
Langdale Dam	GPC	2	1.04	Run-of-river
Riverview Dam	GPC	2	0.48	Run-of-river
Bartletts Ferry	GPC	6	173	Modified run-of-river
Goat Rock Dam	GPC	6	38.60	Modified run-of-river
Oliver Dam	GPC	4	60.00	Modified run-of-river
North Highlands	GPC	4	29.60	Modified run-of-river
Walter F. George L&D	USACE	4	168.00	Peaking
Jim Woodruff L&D	USACE	3	43.35	Run-of-river

2.6.4 Agricultural Water Supply

Agriculture is a vital component of the regional economy and, therefore, the availability of adequate water supplies for agricultural purposes is important. The U.S. Census Bureau divides agriculture areas into agricultural districts. Table 2.6-9, Table 2.6-10, and Table 2.6-11 show the breakdown of the counties within the ACF Basin and the agricultural district to which they are attributed.

According to the 2012 American Community Survey, approximately 3.5 percent of the Alabama workforce was employed in the agriculture, forestry, and fisheries industries; in Florida, this figure was 4.3 percent; in Georgia, it was 3.6 percent (U.S. Census Bureau 2014). Potential shortages in meeting agricultural water demands could result in significant economic impacts on portions of the ACF Basin. Details of agricultural water withdrawals are provided in section 2.1.1.2.5.

Table 2.6-9.
Georgia Agricultural Districts

Central	CRAWFORD		CARROLL
	HOUSTON		CHATTAHOOCHEE
	MONROE		CLAYTON
	PEACH		COWETA
North Central	CHEROKEE		DOUGLAS
	COBB		FAYETTE
	DAWSON		HARRIS
	DEKALB		HEARD
	FORSYTH		HENRY
	FULTON		LAMAR
	GWINNETT	**West Central**	MACON
	HALL		MARION
	LUMPKIN		MERIWETHER
	WHITE		MUSCOGEE
Northeast	BANKS		PIKE
	HABERSHAM		SCHLEY
Northwest	PAULDING		SPALDING
South Central	COLQUITT		TALBOT
	CRISP		TAYLOR
	DOOLY		TROUP
	TURNER		UPSON
	WORTH		
Southwest	BAKER		
	CALHOUN		
	CLAY		
	DECATUR		
	DOUGHERTY		
	EARLY		
	GRADY		
	LEE		
	MILLER		
	MITCHELL		
	QUITMAN		
	RANDOLPH		
	SEMINOLE		
	STEWART		
	SUMTER		
	TERRELL		
	WEBSTER		

Table 2.6-10.
Alabama Agricultural Districts

BLACK BELT	BULLOCK
	MACON
UPPER PLAINS & PIEDMONT	CHAMBERS
	LEE
	RANDOLPH
WIREGRASS	BARBOUR
	GENEVA
	HENRY
	HOUSTON
	RUSSELL

Table 2.6-11.
Florida Agricultural Districts

NORTHWEST	BAY
	CALHOUN
	FRANKLIN
	GADSDEN
	GULF
	JACKSON
	LIBERTY
	WASHINGTON

2.6.4.1 Farming Operations

Farming operations and the number of acres farmed are shown by agricultural district in Table 2.6-12. A total of 14,574 farms are located within the Georgia portion of the watershed. The West Central agricultural district has the greatest number of farms within the Georgia portion of the watershed. However, approximately 50 percent of the acres farmed lay within the Southwest agricultural district. A total of 5,034 farm operations are located within the Alabama portion of the watershed. Sixty percent of the acres involved in a farming operation are in the Wiregrass agricultural district.

Table 2.6-12.
Farming Operations in the ACF Basin

	Number of acres in farm operation	Number of farm operations
Georgia		
CENTRAL	136,942	754
NORTH CENTRAL	173,653	2,565
NORTHEAST	97,607	941
NORTHWEST	8,368	142
SOUTH CENTRAL	748,972	1,767
SOUTHWEST	1,827,812	3,667
WEST CENTRAL	757,547	4,738
Total	**3,750,901**	**14,574**
Alabama		
BLACK BELT	267,917	625
UPPER PLAINS & PIEDMONT	269,283	1,227
WIREGRASS	908,197	3,182
Total	**1,445,397**	**5,034**
Florida		
NORTHWEST	869,885	9,400
Total	**869,885**	**9,400**

Source: USDA 2012.
Note: Information may have been omitted due to protection of proprietary information.

2.6.4.2 Agricultural Activities that Occur within the Watershed

The ACF region hosts many different types of agriculture activities, including both crop and animal production. Table 2.6-13 and Table 2.6-14 display the total sales related to agricultural activity that occurred in 2012. Georgia had more than $6 billion in sales related to animals and animal products. The Southwest and South Central districts account for the majority of crop sales in the Georgia portion of the ACF watershed. The largest portion of sales in Alabama is in the Wiregrass agricultural district, which accounts for the majority of crop sales in the Alabama portion of the watershed.

Table 2.6-13.
Animals and Related Products Sales (in thousands)

Georgia	**Georgia Total**	**$ 6,033,972**
	CENTRAL	$ 259,320
	NORTH CENTRAL	$ 1,693,307
	NORTHEAST	$ 993,928
	NORTHWEST	$ 51,282
	SOUTH CENTRAL	$ 436,358
	SOUTHWEST	$ 979,736
	WEST CENTRAL	$ 1,620,041
Alabama	**Alabama Total**	**$ 433,168**
	BLACK BELT	$ 23,720
	UPPER PLAINS & PIEDMONT	$ 115,691
	WIREGRASS	$ 293,757
Florida	**Florida Total**	**$ 29,045**
	NORTHWEST	$ 29,045

Source: USDA 2012.
Note: Information may have been omitted due to protection of proprietary information.

Table 2.6-14.
Crops and Related Products Sales (in thousands)

Georgia	**Georgia Total**	**$ 4,514,848**
	CENTRAL	$ 200,234
	NORTH CENTRAL	$ 142,904
	NORTHEAST	$ 10,228
	NORTHWEST	$ 6,138
	SOUTH CENTRAL	$ 1,283,077
	SOUTHWEST	$ 2,566,491
	WEST CENTRAL	$ 305,776
Alabama	**Alabama Total**	**$ 232,383**
	BLACK BELT	$ 46,046
	UPPER PLAINS & PIEDMONT	$ 4,161
	WIREGRASS	$ 182,176
Florida	**Florida Total**	**$ 157,191**
	NORTHWEST	$ 157,191

Source: USDA 2012.
Note: Information may have been omitted due to protection of proprietary information.

2.6.4.3 Employment within the Agricultural Sector

The Agricultural Census classifies agricultural labor into three groups: hired, migrant, and unpaid labor. The total number of laborers is shown in Table 2.6-15 by state and agricultural district. A large percentage of the labor force is employed in southwest Georgia, which mirrors where the most farm revenue is generated.

Table 2.6-15.
Agricultural Labor by District

Georgia	**Georgia Total**	**33,734**
	CENTRAL	2,311
	NORTH CENTRAL	4,844
	NORTHEAST	1,643
	NORTHWEST	246
	SOUTH CENTRAL	6,854
	SOUTHWEST	9,963
	WEST CENTRAL	7,873
Alabama	**Alabama Total**	**9,086**
	BLACK BELT	1,753
	UPPER PLAINS & PIEDMONT	2,091
	WIREGRASS	5,242
Florida	**Florida Total**	**8,193**
	NORTHWEST	8,193

Source: USDA 2012.
Note: Information may have been omitted due to protection of proprietary information.

2.6.4.4 Oyster Industry of Apalachicola Bay

According to the Florida Department of Agriculture and Consumer Services, Apalachicola Bay provides 90 percent of Florida's oysters. As stated in the 2012 report, the greatest number of landings were reported in the early 1980s. As shown in Table 2.6-16, the oyster landings ranged from 1.4 million

pounds of meats in 2003 to 2.7 millions pounds of meats in 2009. The number of bags per trip was at its lowest in 2010. The National Agricultural Statistical Service reported sales revenue of oysters in Franklin County of $302,000 in its 2012 survey. This is down from over $600,000 in its 2007 survey.

Table 2.6-16.
Apalachicola Bay Oyster Statistics 2000–2012

Year	Pounds (meats)	Number of trips reported	AB oyster harvesting licenses	Bags/trip
2000	2,327,402	25,550	958	13.9
2001	2,333,968	25,261	1,135	14.1
2002	1,725,776	20,294	914	13
2003	1,449,890	18,467	759	12
2004	1,502,056	17,692	719	12.9
2005	1,260,996	12,663	714	15.2
2006	2,127,049	22,644	916	14.3
2007	2,645,359	29,104	1,142	13.9
2008	2,238,482	27,603	1,168	12.3
2009	2,695,701	39,942	1,433	10.2
2010	1,938,059	32,330	1,909	9.1
2011	2,380,810	39,176	1,799	9.3
2012			1,687	

Source: FDACS 2012.

2.6.5 Flood Risk Management

Flood risk management has long been an important focus of USACE and the reservoirs it operates. Within the ACF Basin, Lake Lanier and West Point Lake provide important flood risk management storage with spillway capacities sufficient to discharge floods with return intervals of 500 years.

Lake Lanier is primarily in Forsyth County in northern Georgia. Construction of the Buford Dam began in March 1950 and was completed in June 1959. The project is described in sections 3.1.1 and 2.1.1.1.6.1. The 500-year floodplain south of Lake Lanier extends through Forsyth, Gwinnett, Fulton, and Cobb counties. It begins at Buford Dam and concludes downriver of the Chattahoochee River's confluence with Peachtree Creek. At the maximum flood control pool elevation of 1,085 ft, the reservoir has an area of 47,182 ac and a gross capacity of 2,554,000 ac-ft, of which 637,000 ac-ft is reserved for flood storage at elevation 1,070.

Construction of the West Point Lake Dam began in June 1966 and was completed in 1975. The project is described in sections 3.1.1.2 and 2.1.1.1.6.3. West Point Lake, at the Georgia-Alabama state line, has a 500-yr floodplain that incorporates areas of Troup and Harris counties in Georgia and Chambers County in Alabama. At the maximum flood pool elevation of 641 ft, the reservoir has a total storage at maximum flood pool of 774,798 ac-ft, of which 170,271 ac-ft is reserved for flood storage between elevations 635 and 641.

2.6.5.1 Flood Damages Prevented

Both Buford Reservoir and West Point Reservoir have provided millions of dollars in flood risk management benefits over the decades. Table 2.6-17 presents the flood risk management benefits that the projects have provided over the last five fiscal years. The total flood risk management benefits provided for both reservoirs for FY09–FY13 were valued at $6.9 million.

Table 2.6-17.
Flood Damages Prevented by ACF Projects, Fiscal Years 2009–2013

Reservoir	*FY09*	*FY10*	*FY11*	*FY12*	*FY13*
Buford	$ 4,163,000	$ 1,107,000	$ 238,000	$ -	$ 774,000
West Point	$ 514,000	$ 131,000	$ -	$ -	$ 37,000

2.6.5.2 Floodplain Characteristics

This section provides a summary of the ACF floodplain structure data. Because of time and funding constraints, the structure inventory information contained in this document was taken from the *Draft Environmental Impact Statement*, *Water Allocation for the Apalachicola-Chattahoochee-Flint River Basin*, Appendices Volume 2, September 1998. The price level was from fiscal year 1998, when the federal interest rate was 7-1/8 percent. It is recognized that development has occurred since 1998, and structure values have most likely increased. The recurrence interval assumed in the sections to follow is 500 years. The frequency floodplain is assumed with-project since the analysis year began in 1995, with Buford Dam being competed in 1959 and West Point Dam being completed in 1975.

2.6.5.2.1 Floodplain below Buford Dam

The floodplain south of the Buford Dam consists of 5,108 residential structures, 16 public structures, and 218 commercial structures. Tax assessor-appraised residential structure values range from a $5,000 trailer to several $1.4 million dollar homes, with a floodplain residential structure value of over $1 billion. Residential structure content value is estimated to be over $466 million. Public structures in the floodplain have a total value of over $30.6 million. The structures range in value from a $7,500 storage building to a $14 million water treatment plant. Public structure inventory and equipment values total over $20 million and $6 million, respectively. The floodplain tax-appraised commercial structure values range from a $2,500 storage building to a $23 million power plant, with a floodplain total commercial value of over $109 million. Commercial structure inventory and equipment values total over $34 million and $209 million, respectively. The estimated floodplain totals for each category of structures are provided in Table 2.6-18.

Table 2.6-18.
Buford Dam Floodplain Value Data

Structure type	Structure ($)	Content ($)	Inventory ($)	Equipment ($)
Residential	1,048,486,000	466,014,000	--	--
Public	30,642,000	--	19,723,000	5,653,000
Commercial	109,238,000	--	34,000,000	208,647,000
Total	**1,188,366,000**	**466,014,000**	**53,723,000**	**214,300,000**

2.6.5.2.2 Floodplain below West Point Dam

The floodplain south of West Point Dam consists of 171 residential structures, 18 public structures, and 220 commercial structures. Approximately 90 percent of the floodplain is on the Chattahoochee River between RMs 306.2 and 304.2. Tax assessor-appraised residential structure values range from $2,500 to $130,000, with a floodplain total residential structure value of approximately $5 million. Residential structure content values range from $1,091 to $58,000, with a floodplain total value estimated to be $2 million.

West Point floodplain public structures have an estimated total value of $3 million. The respective structures range in value from a $1,000 storage building to $500,000 municipal buildings. Public structure inventory and equipment values are estimated to total $893,000 and $2 million, respectively.

The floodplain tax-appraised commercial structures have a total value of approximately $28 million. Commercial structure values range from a $1,250 storage building to a $4 million industrial plant. Commercial structure inventory and equipment values total more than $89 million.

The floodplain totals for each structure type is provided in Table 2.6-19.

Table 2.6-19.
West Point Dam Floodplain Value Data

Structure type	Structure ($)	Content ($)	Inventory ($)	Equipment ($)
Residential	5,361,000	2,363,000	--	--
Public	2,643,000	--	893,000	2,024,000
Commercial	28,453,000	--	60,153,000	88,819,000
Total	**36,457,000**	**2,363,000**	**61,046,000**	**90,843,000**

2.6.6 Recreation

The reservoirs, rivers, and streams of the ACF Basin are heavily used for recreation purposes. The basin contains several national forests, national and state parks, and resort communities that are favorite weekend and vacation destinations. Much of the area in the north portion of the basin (north of Lake Lanier) falls within the Chattahoochee National Forest. Solely because of the presence of Buford Dam, a world-class and highly used *put and take* trout fishery exists below Buford Dam. A description of the CRNRA is presented in section 2.1.1.2.4.5 of water resources and section 2.4 of land use. The Eufaula National Wildlife Refuge is in southeast Alabama and southwest Georgia and straddles both sides of the Chattahoochee River. Hunting and fishing are among the recreational opportunities in this area. Wildlife management facilities in the basin are presented in Table 2.5-6. The area in the southern portion of the basin falls within the Apalachicola National Forest, the largest forest in Florida. These national forests provide both developed and dispersed recreation opportunities. The developed sites provide a range of primitive to modern facilities; the dispersed activities include hunting, fishing, boating, hiking, and off-road vehicle riding.

Lake Lanier, north of Atlanta, has more than 7.5 million visitors annually. Within Metro Atlanta, the CRNRA is a popular recreation area. South of Atlanta, several reservoirs in the basin, including West Point Lake, Walter F. George Lake, and Lake Seminole, are major recreational fishing destinations.

Seven reservoirs in the ACF Basin provide various recreation opportunities and receive varying degrees of usage. Six of the reservoirs are on the Chattahoochee and Flint rivers. Five reservoirs are operated by USACE and two by GPC. Recreation facilities on the reservoirs include public docks, fishing piers, and

access sites; boat launches; swim areas; camping facilities; and playground areas. Additional information regarding the recreational facilities at the various reservoirs in the basin is provided in section 2.4. Table 2.6-20 summarizes the recreation facilities on each of the reservoirs.

Table 2.6-20.
Recreation Facility Descriptions

Reservoir/ surface area	No. of parks	No. of marinas	No. of campgrounds	Recreation components
Lake Lanier/ 38,542 ac	62	10	10	Public: Swim areas, boat ramps, picnic shelters/tables, restrooms, showers, campsites, and boat launches. Private: Lake Lanier Islands Beach and Water Park offers swimming; powerboat, sailboat, and bicycle rentals; water skiing; fishing; and horseback riding. An 18-hole, par-72 championship golf course is next to the water park.
West Point Lake/ 25,864 ac	26	2	10	Public: Boat launches, swim areas, picnic shelters/tables, restrooms, showers, and campsites.
Bartletts Ferry/ 5,850 ac	3	1	2	Public: Marinas, boat ramps, and fishing areas below the dam. Blanton Creek Wildlife Management Area has camping, nature trails, and wildlife viewing. Private: Marinas, fishing areas.
Lake Oliver/ 2,150 ac	0	1	0	Public: Boat ramp, parking, bank fishing areas, and access to the Goat Rock tailrace. City Marina (operated by city of Columbus). Common recreation activities at the marina include bank fishing, pier fishing, tournament fishing, picnicking, and hiking on the riverwalk. Facilities provided at City Marina include a bait shop, five boat docks, three boat launching lanes, a fishing pier, two expansive picnic areas, large parking area, and several bank fishing areas.
Walter F. George Lake/ 45,181 ac	13	4	4	Public: State parks on the lake, bank shore fishing, fishing piers, and boat ramp areas.
George W. Andrews/ 1,540 ac	3	No data are available	5	Three public use boat ramps are available on the lake.
Lake Seminole/ 37,500 ac	16	6	5	Two state parks that are known nationally as some of the best sites for sportfishing in America.

Sources: Brown and Smith 1997; USACE 1998.

2.6.6.1 Lake Lanier Impact Levels

Lake Lanier has impact levels defined at pool elevations of 1,066 ft, 1,063 ft, 1,060 ft, 1,045 ft, and 1,035 ft. The elevation range of 1,066–1,063 ft is defined as the Initial Impact Level (IIL). Effects on swim areas include increased beach area and reduced swim areas. The swim line is set at 1,064 ft at full summer pool and cannot always be moved to accommodate a lower pool elevation. Non-USACE-operated swim areas might be affected at the 1,064 ft level. Recreational navigation hazards are marked at the 1,064 ft level. Rocks, reefs, and stumps below 1,064 ft are unmarked. Boat ramps are minimally affected at 1,066 ft; three boat ramps are unusable. Non-USACE boat ramps are not affected at that level. Approximately 10 percent of private boat docks are affected. Marina, clubs, and community docks are not affected at this level.

The elevation range of 1,063–1,060 ft is defined as the Recreation Impact Level (RIL). Most swim areas (USACE and non-USACE) will become unusable at this level. Recreational navigation hazards will increase, and boaters must exercise more caution to avoid hazards. USACE-operated boat ramps are affected, resulting in lanes at 14 boat ramps being unusable. Non-USACE boat ramps are less affected; one boat ramp is unusable. Twenty percent of private boat docks are affected. Boat slips in marinas are minimally affected; 142 slips, or 2 percent, are unusable. Roughly 15 percent of slips in community docks are unusable.

The elevation range of 1,060–1,045 ft is defined as the Water Access Limited (WAL). In general, most water-based recreation activities would be severely restricted and become increasingly dangerous. Most USACE swim areas are unusable. Non-USACE swim areas are all unusable. Recreational navigation hazards become more numerous, and vessels must be operated with increased caution. USACE boat ramps are significantly affected at this level. Twenty-nine boat ramps have lanes that are unusable. Non-USACE boat ramps are marginally affected; three boat ramps have lanes that are unusable. Approximately 50 percent of private boat docks are affected. Boat slips in shallow areas of marinas are marginally affected. Approximately 10 percent, or 920 slips, are unusable. Community docks are significantly affected; roughly 30 percent of slips are unusable.

2.6.6.2 West Point Lake Impact Levels

West Point Lake has impact levels defined at elevations of 632.5 ft, 629 ft, and 627 ft. The IIL is defined at 632.5 ft. Swim lines are set at 629 ft; swim areas are only marginally usable when the pool level falls below this impact line. Docks must be shifted to deeper water, if allowable. Unmarked recreational navigation hazards begin to appear. Approximately 35 percent of private docks become marginally usable with only 2 ft of water beneath them. Lanes of boat ramps can partially silt in, in some areas.

The elevation of 629 ft is defined as the major impact level. All swim areas become unusable. Approximately 40–50 percent of private docks become unusable. Unmarked navigation hazards continue to emerge. Activities such as water skiing and wakeboarding become unsafe in some areas. Approximately 10 percent of project boat launch ramps are affected with less than 6 ft of water at the end of the slab. Other ramps continue to have silt buildup. Approximately 30 percent of courtesy ramps become unusable.

The elevation of 627 ft is defined as the severe impact level. Water is 50–100 ft from the normal shoreline and access to water is limited by mud. Recreational navigation hazards continue to emerge, and water skiing and wakeboarding is limited to main bodies of the lake. The boat ramp at Highland Marina becomes unusable. Over 50 percent of courtesy docks at boat ramps become unusable. Silt buildup and drop-offs continue to increase at boat ramps. Approximately 70 percent of private boat docks are unusable at this level.

2.6.6.3 Walter F. George Lake Impact Levels

The Walter F. George Lake has impact levels defined at elevations of 187 ft, 185 ft, and 184 ft. At the 187-ft level, swim areas become only marginally usable. Unmarked recreational navigation hazards begin to emerge. Silt buildup can begin to occur at boat ramps. Approximately 30 percent of private boat docks become marginally usable with 2 ft of water under them. At elevation 185 ft, all swim areas become unusable with only 1–2 ft of water within the buoy lines. Boat slips at some marinas become inaccessible, and 30-40 percent of private boat docks become unusable. Unmarked navigation hazards continue to appear, and some areas in the reservoir become unsafe for skiing and wakeboarding. Approximately 70 percent of boat docks have 4 ft of water or less at the end of the slab. Four ramps become unusable. All ramps are affected by silt buildup. Approximately 50 percent of courtesy docks become unusable. At the elevation of 184 ft, water is 50–100 ft from the shoreline and access to water is severely limited by mud.

Recreational navigation hazards continue to emerge, and skiing and wakeboarding is limited to the main bodies of the lake. Swimming areas are unusable. Approximately 85–90 percent of private boat docks are affected, and 75 percent of boat ramps are affected.

2.6.6.4 Current Recreation Visitation at USACE Projects within the ACF Basin

USACE projects within the ACF Basin provide many opportunities for recreation. Peak recreation within the ACF Basin occurred in fiscal year 2006, when total visits reached 12.7 million. More than 50 percent of the visits to a project each year occur at Lake Lanier. Table 2.6-21 displays visitation by project during the last decade. Visitation includes visits at both private and public facilities.

Table 2.6-21.
Visitation at ACF Projects, Fiscal Years 2003–2012

	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
Buford Dam - Lake Sidney Lanier	7,697,482	7,698,005	7,725,328	7,552,119	7,738,041	6,857,691	6,863,752	7,112,961	7,195,417	6,548,130
George W. Andrews	253,289	304,412	269,801	241,980	231,869	240,062	271,535	271,435	249,870	221,346
Jim Woodruff L&D-Lake Seminole	925,323	1,039,952	1,223,736	1,223,532	1,253,639	1,149,491	1,292,092	1,259,556	1,345,410	1,531,659
Walter F. George	4,384,766	4,423,694	3,693,899	4,340,890	3,792,794	3,919,741	3,799,469	3,952,851	3,645,445	3,268,987
West Point Lake	2,691,920	2,947,170	3,238,883	3,300,836	3,214,536	2,262,983	2,361,491	2,347,198	2,294,682	2,014,599
Grand Total	15,952,780	16,413,233	16,151,647	16,659,357	16,230,879	14,429,968	14,588,339	14,944,001	14,730,824	13,584,721

2.6.7 Population

According to the U.S. Census Bureau, the population in the ACF Basin is 6,848,411 people. The population has more than doubled in the region over the last 50 years. The tables below show population estimates and growth rates over the last 40 years of the basin as a whole and of the portion of each state individually. As shown in Table 2.6-22, about 89 percent of the population in the ACF Basin resides in Georgia, with the remainder in Alabama and Florida. The compound annual growth rate over the last 40 years has averaged about 2.1 percent for the Georgia portion of the basin compared to less than 1 percent for the Alabama portion and 1.4 percent for the Florida portion. The overall annual growth rate for the ACF Basin was 1.96 percent for 1970 through 2012 (Table 2.6-23).

Table 2.6-22.
Population Estimates

Location	2012	2000	1990	1980	1970
ACF (AL)	456,912	419,766	372,502	359,273	312,309
ACF (FL)	340,381	305,561	263,444	224,950	188,518
ACF (GA)	6,051,118	5,036,182	3,790,659	3,056,484	2,526,697
ACF Basin	6,848,411	5,761,509	4,426,605	3,640,707	3,027,524

Source: U.S. Census Bureau 2009.

Table 2.6-23.
Population Annual Growth Rates

Location	Total	1960–1970	1970–1980	1980–1990	1990–2000	2000–2012
ACF (AL)	0.96%	0.18%	1.41%	0.36%	1.20%	0.40%
ACF (FL)	1.42%	0.26%	1.78%	1.59%	1.49%	0.52%
ACF (GA)	2.10%	2.15%	1.92%	2.18%	2.88%	0.88%
ACF Basin	1.96%	1.80%	1.86%	1.97%	2.67%	0.83%

Note: Calculated from historical data.

In Table 2.6-24, the population densities are given for the entire basin as well as for Georgia, Florida, and Alabama portions individually, along with the corresponding annual growth rates between 1980 and 2000. The data were gathered from the 1980, 1990, and 2000 U.S. censuses (latest available data). The growth rates for the population density similarly mirror the annual growth of the population as a whole. The Georgia portion of the basin includes the suburban areas of Metro Atlanta. When the Alabama, Florida, and Georgia portions are separated, it can be seen that between 1980 and 2000 the population density for the Georgia portion increased 63 percent versus a change of roughly 13 percent in the Alabama portion and 35 percent in the Florida portion.

Table 2.6-24.
Population Density

Location	Population per sq mi			Annual growth rate
	2000	1990	1980	1980–2000
ACF (AL)	66.5	60.8	58.8	0.62%
ACF (FL)	55.6	48.0	41.3	1.50%
ACF (GA)	262.7	200.2	160.8	2.48%
ACF Basin	216.3	166.7	135.5	2.37%

Source: U.S. Census Bureau 2009.

Housing statistics were gathered for the ACF Basin during the last 50 years. Housing counts include single-family residential, mobile homes, and multi-family residential. For the year 2012, the total number of housing units was an estimate based on the American Community Survey, which is published by the U.S. Census Bureau in years when it does not conduct a census. Table 2.6-25 shows the housing counts for the entire basin, as well as for the Alabama, Florida, and Georgia portions. In 2012, there were a total of 2,875,431 housing units in the ACF Basin; of those, roughly 7.3 percent were in Alabama, 86 percent in Georgia, and the remainder in Florida. The annual growth rate for housing for the ACF Basin between 1960 and 2012 was 2.61 percent. However, housing has grown much faster in the Georgia portion of the ACF Basin (2.75 percent) than in the Alabama portion (1.67 percent). There was an even greater disparity in growth in the last seven years.

Table 2.6-25.
Total Housing Units

Location	2012	2000	1990	1980	1970	1960
ACF (AL)	210,049	187,517	155,556	136,405	101,797	88,875
ACF (FL)	177,712	148,804	123,736	91,681	64,063	56,065
ACF (GA)	2,487,670	1,976,786	1,552,261	1,138,693	809,632	606,402
ACF Basin	2,875,431	2,313,107	1,831,553	1,366,779	975,492	751,342

2.6.8 Income

Per capita income statistics were gathered for the ACF Basin over the past 50 years. According to the American Community Survey 5-year estimate (2008–2012), the average per capita income for the ACF Basin was $20,699 (Table 2.6-26). The average per capita income for the Georgia portion of the basin was $21,148; for Alabama, $19,667; and for Florida, $18,615. Table 2.6-26 gives a snapshot of per capita income in the ACF Basin over the last 53 years. It includes the annual growth rates for the region and the state portions of the basin separately. In general, both the Georgia and Alabama portions of the ACF Basin bordering metropolitan areas (including Atlanta, Columbus, and Albany) had considerably higher per capita income than the rural areas.

Table 2.6-26.
Income Statistics

	Personal income per capita						Annual growth rate					
Location	2012	1999	1989	1979	1969	1959	1959–2012	1999-2012	1999–1989	1989–1979	1979–1969	1969–1959
ACF (AL)	$19,667	$14,672	$9,594	$8,230	$5,972	$3,646	3.23%	2.28%	4.34%	1.55%	3.26%	5.06%
ACF (FL)	$18,615	$15,285	$9,952	$8,035	$5,825	$4,087	2.90%	1.53%	4.38%	2.16%	3.27%	3.61%
ACF (GA)	$21,148	$17,710	$11,100	$9,159	$6,646	$3,993	3.20%	1.37%	4.78%	1.94%	3.26%	5.22%
ACF Basin	$20,699	$17,071	$10,789	$8,925	$6,475	$3,958	3.17%	1.49%	4.70%	1.92%	3.26%	5.04%

Source: U.S. Census Bureau 2014.

2.6.9 Employment

Employment statistics for the year 2012 were obtained from the 2012 American Community Survey. In 2012, there were 3,504,346 people in the labor force in the ACF Basin, 89 percent of which were in the Georgia portion, 6 percent in the Alabama portion, and 4 percent in the Florida portion. Also, 32,231 people served in the military over the survey period. In the ACF Basin, 44.9 percent of the population 16 and older were considered not in the workforce. The average unemployment for the basin was 6.6 percent. A few counties in the Alabama and Georgia portions of the basin had unemployment rates more than 10 percent. These areas tended to be more rural in nature. Table 2.6-27 provides employment statistics for the ACF Basin.

According to the 2012 American Community Survey, more than 90 percent of all jobs in the ACF Basin are provided by the private sector. The primary sources of employment are management and professional occupations and sales and office occupations; together, they account for more than 50 percent of the total employment in the ACF Basin. Government employment makes up more than 13.6 percent of total employment in the Florida portion of the ACF Basin. Table 2.6-28 provides a breakdown of employment in percentages by general occupations for the ACF Basin as a whole and with the state portions broken out.

Table 2.6-27.
Employment Statistics

	Civilian labor force					
Location	Total	Employed	Unemployed	Percent unemployed	Armed Forces	Percent not in labor force
ACF (AL)	212,432	189,591	22,841	6.8	2,628	43.7
ACF (FL)	151,789	135,222	16,567	6.4	3,904	50.2
ACF (GA)	3,140,125	2,800,768	339,357	6.6	25,699	40.8
ACF Basin	3,504,346	3,125,581	378,765	6.6	32,231	44.9

Source: U.S. Census Bureau 2014.

Table 2.6-28.
Employment by Occupation

		ACF (Alabama)	ACF (Florida)	ACF (Georgia)	ACF Basin
Percent distribution by occupation	Management, professional, and related occupations	26.7	26.5	29.2	27.5
	Service occupations	17.3	24.1	17.3	19.6
	Sales and office occupations	24.3	24.5	24.3	24.4
	Construction, extraction, and maintenance occupations	12.7	14.6	12.0	13.1
	Production, transportation, and material moving occupations	19.1	10.3	17.1	15.5
Percent in selected industries	Agriculture, forestry, fishing, and hunting	3.6	4.3	3.5	3.8
	Manufacturing	16.2	5.7	13.5	11.8
Percent of government workers (local, state, or federal)		5.7	13.6	6.8	8.7

Source: U.S. Census Bureau 2014.

2.6.10 Environmental Justice

On February 11, 1994, President Clinton issued EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*. The order requires that federal agencies identify and address, as appropriate, disproportionately high and adverse human-health or environmental effects of its programs, policies, and activities on minority and low-income populations. By the memorandum of February 11, 1994, the President directed EPA to ensure that agencies analyze environmental effects on minority and low-income communities, including human-health, social, and economic effects.

The term *minority population* includes people who identify themselves in the census as African American, Asian, Pacific Islander, Native American or Alaska Native, or Hispanic. A minority population exists if the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population of the larger surrounding area (CEQ 1997). A minority community can be a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans). Either type of group experiences common conditions of environmental exposure or effect. A selected appropriate unit of geographic analysis might be a governing body's jurisdiction, a neighborhood, a census tract, or another similar unit with no artificial dilution or inflation of the affected minority population. A minority population also exists if there is more than one minority group and the aggregate minority percentage meets one of the above-stated thresholds.

Table 2.6-29 shows the demographic characteristics of the ACF Basin. This demographic information is derived from the 2012 American Community Survey 3-year estimate. An analysis of the demographic data shows that the population is almost 65 percent white. African Americans represent the next largest ethnic group, comprising 29.8 percent of the basin's population. For Alabama, the proportion of minority people living inside the ACF Basin (42.8 percent) is higher than for the state as a whole (30.7 percent). In Georgia, however, the proportion of minority people living within the basin (35.0 percent) is similar to that of the state as a whole (39.4 percent). Florida has a lower minority representation (23.7 percent) compared to the basin as a whole (35.4 percent). Other minority groups are represented in similar proportions in the basin and in surrounding states.

Table 2.6-29.
Basin Demographics
(percent distribution)

Location	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some other race	Two or more races	Hispanic or Latino (of any race)
Alabama	69.3	26.4	0.5	1.2	0	1.2	1.4	4.0
Georgia	60.6	30.7	0.3	3.3	0.1	3.1	1.9	9.0
Florida	76.3	16.0	0.3	2.5	0	2.6	2.3	22.9
ACF (AL)	57.2	38.7	0.4	0.6	0.1	1.8	1.3	3.3
ACF (FL)	73.5	19.5	1.6	0.5	0.1	2.9	1.9	5.8
ACF (GA)	65.0	29.0	0.4	1.2	0.0	2.8	1.6	5.7
ACF Basin	65.2	29.1	0.8	0.8	0.1	2.5	1.6	4.9

Source: U.S. Census Bureau 2014.

The presence of low-income persons in the ACF Basin was determined from the 2009 U.S. statistical poverty threshold, which is based on income and family size. The U.S. Census Bureau defines a poverty area as having 20 percent or more of the residents with incomes below the poverty threshold. Overall, 21.1 percent of the basin's population (including persons of all ages) is below the poverty level (Table 2.6-30). Within the basin, the proportion of persons below the poverty level is higher in Alabama (22.0 percent) than in Georgia (21.0 percent). For Alabama, the proportion of low-income residents is higher in the basin (22 percent) compared to the state as a whole (18.1 percent). For Georgia, the percentage of low-income persons is higher in the basin (21 percent) than in the state as a whole (17.4 percent) and is higher than the nationwide poverty rate of 12.8 percent. For Florida, the percentage of low-income persons is higher in the basin (20.9 percent) than in the state as a whole (15.6 percent) and the state rate is higher than the nationwide poverty rate of 12.8 percent.

Table 2.6-30.
Basin Poverty Status

Geographic Area	Population for whom poverty status is determined									Families with income in 2012 below poverty level			
	Total	Income in 2012 Below Poverty Level								All families		Families with female householder with no husband present with related children under 18	
		All ages		Related Children				Population 65 and over					
				Under 18 yr of age		5–17 yr of age							
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Alabama	4,662,094	842,292	18.1	290,406	26.0	286,760	25.8	71,323	11.1	172,714	13.9	87,901	47.6
Florida	18,479,273	2,887,151	15.6	885,588	22.5	869,595	22.2	325,033	10.1	527,980	11.4	219,062	36.6
Georgia	9,448,393	1,645,272	17.4	589,734	24.1	581,183	23.8	114,940	11.3	321,231	13.4	153,291	41.5
ACF (AL)	442,323	93,119	22.0	29,756	33.0	29,481	32.8	7,500	14.7	17,482	13.1	9,645	51.0
ACF (FL)	315,267	55,389	20.9	17,923	29.1	17,439	28.1	5,429	12.8	10,913	13.2	4,853	45.1
ACF (GA)	5,916,658	934,555	21.0	346,135	30.2	341,052	30.0	60,107	13.7	181,891	12.2	87,267	37.8
ACF Basin	6,674,248	1,083,063	21.1	393,814	30.4	387,972	30.1	73,036	13.7	210,286	12.5	101,765	39.2

Source: U.S. Census Bureau 2014.

2.6.11 Protection of Children

On April 21, 1997, President Clinton issued EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, which recognizes that a growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health and safety risks. This order requires federal agencies, to the extent permitted by law and mission, to identify and assess such environmental health and safety risks.

While the EO does not provide guidance on the age to which children should be protected, the Federal Interagency Forum on Child and Family Statistics, which was founded in 1994 and formally established by the order, focuses on those aged 17 and under (FIFCFS 1997). In the ACF Basin, 1,759,298 children 17 and under were identified in the 2012 American Community 5-Year Survey. This represents more than 25.6 percent of the basinwide population. More than 89 percent of the children in the basin were residents of Georgia (1,580,536). The Alabama portion of the ACF Basin had 105,555 children (6.0 percent). The Florida portion of the ACF Basin had 73,207 (4.2 percent) (U.S. Census Bureau 2014).

2.7 Aesthetic Resources

Scenic views and vistas within the river and stream corridors of the ACF Basin encompass a wide range of river, stream, and reservoir settings, including cascading streams rising from the upper reaches of the Chattahoochee River watershed in the mountains and foothills of the Southern Appalachian highlands; rivers and streams in the Piedmont province and along the Fall Line in the middle Chattahoochee River and upper Flint River watersheds; and the larger meandering lower Flint, lower Chattahoochee, and Apalachicola rivers flowing through the Coastal Plain toward Apalachicola Bay and Gulf of Mexico. Interspersed along the rivers and primary streams throughout ACF Basin are both federal and nonfederal reservoirs, as discussed in section 2.1.1.1.6. The streams, rivers, and reservoirs of the ACF Basin provide valued aesthetic resources to the residents and tourists in the region, many of which are directly associated with a variety of water-based recreational pursuits.

These aesthetic values are institutionally recognized, as reflected by the establishment of many public access points and public use areas on USACE and nonfederal reservoirs as well as the establishment of numerous national, state, and local parks and protected areas within the basin (see section 2.4.1.1). There are no formally designated National Wild and Scenic Rivers within the ACF Basin. However, the river corridors throughout the basin are widely recognized for their scenic diversity and value. For example, several river and stream corridors within the upper Chattahoochee River Basin lie within the boundaries of Chattahoochee National Forest; a 48-mile stretch of the Chattahoochee River downstream of Buford Dam is designated as the Chattahoochee National Recreation Area (see section 2.4.3); and much of the lower Apalachicola River corridor consists of publicly owned lands and wetlands that are protected and managed for environmental purposes.

2.8 Air Quality and General Conformity

EPA Region 4 and ADEM regulate air quality in Alabama; EPA Region 4 and the Florida DEP regulate air quality in Florida; and EPA Region 4 and the Georgia DNR regulate air quality in Georgia.

The Clean Air Act (CAA) (42 U.S.C. 7401-7671q), as amended, gives EPA the responsibility to establish the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) that set acceptable concentration levels for six criteria pollutants: particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrous oxides (NO_x), ozone (O_3), and lead. Short-term NAAQS (i.e., 1-, 8-, and 24 hour periods) have been established for pollutants contributing to acute health impacts, while long-term NAAQS (i.e., annual averages) have been established for pollutants contributing to chronic health impacts. Each state has the authority to adopt standards stricter than those established

under the federal program; however, Alabama, Florida, and Georgia all have adopted the federal standards.

Federal regulations designate Air Quality Control Regions (AQCRs) in violation of the NAAQS as *nonattainment areas*. Federal regulations designate AQCRs with levels below the NAAQS as *attainment areas*. According to the severity of the pollution problem, nonattainment areas can be categorized as marginal, moderate, serious, severe, or extreme. EPA has designated 16 out of the 81 counties in the ACF Basin as nonattainment areas for at least one criteria pollutant (Table 2.8-1).

Table 2.8-1.
Counties in the ACF Basin Designated as Nonattainment Areas

State	Counties	Nonattainment pollutant
Georgia	Carroll, Hall, Heard, Spaulding	$PM_{2.5}$
	Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding	$PM_{2.5}$ and O_3

Source: USEPA 2010b
Note: $PM_{2.5}$ = fine particulate matter.

EPA, ADEM, Florida DEP, and Georgia DNR have established general conformity rules specifically to ensure that the actions taken by federal agencies in nonattainment and maintenance areas do not affect a region's ability to meet the NAAQS in a timely fashion. The conformity regulations play an important role in helping states and tribal regions improve air quality in those areas that do not meet the NAAQS. This is also true for federally supported activities that take place within the 16 nonattainment counties within the ACF Basin. The updates to the water control manual are not expected to result in any reasonably foreseeable direct or indirect emissions. These types of federal activities are specifically exempt from the general conformity regulations. The requirements of the general conformity rule would not apply to the water control manual updates because the proposed activities would result in no emissions increase (40 CFR 93.153(c) (2)), or the emissions are not reasonably foreseeable, such as electric power marketing activities that involve the acquisition, sale, and transmission of electric energy (40 CFR 93.153(c)(3) (ii)). A Record of Non-Applicability (RONA) of the general conformity rule has been prepared; it is provided in Appendix I.

Although regional air quality and air emissions are partially a function of population and land use, for the purposes of this EIS, population and land use throughout the basin are not expected to change appreciably due to the proposed updates. As a result, it is assumed that any changes in air quality would have occurred under the No Action Alternative. It is for these reasons that air quality was not carried forward for detailed analysis in this EIS and is not discussed in section 6.

2.9 Noise

Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise intrusive. Human response to noise varies depending on the type and characteristics of the noise, the distance between the noise source and the receptor, receptor sensitivity, and time of day. Noise is often generated by activities that are part of everyday life, such as construction or traffic.

Sound varies by both intensity and frequency. Sound pressure level, described in decibels (dB), is used to quantify sound intensity. The *decibel* is a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level. The *hertz* (Hz) is used to quantify sound frequency. The human ear

responds differently to different frequencies. *A-weighing*, described in a-weighted decibels (dBA), approximates this frequency response to accurately express the perception of sound by humans. Sounds encountered in daily life and their approximate levels in A-weighted decibels are provided in Table 2.9-1.

Table 2.9-1.
Common Sounds and Levels

Outdoor	Sound level (dBA)	Indoor
Snowmobile	100	Subway train
Tractor	90	Garbage disposal
Noisy restaurant	85	Blender
Downtown (large city)	80	Ringing telephone
Freeway traffic	70	TV audio
Normal conversation	60	Sewing machine
Rainfall	50	Refrigerator
Quiet residential area	40	Library

Source: Harris 1998.

The dBA noise metric describes steady noise levels. Very few noises are, in fact, constant; therefore, a noise metric, *Day-Night Sound Level* (DNL), has been developed. DNL is defined as the average sound energy in a 24-hour period with a 10-dB penalty added to the nighttime levels (10 p.m. to 7 a.m.). DNL is a useful descriptor for noise because 1) it averages ongoing yet intermittent noise, and 2) it measures total sound energy over a 24-hour period. In addition, *Equivalent Sound Level* (L_{eq}) is often used to describe the overall noise environment. L_{eq} is the average sound level in dB.

The Noise Control Act of 1972 (P.L. 92-574) directs federal agencies to comply with applicable federal, state, and local noise control regulations. In 1974, EPA provided information suggesting that continuous and long-term noise levels in excess of DNL 65 dBA are normally unacceptable for noise-sensitive land uses such as residences, schools, churches, and hospitals. Alabama, Florida, and Georgia have not implemented noise regulations at the state level. Many counties within the ACF Basin maintain nuisance noise regulations, but most do not outline specific not-to-exceed noise levels. The vast majority of county- and city-based noise ordinances exempt construction noise during the daytime hours.

Existing noise levels (L_{eq} and DNL) were estimated for the areas internal to, and on the perimeter of, the ACF Basin using the techniques specified in the *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound Part 3: Short-term measurements with an observer present* (ANSI 2003), and they are provided in Table 2.9-2. People residing in urban areas in the ACF experience outdoor DNL values ranging from 45 to 65 dBA. The levels shown are the lowest provided by the American National Standards Institute (ANSI) standard, and noise levels in remote areas could be substantially lower. Very rural and remote areas are estimated to have DNL values ranging from 20 to 45 dBA.

The updates to the Master Manual are not expected to result in any appreciable changes in the noise environment. No new noise from man-made sources would be introduced from the proposed updates. Small changes in the natural soundscape, associated with water movement and with animal movement and vocalizations in and around the projects, might take place. Although noise is partially a function of population and land use throughout the basin, for the purposes of this EIS, noise is not expected to change appreciably due to the proposed updates. As a result, it is assumed than any changes in noise levels would have occurred under the No Action Alternative. It is for these reasons that noise was not carried forward for detailed analysis in this EIS and is not discussed in section 6.

Table 2.9-2.
Estimated Noise Levels for Varying Land Use Intensity

Example land use category	Average residential intensity (people per acre)	DNL (dBA)	L_{eq} (dBA)	
			Daytime	Nighttime
Noisy Urban Residential	80	65	64	57
Quiet Commercial, Industrial, and Normal Urban Residential	25	60	58	52
Quiet Urban Residential	8	55	53	47
Quiet Suburban Residential	3	50	48	42
Rural Residential	1	45	43	37

Source: ANSI 2003.

2.10 Traffic and Transportation (Nonnavigation and Nonrecreation)

This section briefly characterizes landside transportation systems in the immediate vicinity of the lakes and river corridors in the ACF Basin. It summarizes the existing traffic resources in the areas adjacent to the USACE projects, which include vehicles to support varying land uses, the operation and maintenance of the USACE-managed facilities, and personal operating vehicles for residents, recreational vehicles, and tourists.

Transportation infrastructure along the ACF Basin is highly variable. It supports a wide range of conditions and needs, including dense residential and second home development around lakes; highly urbanized development around Atlanta and Columbus; and remote and rural areas in southern Alabama and Georgia, and northern Florida. It provides direct access to the water's edge throughout the system to support public recreation, commercial navigation, project operations activities, and other water-related activities. In general, the existing land base transportation network around the ACF Basin is adequate for its current use.

When channel availability within ACF Basin deteriorates to where navigation is not supported, then a shift of transportation mode may occur. When channel depth availability is below 7.5-ft limited navigation to support the transport of goods and materials, the transportation mode shifts to the next least costly alternative, normally rail. Regardless, movements of goods would retain both their origins and destinations, and shift transportation modes to rail or truck. Historically, depending on the month, the percent of time the water depth has been sufficient to transport goods and materials ranges from 55 percent in November to 94 percent in March. Normally, the towing companies and their tow operators would have information with regards to depth availability, would load barges restricted only by depth availability, and would schedule shipments to coincide with periods of adequate water depth.

The connection (i.e., relationship) between water management activities on the ACF Basin in general, and nonnavigation and nonrecreation transportation resources is limited. The Proposed Action to manage pool levels and flow requirements would not affect the transportation resources immediately adjacent to the dams and lakes, such as limited development for shoreline and lake access, recreation (marinas, parks, and picnic areas), protected areas, and prohibited access areas.

The updates to the Master Manual are not expected to result in any appreciable changes in nonnavigation and nonrecreation traffic. No additional traffic would be directly introduced from the proposed updates. Small changes in traffic in and around the projects might take place due to incremental changes in shipping modes. However, nonnavigation and non-recreation traffic is not expected to change appreciably due to the proposed updates. As a result, it is assumed than any changes in nonnavigation and nonrecreation traffic would have occurred under the No Action Alternative. It is for these reasons that

nonnavigation and nonrecreation traffic was not carried forward for detailed analysis in this EIS and is not discussed in section 6. Existing recreational activities are covered in detail in section 2.6.6, and navigational activities are covered in detail in section 2.6.2.

2.11 Cultural Resources

The term *cultural resources* can be used to describe a wide variety of objects, locations, structures, records, or other associations with human activity. Cultural resources are significant for their association or linkage to past events, historically important persons, and design or construction value, and for their ability to yield important information about prehistory and history. They can include prehistoric or historic archaeological sites, battlefields, shipwrecks, structures, objects, landscapes, or other features deemed to have importance to past human activity. A number of federal laws and regulations provide for protection of significant cultural resources. Those include the National Historic Preservation Act (NHPA) of 1966; Archaeological Resources Protection Act (ARPA) of 1979; Antiquities Act of 1906; NEPA; Archaeological and Historic Preservation Act of 1960 (also known as the Reservoir Salvage Act); Abandoned Shipwreck Act of 1987; Native American Graves Protection and Repatriation (NAGPRA) Act of 1990; and American Religious Freedom Act of 1978. Section 106 of the NHPA and its implementing regulations in 36 CFR Part 800 specifically address the process that individual federal agencies must follow to identify, evaluate, and coordinate their efforts and determinations concerning significant cultural resources.

In accordance with NHPA, significant cultural resources are those that have been identified as being eligible for inclusion or listed on the National Register of Historic Places (NRHP). Sites that are found to meet at least one of the criteria for listing on the NRHP are considered significant and are referred to as *historic properties*. A significant impact is considered to occur to cultural resources under NEPA when the lead federal agency determines that a project will have an adverse effect on a historic property that cannot be avoided or resolved in accordance with the provisions in 36 CFR Part 800.

All the ACF Basin projects were authorized and constructed before NHPA was enacted, with the exception of West Point Lake. As such, consideration for the construction and operation of the various components on cultural resources were done under the guidance of the Antiquities Act of 1906 and the Reservoir Salvage Act. In accordance with those acts and others, USACE was aided by the NPS to begin a program of systematic archaeological surveys. The surveys were initiated in the Andrews Lake area. In 1947, Wesley R. Hurt conducted an archaeological survey of the west (Alabama) side of the Chattahoochee River from the Florida state line to the Fall Line at Columbus, Georgia, for the Alabama Museum of Natural History (deJarnette 1960, 1963, and 1975). Subsequently, in 1959, more detailed excavations were conducted by Robert W. Neuman (Neuman 1961). The archaeological surveys and numerous excavation projects carried out by the NPS were done to satisfy the requirements concerning cultural resources.

The West Point Lake project was completed in 1974. Although the newly enacted NHPA became the overriding compliance driver, the mitigation was essentially the same as for the earlier projects. The NPS aided USACE in completing surveys for the reservoir area before construction and filling of the reservoir (Chase and De Baillou 1962; Huscher 1972; Hally and Rudolf 1982). More than 1,008 archaeological sites were identified. Potentially significant sites were subject to a testing program (Cantley and Joseph 1991). Mitigation through excavation was carried out on those sites that could not be avoided by the project.

The enactment of NHPA in 1966 did not directly affect the operation of the ACF Basin because the construction and operation were authorized and ongoing before its enactment. However, section 110 of the act requires that federal agencies establish a program to deal with historic properties under their

jurisdiction or control. That includes conducting inventories and NRHP evaluations, and considering those properties during planning. Engineering Regulation (ER) 1130-2-540 *Cultural Resources Stewardship* and ER 1130-2-438 *Project Construction and Operation Historic Preservation Program* establish the policy for dealing with section 110, ARPA, NAGPRA, and other regulations at operating civil works water resources projects for USACE. The preparation of a *Historic Property Management Plan* (HPMP) also known as an *Integrated Cultural Resources Management Plan*, which details actions and procedures to be followed concerning cultural resources is mandated.

In recognition of the statutory and regulatory requirements, USACE established a cultural resources program for the ACF Basin. The program consisted of completing cultural resources inventories for all fee-owned land and reservoir shores. The inventories were completed between the late 1970s and the 1980s. A few areas missed by those surveys were inventoried in 2010 (Brockington 2010). Annual inspections of identified historic properties were also established for the projects. The details of the cultural resources program, history of consultation, and lists of standard operation procedures are provided in the project HPMPs, which have been completed for the entire ACF Basin project.

2.11.1 Method of Assessment

USACE contracted Brockington and Associates of Norcross, Georgia in July 2009 to complete the second phase of a cultural resources study of the ACF Basin, as a follow-up to the initial phase conducted in 1998 (USACE 1998b). The initial phase provided a general overview and large-scale archaeological sensitivity model and a definition of the potential impacts and comparative analysis of impacts projected for three hypothetical water regulation formulas devised at the time. The second phase of analysis focused on predicting the severity of impacts of the potential effects from changes in water level management. Those include the erosion of artifacts and features from known site locations, deposition of sediment atop known sites, and increased or decreased access to known sites by vandals or looters. The complete study is in the final report of the second phase study titled, *Cultural Resources Investigations for the Apalachicola-Chattahoochee-Flint (ACF) River Basin Water Control Manual and EIS* (Brockington 2010).

The second phase of analysis focused on predicting the severity of impacts of the potential effects from changes in water-level management. Those include the erosion of artifacts and features from known site locations, deposition of sediment atop known sites, and increased or decreased access to known sites by vandals or looters. The results of the study include:

- An updated inventory of known sites along the waterway
- A review of regional histories, archaeological surveys, sensitivity models, and HPMPs that pertain to the areas of sensitivity
- Field visitation, geomorphological and GIS analysis of selected site locations that represent a sample of the recorded and potential site areas, and can give an indication of the severity of potential impacts

A background literature search was conducted of the study area and included an inventory of state archaeological site files from Alabama, Florida, and Georgia and a review of previously conducted archaeological studies in the basin. Site inventory includes all sites to within one-quarter mile of the government properties or jurisdiction at the lakes and river boundaries. The HPMP for each of the lakes was reviewed. The background research and context statements from previous studies conducted along the ACF were used to define contexts for the study and define the site inventory in the basin. The regional histories overview and historic context included a review of the prehistoric and historic periods; topics covered include Native American presence and movements in the ACF Basin (specifically the Creeks and Cherokees and others along the Chattahoochee and Apalachicola rivers) and river trade (including

steamboat navigation and commerce). The industrial development along the waterway was studied, including the 1800s use of the river for textile and gristmills to the early 1900s with development of hydroelectric power and control of the basin through congressional legislation for floodwater management, power generation, and navigation.

Brockington conducted field investigations at 15 sites in lakeshore locations, or along the riverbank, to determine prior impacts and potential effects from proposed changes in water-level management. Selected sites include two sites at each of the USACE reservoirs (Lake Lanier, West Point Lake, Lake Walter F. George, Lake George W. Andrews, and Lake Seminole—one at pool level and one downstream of the dam) along with five sites spread throughout the basin (Table 2.11-1). USACE selected the sites in consultation with Brockington to provide the clearest understanding of observable water-level effects. The site descriptions in the report focus on the specific conditions of the known site (i.e., its integrity, observed ongoing effects, and indications of past effects) and identify the potential for effects from changes in management of water levels. Brockington addressed the potential of in-pool and downriver effects from water flows whether from maintaining existing conditions or, seasonal drawdowns, or during periods of power production or periods of tropical storm events.

Table 2.11-1.
2009 Sampled Lakeshore and Riverine Cultural Resource Sites

USACE project	Position relative to federal project[a]	Cultural affiliation	Site type	NRHP status
Lake Lanier	Flood pool	Woodland; Historic, 19th-20th century[b]	Lithic reduction	Potentially eligible
Lake Lanier	Downstream	Historic (pre-1820)	Fish weir	Unknown
Chattahoochee River	Downstream	Late Woodland; Early Mississippian; Protophistoric	Village/mound	Determined eligible
West Point Lake	Flood pool	Archaic-Mississippian; General Historic	Scatter/dumpsite	Potentially eligible
West Point Lake	Flood Pool	Archaic-Mississippian; General Historic	Quarry	Potentially eligible
West Point Dam	Downstream	Protohistoric	Village/mound	Unknown
Walter F. George Dam	Downstream	Mississippian	Artifact scatter	Potentially eligible
Walter F. George Lake	Flood pool	Archaic-Mississippian	Village/mound	Potentially eligible
George W. Andrews Dam	Downstream	Archaic-Mississippian	Artifact Scatter	Potentially eligible
George W. Andrews Dam	Downstream	Woodland; Historic, Nineteenth century	Artifact scatter	Potentially eligible
Flint River	Downstream	Middle Woodland	Midden	Potentially eligible
Lake Seminole	Flood pool	Late Woodland	Artifact scatter	Potentially eligible
Lake Seminole	Flood pool	Archaic-Late Woodland	Artifact scatter	Potentially eligible
Apalachicola River	Downstream	Historic, 20th century (1940)	Wreck	Unknown
Apalachicola River	Downstream	Middle-Late Mississippian	Midden	Unknown

Notes:
NRHP = National Register of Historic Places.
[a] Sites in the *flood pool* generally surround the lake. *Downstream* locations are downstream of federal dams.
[b] A historic, 19th-20th century homestead complex was visited in an area adjacent to the selected site (Brockington 2010).

Geoarcheology Research Associates was retained to provide observations of geomorphic contexts for a select number of archaeological sites in conjunction with site inspections conducted by Brockington. Geoarcheology Research Associates visited sites to provide geomorphic insights for the archaeological evaluations. An effort was made to examine sites at or near the pool level of the lakes and sites downstream of the impoundment structures. Observations focused on recording landform configurations, properties of soils, vegetation patterns, and existing disturbances and conservation measures. The investigations provide a geomorphic perspective on the state of site preservation and assess the potential for future impacts. Seven sites in Georgia were investigated that represented a diversity of site types (from Prehistoric lithic scatters to Mississippian villages) in a variety of physical environments (from Piedmont uplands to the Coastal Plain) with varying degrees of preservation (e.g., heavily eroded pool-level sites, managed and protected slopes, and eroding scarp edges). The goal of geomorphic assessments was to examine how river channels downstream of reservoirs respond to changes in flow regulated by dams and how decreased sediment loads influence the cross-section of the river channel. Channels typically respond to changes in flow by widening or degrading in the form of bank erosion (Knighton 1998; Williams and Wolman 1984). That process can affect archaeological sites when they are in areas of the floodplain that are actively eroding.

2.11.2 Result of Assessment

The research resulted in a finding that existing ACF Basin operations can and do result in effects (both adverse and unknown) on cultural resources, including significant ones (historic properties). Both the literature review and field assessments confirm that finding. For example, NPS conducted a study on the impact of inundation from reservoirs on archaeological sites. Originally authored by Lenihan et al. (1981), *The Final Report of the National Reservoir Inundation Study, Volume I,* provides a framework for categorizing effects on archaeological sites in reservoir settings. NPS identifies four categories of processes affecting archaeological sites: 1) mechanical—relating to physical erosion and deposition such as wave action, fluctuating shorelines, siltation, and saturation; 2) biochemical—alteration of site soils and degradation of archaeological contexts associated with changing ecosystems; 3) human factors, which consist of artificial impacts such as borrow pits, construction, and increased wave action from boat traffic; and 4) miscellaneous factors—inundation, submergence, or changes in floral and faunal components (Lenihan et al. 1981).

Mechanical and biochemical processes can displace or bury artifacts, or features. The process of displacement is generally defined by *erosion*, where the soil matrix supporting the site is removed, exposing archaeological material to other adverse effects. *Deposition* refers to the process of burying sites. Deposition alters the known context of sites or features preventing access to, or knowledge of, them. *Access* is defined as the relative ability for the site to fall subject to human processes of vandalism or artifact collection (including knowledge of sites as previously mentioned) that can destroy contexts or deplete significant materials. The existing condition of archaeological sites in the ACF Basin can be undergoing, or have undergone, any or all three sets of effects. The effects can be adverse or beneficial. For example, deposition can protect an archaeological site from erosion induced by human activities; however, the deposition can accelerate decay of significant materials at the site.

Using the NPS study as a framework for effects analysis, field research found that the most common effect at archaeological sites in the ACF Basin falls under the *mechanical* type, mainly erosion. Clear evidence of erosion was found at 14 of 15 sampled sites. The site not affected by erosion is far from the river. Extensive research has not been done on that site to determine the site's exact extent. A small edge of it is near the water's edge, and it is possible that the proximity to the riverbank would change given more information.

Eleven of 15 sites have been affected by access issues associated with looting or *human factors* in the past. Intentional and unintentional human effects are ongoing at some of the sites. Because the sampled sites are known locations, it can be assumed that the actual number of sites affected by access issues is a smaller percentage than what was reflected during the site visits. Further research based on Brockington's study illustrates the trend in access issues during the course of a year (Fedoroff 2014), highlighting in some instances no effects from access.

The effects of deposition were found at only five of the 15 sites. At those sites, artifacts and archaeological contexts are being buried at varying rates. At all the sites where soil is depositing on artifacts and archaeological contexts, erosion is also occurring. It is likely that soil is eroded from one area and depositing on another area of the site. The ability to interpret the content of a site is the greatest loss that can occur from deposition. Deposition can reverse temporal deposits, change preservation states, or chemically alter radiocarbon samples.

It appears that significant erosion is most common at lakeshore sites, especially those that are on exposed peninsulas or along steep shorelines. Those locations further upstream tend to have higher potential for being protected from wave action erosion by sinuous and dendritic bays. They also tend to be in shallow, inundated creek channels with more gradually sloping terrain. Upstream protected areas are also more likely to be farther from boat ramps and, therefore, human recreational access. Steep riverbanks that can be severely undercut by the current are often found along river channels. However, the sites in the sample that are in those locations often do not appear to be significantly altered by erosion. It can be generally asserted that those sites in the Piedmont along waterway channels are the most likely to experience significant erosion, particularly along the outside of river bends. In the Coastal Plain, erosion is comparatively less damaging. Similarly, the greater average height of the riverbanks on the Coastal Plain waterways protects perched sites to an additional degree. Sites that are at points of river access are the ones most likely to undergo human-induced adverse effects.

2.11.2.1 Upper Chattahoochee River Basin

Three sites were investigated in the Upper Chattahoochee River Basin: 1) along the banks of Lake Lanier, 2) downstream of Buford Dam on the Chattahoochee River, and 3) along the Chattahoochee River in Fulton County, Georgia.

One site along the bank of Lake Lanier was documented extensively for evaluation in this study. The site is made up of stone tools and ceramics dating back to the Woodland period. It is in an area with heavy human activity in a public use area. Erosion has occurred down to bedrock, and riprap is being used to protect the shoreline. The banks have been built up and secured with riprap extending approximately 6.5 ft above the water level. Development and heavy public use have affected the site. Under existing conditions, however, the site is being well-managed and the riprap placed along the shoreline should prevent any future erosion.

Three additional sites near the documented site were also visited to compare conditions. The sites were briefly described but not documented extensively. One site is considered NRHP-ineligible and is inundated 130 ft out from the shoreline. The other documented sites are determined potentially eligible. One is a housing complex providing an example of rural life in northeastern Georgia. The third site visited includes Woodland lithic scatter in an area that is almost entirely washed away.

A historic fishing weir built before 1820 was visited downstream of Buford Dam on the Chattahoochee River. In 1821, a law was passed forbidding fishing traps and other obstructions reaching more than one third of the river. Traps in the area might have been built by the Cherokee but could have also been constructed by historic Anglo-Americans. The obstructions were used to catch both anadromous and

catadromous fish—fish that migrate from oceans to spawn in freshwater and those that migrate from freshwater to spawn in the ocean, respectively.

The historic fishing weir site is in an area under management by the NPS. Review of aerial photographs indicates that no appreciable migration of the channel has occurred. Evidence does not point to destructive influences caused by the intensity of the streamflows or fluctuations in the water level. The water releases would not likely displace the large rocks used in the fish trap. Riverbanks upstream of the site are undercutting and could contribute to adverse effects from debris. However, increased recreational river activities are likely the greatest contributor to scattering of rocks. Recreational canoers, kayakers, and inner-tubers are heavy users of the area and could intentionally or unintentionally move or displace rocks because of the shallow depth along this reach.

The third site visited in the Upper Chattahoochee River Basin is on a high terrace that formed on the inside of a large river bend meander several miles downstream of Buford Dam. The site is a prehistoric village with Late Woodland, Early Mississippian, and Protohistoric components. Exposed soils indicate that the terrace was built by historic material deposited during flood events and now only rarely experiences high-magnitude flood events. Vegetation on the terrace is well established, and the Chattahoochee River channel form appears to be stable, suggesting that the channel is not meandering. The greatest existing threat to this site appears to be from road and utility construction.

2.11.2.2 West Point Lake and Downstream Area

Two sites were examined in the flood pool of West Point Lake, and another was visited downstream of the dam.

The first site visited around West Point Lake is an artifact scatter site near the flood pool. The historic artifacts include metal pots, glass bottles, jars, quartz and chert flakes, and tools. The water level did not appear to reach artifact areas. Water levels adjacent to the site indicate minimal erosive effect. Adjacent and old roads were also not noted to increase access.

The second site in the flood pool of West Point Lake is experiencing erosion. The site was once an upland ridge but is now an exposed peninsula in the lake. The peninsula has the appearance of a hardwood forest, but artifacts are exposed to fluctuations in water level, boat wake, and wave action. Those shoreline processes, the low relief, and absence of bedrock are the factors that influence active erosion in areas with artifacts. High-water marks around the peninsula extend up to 50 ft above the shoreline. Water is also making its way up an old dirt road that bisects the site, eroding greater portions of the site.

Downstream of West Point Dam, the Faulkner and Okfuskutchi-Tallahassee protohistoric village and mound site are on a terraced slope. Much of the site is on private property, but some areas extend onto USACE property. The historic river terrace rises above the water surface of the Chattahoochee River. The slope of the bank is sheer and vegetated in grasses and forbs, as is the site surface. A small tributary runs along the higher terrace where some erosion control features have been installed. No erosion control measures are being taken along the vegetated banks of the Chattahoochee River. Under existing conditions, the sandy soils that make up the terrace do not seem to be experiencing erosion. Review of historical aerial photographs suggests the river is moving laterally toward the site. However, given ongoing access to the site for fishing and posted signs announcing the site's location, it is clear that access and looting are affecting artifacts.

2.11.2.3 Walter F. George Lake

Sites in the headwaters of the lake and downstream of Walter F. George Dam were visited. The upstream site is at the mouth of a creek that flows into a backwater area of Walter F. George Lake. The site is set on

a level ridge forming a bank of the creek. Debris along the reservoir side of the site indicates occasional flooding. The other side of the site is higher and does not appear to experience flooding. A previous investigation of the site allowed for comparison of changes. The site had been looted in the past, but there was no evidence of recent looting in 2009 (Brockington 2010). Sediment from upland sources has filled in the embayment of the lake, and new vegetation has been established. The sediment could have deposited over existing artifacts and contained intact archaeological deposits. At an area where water levels fluctuate, soils experience wetting and drying. At this location, artifacts can experience biochemical alterations because of seasonal fluctuation of the water table, or the sediment can protect the area from additional shoreline erosion.

The site downstream of Walter F. George Lock and Dam is adjacent to a power line with access to a picnic area that has been gated to protect wildlife. Access there appears easy, and looting could be an ongoing threat. Evidence of looting was found during the site visit, and no surface artifacts were visible. Tall, dense vegetation in the power line corridor and a 30-ft shear drop along the riverbank might limit access to some areas. The steep slope along the river becomes more gradual, and a sandbar has formed on the downstream area of the site. Review of photographs suggests that erosion of the riverbank began following completion of the dam and appears to be straightening. Intact deposits were found along the northern half of the site where erosion appears to be having the least effect.

2.11.2.4 George W. Andrews Lake

Two sites with scattered artifacts were visited near George W. Andrews Lake along the Chattahoochee River. One of the sites is upstream of the George W. Andrews Lock and Dam along a bluff above the flood level, and the second is a Fort Walton midden site on the Chattahoochee River terrace south of the George W. Andrews Lock and Dam.

The site upstream of the dam has stabilized since construction of the dam and when it was heavily affected in the 1970s. The site area has been used as a borrow pit, but young pine and hardwood trees have overgrown most of the area. In areas where there is limited to no ground cover, there is evidence of localized erosion. However, as a whole, an extensive effort has been made at the site to curb erosion. Steep slopes from the top of the bluff down to the water surface have been contoured and planted for stabilization. Well below the site, riprap has been added to the banks of the reservoir to inhibit shoreline erosion at the pool level.

The site downstream of the dam is on private land approximately 200–250 ft and nearly 50 ft higher than the river water level. The area was once farmed but has been covered in mixed hardwoods and pines in the south, and scrubby vegetation in the northern portion of the site. Natural erosion of the steep riverbank is severe, but the site remains unaffected because of its distance from the water surface. There is little to no evidence of looting, and if the site remains uncultivated, it will remain relatively unaffected.

2.11.2.5 Lake Seminole

Two recommended eligible NRHP sites were visited around Lake Seminole, and a third was visited along the Flint River just upstream of the reservoir at Bainbridge, Georgia.

The site along the Flint River has experienced looting, shoreline erosion, sheetwash and gully erosion, recreational traffic, and dumping. It is a midden site accessible on a dirt road from a highway. Aerial photographs indicate that water levels have increased in the area since the 1950s. Water levels could be contributing to shoreline erosion, but photographs also indicate that vegetation has increased in the area providing protection to the site from access and erosion. However, the site's use for fishing could make restricting access impossible.

The second site visited along Lake Seminole has been encroached upon by the lake, but little looting or degradation due to access was reported. The most evident pressure was from erosion caused by high water in the 1970s. During the current survey, lower water levels have reduced undercutting of the riverbank. However, proximity of midden deposits to the water edge indicates that loss of some artifacts and their context would be expected. Bank stabilization would benefit artifacts at this site.

Fort Scott prehistoric site was the second site visited in the flood pool of Lake Seminole. Artifacts from this site are from several periods including Historic Euro-American, Lower Creek, Swift Creek, Weeden Island, Late Archaic, and Indeterminate Mississippian. The site is accessible only by boat. The location of the site and forestation limit access. However, many of the sites of the island previously recorded as being exposed were underwater during the 2009 visit. Aerial photographs lead reviewers to suggest that the original riverbank might have been eroding into the site before the reservoir was constructed.

2.11.2.6 Apalachicola River

Two sites were visited downstream of Lake Seminole in the Apalachicola River—the Barbara Hunt wreck and Ocheessee Landing.

The *Barbara Hunt* was a steamboat with a regular passenger route in the ACF Basin after 1938. The steamboat sank in the summer of 1940. Today, the boat is exposed where the hull is used as a perch by local fisherman. Sediment has deposited on the upstream side of the wreck, and scouring is occurring around the downstream end. The scoured sediment has redeposited about 165 ft downstream behind another historic site, the Daniels Barge. Looting at the site is not evident, but continued human contact with the wreck is likely to cause both intentional and inadvertent degradation.

Ocheessee Landing is the site of a village midden dated to the mid-late Mississippian period. The site is in a public use area along an eroding river terrace and along an outside bend. An aerial photograph does not suggest much river migration along the reach, but the site is clearly being affected by fluctuations in water levels. Bank erosion is notably the most destructive force affecting the site.

2.12 Hazardous and Toxic Materials

Operating and maintaining USACE projects typically requires the use of hazardous and toxic materials. The use of materials such as pesticides, paints, solvents, and petroleum products would be expected during the operation and maintenance of USACE-managed facilities, shoreline, vehicles, and equipment. The use of petroleum products would also be expected from the operation of marinas and from recreational vehicle use. The handling, use, storage, and disposal of these materials must be in accordance with label recommendations; USACE regulations; and local, state, and federal regulatory guidelines. Notably, the Proposed Action to manage reservoir operations would not be expected to have an effect on hazardous and toxic materials and are not discussed in section 6.

3 Framework for Decision Making

3.1 Projects in the ACF Basin

As discussed in section 2.1.1.1.6, USACE operates five dams in the ACF Basin (in downstream order): Buford, West Point, Walter F. George, George W. Andrews, and Jim Woodruff. These dams and their associated reservoirs are shown on Figure 1.1-1. In addition to the five USACE projects, nine non-USACE reservoir projects are on the mainstems of the Chattahoochee and Flint rivers in the ACF Basin. Those non-USACE projects, operated by the Georgia Power Company (GPC) and others, are described in more detail in section 2.1.1.1.6. Limited amounts of water can be stored at some of the non-USACE projects. Table 2.1-3 provides an overview of all the dams (USACE and non-USACE) on the primary rivers in the ACF Basin and their current operating purposes.

3.2 Applicable USACE Guidance

The following USACE regulations and manuals apply to operation of the ACF Basin projects and management based on the WCMs. The directives may be found at http://www.publications.usace.army.mil/.

- EM 1110-2-3600, *Management of Water Control Systems* (November 30, 1987). This manual provides guidance to field offices for managing water control projects or systems authorized by Congress and constructed and operated by USACE. It also applies to certain water control projects constructed by other agencies or entities.
- ER 1110-2-240, *Water Control Management* (October 8, 1982) (also published as 33 C.F.R. part 222.5). This regulation prescribes policies and procedures to be followed by USACE in carrying out water control management activities, including establishing water control plans for USACE and non-USACE projects, as required by federal laws and directives.
- ER 1110-2-1150, *Engineering and Design for Civil Works Projects* (August 31, 1999). This regulation defines engineering responsibilities, requirements, and procedures during the planning, design, construction, and operation phases of civil works projects. The regulation provides guidance for developing and documenting quality engineering analyses and designs for projects and products on time and in accordance with project management policy for civil works activities.
- ER 1110-2-1941, *Drought Contingency Plans* (September 15, 1981). This regulation provides policy and guidance for preparing drought contingency plans as part of USACE's overall water control management activities. It prescribes the policy that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs.
- ER 1110-2-8154, *Water Quality and Environmental Management for USACE Civil Works Projects* (May 31, 1995). This regulation establishes a policy for the water quality management objective at USACE civil works projects.
- ER 1110-2-8156, *Preparation of Water Control Manuals* (August 31, 1995). This regulation is standardizes the procedures to be followed when preparing WCMs.
- ER 1105-2-100, *Planning Guidance Notebook* (April 22, 2000). This regulation provides the overall direction by which USACE civil works projects are formulated, evaluated, and selected for implementation. It contains a description of the USACE planning process, USACE missions and programs, specific policies applicable to each mission and program, and analytical

requirements. Its fundamental purpose is to describe the planning process in a straightforward, plain-language manner. In particular, this regulation provides policy and guidance regarding water supply storage reallocation.

- *The Water Supply Handbook* (revised IWR Report 96-PS-4). This report is a desk reference for water supply planning and management.

The Mobile District continually reviews the WCM as needed to ensure that the best use is made of available water resources. At a minimum, the District reviews the manual every 5 years to determine whether updates are needed (USACE 2010a).

In addition to the above guidance, USACE established Environmental Operating Principles (EOPs) in 2002 to guide and ensure that USACE mission activities include totally integrated sustainable environmental practices (USACE 2012). The EOPs are applicable to the ACF WCM update. The following seven principles were reviewed, updated, and reissued in August 2012:

1. Foster sustainability as a way of life throughout the organization.
2. Proactively consider environmental consequences of all USACE activities and act accordingly.
3. Create mutually supporting economic and environmentally sustainable solutions.
4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE that may impact human and natural environments.
5. Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs.
6. Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.
7. Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.

Application of the EOP to the ACF WCM update process is summarized at the beginning of section 6.

3.3 Background on Atlanta Water Supply Needs

3.3.1 Metropolitan Atlanta Area Water Resources Management Study

The Metropolitan Atlanta Area Water Resources Management Study (MAAWRMS) was authorized by a resolution of the U.S. Senate adopted March 2, 1972. The study was initiated in 1973 with policy guidance and overall direction being provided by a 5-member executive group comprised of regional, state, and federal agencies. Although the scope of the study initially encompassed multiple water and related land resource needs, it soon became evident that a plan for ensuring a long-term water supply for Metro Atlanta was needed and study efforts were then focused on developing that plan.

The final MAAWRMS report in 1981 recommended construction of a reregulation dam approximately 6.3 miles downstream of Buford Dam for the purpose of reregulating peak power releases from the dam and providing a minimum flow to meet 2010 average summer water supply demands of 487 mgd, plus 750 cfs for water quality purposes. This plan, when compared to other alternatives evaluated, had the greatest net benefits and was the National Economic Development (NED) plan in accordance with planning guidance then in effect. The Assistant Secretary of the Army for Civil Works recommended to Congress in 1985 that the reregulation project be constructed by nonfederal interests. The final report was never officially transmitted to Congress. Nevertheless, Congress authorized construction of the reregulation dam in the Water Resources Development Act of 1986 (Public Law 99-662), subject to

approval of a general design memorandum (GDM) and with project costs shared by federal and nonfederal sources 25 percent and 75 percent, respectively.

The GDM investigations re-examined the benefits and costs of four plans investigated in the MAAWRMS report. When submitted to the South Atlantic Division in March 1988, the draft GDM confirmed that the plan recommending the reregulation dam still had the greatest net benefits of the four plans, but only by a small margin. Another plan that had almost the same net benefits was the reallocation of storage in Lake Lanier. Due to the closeness of the net benefits of the two plans, a more detailed evaluation of the hydropower impacts was conducted, and in October 1988, the reallocation of storage plan was designated the NED plan and recommended for implementation. This result was coordinated with the Governor of Georgia who, in November 1988, concurred with the recommendation. The appropriate procedure to pursue implementation of the reallocation plan was determined to be preparation of a Post-Authorization Change (PAC) report, which was initiated in March 1989. The report was to fully evaluate the future water needs for Metro Atlanta to the year 2010, determine the storage from Lake Lanier needed to satisfy these projected demands, and identify the associated impacts to all project purposes, both upstream and downstream of Lake Lanier. The PAC report is discussed in more detail in section 3.3.4.

3.3.2 Atlanta Withdrawals from the Chattahoochee River

As described in section 2.1.1.2.4.6, the original operational scheme adopted upon completion of the Lake Lanier project in the late 1950s provided for maximum ("peak") hydropower generation on weekdays through one or both large turbines, with minimal ("off-peak") hydropower generation through the small turbine on weekends. This mode of operation, in combination with inflows between Buford Dam and Atlanta and reregulation at Morgan Falls Dam north of Atlanta (owned and operated by GPC), generally yielded sufficient downstream flows to meet Atlanta's water supply needs for the first 15 years of project operations (Stockdale 2009). During the 1970s, as the MAAWRMS was underway, water supply demands in Metro Atlanta continued to grow and USACE began to adjust Buford Dam operations to provide increased downstream flows to accommodate the growing demand. By 1986, a long-term solution for the region's water supply needs had still not been developed and demands continued to increase to the point at which USACE determined that further adjustments in releases from Buford Dam would require a contract under separate authority. Accordingly, under the authority of the Independent Offices Appropriations Act (IOAA) (31 U.S.C. 9701), in 1986 USACE entered into a withdrawal contract with the Atlanta Regional Commission (ARC) that provided for withdrawals of up to 377 mgd from the Chattahoochee River with payment to the U.S. Government required for withdrawals exceeding 327 mgd.

3.3.3 Additional Interim Water Supply Contracts

The 1970s also were a time of population growth in communities and counties around Lake Lanier, which led them to request to withdraw water from Lake Lanier while the MAAWRMS was underway. Gwinnett County was the first to make such a request. On July 2, 1973, an interim withdrawal contract was executed under the authority of the IOAA that allowed Gwinnett County to withdraw water from Lake Lanier at a rate not to exceed 40 mgd "until such time as the Government's study (MAAWRMS) of the area's water supply needs is completed." (Gwinnett Contract Article 1(a)). The contract was modified in 1988 to increase the withdrawal rate to an average rate of 53 mgd and, in 1989, to redefine the term of the contract to be "until such time as the Government establishes a basis for the determination of cost of water storage space contract in the Project and is prepared to enter into a water storage space contract with the User, or until January 1, 1990, whichever occurs first."

Requests to withdraw water from Lake Lanier were received by USACE from other communities and similar interim withdrawal contracts were executed under the authority of the IOAA as follows:

- On June 27, 1978, an interim withdrawal contract was executed with the city of Cumming allowing withdrawal of up to 2.5 mgd until the completion of the MAAWRMS or a period of 5 years, whichever occurred first, and subject to extension by mutual agreement for additional periods not to exceed 5 years each. This contract was subsequently modified in 1985 to extend the contract term to July 1, 1989; increase the rate of withdrawal to 5 mgd through July 31, 1988; and to increase the rate of withdrawal to 10 mgd from July 1, 1988, through July 1, 1989.
- On May 28, 1987, an interim withdrawal contract was executed with the city of Gainesville allowing withdrawal of up to 20 mgd until July 1, 1989, and subject to extension by mutual agreement for additional periods not to exceed 5 years each.

In 1986, the Army General Counsel concluded that the IOAA, a statute that authorizes USACE to accept payment for services rendered in providing for withdrawals but does not provide for the reallocation of storage space, was not the preferable authority for accommodating water supply needs. This opinion led to revisions in USACE policies regarding water supply, and accordingly, USACE allowed the four contracts entered into under this authority (i.e., ARC, Gwinnett County, city of Cumming, and city of Gainesville) to expire in 1990, with the intention of entering into new contracts for storage space at Lake Lanier to meet existing and future water supply needs of Metro Atlanta under the Water Supply Act of 1958. As described below, however, withdrawals by these communities have continued.

3.3.4 Post-Authorization Change Report

In March 1989, USACE initiated a Post-Authorization Change Report (PAC) to implement the findings of the GDM for the reregulation dam. The PAC was conducted under the authority of the Water Supply Act of 1958, which provides that storage may be included for present and future municipal or industrial water supply in USACE projects; and section 216 of the Flood Control Act of 1970, which allows USACE to review the operation of completed federal projects and recommend project modifications "when found advisable due to significantly changed physical or economic conditions...and for improving the quality of the environment in the overall public interest". The purpose of the report was to fully evaluate the future water needs for Metro Atlanta to the year 2010, to determine the storage from Lake Lanier needed to satisfy the projected demands, to identify the associated impacts to all project purposes, both upstream and downstream of Lake Lanier, and to develop a water control plan that would consider balanced operations for all project purposes, including water supply.

The Georgia Environmental Protection Division (GAEPD), which has regulatory authority over water usage in the state, furnished estimates of the average water demands for 2010 for the various communities in Metro Atlanta that would utilize storage in Lake Lanier amounting to 150.96 mgd withdrawn from Lake Lanier and 178.4 mgd withdrawn from the Chattahoochee River below Buford Dam. The estimated demands for reservoir withdrawal did not include amounts associated with relocation contracts: 2 mgd for Buford and 8 mgd (net withdrawal) for Gainesville. Further, the estimated demand for downstream withdrawal was the amount that could not be met by authorized project operations of 600 cfs continuous release during the weekends. The storage required to provide the requested water supply amounted to 141,614 acre-feet for the communities withdrawing from Lake Lanier and 65,225 acre-feet for the communities withdrawing from the Chattahoochee River. A draft reallocation and post-authorization change report and a draft environmental assessment (EA) were completed in October 1989, which recommended reallocation of 206,839 acre-feet of storage in Lake Lanier to water supply for municipal and industrial purposes.

3.4 Background on Water Control Manuals

Water control manuals are guidance documents that assist federal water managers in operating individual and multiple interdependent USACE reservoirs on the same river system. They provide technical, historical, hydrological, geographic, demographic, policy, and other information that guides the proper management of reservoirs during times of high water, low water, and normal conditions. The manuals contain water control plans for each of the reservoirs in the basin system and specify how the various reservoir projects are to be operated as a balanced system. The manuals also contain drought operations plans and divide the amount of water in storage into zones to assist federal water managers in knowing when to reduce or increase reservoir releases and conserve storage in USACE reservoirs, and how to ensure the safety of dams during extreme conditions such as floods. The authority and guidance for USACE to prepare and update the manuals is in section 7 of the Flood Control Act of 1944 and the USACE regulations listed in section 3.2.

The original *Apalachicola River Basin Reservoir Regulation Manual* was completed in February1958, shortly after completion of the Jim Woodruff Lock and Dam and about the time Buford Dam was completed. The original 1958 Master Manual does not include WCMs for Buford Dam or for West Point Dam, Walter F. George Lock and Dam, or George W. Andrews Lock and Dam projects, all of which were completed later. The individual reservoir project WCMs were completed as the projects were constructed and placed into operation, and when approved, the project-specific manuals were attached as appendices to the 1958 Master Manual. The following identifies the appendices to the master WCM and their year of completion or most recent year of revision.

- Appendix A Jim Woodruff Lock and Dam Water Control Manual, 1972
- Appendix B Buford Dam and Lake Sidney Lanier Water Control Manual, 1991
- Appendix C Walter F. George Lock and Dam and Walter F. George Lake Water Control Manual, 1993
- Appendix D George W. Andrews Lock and Dam and Lake George W. Andrews Water Control Manual, 1996
- Appendix E West Point Dam Water Control Manual, 1975

A draft update to the main body of the 1958 Master Manual for the ACF Basin entitled *Apalachicola-Chattahoochee-Flint Basin Water Control Plan* was prepared in 1989, along with certain changes to the project manuals, and was included as an appendix to the PAC report described above. Those proposed updates, however, were never finalized or formally approved because of litigation that ensued in 1990 and thereafter. Section 3.5 summarizes the history of litigation on water resources in the ACF Basin. The 1989 update incorporated several operational adjustments, primarily focusing on adjustments gathered through experience and lessons learned during severe drought periods in the 1980s. These adjustments included the development of the action zones for Lanier, West Point, and Walter F. George lakes that are currently the basis for systemwide reservoir management.

USACE has continued to operate essentially in accordance with the 1989 manual update, making minor adjustments as additional experience and circumstances have dictated. In addition, USACE has continued to accommodate water supply withdrawals from Lake Lanier and from the Chattahoochee River downstream, although USACE has never taken action to effect a formal reallocation of storage in Lake Lanier nor to accommodate the future water supply needs that were anticipated in 1989.

3.5 Negotiations and Litigation

3.5.1 Principal Efforts for Resolution

In 1989, at the same time the Lake Lanier reallocation was being considered, USACE also proposed to reallocate storage to municipal and industrial (M&I) water supply at Allatoona Lake and Carters Lake in the Alabama-Coosa-Tallapoosa River (ACT) Basin. Additionally, Georgia was proposing to develop a regional reservoir near the Alabama state line (i.e., the West Georgia Regional Reservoir). These proposals caused controversy among water user groups; Alabama, Florida, and Georgia; and various federal agencies. Alabama filed a lawsuit against USACE in June 1990 to halt the proposed actions. As a result of the litigation, the proposed storage reallocations were deferred while the parties negotiated.

After a period of negotiation, the governors of Alabama, Florida, and Georgia and the Assistant Secretary of the Army for Civil Works addressed the issues of concern by signing a memorandum of agreement (MOA) on January 3, 1992. The MOA specified that a comprehensive study of the water resources of the basins would be conducted under a partnership involving the states and USACE to develop the needed water resources data and to investigate the feasibility of implementing an interstate coordination mechanism (compacts) for resolving water resources issues in the ACT and ACF basins. The MOA contained a *live and let live* provision for water use in the basins while the ACT/ACF comprehensive study and negotiations were conducted. That provision memorialized the parties' understanding that existing water users could continue to make withdrawals for water supply, including reasonable increases in withdrawal amounts, for the period necessary to negotiate a solution to the water issues. The MOA also specified that USACE would operate the USACE reservoirs in the ACT and ACF basins within its statutory and contractual obligations to maximize water resource benefits to the basins as a whole, while taking into account the needs of existing water users and the need to maintain the historical flow regime in the rivers in the basins. Subsequent supplemental MOAs extended the term of the agreements and continued to extend the "live and let live" provision.

It was envisioned that the comprehensive study would recommend, among other things, a conceptual plan for management of water resources in the ACT and ACF basins, including the following elements:

- Management of the federal and non-USACE reservoirs in the basins
- An assessment of existing and future water resource needs
- The extent of water resources available in the basins to serve such needs
- An appropriate mechanism to implement management of the basins

Prior to the completion of the comprehensive study, however, the state partners recommended river basin compacts between the states as the mechanism for negotiating water allocation formulas and managing the basins. The "live and let live" provision was incorporated into the Interstate River Basin Compact for each basin and signed into law by President Bill Clinton in November 1997; the MOAs were allowed to expire in September 1998. The Interstate River Basin Compact created an interstate administrative agency, the ACF Commission, composed of the governors of Alabama, Florida, and Georgia (state commissioners) and a federal commissioner appointed by the President of the United States. The comprehensive study was never completed, although useful data on water resource needs and availability were generated and assessment and modeling tools were developed to assist in resource assessment and basin management.

Interstate River Basin Compact negotiations began in early 1998, with a December 31, 1998, deadline for reaching agreement on the water allocation formulas. In anticipation of the states agreeing on a water allocation formula, USACE issued the *Water Allocation for the Apalachicola–Chattahoochee–Flint (ACF) River Basin, Alabama, Florida, and Georgia, Draft Environmental Impact Statement* in September

1998 (USACE 1998). Article VII of the ACF Interstate River Basin Compact required the federal commissioner to concur with the water allocation formula developed by the state commissioners for it to be implemented. The 1998 draft EIS was prepared to provide a basis for the federal commissioner's concurrence. By mutual agreement and in accordance with the provisions of the compacts, the states extended the deadline numerous times. Nevertheless, the state commissioners were unable to reach an agreement on an equitable apportionment of the waters in either basin, and the compacts were allowed to expire in August 2003 (ACF Basin) and July 2004 (ACT Basin); the 1998 draft EIS was never finalized. Upon expiration of the ACT and ACF compacts, Alabama and Florida reactivated their previous litigation and filed new litigation. The states asserted in that litigation that water control operations in the ACF Basin were not being conducted in accordance with approved water control plans, USACE regulations, and federal law.

Court-ordered mediation between the parties was initiated in March 2006 for both the ACT and ACF litigation. The mediation expired in March 2007 (ACF Basin) and September 2007 (ACT Basin). In March 2007, the ACF claims were consolidated as Multiple District Litigation to be heard by one judge, with the proceedings to be held in the federal district court for the Middle District of Florida. On November 1, 2007, the governors of Alabama, Florida, and Georgia met with executive branch leaders (Secretary of the Department of the Interior, Chairman of the CEQ, and Chief of Engineers) to discuss strategies for developing solutions to the decades-long dispute among the three states and associated litigation. The resulting discussions focused primarily on the ACF Basin and the need for the states to agree on a drought operations plan. The mutually agreed-upon deadline was March 1, 2008. The parties did not reach an agreement, and negotiations ended on the deadline.

Meanwhile, on January 30, 2008, Secretary of the Army Pete Geren directed USACE to proceed with updating the water control plans for the ACF Basin. On February 22, 2008, the Mobile District published in the *Federal Register* the NOI to prepare an EIS for the ACF Master Manual update.

3.5.2 Litigation

As indicated above, Alabama filed a lawsuit in June 1990 to halt proposed reallocations of storage in USACE reservoirs for M&I water supply. Between June 1990 and January 2013, several cases related to the ACF Basin were heard in federal court. The following paragraphs summarize the issues involved in those cases.

3.5.2.1 The Alabama Case

In 1990, Alabama and Florida filed suit (the Alabama case) against USACE to stop the larger withdrawals it had approved for Georgia, based in part on the effect they would have on downstream users and a failure to comply with NEPA (42 U.S.C. 4321–4347). The suit alleged that USACE had exceeded its authority under the Water Supply Act of 1958 by reallocating storage in the ACF reservoirs. Under the act, a modification to reservoir projects, "which would seriously affect the purposes for which the project was authorized...or which would involve major structural or operational changes shall be made only upon the approval of Congress." The authorized purposes of Lake Lanier were disputed among the parties and became a recurring issue in each of the lawsuits filed. Generally, each of the parties except Georgia and USACE recognized three authorized uses—flood risk management, hydroelectric power generation, and navigation. Georgia and USACE, however, have maintained that M&I use was also authorized. USACE and Georgia, however, disagreed over the amount of M&I water supply that was authorized and the source of the water supply authority. The parties suspended the proceeding in 1992 with the signing of an MOA as described in section 3.5.1 above.

3.5.2.2 The D.C. Case

While the action was suspended in the Alabama case pending negotiations, another case was brought in the federal district court for the District of Columbia (D.C. District Court) in December 2000 by Southeastern Federal Power Customers, Inc. (SeFPC), a nonprofit corporate consortium of rural electric cooperatives and municipal electric systems. SeFPC alleged that the USACE contracts that provided for increased withdrawals from Lake Lanier, without appropriate compensation to hydroelectric power customers, exceeded USACE's authority under the Water Supply Act of 1958. The increased withdrawals, it argued, consequently diminished the flow-through by which hydroelectric power is generated. SeFPC claimed that its members were paying for Buford Dam hydroelectric power generation at prices disproportionate to the residual share of the water stored in Lake Lanier that was allocated to power generation. The proceedings of the Alabama and D.C. cases were interrelated. In the Alabama case, Alabama and Florida sued to prevent withdrawals of water from Lake Lanier made to the detriment of downstream users.

In January 2003, the parties in the D.C. case, including Georgia and USACE, reached a settlement agreement and requested the court's approval. The settlement agreement included a proposal for USACE to enter into 10-year interim water storage contracts at Lake Lanier for several municipalities and local governments, along with the potential for the interim water storage contracts to roll over to permanent reallocation storage contracts in the future, subject to NEPA compliance. Because the parties in the D.C. case attempted to implement a settlement agreement that would affect the use of the water at issue in the Alabama case, Alabama and Florida revived the Alabama case to challenge the settlement agreement. Alabama and Florida also intervened in the D.C. case to oppose the approval of the agreement as a violation of the suspension of proceedings in the Alabama case. In October 2003, the federal district court in the Alabama case granted Alabama and Florida's motion for a preliminary injunction, enjoining USACE and Georgia from implementing the agreement in the D.C. case. In February 2004, the federal district court in the D.C. case approved the settlement agreement but required that the injunction entered in the Alabama case be dissolved before the agreement could be implemented. In 2005, the 11th Circuit Court of Appeals vacated the Alabama District Court's injunction order, finding that Alabama and Florida did not establish an imminent threat of irreparable harm or a substantial likelihood of prevailing on the merits of the case. On December 21, 2005, the SeFPC filed a motion with the D.C. District Court to stay proceedings in the case pending completion of the NEPA process contemplated by the settlement agreement.

In January 2006, the D.C. District Court issued an order granting the stay and specifically stating that USACE would not be released from its existing legal obligation to implement the settlement agreement as expeditiously as practicable. On June 16, 2006, the Mobile District published in the *Federal Register* an NOI to prepare an EIS to address the proposed interim storage contracts. Public scoping meetings were held in November 2006, and a final scoping report was published in February 2007. Alabama and Florida appealed the D.C. District Court decision to the D.C. Circuit Court of Appeals, and arguments were heard in November 2007. In February 2008, the Court of Appeals for the D.C. Circuit reversed the federal district court's approval of the settlement agreement reached by the parties in the D.C. case. The court's opinion addressed only one of the statutory issues raised by the appeal—the Water Supply Act of 1958. The court determined the settlement agreement involved a reallocation of 22 percent of the conservation storage in Lake Lanier and held that "the Agreement's reallocation of Lake Lanier's storage space constitutes a major operational change on its face" and therefore, under the act, required prior congressional approval. Because Congress did not authorize the change, the court ruled that the agreement could not be enforced. Florida and Alabama also claimed that the agreement violated the Flood Control Act and NEPA, but the court did not address those issues. Georgia filed a petition for a writ of certiorari with the U.S. Supreme Court. The U.S. Supreme Court denied the petition on January 12, 2009.

3.5.2.3 The Georgia I Case

In 2000, the Governor of Georgia made a written request for a water supply reallocation study asking USACE to commit to making increased releases of water from the Buford Dam until the year 2030 to ensure a reliable M&I water supply to Metro Atlanta. In 2001, after 9 months without a reply, Georgia sued USACE to increase its water supply. While the Alabama and D.C. cases were being litigated, Florida and SeFPC filed motions to intervene in the Georgia I case, but the federal district court denied the motions. After that denial, USACE denied Georgia's request, claiming that it lacked the "legal authority to grant Georgia's request without additional legislative authority, because the request would involve substantial effects on project purposes and major operational changes." On appeal, the Court of Appeals for the 11th Circuit overturned the federal district court's decision. The court permitted Florida and SeFPC to intervene and returned the case to the district court for further adjudication. The federal district court, noting the similarity of the parties and the subject matter, found the case to be parallel to the Alabama case. The court suspended the proceedings in the Georgia I case pending resolution of the Alabama case.

3.5.2.4 The Georgia II Case

In 2006, USACE issued an IOP for Jim Woodruff Dam for the purpose of protecting federally protected species in the Apalachicola River. Georgia sued USACE to challenge the IOP, claiming that it constituted a change from the only approved water control plan (which had been adopted in the late 1950s). Georgia argued that, by releasing more water from reservoir storage to meet the in-stream requirements in the IOP for the Apalachicola River, USACE was jeopardizing the state's future water supply. The releases allegedly did not account for dry-weather conditions and did not reserve enough water to supplement the dry summer conditions in northern Georgia. The suit also alleged that water supply was a contemplated purpose of USACE's water project.

3.5.2.5 The Florida Case

In September 2006, USFWS issued a biological opinion regarding the impact of the IOP for Jim Woodruff Dam on protected species downstream. Florida filed a lawsuit to review the biological opinion, which was issued pursuant to the ESA. The biological opinion concluded that USACE's operations under the IOP were not likely to jeopardize the species or their habitat. Florida sought review of the biological opinion and the NEPA supporting the IOP. The biological opinion, according to Florida, violated rational decision-making standards. Furthermore, Florida alleged that the M&I water uses for which Georgia sought water were not authorized purposes.

3.5.2.6 The City of Columbus Case

In 2007, Columbus, Georgia, sued USACE, challenging the validity of the IOP. Columbus asserted that USACE had failed to adopt a formally finalized water control plan for the ACF Basin and that USACE's operation under the IOP violated its legal authority. USACE was operating under a third revision of the IOP (each IOP had changed the flow levels in the rivers) at the time Columbus filed the lawsuit. Columbus claimed that the lack of reliable flow from the Chattahoochee River impaired its ability to discharge water that it used to provide services to the city in compliance with regulatory requirements. The city alleged that the IOP improperly revised the water control plan because it was published in final form without public comment and was put into effect for an indefinite period. According to Columbus, the IOP resulted in over-releases of water from the ACF reservoirs to the city's detriment.

3.5.2.7 The City of Apalachicola Case

In 2008, Apalachicola, Florida, sued USACE, challenging its management and operation of the ACF facilities. The lawsuit arose from the city's interest in maintaining the Apalachicola Bay ecosystem,

which the city claims as a basis for its economy and livelihood. Apalachicola alleged that USACE had not completed an adequate NEPA review when it issued the original IOP, the modified IOP, or the Exceptional Drought Operations modification to the modified IOP. The city also claimed that USACE had not complied with the Environmental Assessments (EAs) required under the Coastal Zone Management Act. Apalachicola also alleged that various contracts entered into by USACE, which provide for withdrawals for purposes other than those authorized by law, and USACE's application of the draft water control plan violate the Water Supply Act, the Flood Control Act, and NEPA.

3.5.2.8 Consolidated Cases

In March 2007, the Alabama, Georgia I, Georgia II, and Florida cases were consolidated and transferred to the federal district court for the Middle District of Florida "to serve the convenience of the parties and witnesses and promote the just and efficient conduct of the litigation." The Columbus and Apalachicola cases were also included in the consolidated litigation. The D.C. case was excluded from the consolidation of proceedings because it had already reached the appellate court, whereas the cases that were consolidated remained in various federal district courts.

3.5.2.8.1 Federal District Court for the Middle District of Florida

After the cases were consolidated, the parties agreed that the court should consider the claims in two phases to address separate distinct legal issues.

- Phase I addressed USACE's authority to operate Lake Lanier for water supply and reallocate storage under the Water Supply Act of 1958 (WSA 1958), as well as claims raised under NEPA and other statutes.
- Phase II consisted of environmental claims concerning USACE compliance with the ESA, as well as claims raised under NEPA.

In general, Florida, Alabama, Alabama Power Company, and SeFPC contended that USACE was obligated to seek congressional approval for actions it had taken with respect to water supply in Lake Lanier because those actions significantly affect the purposes for which the Buford Dam project was authorized or constitute major structural or operational changes. The Georgia parties contended that USACE has authority to allocate storage to accommodate increased levels of water supply, and improperly rejected Georgia's request in 2000 for additional water supply from Lake Lanier to meet anticipated future needs. USACE contended that, while it properly denied Georgia's 2000 request for future water supply storage, it has sufficient authority under the Buford Project authorization and the Water Supply Act to reallocate storage to accommodate present water supply withdrawals from Lake Lanier and the Chattahoochee River downstream.

The phase I summary judgment hearing was held on May 11, 2009. On July 17, 2009, the U.S. District Court for the Middle District of Florida issued an order in *In re Tri-State Water Rights Litigation* (Case No. 3.07-md-01) (J. Magnuson), which addresses the fundamental question of whether, by taking or failing to take the actions complained of in the various lawsuits, USACE had violated section 301 of the Water Supply Act of 1958. That act provides that:

> Modifications of a reservoir project heretofore authorized, surveyed, planned, or constructed to include storage [for water supply] which would seriously affect the purposes for which the project was authorized, surveyed, planned, or constructed, or which would involve major structural or operational changes shall be made only upon the approval of Congress. 43 U.S.C. 390b(d). (Emphasis added.)

The federal district court reviewed the legislative history and USACE's own statements to determine whether water supply was an authorized purpose of the project. After lengthy review of a large number of historical sources (e.g., congressional testimony, the 1958 WCM), the court concluded that water supply is not an authorized purpose for Lake Lanier.

The court then took up the question of whether water supply reallocation might be permissible under the Water Supply Act of 1958. For minor reallocations of a reservoir to water supply, USACE may act unilaterally. Approval of Congress would be required, however, if the reallocation "would seriously affect the purposes for which the project was authorized … or … involve major structural or operational changes." The court looked at the factual information concerning the amounts committed to interim contracts (now hold-over contracts because of their expiration) for withdrawal of water from the reservoir, the amounts taken from the Chattahoochee River near Atlanta, and the capacity of the reservoir's conservation pool. The court concluded that USACE actions would seriously affect hydroelectric power generation and constitute major operational changes.

On the basis of those analyses, the court concluded that USACE must seek congressional approval before it reallocates storage in Lake Lanier for water supply and issued its rulings accordingly on the various motions for summary judgment. Noting the *draconian nature* of a decision to potentially reduce Atlanta's water supply so much, the court gave the parties 3 years to obtain the necessary congressional approval. However, without congressional authorization, the district court's order required that withdrawals from Lake Lanier (apart from relocation agreements) must cease and off-peak releases for water supply must be limited to 600 cfs by July 2012.

The phase II summary judgment hearing was held on June 8, 2010. On July 21, 2010, the U.S. District Court for the Middle District of Florida issued a second phase order in *In re Tri-State Water Rights Litigation* determining that USACE and the USFWS had complied with the ESA, but that USACE had not properly complied with NEPA requirements. The appropriate remedy would be for USACE to conduct new NEPA on the WCM; however, because USACE had already agreed to develop an EIS as part of the WCM update, the court determined Florida's claims were moot. Florida appealed the phase II ruling to the 11th Circuit. After the appeal was filed, new information on endangered species caused the USFWS to request USACE to reinitiate consultation. All parties agreed to stay the appeal while USACE and the USFWS conducted additional studies.

3.5.2.8.2 U.S. Court of Appeals for the 11th Circuit

On May 3, 2010, the Solicitor General authorized appeal of the phase I ruling. On June 28, 2011, the U.S. Court of Appeals for the 11th Circuit issued an opinion that the authorizing documents for the Buford Dam project should include water supply as an authorized purpose. The opinion reversed the judgment of the District Court on the phase I ruling, vacated its findings and conclusions of law, and remanded the case *In re Tri-State Water Rights Litigation* to the district court with instructions to remand to USACE for further proceedings "not inconsistent with this order." As to the merits, the court held that the majority of plaintiffs' claims in the ACF were not final agency actions and, therefore, not subject to judicial review.

This decision set aside the Army's 2002 decision to deny Georgia's 2000 request and ordered a remand to USACE to reconsider whether it has the legal authority to operate the Buford Project to accommodate Georgia's request, in light of the legal authority conferred by Congress in the River and Harbor Act of 1946, Public Law No. 84-841 (July 30, 1956) (1956 Act), and the Water Supply Act of 1958. The court of appeals also directed USACE to consider a number of other issues related to the legal authority to accommodate Georgia's request, including how to measure the impacts of Georgia's projected withdrawals and return flows on authorized purposes and whether compensation to hydropower users was appropriate.

An appeal by Alabama, Florida, and the SeFPC for the case to be heard by the full panel of the U.S. Court of Appeals for the 11th Circuit was denied on September 16, 2011. On October 5, 2011, the district court remanded the matter to USACE in accordance with the appeals court's instructions. Limited jurisdiction was retained by the 11th Circuit pending the submittal by USACE of its position regarding authority to grant Georgia's 2000 request. USACE submitted its legal opinion, discussed below, on June 25, 2012. On July 10, 2012, the appeals court remanded any remaining jurisdiction in the cases to the district court. A subsequent appeal by Alabama, Florida, and the SeFPC to the U.S. Supreme Court on the phase I ruling was denied on June 25, 2012.

On January 24, 2013, the district court vacated its phase II ruling on the grounds that USACE and the USFWS reinitiated consultation while the appeal was pending, thus rendering the appeal moot and making it proper to vacate the underlying order. Accordingly, there currently is no active litigation regarding USACE operation of the ACF Basin.

3.5.2.8.3 USACE 2012 Legal Opinion

USACE's legal opinion (Stockdale 2012) submitted to the 11th Circuit Court of Appeals on June 25, 2012, sets forth USACE's view that:

- It has the legal authority under the River and Harbor Act (RHA) of 1946 to release water from Buford Dam sufficient to accommodate Georgia's requested downstream withdrawals of 408 mgd;
- Withdrawals of 20 mgd from Lake Lanier are authorized under relocation agreements and the 1956 Act; and
- It has discretion under the Water Supply Act of 1958 to accommodate additional net withdrawals of 170 mgd from Lake Lanier (including withdrawals of 277 mgd and returns of 107 mgd to the reservoir), because accommodating those withdrawals and returns would not fundamentally depart from Congressional intent for the Buford Project and the ACF system.

USACE could accommodate the downstream withdrawals without reallocating or charging for storage in Lake Lanier, because Congress expected that the downstream water supply needs of Metro Atlanta would be accommodated by the use of the existing multipurpose storage pool authorized under the 1946 RHA, and did not expect or provide for repayment of storage costs associated with the downstream water supply purpose. Withdrawals from Lake Lanier beyond the 20[4] mgd already authorized under relocation agreements would require contracts with the state of Georgia or other entities for storage pursuant to the 1956 Act and the Water Supply Act of 1958. Any operational decisions to accommodate Georgia's request, and any determinations of how much storage to reallocate for the additional Lake Lanier withdrawals, are questions outside the purview of the legal opinion; however, because operations to accommodate Georgia's projected water supply withdrawals and return flows to Lake Lanier would not significantly depart from congressional intent for the ACF system, the legal opinion concluded that USACE has the legal authority under the relevant statutes to accommodate Georgia's request (Stockdale 2012).

3.6 Other Relevant Statutes and Executive Orders

A decision on whether to proceed with the proposed action rests on numerous factors such as mission requirements, schedule, funding availability, and environmental considerations. In addressing

[4] Presently, Gainesville withdraws 18 mgd and returns 10 mgd resulting in a net withdrawal of 8 mgd. The total gross withdrawal under relocation contracts is 20 mgd.

environmental considerations, the Army is guided by relevant statutes (and their implementing regulations) and executive orders (EOs) that established standards and provide guidance on environmental and natural resources management and planning. Table 3.6-1 provides a brief list of applicable laws and EOs that are addressed in various sections throughout this EIS when relevant to environmental resources and conditions. The full text of the laws, regulations, and EOs is available on the Defense Environmental Network and Information Exchange Web site at www.denix.osd.mil.

Table 3.6-1.
Applicable laws and Executive Orders

Anadromous Fish Conservation Act of 1965, as amended (16 U.S.C. 757 et seq.)	Noise Control Act of 1972 (P.L. 92-574)
Antiquities Act of 1906, as amended (16 U.S.C. 431)	North American Wetlands Conservation Act (16 U.S.C. 4401 et seq.)
Archeological and Historical Preservation Act (16 U.S.C. 469)	Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901-6992k)
Archeological Resources Protection Act (16 U.S.C. 470aa-470ll)	River and Harbors Act of 1888 (33 U.S.C. 608); of 1899 (33 U.S.C. 401-413); as amended and supplemented
Clean Air Act (42 U.S.C. 7401)	Safe Drinking Water Act (P.L. 93-523; 42 U.S.C. 300f-j-10)
Clean Water Act (33 U.S.C. 1344 et seq); also known as the Federal Water Pollution Act of 1972, as amended	Toxic Substances Control Act (15 U.S.C. 2601–2692)
Coastal Zone Management Act (P.L. 92-583, 16 U.S.C. 1451-1456)	Water Resources Development Act of 1986 (P.L. 99-662; 33 U.S.C. 2201-2330), as amended 1988, 1990, 1992, 1996, 1999, 2000, and 2007)
Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601-9675)	Watershed Protection and Flood Prevention Act (16 U.S.C. 1001)
Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901-3932)	Water Pollution Control Act Amendments of 1961 (P.L. 87-88)
Endangered Species Act (16 U.S.C. 1531)	EO 11514 (Protection and Enhancement of Environmental Quality)
Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701-1784)	EO 11988 (Floodplain Management)
Federal Water Project Recreation Act of 1965 (P.L 89-72, 79 Stat. 213; 16 U.S.C. 4601-12 et seq.), as amended	EO 11990 (Protection of Wetlands)
Fish and Wildlife Conservation Act (16 U.S.C. 2901)	EO 12088 (Federal Compliance with Pollution Control Standards)
Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661)	EO 12580 (Superfund Implementation)
Flood Control Act of 1944, as amended (16 U.S.C. 460)	EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations)
Food Security Act of 1985 (16 U.S.C. 3811 et seq.)	EO 13045 (Protection of Children from Environmental Health Risks and Safety Risks)
Historic Sites Act of 1935 (16 U.S.C. 461)	EO 13061 (American Heritage Rivers)
Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (P.L. 104-267; 16 U.S.C. 1801)	EO 13101 (Greening the Government through Waste Prevention, Recycling, and Federal Acquisition)
Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1401-1445, 16 U.S.C. 1431 et seq. and 33 U.S.C. 1271)	EO 13123 (Greening the Government through Efficient Energy Management)
Migratory Bird Treaty Act (16 U.S.C. 701-719c)	EO 13148 (Greening the Government through Leadership in Environmental Management)
National Environmental Policy Act (P.L. 91-190)	EO 13175 (Consultation and Coordination with Indian Tribal Governments)
National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.) and amendments of 1980 (16 U.S.C. 469a)	EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)
Native American Graves Protection and Repatriation Act (25 U.S.C. 3001)	EO 13547 (Stewardship of the Ocean, Our Coasts, and the Great Lakes)

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4 Development and Description of ACF Water Management Proposed Action and Alternatives

As previously indicated, the purpose of this EIS is:

- To update the WCM for the ACF Basin as directed by Secretary of the Army Pete Geren on January 30, 2008, and
- Consider, along with operations for all authorized purposes, an expanded range of water supply alternatives associated with the Buford Dam/Lake Lanier project, including current levels of water supply withdrawals and additional amounts that Georgia, in 2013, requested from Lake Lanier and downstream at Atlanta.

The updated manual will be prepared in compliance with ER 1110-2-240 and other USACE regulations and policies. To respond to Georgia's 2013 request, a water supply storage assessment (WSSA) was prepared following guidance in ER 1105-2-100 and *The Water Supply Handbook* (Revised IWR Report 96-PS-4) for reports on reallocation of reservoir storage (Appendix B).

USACE is taking the opportunity to make revisions to the water management procedures to improve overall performance of the ACF Basin and to implement the June 2011 ruling of the 11th Circuit Court of Appeals. In updating the Master Manual and considering Georgia's 2013 water supply request within the context of the purpose and need statement (section 1.2), USACE used a 6-step planning process described in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources* (P&G) and in ER 1105-2-100. This process is a structured approach to problem solving that provides a rational framework for sound decision making. Although specifically required for planning studies, this process was well suited for this Master Manual update and is consistent with CEQ's Regulations for Implementing NEPA (40 CFR Parts 1500–1508). Following are the six steps in the planning process:

- Step 1 - Identify problems (challenges) and define objectives (includes scoping as required by 40 C.F.R. 1501.7).
- Step 2 - Inventory and forecast critical resources (i.e., physical, environmental, economic, and demographic) and develop the No Action Alternative (NAA).
- Step 3 - Formulate alternatives.
- Step 4 - Evaluate alternatives.
- Step 5 - Compare alternatives.
- Step 6 - Select a plan.

The six steps are presented and discussed in sequence for ease-of-understanding; however, they usually occur iteratively and sometimes concurrently. The steps were repeated as necessary to formulate efficient, effective, complete, and acceptable plans.

Plans considered in this EIS were formulated in two phases. In the first phase, water management measures were identified and screened to determine the set of measures to be combined to form water management alternatives. For analytical purposes, the evaluation of water management alternatives in this phase assumed that the water supply withdrawals from Lake Lanier would be limited to the 20 mgd currently authorized to be withdrawn by the cities of Buford and Gainesville under the relocation contracts, and releases from Buford Dam would be made in accordance with the CRMS to support water supply withdrawals from the Chattahoochee River in Metro Atlanta limited to the amounts withdrawn in 2007 (277 mgd). Water supply providers contributed return flows to Lake Lanier and downstream returns

were also taken into account. Withdrawals elsewhere in the basin also would be limited to the amounts withdrawn in 2007. These assumptions facilitated the comparison of the performance of the water management alternatives using a consistent baseline condition that is relatively independent of the influence of the water supply withdrawals from Lake Lanier under the expired contracts.

The Water Supply Act of 1958 stipulates that Congressional authorization is required for any reallocation of storage in completed reservoirs that would seriously affect the purposes for which the project was authorized or that would involve major structural or operational changes. The 2-phased approach facilitates the identification of a Water Management Proposed Action Alternative that is then used as a baseline for evaluating the effects on other project purposes when considering reallocation of storage in Lake Lanier for water supply. Based on the outcome of this evaluation, a determination can be made regarding whether any proposed reallocation would seriously affect the purposes for which the project was authorized or that would involve major structural or operational changes.

In the second phase of alternatives formulation measures for addressing the Georgia 2013 request for water supply from Lake Lanier and for downstream withdrawers were identified and screened to develop the set of water supply options to be considered. For this phase, Water Management Alternative 1 and the Water Management Proposed Action Alternative (e.g., Water Management Alternative 7) were combined with water supply options to form alternatives that were evaluated and compared. The result of this formulation phase was the identification of a Proposed Action Alternative (PAA). Refinements to the Water Management Proposed Action Alternative were then considered in the interest of improving efficiency or reducing adverse effects. The PAA resulting from the 2-phased formulation process will consist of a Water Management Proposed Action Alternative together with a proposal for providing some amount of water supply for Metro Atlanta.

4.1 Water Management Alternative Formulation

Problems and challenges associated with water management were identified by the scoping process (stakeholder comments). Additionally, USACE water management staff performed a review based on experience gained from operating under the draft 1989 Master Manual. The following water management challenges were identified as a result of these efforts:

- Making operational decisions on the basis of the 1989 action zones affected reservoir levels disproportionately. Explaining the basis for the action zones in the draft 1989 Master Manual was not easy. The zones were based on experience gained in the 1980s in responding to droughts and attempting to support navigation in the system. Additional experience gained in operating in drought conditions, to conserve threatened and endangered species, and to support navigation in the system is considerably different than in the 1980s.
- Current USACE water control plans do not have a basinwide drought management plan.
- When operating under the May 2012 RIOP, there remains a need to suspend ramping rates during prolonged low flows.
- Sustained hydroelectric power operations during drought have an adverse effect on USACE's ability to continually operate for conservation of federally listed threatened and endangered species.
- Historic operations at Lake Lanier, West Point Lake, and Walter F. George Lake have seldom maintained a full pool during the May–October period.
- Navigation on the Apalachicola River is undependable.

USACE developed several objectives for the Master WCM update and the WSSA to address the water management issues. In the context of this EIS, an "objective" is a statement of what the updated Master WCM should try to achieve. Accordingly, the following objectives have been developed:

- To define action zones on a scientific basis that eliminate a disproportionate impact on reservoirs and address current system needs.
- To develop and implement a basinwide USACE reservoir drought operation plan.
- To reduce or eliminate the chance of prematurely returning to drought operations and reducing flows downstream from Jim Woodruff Dam below 5,000 cfs.
- To reduce or eliminate the adverse effect of system operations on federally listed threatened and endangered species.
- To improve system performance to achieve congressionally authorized project purposes.
- To increase the reliability of navigation on the ACF system.

The planning process for the WCM is illustrated in Figure 4.1-1.

On the basis of the foregoing operational challenges and problems, extensive stakeholder input during three rounds of scoping, and accounting for the 11th Circuit Court of Appeals' ruling, USACE identified numerous management measures for possible consideration in the updated Master WCM. A "measure" can be defined as a feature or activity that can be implemented at a specific geographic site to address one or more of the objectives. The measures considered in updating the Master WCM included the following:

- Variations for revising reservoir drawdown and refill periods, reshaping action zones, and balancing zone drawdown proportionally among projects
- Revising hydroelectric power generation
- Revising drought operations and environmental flows
- Developing navigation-specific operations

USACE used an iterative process to identify the various measures that would be further developed, analyzed, and refined toward the goal of developing an updated Master WCM. The process relied extensively on modeling using the latest software application, HEC-ResSim Version 3.2, Build 3.2.1.19. USACE HEC developed the software that is now the standard for USACE reservoir operations modeling. The software incorporates characteristics of the basin and individual reservoirs including physical constraints (e.g., spillway capacities, area-discharge curves, and flows associated with hydroelectric power generation) and operational procedures (e.g., action zones, balancing, and the like). USACE selected HEC-ResSim as the tool most capable of faithfully representing District water management practices at the culmination of a 3-year model development and verification process. In accordance with Engineering and Construction Bulletin (ECB) 2007-6, Subject: Model Certification Issues for Engineering Software in Planning Studies, issued April 10, 2007, HEC-ResSim falls under the category of "engineering models used in planning studies," leaving certification to the Science & Engineering Technology (SET) initiative associated with the USACE's Technical Excellence Network (TEN). As of January 2010, the TEN guidance listed HEC-ResSim as "Community of Practice Preferred" for the purpose of reservoir system analysis.

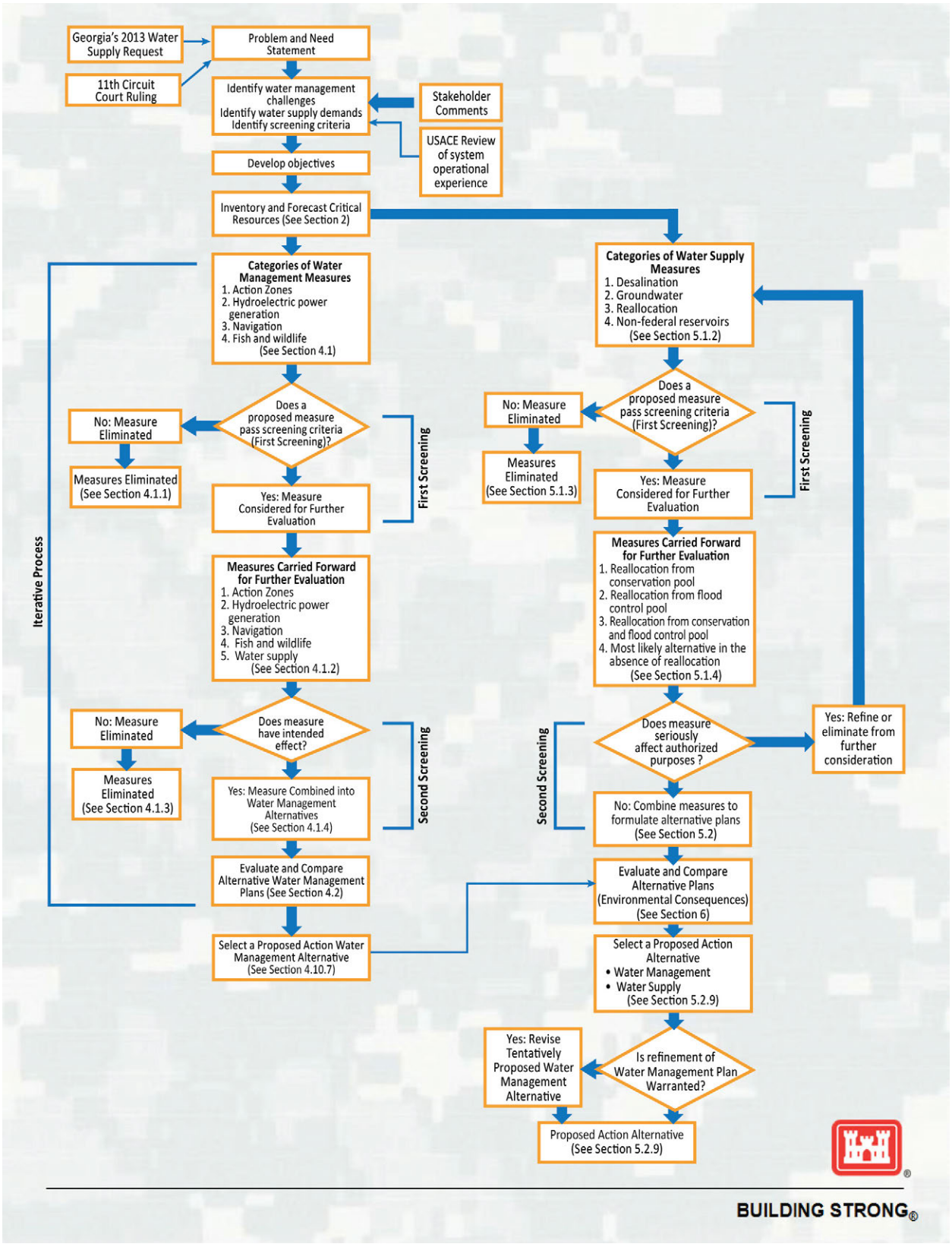

Figure 4.1-1. Water Management Planning Process

In 2006, the Mobile District began working with HEC to create ResSim watershed models of its established HEC-5 models simulating 1977, 1995, and 2006 physical and operational conditions. The three HEC-5 models hold significance as the tools *of record* for analyses concerning the 1998 draft EIS, the comprehensive study, the 2006 IOP, the 2008 RIOP, and the 2012 RIOP. After ensuring that the corresponding HEC-ResSim models could effectively reproduce the HEC-5 results, Mobile District and HEC created another HEC-ResSim model that captured the most significant operations as of 2008, including the RIOP rules and head limits constraints. That model was presented to stakeholders in October 2008 and generally accepted as a promising improvement to ACF reservoir system modeling.

As the HEC-ResSim model for the ACF Basin was further refined and initial baseline model runs were conducted, USACE conducted a second stakeholder workshop in May 2011. Participants in these workshops included representatives of the states of Alabama and Georgia, U.S. Geological Survey, Alabama Power Company, local water utilities in the basin, and several consultants. Mobile District and HEC have continued to refine the HEC-ResSim model, using it to evaluate alternatives in support of the 2012 legal opinion and this EIS. HEC-ResSim modeling conducted for this EIS for the period of January 1939–December 2011 is documented in Appendix E. Additionally, HEC-ResSim's Firm Yield subroutine was used in the *Federal Storage Reservoir Critical Yield Analyses* (USACE Mobile District 2014) (Appendix F).

USACE considered each water management measure individually and determined whether it passed the screening criteria listed in section 1.4.4.

Measures failing to pass the criteria in the first screening were not carried forward for further evaluation (i.e., eliminated from further consideration).

Measures carried forward for further evaluation were refined, if required, and then further evaluated and screened a second time to determine their feasibility.

The water management measures passing the second screening were combined to form basinwide alternatives that address one or more of the objectives identified above.

HEC-ResSim was used to model the effects of those alternatives providing data outputs (e.g., hydroelectric power generation, reservoir levels, and river flows and stages) across the entire hydrologic period of record (1939–2011).

Outputs were evaluated in terms of project and watershed criteria (i.e., channel availability; generation and capacity; reservoir recreation impact levels; and other authorized purposes, intended benefits, and existing uses in the system).

The iterative process is illustrated in Figure 4.1-2. Ultimately, the updated Master WCM reflects the recommended plan or PAA and represents the combination of measures that best balances system operations.

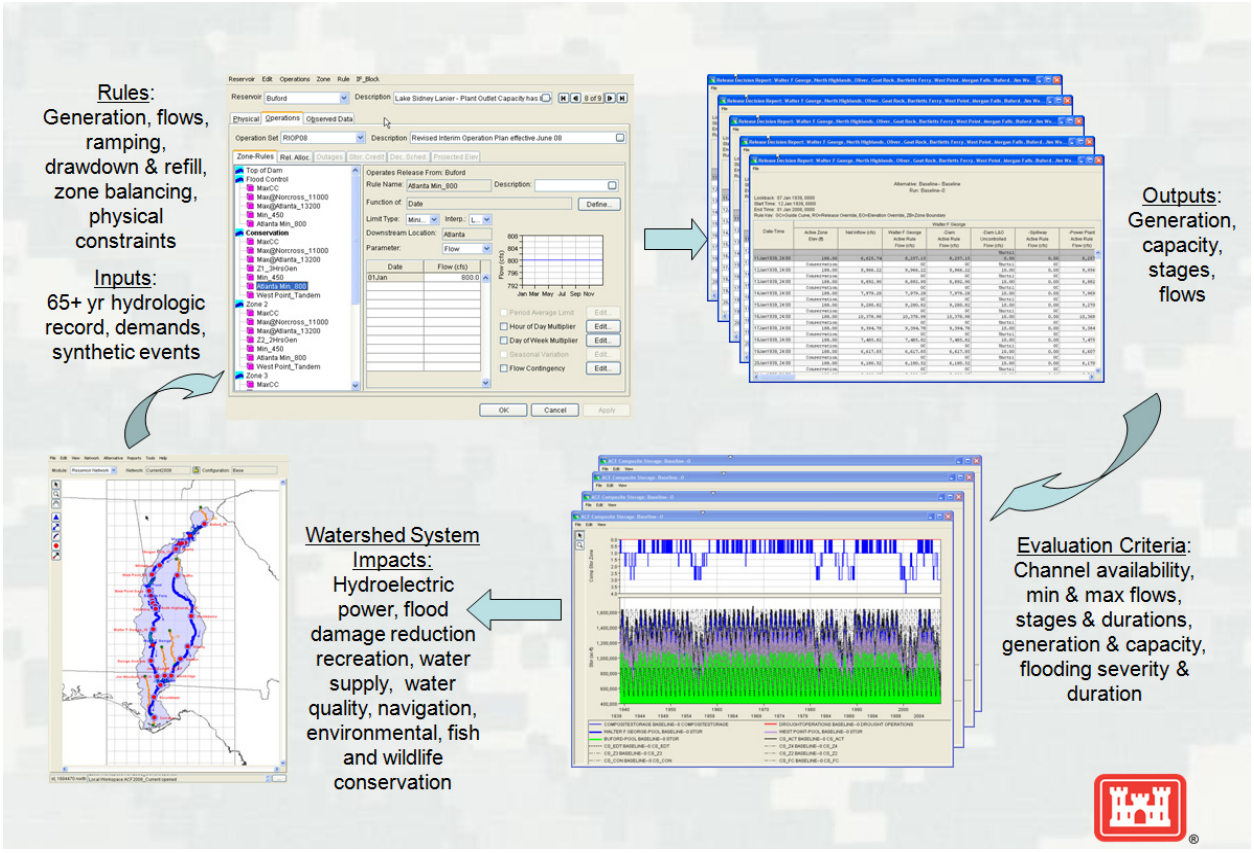

Figure 4.1-2. Process of Refining Current Operations

The following sections outline operational revisions considered in updating WCMs for the ACF Basin.

4.1.1 Water Management Measures Eliminated from Further Consideration (First Screening)

The purpose of the federal action is to update the water control plans and manuals for the federal system of improvements in the ACF Basin to operate for congressionally authorized purposes, taking into account changed conditions since the last approved manual and public comments. USACE solicited public comments on the proposed scope of the water control manual update effort. After reviewing public comments, and in light of the overall purpose, USACE developed screening criteria, as discussed in section 1.4.4, to guide the scope of the federal action. Management measures eliminated from further consideration were those that did not pass the screening criteria. Further, in the scoping comments received, a number of specific management measures (or alternatives) were identified that were found to be outside the scope of this EIS. Appendix D details 228 specific management measures (or alternatives) identified in scoping some of which were eliminated from further evaluation. This section briefly discusses some examples of the eliminated measures.

USACE does not prioritize project purposes with the exception of flood risk management during a flood event as explained in section 2.1.1.2. All project purposes, regardless of whether they are identified in the project authorization or by subsequent general legislation, are considered equally when making water management decisions. Therefore, any measure proposed during public scoping that recommended

prioritization of project purposes (e.g., WQ16[5], WS2 and WS6, or HP1) was not carried forward for further consideration.

Because navigation is one of the congressionally authorized purposes in the ACF Basin, it must be considered in making any operational decisions. Accordingly, any recommendations to eliminate navigation as a project purpose (e.g., NV4) were not considered. Eliminating a project purpose would not meet the purpose and need of the federal action, which is to determine how the federal projects in the ACF Basin should be operated for their authorized purposes, in light of current conditions and applicable law.

Management measures that suggest use of flood storage for purposes other than flood storage (e.g., WM52 and FRM5) were not considered. Thus the management measure to raise Lake Lanier 2 ft to a conservation pool elevation of 1,073 ft was eliminated from further consideration. As described in Appendix D, USACE's authority to consider raising the pool at Lake Lanier would reduce the available flood storage and require a reallocation of that storage to some other purpose. USACE is not exercising that discretionary authority as part of this Master Manual update. The update is being conducted to determine how the federal projects in the ACF Basin should be operated for their authorized purposes, in light of current conditions and applicable law.

Flood risk management at West Point Lake is an authorized purpose. Some stakeholders suggested managing the reservoir for recreation rather than flood risk management or maintaining a constant pool level of 632.5 ft year-round (e.g., FRM2 and FRM4). This suggestion is not consistent with the screening criteria that any alternative considered by USACE should not increase flood risk above the current level. Additionally, managing West Point Lake for recreation or maintaining a constant pool level would essentially ignore a congressionally authorized purpose. It is not the purpose of this EIS to investigate the feasibility of eliminating or reducing the level of flood protection afforded downstream communities by West Point Lake.

Measures suggesting studies to determine the allocation of water among Alabama, Florida, and Georgia (e.g., WM17 and DS15) were also not carried forward for further consideration. USACE acknowledges that the states are in longstanding disagreement regarding the allocation of waters in the ACF Basin. While USACE would, within the limits of applicable law and authority, seek to incorporate any tri-state agreement into its operation of federal projects in the ACF Basin, the allocation of waters among the states is not within USACE's authority. Meanwhile, USACE intends to implement updated water control plans and manuals for ACF Basin federal projects, in compliance with all applicable law.

USACE also did not carry forward management measures that change minimum releases (for other than threatened and endangered species) or minimum flows to ensure that other entities meet their federal compliance requirements in the future (e.g., WM15, WM16, WM18, WM19, WM59, and WM60; NEPA17; BR15; and HP9). USACE recognizes existing minimum flow requirements of various entities within the ACF Basin, but authorized project purposes of federal projects do not include operating to meet requirements for which other parties are responsible. The use of West Point Dam releases to ensure that the GPC complies with its Federal Energy Regulatory Commission license is an example of a recommendation that was not carried forward. Management measures to ensure discharges by municipalities and industries comply with the Water Pollution Act of 1972 as amended are also not within USACE authority. States have the regulatory authority to ensure that discharges to surface water meet permitted standards. Setting minimum flow targets to ensure compliance with water quality standards is the responsibility of the states, not USACE.

[5] See section 1.4.4 and Table 1.4-2 for an explanation of the identifiers for scoping comments/suggestions detailed in Appendix D.

The difference in the water level behind a dam and in the tailrace of the dam is critical in water management. This difference is referred to as "head" in hydrologic modeling. Changes to the existing head at dams in the ACF Basin could increase the risk to the structural integrity of the projects. Therefore, measures that would potentially change the existing head limits for projects in the ACF Basin (e.g., WM52 and FRM5) were eliminated from further consideration.

Management measures that suggest structural modifications to the ACF project or other USACE projects do not meet the purpose and need to determine how the existing federal projects in the ACF Basin should be operated for their authorized purposes, in light of current conditions and applicable law. Accordingly, suggestions to repair and reverse channel degradation in the Apalachicola River (e.g., WM44); to halt or limit the current diversion of fresh water caused by the Chipola Cutoff (e.g., WM45); to build another dam within Lake Lanier at or near Browns Bridge (e.g., WM57); to build a large lake on the Flint River (e.g., WM65); or to close or install a lock at Sikes Cut (e.g., WM66 and NEPA15) were not carried forward for further consideration. Separate authorities that might be pursued to address some of those issues include section 216 of the River and Harbor and Flood Control Act of 1970 (Review of Completed Projects); section 1135 of Water Resources Development Act (WRDA) 1986, as amended (Project Modifications for Improvement of the Environment); and section 206 of WRDA 1996, as amended (Small Aquatic Ecosystem Restoration Projects). The latter two authorities have specific limits on federal funds that can be expended on each project ($10 million).

4.1.2 Water Management Measures Considered for Further Evaluation (First Screening)

Only management measures that passed the screening criteria presented in section 1.4.4 (first screening) were considered in updating the Master WCM. Each measure was considered individually and refined iteratively as described above. The following categories of measures are described in more detail in the subsections that follow:

- Guide Curves
- Action Zones
- Drought Zone Revisions
- Minimum Flows at Peachtree Creek
- Hydroelectric Power Generation
- Navigation
- Basin Inflow
- Fish and Wildlife Conservation
- Water Supply

4.1.2.1 Guide Curves

USACE considered maintaining the existing guide curves as well as redefining guide curves at West Point Lake and Walter F. George Lake.

Existing guide curves are shown in the WCMs for the Buford Dam (1991), West Point Dam (1984), Walter F. George Lock and Dam (1993), George W. Andrews Lock and Dam (1996), and Jim Woodruff Lock and Dam (1985) projects. The guide curves for Lanier, West Point, and Walter F. George lakes are shown in Figures 2.1-22, 2.1-28, and 2.1-33.

Measures to modify guide curves (which would modify the summer pool duration) at West Point Lake and Walter F. George Lake were considered in partial response to stakeholder comments. Consideration for this measure was given to adjusting the timing of refill and drawdown periods between winter and

summer pool (guide curve shoulders). The initial variations considered to adjust shoulders at West Point Lake are shown in Figure 4.1-3.

At Walter F. George Lake, guide curve modifications also included lowering the summer pool level to minimize the static head limitations. There is a 2-ft fluctuation between the winter level of 188 ft and summer pool of 190 ft which is equivalent to 87,300 ac-ft of storage. Two factors play into the variability in pool elevation between the summer and winter level at Walter F. George Lake.

- Walter F. George Lake is the furthest downstream storage project and the first project to make releases in support of needs at Jim Woodruff Dam and the Apalachicola River.
- The limited flood storage requires rapid response to high flow conditions and results in abrupt changes in storage.

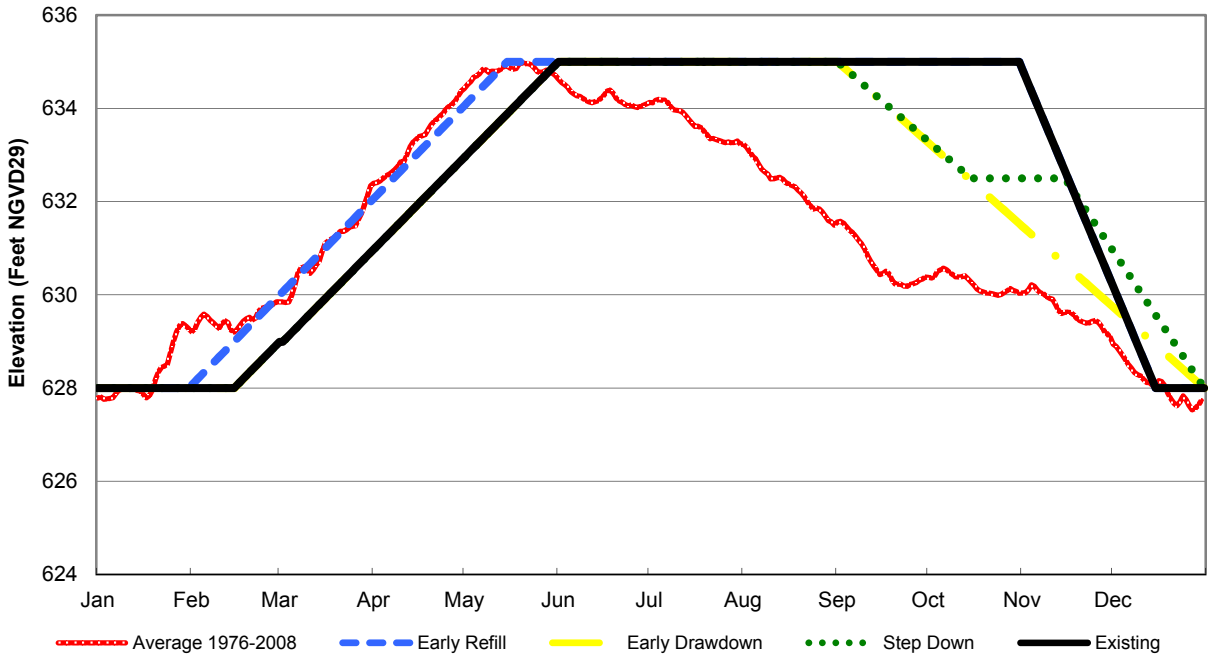

Figure 4.1-3. West Point Lake Guide Curve Options

Figure 4.1-4 displays the options considered including the existing, or no action, condition.

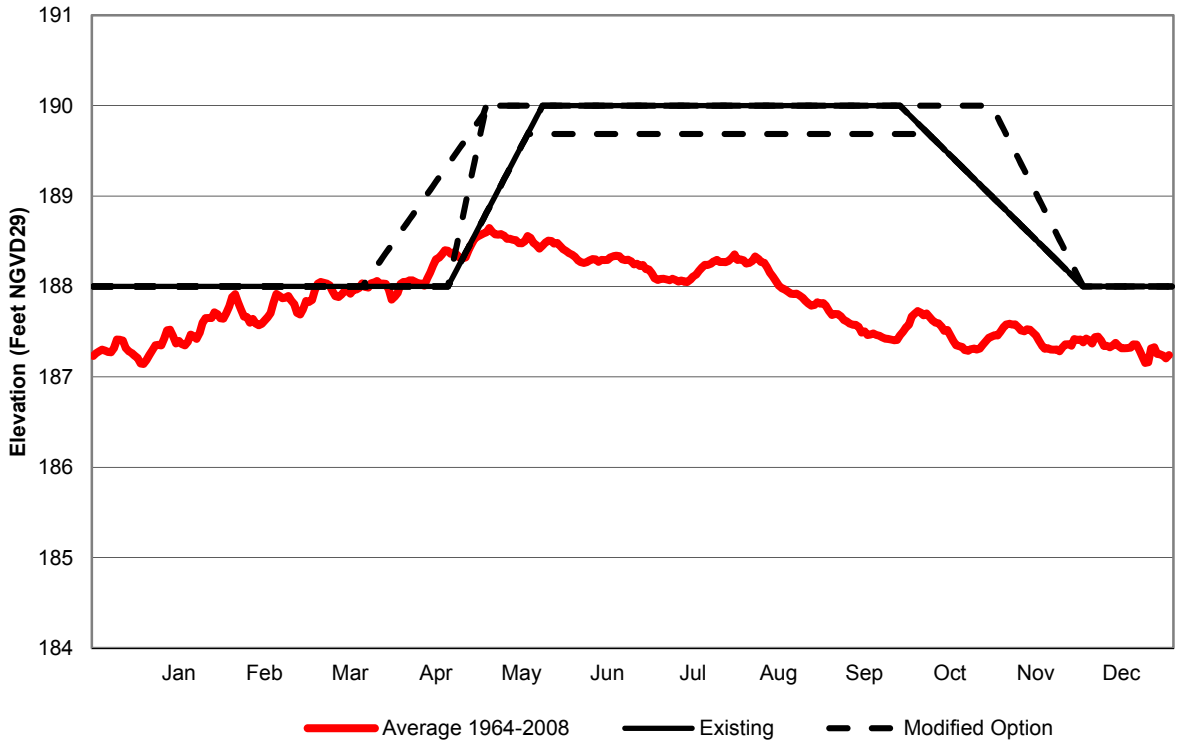

Figure 4.1-4. Walter F. George Lake Guide Curve Options

4.1.2.2 Action Zones

4.1.2.2.1 Maintain Existing Action Zones

The *1989 draft ACF Water Control Plan* (USACE, Mobile District 1989) defines action zones for each of the three major storage projects on the ACF Basin—Lake Lanier (Figure 2.1-22), West Point Lake (Figure 2.1-28), and Walter F. George Lake (Figure 2.1-33). Those zones are used to manage the reservoirs at the highest level possible while balancing the needs of all the authorized purposes. Zone 1, the highest in each reservoir, defines a reservoir condition where all authorized project purposes should be met. As lake levels decline, Zones 2 through 4 define increasingly critical system water shortages and guide USACE in reducing flow releases resulting from drier-than-normal or drought conditions. The action zones also provide guidance on meeting minimum hydroelectric power generation needs at each project, and they determine the amount of storage available for downstream purposes such as flood risk management, hydroelectric power generation, navigation, fish and wildlife conservation, recreation, water quality, and water supply.

At the time of their development in 1989, action zones were derived on the basis of past project operations, which considered time of year, historical pool level/release relationships, operational limits for conservation, and recreational resource impact levels. The action zones have provided a key management tool for more than 20 years, providing the basic guidelines for operating the river system; however, other factors and activities might cause USACE to operate the reservoirs differently than the zones shown on the charts. Examples of those factors or activities could include exceptional flood risk management measures, fish spawn operations, maintenance and repair of turbines, emergency situations such as a drowning and chemical spills, draw-downs because of shoreline maintenance, and releases made to free grounded barges.

The storage projects are operated to maintain their lake level in the same zones concurrently. However, because of the hydrologic and physical characteristics of the river system and factors mentioned above, there might be periods when one reservoir is in a higher or lower zone than another. When that occurs, USACE makes an effort to bring the reservoirs back into balance with each other as soon as conditions allow. By doing so, effects on the river basin are shared equitably among the projects. The following definitions apply to the action zones:

- Zone 1: Indicates that releases can be made in support of seasonal navigation (when the channel has been adequately maintained) and hydroelectric power releases. If all reservoirs are in Zone 1, USACE would operate the river system normally.
- Zone 2: Indicates that water to support seasonal navigation might be limited. Hydroelectric power generation is supported at a reduced level. Minimum flows are met.
- Zone 3: Indicates that water to support seasonal navigation might be significantly limited. Hydroelectric power generation is supported at a reduced level. Minimum flows are met.
- Zone 4: Indicates that navigation is not supported. Hydroelectric power demands will be met at minimum levels and might occur only for concurrent uses. Minimum flows are met.

4.1.2.2.2 Modified Action Zones at Lanier, West Point, and Walter F. George Lakes

In modifying existing action zones, USACE reviewed changing summer and winter pool levels and the proportionality of fill and drawdown relative to each zone at storage projects—Lake Lanier, West Point Lake, and Walter F. George Lake.

- Summer levels—USACE considered the refill capability of each storage project. Because of their larger drainage areas, West Point and Walter F. George lakes are more likely to refill each year than Lake Lanier. Consequently, a greater percentage of Lake Lanier's conservation storage contributes to the lower composite conservation storage zones (e.g., Lake Lanier's Zones 3 and 4 compose the bulk of composite conservation storage in Zones 3 and 4).
- Winter levels—USACE considered tying action zones to recreation effects and hazard levels.
- Proportional fill and drawdown—Lower reservoirs in the basin have less storage volume; however, because of the basin hydrology, the lower reservoirs also have a larger drainage area and, therefore, refill more quickly than reservoirs located in the upper portion of the basin. USACE compared individual project conservation storage contributions to the composite conservation storage zones on the basis of a project's drainage area contribution. Reflecting hydrology, USACE relies on using storage first from the lower projects during normal and incipient drought conditions.

Table 2.1-3 presents the drainage areas at Lake Lanier, West Point Lake, and Walter F. George Lake and their respective conservation storage capacities.

Two modified action zone measures were considered in formulating water management alternatives as described below.

4.1.2.2.2.1 Watershed proportional action zones (Level 1)

In recognition of experience in operating the basin, USACE explored the feasibility of adjusting the size of the action zones at Lake Lanier, West Point Lake, and Walter F. George Lake. The changes in action zones were based on the proportion of reservoir storage to the relative size of the contributing watershed at each project (as depicted in Table 2.1-3). In refining the action zones, USACE reviewed the option of changing the timing of the following:

- Transitioning from summer to winter pool levels
- The proportionality of fill and drawdown relative to each zone during the summer period
- The refill capability of each storage project

The winter levels of the action zones are tied to recreation impact and hazard levels for all three reservoirs with a 0.5 ft buffer. In considering action zone summer period revisions, USACE took into account that West Point and Walter F. George lakes are more likely to refill each year than Lake Lanier because of reservoir inflow and precipitation. The contributing watershed area to West Point and Walter F. George lakes is greater than at Lake Lanier. Annual precipitation is also greater in more southerly portions of the ACF Basin. Consequently, because the conservation storage at Lake Lanier is greater, a greater percentage of Lake Lanier's conservation storage contributes to storage in West Point and Walter F. George lakes. That is especially true when basinwide storage is in the lower composite zone.

Proportional sizing of action zones 1 and 2 summer period at each project was based on the size of the project's contributing watershed. This works well for zones 1 and 2 and to a certain extent for Zone 3. In composite storage Zone 4, however, the system is under stress and Lake Lanier contributes 78 percent of the system storage to composite Zone 4, reserving the bulk of the storage for drought operations support to the largest headwater project, which also has the smallest drainage area. The elevation range difference in zones 1 and 2 remained about the same for West Point and Walter F. George lakes, 2.5 ft and 0.5 ft, respectively (Table 4.1-1). However, this approach to sizing the action zones led to a narrowing of zones 1, 2, and 3 at Lake Lanier to 0.75, 0.15, and 0.4 ft per zone, respectively, for summer pools levels, compared to zone level increments of 3.0, 1.0, and 2.0, respectively, under current operations (Figure 4.1-5). Such a narrowing of the action zone intervals results from the disproportionately large storage volume in Lake Lanier compared to the relatively small contributing watershed above Buford Dam (Table 4.1-1). This set of potential action zones for the projects, proportionally sized based on contributing watershed size, are called Level 1 action zones for purposes of this analysis.

Table 4.1-1.
Level 1 Action Zones in Feet on June 1

	Lake Lanier	West Point Lake	Walter F. George Lake
Top of Zone 1	1,071	635	190
Top of Zone 2	1,070.25	632.5	187.5
Top of Zone 3	1,070.1	632	187
Top of Zone 4	1,069.7	631	186.3

A linear foot-for-foot drawdown relationship was created between West Point Lake and Walter F. George Lake for the upper action zones. This concept supports using storage from the lower projects first, during normal and initial drought conditions. During severe droughts, Lake Lanier will support the majority of the system demands. The lower action zone elevations at West Point and Walter F. George lakes were not changed to reflect a linear drawdown relationship.

Figure 4.1-6 shows the Level 1 summer pool comparison of drainage area, storage contributions, and elevation ranges for Lanier, West Point, and Walter F. George lakes for the four action zones.

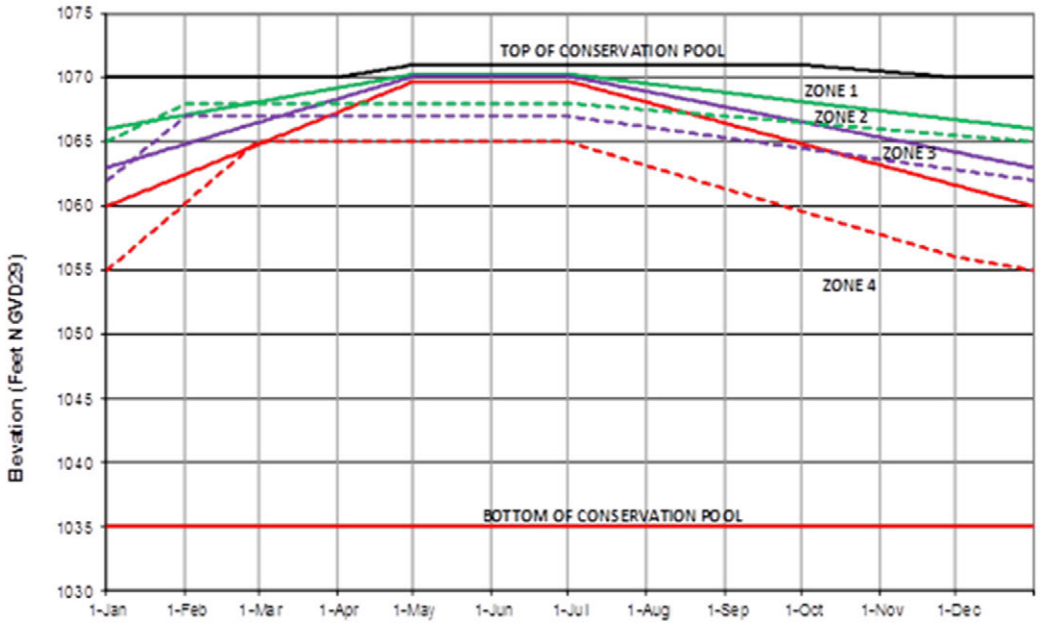

Figure 4.1-5. Lake Lanier Level 1 Action Zones

Action Zones, Summer Pool Storage Comparison

Buford Alternative B | % of Drainage Area Comparison

1-Jun	Buford	West Pt	George	Buford2	West Pt3	George4	Total
	elev	elev	elev	dsf	dsf	dsf	dsf
Top1	1071.00	635.0	190.0	985747	304782	471093	
Bott1	1070.25	632.5	187.5	971302	273478	416593	
Diff.	0.75	2.5	2.5	14444	31304	54500	100249
				14.41%	31.23%	54.37%	% Zone 1
				14.19%	30.15%	55.66%	% drainage area

The zone and drainage area contributions are similar

Elevation range same for West Point & WF George

1-Jun	Buford	West Pt	George	Buford	West Pt	George	Total
	elev	elev	elev	dsf	dsf	dsf	dsf
Top2	1070.25	632.5	187.5	971302	273478	416593	
Bott2	1070.10	632.0	187.0	968413	267453	406106	
Diff.	0.15	0.5	0.5	2889	6025	10487	19401
				14.89%	31.06%	54.05%	% Zone 2
				14.19%	30.15%	55.66%	% drainage area

The zone and drainage area contributions are similar

Elevation range same for West Point & WF George

1-Jun	Buford	West Pt	George	Buford	West Pt	George	Total
	elev	elev	elev	dsf	dsf	dsf	dsf
Top3	1070.10	632.0	187.0	968413	267453	406106	
Bott3	1069.70	631.0	186.3	960770	255784	392025	
Diff.	0.40	1.0	0.7	7643	11669	14081	33393
				22.89%	34.94%	42.17%	% Zone 3
				14.19%	30.15%	55.66%	% drainage area

1-Jun	Buford	West Pt	George	Buford	West Pt	George	Total
	elev	elev	elev	dsf	dsf	dsf	dsf
Top4	1069.7	631	186.3	960770	255784	392025	
Bott4	1035.0	620	184	437415	150441	347875	
Diff.	34.7	11.0	2.3	523355	105343	44150	672848
				77.78%	15.66%	6.56%	% Zone 4
				14.19%	30.15%	55.66%	% drainage area

Figure 4.1-6. Level 1 Action Zones for Buford, West Point, and Walter F. George Dams

4.1.2.2.2.2 Revised Level 1 action zones

The Level 1 action zones were refined to better achieve the objective to define action zones on a scientific basis that eliminates disproportionate impact on reservoirs and addresses current system needs. At Lake Lanier, the summer period for zones 1, 2, and 3 was expanded to reflect proportionality of contributing watershed size and historic operations to meet system demands (Table 4.1-2). A comparison of the Lake Lanier summer zone elevations for current, Level 1, and Revised Level 1 options is shown in Table 4.1-3. The action zones reflected by Figure 4.1-7 achieve a more equitable balance between action zone sizing based on the project's watershed size and because they provide a proportionately balanced drawdown among the projects when operating in Zone 1. As the action zones were refined, generally they were revised upward in the winter months at Lake Lanier and at West Point Lake and downward in the summer months at Walter F. George Lake, as reflected in Figure 4.1-7, Figure 4.1-8, and Figure 4.1-9, respectively. The new zones fulfill the objectives of putting the greater burden of the system demands on the lower two reservoirs when in the upper action zones and on Lake Lanier when the system reaches drought operation.

Table 4.1-2.
Revised Level 1 Action Zones in Feet on June 1

	Lake Lanier	West Point Lake	Walter F. George Lake
Top of Zone 1	1,071	635	190
Top of Zone 2	1,068	632.5	187.5
Top of Zone 3	1,066.5	632	187
Top of Zone 4	1,065	631	186.3

Table 4.1-3.
Lake Lanier Action Zone in Feet on June 1

	No Action (Current)	Level 1	Revised Level 1
Top of Zone 1	1,071	1071.00	1,071
Top of Zone 2	1,068	1070.25	1,068
Top of Zone 3	1,067	1070.10	1,066.5
Top of Zone 4	1,065	1069.70	1,065

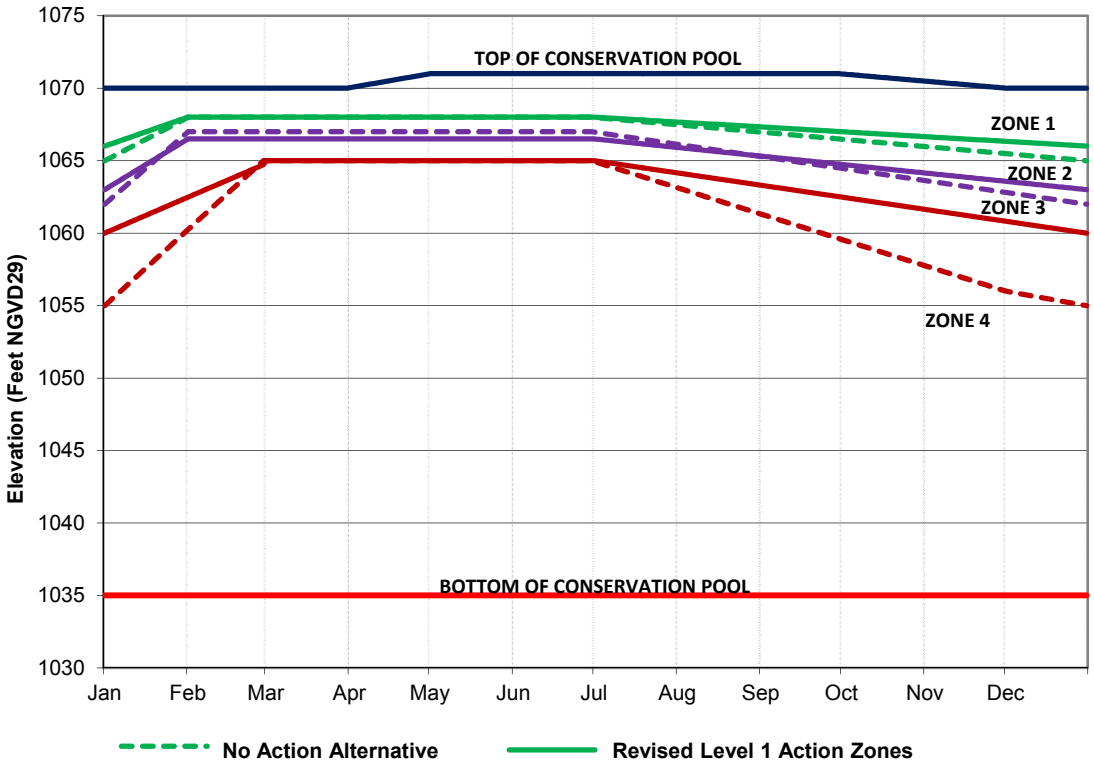

Figure 4.1-7. Lake Lanier Water Control Action Zones

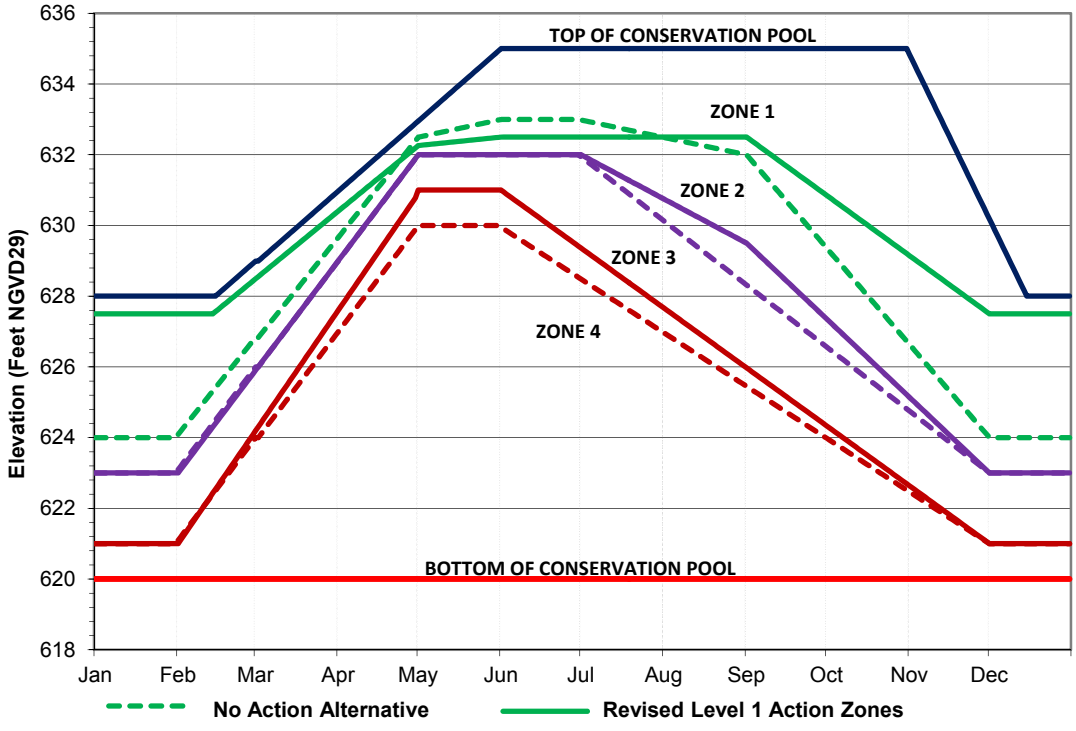

Figure 4.1-8. West Point Lake Water Control Action Zones

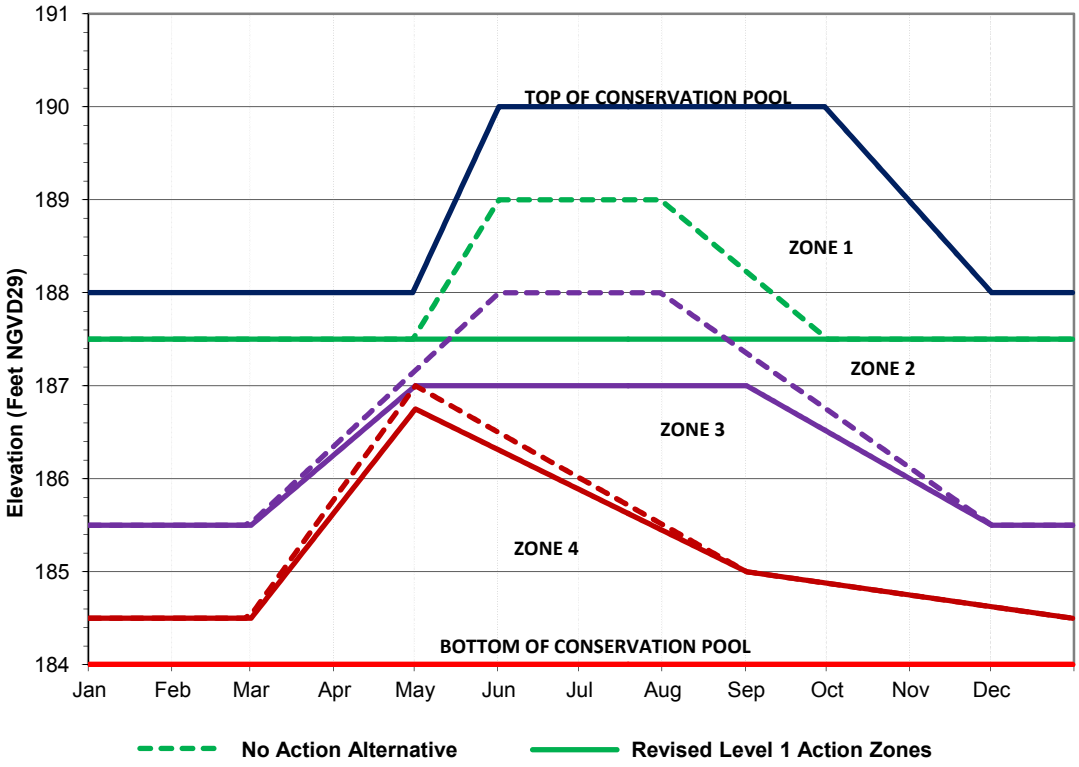

Figure 4.1-9. Walter F. George Lake Water Control Action Zones

4.1.2.3 Drought Operations

The current drought plan specifies a minimum release from Jim Woodruff Dam and temporarily suspends the other minimum release and maximum fall rate provisions of the May 2012 RIOP until composite conservation storage (see Figure 2.1-40) within the basin is replenished to a level that can support them. The definition of composite conservation storage and its role in the implementation of drought operations is provided in the more detailed discussion of the RIOP in section 2.1.1.2.4.4. Under the drought plan, the minimum discharge is determined in relation to composite conservation storage and not average basin inflow. The drought plan is "triggered" when composite conservation storage falls below the bottom of Zone 3 into Zone 4. At that time, all the composite conservation storage Zone 1-3 provisions (i.e., seasonal storage limitations, maximum fall rate schedule, and minimum flow thresholds) are suspended and management decisions are based on the provisions of the drought plan. The drought plan includes a temporary waiver from the existing WCM to allow temporary storage above the winter pool guide curve at the Walter F. George and West Point projects if the opportunity presents itself and/or to begin spring refill operations at an earlier date in order to provide additional conservation storage for future needs. It also provides for minimum releases less than 5,000 cfs from Jim Woodruff Dam.

The drought plan prescribes two minimum releases based on composite conservation storage in Zone 4 and an additional zone referred to as the "Drought Zone" (Figure 2.1-40). The Drought Zone delineates a volume of water roughly equivalent to the inactive storage in Lake Lanier, West Point Lake, and Walter F. George Lake plus Zone 4 storage in Lake Lanier. However, the Drought Zone line has been adjusted to include a smaller volume of water at the beginning and end of the calendar year. When the composite conservation storage is within Zone 4 and above the Drought Zone, the minimum release from Jim Woodruff Dam is 5,000 cfs and all basin inflow above 5,000 cfs that is capable of being stored may be stored. Once the composite conservation storage falls below the Drought Zone, the minimum release from

Jim Woodruff Dam is 4,500 cfs and all basin inflow above 4,500 cfs that is capable of being stored may be stored. When transitioning from a minimum release of 5,000 cfs to 4,500 cfs, maximum fall rates will be limited to a 0.25 ft/day drop. The 4,500 cfs minimum release is maintained until composite conservation storage returns to a level above the top of the Drought Zone, at which time the 5,000 cfs minimum release is reinstated. Under the current May 2012 RIOP, the drought plan provisions remain in place until conditions improve to the point at which the composite conservation storage reaches a level above the top of Zone 2 (i.e., within Zone 1). If recovery conditions are achieved in February, drought plan provisions will not be suspended until March, provided composite conservation storage remains above Zone 4. At that time, the temporary drought plan provisions will be suspended, and all the other provisions will be reinstated. During the drought contingency operations, a monthly monitoring plan that tracks composite conservation storage to determine water management operations will be implemented to determine which operational triggers are applied (the first day of each month will represent a decision point). In addition, recent climatic and hydrological conditions experienced and meteorological forecasts will be used to determine the set of operations to utilize in the upcoming month.

4.1.2.3.1 Extreme Drought Operations

When the remaining composite conservation storage is about 10 percent of the total capacity, additional emergency actions might be necessary. When conditions have worsened to that extent, use of the inactive storage must be considered. For example, such an occurrence could be contemplated in the second or third year of a drought. Inactive storage zones have been designated for the three federal projects with significant storage. The operational concept established for the extreme drought impact level and to be implemented when instituting the use of inactive storage is based on the following actions:

- Inactive storage availability will be identified to meet specific critical water use needs within existing project authorizations.
- Emergency uses will be identified in accordance with emergency authorizations and through stakeholder coordination. Typical critical water use needs within the basin are associated with public health and safety.
- Weekly projections of the inactive storage water availability to meet the critical water uses from Buford Dam downstream to the Apalachicola River will be used when making water control decisions regarding withdrawals and water releases from USACE reservoirs.
- The inactive storage action zones will be instituted as triggers to meet the identified priority water uses (releases will be restricted as storage decreases).
- Dam safety considerations will always remain the highest priority. The structural integrity of the dams due to static head limitations (i.e., Jim Woodruff at 38.5 ft; George W. Andrews at 26 ft; and Walter F. George at 88 ft) will be maintained.
- Once the composite conservation storage falls below the Drought Zone into the inactive storage, the minimum release from Jim Woodruff Dam is 4,500 cfs, and all basin inflow above 4,500 cfs that is capable of being stored may be stored. When transitioning from a minimum release of 5,000 cfs to 4,500 cfs, fall rates will be limited to a drop of 0.25 ft/day. The 4,500 cfs minimum release is maintained until composite conservation storage returns to a level above the top of the Drought Zone, at which time the 5,000 cfs minimum release is reinstated.

4.1.2.3.2 Drought Plan Revisions

Two potential revisions to the drought plan were considered and are described in the following sections.

4.1.2.3.2.1 Revised drought operations trigger

This measure would revise the "trigger" for initiating the drought plan. As described above, the May 2012 RIOP provides that the drought plan is "triggered" when composite conservation storage falls below the bottom of Zone 3 into Zone 4. The "revised drought operations trigger" measure provides that the drought plan be "triggered" when composite conservation storage falls below the bottom of Zone 2 into Zone 3.

4.1.2.3.2.2 Revised drought operations suspension trigger

As noted in section 4.1.2.3, the May 2012 RIOP provides that the drought plan provisions remain in place until conditions improve to the point at which the composite conservation storage reaches a level above the top of Zone 2 (i.e., within Zone 1). The "revised drought operations suspension trigger" measure would specify that the drought plan provisions remain in place until conditions improve to the point at which the composite conservation storage reaches a level above the top of Zone 4 (i.e., within Zone 3). If recovery conditions are not achieved in February, drought plan provisions will not be suspended until April, provided composite conservation storage remains above Zone 4.

4.1.2.4 Minimum Flows at Peachtree Creek

Three measures have been considered regarding minimum flows at Peachtree Creek and are described in subsequent sections.

4.1.2.4.1 Current Minimum Flow (750 cfs at Peachtree Creek)

This measure involves continuing to make releases from Buford Dam in accordance with the CRMS as described in the *Apalachicola Basin Reservoir Regulation Manual*, Appendix B, Buford Dam (Lake Sidney Lanier) Chattahoochee River, GA, February 1991, which calls for discharges from Buford Dam sufficient to allow for downstream water supply withdrawals and to ensure a continuous net minimum flow of 750 cfs at Peachtree Creek for water quality purposes. USACE currently makes releases from Buford Dam to provide sufficient flows for water quality at Peachtree Creek, accounting for water supply withdrawals between Buford Dam and Peachtree Creek, pursuant to the CRMS. In accordance with the CRMS, GAEPD and the water supply providers manage discharges and withdrawals downstream of Buford Dam to ensure that a minimum flow of 750 cfs at Peachtree Creek is maintained.

4.1.2.4.2 Revised Minimum Flow (750 cfs [May–October]/650 cfs [November–April] at Peachtree Creek)

GAEPD, which manages Clean Water Act compliance for the state of Georgia, has requested on occasion that USACE consider seasonal varying flow. USACE analysis concluded that 650 cfs during November through April is a reasonable flow during the cooler months, to which GAEPD agreed. This measure is similar to the current minimum flow measure, except that GAEPD and the water supply providers would manage discharges and withdrawals downstream of Buford Dam to ensure that a minimum flow of 750 cfs at Peachtree Creek is maintained from May–October and 650 cfs November–April.

4.1.2.4.3 Varying Monthly Flow

This measure specifies a minimum flow at Peachtree Creek for each month of the year that varies depending on reservoir composite conservation storage zone. These minimum flows are shown in Table 4.1-4.

Table 4.1-4.
Minimum Flows for Chattahoochee River at Peachtree Creek

Month	Zone 1	Zone 2	Zone 3	Zone 4
January	1,910	750	650	650
February	2,270	1,170	650	650
March	2,470	1,390	750	650
April	2,400	1,470	750	650
May	2,130	750	750	650
June	1,610	750	750	650
July	1,330	750	750	650
August	1,220	750	750	650
September	1,010	750	650	650
October	1,020	750	650	650
November	1,200	750	650	650
December	1,410	750	650	650

4.1.2.5 Hydroelectric Power Generation

Four specific measures were considered for operations of hydroelectric power generation:

- Current schedule at Buford Dam
- Modified schedule at Buford Dam
- Hydroelectric power drought operations
- Modified schedule at Buford Dam with hydroelectric power drought operations

4.1.2.5.1 Current Schedule

The Buford, West Point, and Walter F. George projects are operated as "peaking" plants and provide electricity during the peak demand periods of each day and week. Typically, those projects provide a minimum of 2 hours of generation a day for 5 days a week at plant capacity throughout the year, as long as their respective lake levels are in the conservation pool. During dry periods, as the lake levels drop below Zone 1, hydroelectric power generation is reduced proportionally as pool levels decline to as low as 2 hours per day generation at each peaking plant project during extreme low flow conditions. Peak generation could be eliminated or limited to conjunctive releases during severe drought conditions. The typical hours of operation by action zone are presented in Table 4.1-5.

In addition to hydroelectric power generation being governed by action zone, physical limitations also factor into the power generation decisions. The main hydroelectric power generation units and small house unit intakes at Buford Dam are at elevation 919 ft. However, severe cavitation occurs in the main hydroelectric power generation units when the water surface falls to 1,035 ft or below, at which time the units are taken out of service and generation ceases. The small house unit goes off-line when water elevations reach 1,020 ft or lower. With this measure, the current hydroelectric power generation schedule would be maintained.

Table 4.1-5.
Typical Hours of Peaking Hydroelectric Power Generation by Federal Project

Action zone	Buford Dam (hours of operation)	West Point Dam (hours of operation)	Walter F. George Dam (hours of operation)
Zone 1	3	4	4
Zone 2	2	2	2
Zone 3	2	2	2
Zone 4	0	0	0

4.1.2.5.2 Modified Schedule at Buford, West Point, and Walter F. George Dams

USACE considered varying the amount of generation it would plan to provide for each action zone at each project. For instance, rather than have a fixed generation schedule as shown in Table 4.1-5, USACE examined the viability of a variable schedule (e.g., 0 to 4 hours would be made available when in Zone 1).

4.1.2.5.3 Hydroelectric Power Drought Operations

Similarly, USACE considered reducing the amount of generation that would be made available when operating under drought protocols. Conservation storage at Lake Lanier is much more sensitive to hydroelectric power generation operations because of the small drainage area upstream of Buford Dam from which the reservoir is refilled, particularly under drought conditions. The modified generation schedule, especially at Lake Lanier, would provide greater operational flexibility to meet power demands in the system while conserving storage as variable climate conditions might dictate.

4.1.2.5.4 Modified Schedule with Hydroelectric Power Drought Operations

This measure combines the measures described in sections 4.1.2.5.2 and 4.1.2.5.3 by modifying the general hydroelectric power generation schedule for Buford, West Point, and Walter F. George Dams to call for a more flexible generation schedule in all action zones under nondrought conditions and a more constrained generation schedule under drier conditions. The typical hours represent releases that normally meet water system demands and provide the capacity specified in power marketing arrangements. During dry periods, generation could be eliminated or limited to conjunctive releases. Table 4.1-6 depicts the proposed modifications where more or less power generation could occur.

Table 4.1-6.
Typical Hours of Peaking Hydroelectric Power Generation by Federal Project

Action zone	Buford Dam (hours of operation) normal ops/drought ops	West Point Dam (hours of operation)	Walter F. George Dam (hours of operation)
Zone 1	3/2	4	4
Zone 2	2/1	2	2
Zone 3	2/1	2	2
Zone 4*	0	0	0

*While hydropower would still be generated in Zone 4, it could not be generated on a regular peaking schedule under severe drought conditions

4.1.2.6 Navigation

The existing project authorizes a 9-ft-deep by 100-ft-wide waterway from Apalachicola, Florida, to Columbus, Georgia, on the Chattahoochee River, and to Bainbridge, Georgia, on the Flint River. Historically, it has been difficult for USACE to provide reliable navigation on the ACF system even with dredging. USACE has not dredged on the Apalachicola River since 2001 for a multitude of reasons, including Florida's denial of water quality certification for dredging in 2005. Limited dredging occurred on the Chattahoochee River between Lake Seminole and Columbus, Georgia, in 2010. Anticipating that such conditions and restrictions will not change in the immediate future, USACE explored several options to provide the most reliable navigation season possible within the constraints of water availability and a lack of dredging. USACE used updated channel survey data, taken during 2010, for the Apalachicola River when developing management measures for navigation.

4.1.2.6.1 Current-No Navigation Operations

The lack of dredging and routine maintenance discussed in section 2.6.2.1 has led to inadequate depths in the Apalachicola River navigation channel, and commercial navigation is possible only seasonally when flows in the river are naturally high, with flow support for navigation suspended during drier times of the year. Specific navigation operations occur on a case-by-case basis, with limited releases for navigation being made for special shipments when a determination can be made that other project purposes will not be significantly affected and any fluctuations in reservoir levels or river stages will be minimal. Over a period of months, the navigation industry in the ACF Basin works closely with USACE to coordinate the special shipments. Under this measure, the current operations in support of navigation would remain in effect unchanged.

4.1.2.6.2 Periodic Navigation

Measures that explored navigation opportunities at several intervals and of various durations throughout the year—conceptually a minimum 2-week period—were developed on the basis of system composite conservation storage. In developing this option, USACE also considered the different number of opportunities that might be possible allowing sufficient flows if dredging did or did not occur at channel depths of 7 ft or 9 ft.

4.1.2.6.3 Defined Navigation Seasons

Another measure considered having definite navigation seasons. Three variations were considered: December–May, January–April, and January–May. In developing this measure, USACE balanced use of storage for navigation versus the use of storage for other authorized project purposes and considered the effects on other needs and requirements in the system (e.g., hydroelectric power generation, recreation). After multiple modeling iterations and analysis, it was determined that navigation operations are feasible only when composite conservation storage is in Zone 1 or 2. That was determined by assessing how often implementation of a navigation concept would trigger drought operations and by assessing the frequency of channel availability.

4.1.2.6.4 4-month /5-month Navigation Seasons (7-ft channel)

A variation of the defined navigation season measure specifies the navigation season as 4 months in duration or, under certain conditions, 5 months. When supported by ACF Basin hydrologic conditions, this measure would provide a reliable navigation season. In so doing, the goal of the water management is to ensure a predictable minimum navigable channel in the Apalachicola River for a continuous period that is sufficient for navigation use.

Assuming basin hydrologic conditions allow, a typical navigation season would begin in January of each year and continue for 4 to 5 consecutive months (i.e., January–April or May). During the navigation season, the flows (16,200 cfs) at the Blountstown, Florida, USGS gage should be adequate to provide at least a 7-ft channel. The most recent channel survey and discharge-stage rating was used to determine the flow required to sustain a minimum navigation depth during the navigation season.

The ability to support a navigation season will depend on actual and projected systemwide conditions in the ACF Basin before and during January, February, March, April, and May. Those conditions include:

- A navigation season can be supported only when the ACF Basin composite conservation storage is in Zone 1 or Zone 2.
- A navigation season will not be supported when the ACF Basin composite conservation storage is in Zone 3 and below. Provided drought operations have not been triggered, navigation support will resume when basin composite conservation storage level recovers to Zone 1 and is forecast to remain above Zone 2 for a practicable, continuous period.
- A navigation season will not be supported when drought operations are in effect. Navigation will not be supported after drought operations have ceased until the ACF Basin composite conservation storage recovers to Zone 1.
- The determination to extend the navigation season beyond April will depend on ACF Basin inflows, recent climatic and hydrological conditions, meteorological forecasts, and basinwide model forecasts. On the basis of an analysis of those factors, USACE will determine if the navigation season will continue through part or all of May.
- Down-ramping of flow releases (regardless of period in the navigation season) will adhere to the Jim Woodruff Dam fall rate schedule for federally listed threatened and endangered species.
- Releases that augment the flows to provide for the 7-ft navigation channel will also be dependent on navigation channel conditions that ensure safe navigation.

When it becomes apparent that, because of diminishing inflows, downstream flows and depths must be reduced, navigation bulletins will be issued to project users. The notices will be issued as expeditiously as possible to give barge owners and other waterway users sufficient time to make arrangements to light load or remove their vessels before action is taken at Jim Woodruff Dam to reduce releases.

Though special releases will not be standard practice, they can occur for a short duration to assist navigation during the navigation season. For instance, releases can be requested to achieve up to a 9-ft channel. Those will be evaluated case by case, subject to applicable laws and regulations and the conditions above.

4.1.2.6.5 Year-round Navigation

A fourth measure that USACE considered is year-round navigation. This measure, suggested by a stakeholder, would require flow augmentation (i.e., releases from upstream reservoirs to supplement flows in the Apalachicola River to provide navigable depths). Flow augmentations of 1,000-cfs to 3,000 cfs were considered. Table 4.1-7 provides the rules used for making release decisions from Jim Woodruff Dam. The flow requirements to provide 7-, 8-, and 9-foot navigation depths are listed at the bottom of the table.

Table 4.1-7.
Navigation Rule from Jim Woodruff Lock and Dam

Months	Composite conservation storage Zone	Basin inflow (BI) (cfs)	Release from Jim Woodruff Lock and Dam (cfs)
March - May	Zone 1	>=34,000	=25,000
		>=min(16,000;9-ft NavQ-9-ft Augmentation)	=max(16,000+50%BI>16,000;9-ft NavQ)
		>=8-ft NavQ-8-ft Augmentation	=8-ft NavQ
		>=7-ft NavQ-7-ft Augmentation	=7-ft NavQ
		>=5,000 and <7-ft NavQ- 7-ft Augmentation	=BI
		<5,000	=5,000
	Zone 2	>=34,000	=25,000
		>=min(16,000;9-ft NavQ-9-ft Augmentation)	=max(16,000+50%BI>16,000;9-ft NavQ+50%BI>9-ft NavQ)
		>=8-ft NavQ-8-ft Augmentation	=8-ft NavQ
		>=7-ft NavQ-7-ft Augmentation	=7-ft NavQ
		>=5,000 and <7-ft NavQ- 7-ft Augmentation	=BI
		<5,000	=5,000
	Zone 3	>=39,000	=25,000
		>=9-ft NavQ-9-ft Augmentation	= 9-ft NavQ+50%BI>9-ft NavQ
		>=8-ft NavQ-8-ft Augmentation	=8-ft NavQ
		>=7-ft NavQ-7-ft Augmentation	=7-ft NavQ
		>=5,000 and <7-ft NavQ- 7-ft Augmentation	=BI
		<5,000	=5,000
Jun-Nov	Zones 1,2, and 3	>=22,000	=max(16,000;9-ft NavQ)
		>=9-ft NavQ-9-ft Augmentation	=9-ft NavQ
		>=8-ft NavQ-8-ft Augmentation	=8-ft NavQ
		>=7-ft NavQ-7-ft Augmentation	=7-ft NavQ
		>=10,000 and <7-ft NavQ- 7-ft Augmentation	=10,000 + 50% BI>10,000
		>=5,000 and <10,000	=BI
		<5,000	=5,000
Dec-Feb	Zones 1,2, and 3	>=9-ft NavQ-9-ft Augmentation	=9-ft NavQ
		>=8-ft NavQ-8-ft Augmentation	=8-ft NavQ
		>=7-ft NavQ-7-ft Augmentation	=7-ft NavQ
		<7-ft NavQ-7-ft Augmentation	=5,000
At all times	Zone 4	NA	=5,000 (store all BI>5,000)
At all times	Extreme drought trigger zone	NA	=4,500 (store all BI>4,500)*

Notes:
*Once composite conservation storage falls below the top of the USACE Extreme Drought Trigger Zone ramp down
9-ft NavQ = 18,800 cfs=BlountstownQ=20,600 cfs
8-ft NavQ = 17,400 cfs=BlountstownQ=18,300 cfs
7-ft NavQ = 16,100 cfs=BlountstownQ=16,200 cfs

4.1.2.7 Basin Inflow

Basin inflow is a parameter used in making decisions regarding releases from Jim Woodruff Dam under various circumstances. The following basin inflow measures were considered:

- Current Basin Inflow Computational Methodology
- Revised Basin Inflow Method 1
- Revised Basin Inflow Method 2

4.1.2.7.1 Current Basin Inflow Computational Methodology

Basin inflow is currently defined as the amount of water that would flow by Jim Woodruff Dam during a given time period if all of the USACE reservoirs maintained a constant water surface elevation during that period. Basin inflow is not the natural or "unimpaired" flow of the basin at the site of Jim Woodruff Dam, because it reflects the influences of reservoir evaporative losses, inter-basin water transfers, and consumptive water uses (e.g., municipal and industrial water supply and agricultural irrigation). As noted in section 1.4, some stakeholders have suggested that alternative methods for computing basin inflow be considered. ACF Basin inflow is currently computed by adding the local flow into the four federal projects: Lake Sidney Lanier (Buford Dam), West Point Lake (West Point Dam), Walter F. George Lake (Walter F. George Lock and Dam), and Lake Seminole (Jim Woodruff Lock and Dam):

ACF Basin Inflow = Buford Local Flow + West Point Local Flow + Walter F. George Local Flow + Jim Woodruff Local Flow

Local Flow = Computed Inflow – Upstream Dam Discharge

Computed Inflow = Dam Discharge + Change in Reservoir Storage

Buford Local Flow *i* = Buford Computed Inflow *i*

West Point Local Flow i = West Point Computed Inflow *i* – Buford Discharge *i*-3

Walter F. George Local Flow *i* = Walter F. George Computed Inflow *i* – West Point Discharge *i*-2

Jim Woodruff Local Flow *i* = Jim Woodruff Computed Inflow *i* – Walter F. George Discharge *i*-1

Where *i* is the current daily time step.

4.1.2.7.2 Revised Basin Inflow Method 1

"Revised basin inflow"—or "RBI"—is an alternative method of calculating basin inflow suggested by a stakeholder that adds depletions to basin inflow as described in section 4.1.2.7.1. RBI is not true basin inflow, but is intended to estimate inflow that would have resulted in the absence of reservoirs and withdrawals for M&I and agricultural water supply demands. According to the revised method:

Real-time RBI = Real-time net-BI + typical* dry, normal, or wet year M&I demands, Agricultural demands, and evaporation losses for the given month

* Typical demands and evaporation losses would be based on the most current summary of demands, similar to Table 4.1-8.

For modeling purposes, each year in the 1939–2012 period of record has been characterized as dry, normal, or wet, as shown in Table 4.1-9, consistent with the methodology developed by the technical team representatives from USACE and the three states as part of the ACT/ACF Comprehensive Study.

Table 4.1-8.
Summary of Depletions (cfs) To Basin Inflow Upstream of Jim Woodruff Dam Used in Revised Basin Inflow—Method 1

	Municipal and industrial				Agriculture				Reservoir evaporation				Total			
	Dry	Normal	Wet	All Years	Dry	Normal	Wet	All Years	Dry	Normal	Wet	All Years	Dry	Normal	Wet	All Years
Jan	334	300	331	312	1	1	0	1	-183	-279	-415	-273	152	22	-85	40
Feb	302	263	295	276	23	3	0	7	-78	-159	-168	-141	246	107	127	142
Mar	345	254	257	276	94	41	31	53	153	-39	-197	-12	592	257	92	316
Apr	453	332	317	359	212	103	83	126	567	389	194	408	1231	825	594	883
May	615	457	340	480	586	344	292	395	672	573	338	569	1873	1374	970	1444
Jun	715	494	406	536	793	439	368	514	666	485	329	509	2173	1419	1104	1559
Jul	700	525	382	550	903	587	506	651	477	387	-61	356	2080	1499	827	1557
Aug	710	532	429	562	955	578	486	658	484	409	321	416	2149	1519	1236	1634
Sep	592	500	485	520	672	328	259	401	418	358	478	386	1682	1186	1222	1307
Oct	552	466	461	486	251	130	105	156	316	315	265	310	1119	912	831	951
Nov	435	378	388	392	192	90	70	112	33	-128	66	-67	660	339	525	437
Dec	399	337	358	354	168	79	62	98	-130	-186	-63	-158	437	230	356	293
Avg	514	404	371	426	406	228	180	266	284	179	91	193	1204	811	652	885

Source: USFWS Biological Opinion May 22, 2012—Table 3.2.1.A.

Table 4.1-9.
Types of Years for Purposes of Computing Revised Basin Inflow—Method 1

Year	Type*	Year	Type*	Year	Type*	Year	Type*
1939	N	1958	W	1977	N	1996	N
1940	N	1959	N	1978	N	1997	N
1941	D	1960	N	1979	N	1998	N
1942	N	1961	N	1980	N	1999	D
1943	N	1962	N	1981	D	2000	D
1944	W	1963	N	1982	N	2001	N
1945	N	1964	W	1983	N	2002	N
1946	W	1965	W	1984	N	2003	W
1947	W	1966	N	1985	N	2004	N
1948	W	1967	N	1986	D	2005	N
1949	W	1968	D	1987	N	2006	D
1950	N	1969	N	1988	D	2007	D
1951	D	1970	N	1989	N	2008	N
1952	N	1971	W	1990	D	2009	N
1953	W	1972	N	1991	W	2010	N
1954	D	1973	W	1992	N	2011	D
1955	D	1974	N	1993	N	2012	D
1956	D	1975	W	1994	W		
1957	N	1976	N	1995	N		

Notes: * W=wet year, N=normal year, D=dry year

Using this methodology in practical applications would require that demand summaries be updated frequently (every 1-2 years) as water use demands change over time and as better information about demands and depletions becomes available. Dry, normal, and wet values should be selected based on an assessment of the current climatological data and drought outlook. Periodic adjustments would be required as more information about depletions becomes available.

4.1.2.7.3 Revised Basin Inflow Method 2

This method of computing basin inflow would track observed flow in the Apalachicola River at Chattahoochee, Florida, and add considerations of storage change in Lake Lanier, West Point Lake, Walter F. George Lake, and Jim Woodruff Dam. Positive storage change represents a net increase in total composite conservation storage, and negative change represents a net decrease.

4.1.2.8 Fish and Wildlife Conservation

Management measures considered for fish and wildlife operations included current USACE operations and recommendations provided by the USFWS in the following documents:

- Planning Aid Letter dated April 2, 2010
- Addendum to the Planning Aid Letter dated March 1, 2011
- Scoping Letter date January 11, 2013
- Planning Aid Letter dated August 29, 2013

Current operations considered in developing alternatives for the updated Master Manual included the following:

- Lake and river fish spawn standard operating procedures
- Fish passage lockages at Jim Woodruff Lock and Dam
- May 2012 RIOP for federally listed threatened and endangered species

The USFWS letters included recommendations for developing alternatives and mitigation, hydrologic modeling, and methods used to evaluate the effects of USACE alternatives (USFWS 2010). Management measures considered by USACE from the USFWS letter included the following:

- Seasonally varying baseflow
- Small pulses or nonhydroelectric power peaking
- Fish passage at the George W. Andrews Lock and Dam and the Walter F. George Lock and Dam
- Manage Walter F. George Lake for the Eufaula Wildlife Refuge
- Revisions to operations for federally listed threatened and endangered species in the Apalachicola River

4.1.2.8.1 Continue Existing Reservoir and River Fish Spawn Standard Operating Procedures

This measure provides that USACE would continue to operate the federal reservoir system to support favorable conditions for annual fish spawning, both in the reservoirs and the Apalachicola River as reflected in South Atlantic DR PDS-O-1, *Project Operations, Lake Regulation and Coordination for Fish Management Purposes* (May 31, 2010), and draft USACE, Mobile District SOP 1130-2-9, *Reservoir Regulation and Coordination for Fish Spawn Management Purposes* (February 2005). In most water years (i.e., October 1 to September 30), it is impossible to hold both lake levels and river stages at a

steady or rising level for the entire spawning period, especially when upstream reservoirs or the Apalachicola River spawning periods overlap. During the fish spawning period for each water body (Table 4.1-10), USACE's goal is to operate for a generally stable or rising lake level and a generally stable or gradually declining river stage on the Apalachicola River for approximately 4 to 6 weeks during the designated spawning period. When climatic conditions preclude a favorable operation for fish spawn, USACE consults with the state fishery agencies and the USFWS on balancing needs in the system and minimizing the effects of fluctuating lake or river levels.

Table 4.1-10.
Project-Specific Principal Fish Spawning Period

Project	Fish spawn period
Lake Lanier	April 1–June 1
West Point Lake	April 1–June 1
Walter F. George Lake	March 15–May 15
Lake Seminole	March 1–May 1
Apalachicola River	April 1–June 1

4.1.2.8.2 Continue Fish Passage Lockages at Jim Woodruff Lock and Dam

In most years since March–May 2005, USACE has operated the lock at Jim Woodruff Dam to facilitate downstream-to-upstream passage of Alabama shad and other anadromous fishes (i.e., those that return from the sea to the rivers where they were born to breed). There are slight differences in the locking technique each year. In general, however, two fish locking cycles are performed each day between 8 a.m. and 4 p.m.; one in the morning and one in the afternoon. The operation consists of opening the lower lock gates and getting fish into the lock in one of three ways—by transporting them into the lock by boat (2005), by using attraction flows to entice the fish into the lock (2006–2007 and 2010–2012), and by leaving the lower gate open for a period before a lockage and allowing the fish to move in without an attraction flow (2008). No lockages were done in 2009. Once the fish are in the lock (or assumed to be in the lock), the downstream doors are closed. The lock is filled to the reservoir elevation and the upper gates are opened. Studies are ongoing to determine the most appropriate technique and timing for the locks, but the number of lock cycles per day will not change. Under this measure, the current fish passage operation would remain in effect unchanged.

4.1.2.8.3 Continue Existing Endangered Species Operations (May 2012 RIOP)

This measure includes all of the provisions in the May 2012 RIOP, which is described in detail in section 2.1.1.2.4.4.

4.1.2.8.4 Seasonally Varying Baseflows

USACE evaluated the feasibility of providing a seasonally varying baseflow hydrograph that would more closely approximate predam conditions (e.g., more closely simulate run-of-the-river, before impoundment conditions).

4.1.2.8.5 Small Pulses or Nonhydroelectric Power Peaking

This measure would provide increased flows through the hydroelectric power units during off-peak hours of the day without generating hydroelectric power (nonhydroelectric power peaking windows) during critical reproductive and rearing periods in the Chattahoochee River below Buford and West Point dams. USFWS requested nonhydroelectric power peaking windows for a minimum of 4 weeks March–May. During that period, the projects would release a continuous flow mimicking a nondam flow regime. This measure also includes high flow pulses in the late winter and early spring to ensure seasonal high flows and river-floodplain connectivity with the timing, frequency, duration, magnitude, and rate of change necessary to sustain ecological functions and wildlife populations.

4.1.2.8.6 Fish Passage at George W. Andrews Lock and Dam and Walter F. George Lock and Dam

This measure would provide fish passage at George W. Andrews Lock and Dam and Walter F. George Lock and Dam similar to that which currently occurs in the spring of the year at Jim Woodruff Lock and Dam.

4.1.2.8.7 Manage Walter F. George Lake for the Eufaula Wildlife Refuge

Under this measure, a request by USFWS would be considered to cycle the reservoir between the highest levels (190 ft) in late winter/early spring to the lowest levels (185 ft) in late summer to accommodate Eufaula National Wildlife Refuge operations.

4.1.2.8.8 Revisions to Federally Listed Threatened and Endangered Species Operations

The current operations for federally listed threatened and endangered species downstream from Jim Woodruff Lock and Dam are the result of several rounds of formal consultation with the USFWS, including the RIOP implemented in June 2008. USACE reinitiated consultation on the RIOP in September 2010 based on new information about the distribution and mortality of endangered fat threeridge mussels (*Amblema neislerii*) in the Apalachicola River. A revised amended biological assessment describing a proposed action and its effects on listed species was submitted to USFWS on February 14, 2012. During the reinitiated consultation, opportunities to further avoid and minimize impacts to the federally listed endangered fat threeridge, and federally listed threatened purple bankclimber (*Elliptoideus sloatianus*) and Chipola slabshell (*Eliptio chipolaensis*) mussels, and their designated critical habitat in the Apalachicola River were considered. USACE examined measures for operations for federally listed threatened and endangered species in tandem with measures for drought operations because low flow conditions are critical for threatened and endangered species. The resulting May 2012 RIOP incorporated a drought operation that specifies a minimum release from Jim Woodruff Dam and temporarily suspends the other minimum release and maximum fall rate provisions until composite conservation storage in the basin is replenished to a level that can support normal operations. Under drought operations, the minimum discharge from Jim Woodruff Dam is determined in relation to composite conservation storage and not average basin inflow. Refer to section 2.1.1.2.4.4 for a more detailed discussion of consultation under section 7 of the Endangered Species Act.

In developing this EIS, USACE is continuing to coordinate and consult with USFWS to comply with both the Fish and Wildlife Coordination Act and the ESA. Revisions proposed as part of the Master WCM update process have been the subject of informal consultation with USFWS as they were developed. The proposed WCM updates are intended to improve system operations, including those for listed threatened and endangered species downstream from Jim Woodruff Lock and Dam. Documentation of ongoing coordination is provided in Appendix J. After public review of the draft EIS, USACE will prepare a draft biological assessment on the effects of the PAA on listed species. The biological assessment will be

included in Appendix J of the final EIS. Formal consultation will be completed and pertinent provisions of the USFWS biological opinion will be incorporated into the Master WCM update prior to its approval and implementation.

In addition to the current provisions of the May 2012 RIOP, USACE considered revisions to operations for federally listed threatened and endangered species in the Apalachicola River, which are described in the following sections.

4.1.2.8.8.1 Revised ramping rate (maximum fall rate)

Table 2.1-6 shows the maximum fall rate for discharges from Jim Woodruff Dam specified in the May 2012 RIOP. Revising the maximum fall rate was considered under this measure, as shown in Table 4.1-11.

Table 4.1-11.
Revised Maximum Fall Rate by Release Range for Composite Conservation Storage Zones 1-4 and Extreme Drought Operations Zone

Approximate release range (cfs)	Maximum fall rate (ft/day), measured at Chattahoochee gage
> 30,000	No ramping restriction
Exceeds Powerhouse Capacity (~ 16,000) and ≤ 30,000*	0.5
Within Powerhouse Capacity (16,000) and > 8,000*	0.25 to 0.5
Within Powerhouse Capacity (16,000) and ≤ 8,000*	0.25

Note: * Including implementation in CCS Zone 4.

4.1.2.8.8.2 Revised percent of basin inflow (BI) stored

The May 2012 RIOP allows 50 percent of basin inflow to be stored under certain conditions of BI and the composite conservation storage zone, as shown in Table 2.1-5. Under this measure, changing the percent of BI stored under those conditions to 60 percent or 70 percent was considered.

4.1.2.8.8.3 Suspend ramping during prolonged low flow

This measure proposed that if BI has been less than 7,000 cfs for 30 days, the use of the ramping rate would be suspended and resumed when BI was greater than 10,000 cfs for 30 days.

4.1.2.8.8.4 Revised seasonal flows

This measure would revise the seasonal minimum flow provisions of the May 2012 RIOP by establishing flow provisions at the Chattahoochee, FL USGS gage in the Apalachicola River for three seasons of the year, as shown in Table 4.1-12:

- Spring (March–May, or spawning season)
- Summer and fall (June–November, or non-spawning season)
- Winter (December–February, or refill season)

Table 4.1-12.
Revised Seasonal Flows

Months	Total storage in reservoirs	Basin inflow (BI) (cfs) or other conditions	State line flow (SLF) (cfs)	Basin inflow to be stored (cfs)
March	Zone 1,2, and 3	NA	>=6,500	Entire or partial BI above SLF, subject to available storage capacity
April 1-May 31	Zone 1,2, and 3	Cumulative BI in February and March > 2.45 million acre-feet	Maintain Q=min(10,500, min(observed moving 30-day flow))	Entire or partial BI above SLF, subject to available storage capacity
		Otherwise if BI>=10,500 If BI<10,500 and >= 5,000 If BI <5,000	>= 10,500 >= BI >= 5,000	
In sub-period April 16-April 30		Lanier>1,066' West Point>632' Walter F George >187'	Maintain Q=min(22,500,max(10,500, min(observed March 17-April 15 daily flow)))	Entire or partial BI above SLF, subject to available storage capacity
June-Nov	Zone 1,2, and 3	BI>= 10,476 & previous 7 days' Chattahoochee gage flow<5,100	>= High Pulse flow (June 14,850, July 15,500, August 14,400, September 11,200, October 10,100, November 10,500), No rise & fall rate limit	Entire or partial BI above SLF, subject to available storage capacity
		BI>= 7,181 and < 10,476 and previous 7 days' Chattahoochee gage flow<5,100	>= Small Pulse flow (June 11,600, July 11,500, August 11,100, September 8,620, October 7,420, November 7,980), No rise & fall rate limit	Entire or partial BI above SLF, subject to available storage capacity
		Other situation	>=5,000	Entire or partial BI above 5,000, subject to available storage capacity
Dec-Feb	Zone 1,2, and 3	NA	>=5,000	Entire or partial BI above 5,000, subject to available storage capacity
At all times	Zone 4	NA	>=5,000	Entire or partial BI above 5,000, subject to available storage capacity
At all times	Drought Zone	NA	>=4,500	Entire or partial BI above 5,000, subject to available storage capacity

4.1.2.8.8.5 Pulse flows

During the period June 1st through November 30th, this measure provides that when the 1-day BI for the period is above its 25th percentile (roughly 7,200 cfs) a 1-day pulse flow corresponding to the 25th percentile daily flow would be made. When BI rises above its median (roughly 10,500 cfs) levels for the season, a pulse flow lasting one day and corresponding to median daily flow would be made. There would be an interval of 7 days between any two consecutive pulses. Table 4.1-12 provides the details of the magnitude of pulses and when they would occur.

4.1.2.8.8.6 Monthly flows

This measure would establish monthly flow provisions and minimum releases from Jim Woodruff Dam. If the 7-day basin inflow exceeds the month/zone figure shown in Table 4.1-13, the specified flow would be released from Jim Woodruff Dam. All basin inflow in excess of the specified flow could be stored. If the basin inflow does not exceed the month/zone figure in Table 4.1-13 minus the zone augmentation limit shown in

Table 4.1-14, the release from Jim Woodruff Dam would be the greater of the month/zone minimum (see Table 4.1-15) or basin inflow plus the zone augmentation limit.

Table 4.1-13.
Monthly Flows (cfs) for Apalachicola River at Jim Woodruff Dam

Month	Zone 1	Zone 2	Zone 3	Zone 4
Jan	19,000	17,000	10,000	5,000
Feb	21,000	19,000	10,000	5,000
Mar	21,000	19,000	14,000	5,000
Apr	21,000	19,000	14,000	5,000
May	19,000	17,000	10,000	5,000
Jun	14,000	14,000	10,000	5,000
Jul	12,000	10,000	10,000	5,000
Aug	12,000	10,000	10,000	5,000
Sep	10,000	10,000	10,000	5,000
Oct	10,000	10,000	10,000	5,000
Nov	10,000	10,000	10,000	5,000
Dec	10,000	10,000	10,000	5,000

Table 4.1-14.
Augmentation Limits (cfs) for Apalachicola River at Jim Woodruff Dam

Month	Zone 1	Zone 2	Zone 3	Zone 4
Jan	2,000	0	1,000	0
Feb	4,000	2,000	2,000	0
Mar	4,000	2,000	3,000	0
Apr	4,000	2,000	3,000	0
May	2,000	4,000	2,000	0
Jun	2,000	2,000	1,000	0
Jul	2,000	2,000	1,000	0
Aug	2,000	2,000	1,000	0
Sep	0	1,500	1,000	0
Oct	0	1,500	1,000	0
Nov	0	1,500	1,000	0
Dec	0	1,500	1,000	0

Table 4.1-15.
Minimum Flows (cfs) for Apalachicola River at Jim Woodruff Dam

Month	Zone 1	Zone 2	Zone 3	Zone 4
Jan	17,000	17,000	5,000	5,000
Feb	17,000	17,000	5,000	5,000
Mar	17,000	17,000	8,000	5,000
Apr	17,000	17,000	8,000	5,000
May	17,000	10,000	8,000	5,000
Jun	12,000	8,000	5,000	5,000
Jul	10,000	7,000	5,000	5,000
Aug	10,000	7,000	5,000	5,000
Sep	10,000	6,000	5,000	5,000
Oct	10,000	5,000	5,000	5,000
Nov	10,000	6,000	5,000	5,000
Dec	10,000	8,000	5,000	5,000

4.1.2.8.8.7 Daily flows

This measure, used together with Revised Basin Inflow Method 1 (described above), would establish a full suite of minimum flows based on historic exceedance values that vary with seasons, reservoir storage zones, and general inflow conditions (dry or normal/wet), as shown in Table 4.1-16.

Table 4.1-16.
Computation Methodology for Daily Flows

If composite conservation storage-P7 is:	And if RBI-P7 is in:	The average flow release-U7 is:	
		Minimum flow	Plus additional flow
Zone 1 or 2	Mid to high range	80% exceedance-U7	50% of any RBI-P7 that exceeds minimum flow
	Low range	85% exceedance-U7	50% of any RBI-P7 that exceeds minimum flow
Zone 3 or 4	Mid to high range	90% exceedance-U7 with a minimum of 6,000 cfs	50% of any RBI-P7 that exceeds minimum flow
	Low range	95% exceedance-U7 with a minimum of 5,000 cfs	Mar-Nov: 50% of any RBI-P7 that exceeds minimum flow Dec-Feb: No additional release required
Extreme drought operations	All conditions	99% exceedance-U7 with a minimum of 5,000 cfs	No additional release required except 50% of storm pulses under certain conditions*

Notes:
*Conditions when 50% of storm pulses are released are under review and will be included at a later time.
Terms: P7=for the last 7 days; U7=for the upcoming 7 days; RBI=revised basin inflow
Mid to high range=>75% exceedance of 7-day rolling average unimpaired flow (1939-2008)
Low range=<75% exceedance of 7-day rolling average unimpaired flow (1939-2008)

4.1.2.9 Water Supply

Based on the June 2011 ruling of the 11th Circuit Court of Appeals and the USACE legal opinion of June 25, 2012, USACE has concluded that it has sufficient authority under the original Buford Dam project authorization and the Water Supply Act of 1958 to accommodate both the current level of releases from Buford Dam and direct withdrawals from Lake Lanier for water supply. For the purpose of evaluating the performance of the water management alternatives, as stated in section 4 above, water supply operations reflected current (2007) water supply use, basinwide and at USACE reservoirs, pursuant to existing relocation contracts. At Lake Lanier, for modeling purposes, it was assumed that no withdrawals would occur other than 20 mgd associated with the relocation contracts for the cities of Buford and Gainesville.

Water supply withdrawals vary on both an average daily and annual basis, but for modeling purposes, a fixed demand was identified to allow for effective comparison of alternatives. The highest levels of basinwide water supply withdrawals occurred in 2007, during the 2006-2008 drought. Although basinwide withdrawals since 2007 have been lower overall, 2007 was selected as representative of "current" demand because using the highest recent figure provides the most conservative estimate of the storage available for all purposes, assuming the greatest amount of reasonably forecasted water supply demand, including during times of drought. The withdrawal figures utilized do not necessarily reflect the maximum withdrawals that could be made at any given time, nor does the USACE analysis guarantee that the modeling withdrawals can actually be made at all times. The following current water supply withdrawals from and returns to Lake Lanier and releases from Buford Dam in accordance with the CRMS and returns to the Chattahoochee River were considered:

- 20 mgd water withdrawals relocation contracts (with the cities of Buford and Gainesville) with a 50 percent return rate.
- Releases from Buford Dam to support current withdrawals (277 mgd) by Metro Atlanta water providers with an 82 percent return rate.

Water supply withdrawals will also continue to occur at West Point Reservoir pursuant to the relocation contract with the city of LaGrange in the amount of 20.96 mgd. In 2007, the city withdrew an annual average of 9.74 mgd.

4.1.3 Water Management Measures Eliminated from Detailed Evaluation (Second Screening)

The measures that passed the first screening were considered for each of the USACE reservoirs in the ACF Basin and the basin as a whole, and a preliminary evaluation was performed. When deciding which measures to consider in a more detailed evaluation, USACE assessed the results of the preliminary analysis against the screening criteria described in section 1.4. The following measures were eliminated from detailed evaluation:

- Modified Guide Curve at West Point
- Modified Guide Curve at Walter F. George Lake
- Level 1 Action Zones
- Modified Hydropower Schedule at Buford, West Point, and Walter F. George Dams
- Hydroelectric Power Drought Operations
- Periodic Navigation
- December–May Navigation Season
- January–April Navigation Season

- Seasonally Varying Baseflows
- Revised Percent of BI Stored
- Small Pulses or Nonhydroelectric Power Peaking
- Fish Passage at George W. Andrews Lock and Dam and Walter F. George Lock and Dam
- Operations to Manage Walter F. George Lake for the Eufaula Wildlife Refuge

The results of the preliminary evaluation and screening process in eliminating measures are described in the following paragraphs.

4.1.3.1 Revised Guide Curves

4.1.3.1.1 Modified Guide Curve at West Point Lake

In considering adjustments to the guide curve at West Point Lake, USACE considered several variations for adjusting the refill and drawdown periods, as shown in Figure 4.1-3. An hourly model (e.g., flows routed on an hourly rather than a daily basis) was developed using hypothetical storm hydrographs to assess the possible effects of the changes to refill and drawdown periods on downstream flooding. Based on this analysis, the options for changing the guide curve for West Point Lake were eliminated from further consideration because they would likely increase the flood risk downstream of the project.

4.1.3.1.2 Modified Guide Curve at Walter F. George Lake

In considering adjustments to the guide curve at Walter F. George Lake, USACE considered several variations for adjusting the refill and drawdown periods (guide curves), as shown in Figure 4.1-4. Those modifications included extending the summer pool elevation by adjusting the timing of the summer refill and fall drawdown and lowering the summer pool level to minimize the static head limitations. There is a 2-ft fluctuation between the winter level of 188 ft and the summer pool of 190 ft, which is equivalent to 83,700 ac-ft. The Walter F. George project is not authorized for flood risk management, and induced surcharge operations are used to release water during flooding conditions. Historically, there is variability in pool elevation between the summer and winter levels at Walter F. George Lake, and two factors are responsible for this variability.

- The Walter F. George project is the furthest downstream storage project and called on first to make releases that support needs at Jim Woodruff Dam and the Apalachicola River.
- The limited flood storage requires rapid response to high flow conditions and results in abrupt changes in the 2-ft range of storage.

The technical team reviewed the guide curves options and concluded that the options provide no substantial benefit above the current guide curve. No change is anticipated in the pool variability between the summer and winter levels, and changing the timing of refill and/or drawdown would not alter that fact. Adjustments were made to the refill and drawdown portions of the guide curve to better meet conservation goals without adverse effect on flood protection, but the adjustments were eliminated from further consideration because of minimal gains.

4.1.3.2 Level 1 Action Zones

Level 1 action zone modifications represent an attempt to address the objective to *define action zones on a scientific basis that eliminate disproportionate impact on reservoirs and address current system needs*. However, when analyzed, this measure produced a more imbalanced use of conservation storage in the projects and generally would result in more disproportionate impact on the reservoirs than current

operations. Level 1 action zones would not effectively *improve system performance to achieve congressionally authorized project purposes.* In addition, this measure would not effectively address the other objectives related to drought operations, further improved operations for federally listed threatened and endangered species, and navigation. Modeled results indicate that management of storage at Lake Lanier, a major component of ACF basinwide water management operations, would be limited by this measure. Additional flexibility in drawdown at Lake Lanier is necessary to *improve system performance to achieve congressionally authorized project purposes* throughout the entire basin. Therefore, the Level 1 action zone modifications measure was not carried forward for detailed evaluation. Instead, the revised Level 1 action zones described in section 4.1.2.2.2.2 were carried forward.

4.1.3.3 Hydroelectric Power

4.1.3.3.1 Modified Schedule at Buford Dam

As noted in section 4.1.2.5.2, USACE considered varying the amount of generation it would plan to provide for each action zone at each project. For instance, rather than having a fixed generation schedule (e.g., when in Zone 1 at Lake Lanier, 4 hours of generation would be made available), USACE examined the viability of a variable schedule (e.g., 2 to 4 hours being made available when in Zone 1). USACE gave this measure no further consideration as a "stand-alone" measure.

4.1.3.3.2 Hydroelectric Power Drought Operations

Similarly, USACE considered reducing the amount of generation that would be made available when operating under drought protocols. Conservation storage at Lake Lanier is much more sensitive to hydroelectric power generation operations because of the small drainage area above Buford Dam from which to refill the reservoir, particularly under drought conditions. The modified generation schedule at Lake Lanier would provide greater operational flexibility to meet power demands in the system while conserving storage as variable climate conditions might dictate. These measures (Modified Schedule and Hydroelectric Power Drought Operations, section 4.1.2.5.4) were eliminated as "stand-alone" measures but were combined for further consideration.

4.1.3.4 Navigation

In developing a navigation operation, USACE explored several options to provide the most reliable navigation season possible within the constraints of water availability and limited dredging. In investigating navigation operations, USACE balanced use of storage for navigation versus the use of storage for other authorized project purposes.

4.1.3.4.1 Periodic Navigation

USACE considered scheduling navigation opportunities, as defined in section 4.1.2.6, where several intervals of 2-week periods of sufficient flow during the year would be identified on the basis of system composite conservation storage and varying channel depths (e.g., 7-ft and 9-ft channels). Table 4.1-17 presents the available navigation opportunities during dry weather months in the summer and fall. USACE also considered the effect of dredging on navigation opportunities. Under this measure, the use of storage would be balanced with other uses so that other project purposes would not be adversely affected. In assessing this measure, USACE analyzed the water requirements necessary to support a 9-ft channel, but concluded that only a 7-ft channel is viable because of the amount of water storage it would require and the adverse effects on other project purposes.

Table 4.1-17.
Navigation Opportunities During Dry-Weather Months

Composite conservation storage	May	June	July	September	October	November
Zone 1	6	5	4	2	2	1
Zone 2	2	2	2	1	1	1
Zone 3	Emergency only					
Zone 4	Emergency only					

Considering the requirements involved in implementing this measure, it is highly unlikely that USACE could obtain the necessary clearances from the Florida Department of Environmental Protection (DEP) in the short-term to conduct limited channel dredging in the Apalachicola River to complement the limited use of storage under this measure. On the basis of the analysis, this measure could not produce a plan for navigation opportunities under those constraints that would be sufficiently reliable to meet navigation industry needs and would not effectively meet the objective to *increase the reliability of navigation on the ACF system.* Therefore, this measure was eliminated from further consideration.

4.1.3.4.2 December–May Navigation Season

This measure explored the viability of providing a 6-month navigation season (December–May) with a 7-ft channel depth made possible when supported by system composite conservation storage.

In assessing this measure, USACE balanced the use of storage for navigation versus the use of storage for other authorized project purposes and considered the impact on other needs and requirements in the system (e.g., hydroelectric power generation, recreation). Accordingly, this measure was analyzed to determine the extent to which additional releases to specifically support navigation would affect upstream conservation storage and trigger drought operations, and the degree to which a reliable commercial navigation channel would likely be available. USACE determined that the 6-month navigation season was not supportable because it would result in excessive depletion of conservation storage, detrimental effects on reservoir levels, and unacceptable effects on other project purposes throughout the ACF Basin. While this measure would *increase the reliability of navigation on the ACF system*, the adverse effects on other project purposes would be too significant. Therefore, this measure was eliminated from further consideration.

4.1.3.4.3 January–April Navigation Season

This measure explored whether a 4-month navigation season (January–April) would be possible when supported by system composite conservation storage. Figure 4.1-10 shows composite conservation storage requirements and the triggers that would suspend and reinstate operations for navigation support.

On the basis of modeling the system over the 73-year period of record, a reliable 4-month navigation season for a 7-ft channel could be provided in the Apalachicola River without an appreciable effect on other upstream water uses or project purposes. The viability of the navigation season was assessed by examining how additional releases to specifically support navigation would affect upstream conservation storage, how often the associated releases would trigger drought operations, and the degree to which a reliable commercial navigation channel would likely be available. Through the assessment, USACE determined that a 4-month navigation season was supportable, but only as long as composite conservation storage remains in Zone 1 or Zone 2.

A 4-month navigation season would be expected to improve system recovery after a drought, reduce the frequency of making releases below 5,000 cfs from Jim Woodruff Lock and Dam, and result in improved conservation of storage by reducing hydroelectric power generation during drought periods and by revising the ramping rate to match the 1-day basin inflow fall rate when discharges are above the powerhouse capacity and below 30,000 cfs.

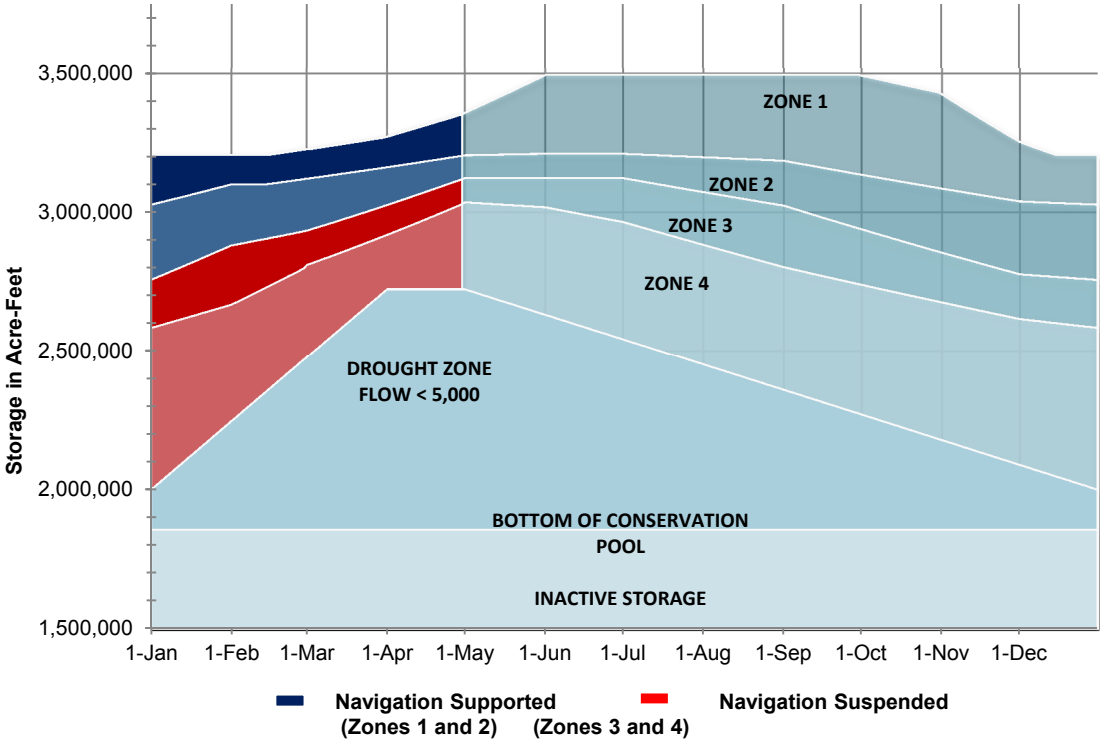

Figure 4.1-10. Conservation Storage in a 4-Month Navigation Season

As a result of the modeling and associated analysis of the alternatives, the 4-month navigation season appeared to be the most appropriate alternative to carry forward for detailed impact analysis. USFWS also recognized that releases to support navigation might also provide collateral benefits for aquatic species downstream of Jim Woodruff Lock and Dam and requested that USACE investigate the feasibility of another measure, essentially including the features of a 4-month navigation season with a 5-month navigation season (January–May). That measure proved to be feasible on the basis of modeling over the 73-year period of record and would be expected to effectively address the systemwide objectives for the Master WCM update. Therefore, the measure providing for only a 4-month (January–April) navigation season was eliminated from further consideration.

4.1.3.5 Fish and Wildlife Conservation

4.1.3.5.1 Seasonally Varying Baseflows

USACE evaluated the feasibility of providing a seasonally varying baseflow hydrograph that would more closely approximate predam conditions (e.g., more closely simulate run-of-the-river, before impoundment conditions). That analysis confirmed that the presence of the dams and their operations have altered the predam flow regime by generally providing a more stable flow pattern with higher base flows and lower

peak flows. The Buford and West Point projects were designed to provide flood risk management and altering seasonal variability, and reducing higher peak flows has been the result. Therefore, operating the projects to match the *natural* flow regime would adversely affect the congressionally authorized purpose of flood risk management.

4.1.3.5.2 Revised Percent of Basin Inflow (BI) Stored

As discussed in section 4.1.2.8.8.2, USACE evaluated the feasibility of changing the percent of BI stored under certain conditions of BI and the composite conservation storage zone to 60 percent or 70 percent (as shown in Table 2.1-5). That analysis established, however, that storing the additional volumes did not result in noticeable improvement in ability to manage the ACF system for endangered species.

4.1.3.5.3 Small Pulses

At the request of USFWS (USFWS 2010), USACE evaluated the effects of providing increased flows through the hydroelectric power units during off-peak hours of the day (i.e., nonhydroelectric power-peaking *windows*) during critical reproductive and rearing periods in the Chattahoochee River below Buford and West Point dams. USFWS requested small pulses for a minimum of 4 weeks March–May. During that period, the projects would release a continuous flow mimicking a nondam flow regime. USFWS also requested high flow pulses in the late winter or early spring to ensure seasonal high flows and river-floodplain connectivity with the timing, frequency, duration, magnitude, and rate of change necessary to sustain ecological functions and wildlife populations. Because the Buford and West Point projects were authorized and designed to operate as peaking hydroelectric power projects, USACE recognized it would have to forgo operating the large generators at both dams for 30 to 60 days to accomplish that option. Doing so would cause a significant loss in hydroelectric power production at the projects, which would be in violation of the existing project authorizations. Further, USACE determined that physical safety and logistical limitations would result from operating the projects to release the amount of flows USFWS requested for any amount of time. Leaving spillway gates open for extended periods would increase the possibility of debris getting lodged in the gate and damaging the equipment and produce increased maintenance costs because of additional wear and tear. That would be especially problematic because the West Point project is operated remotely from the Walter F. George project site. Finally, the option would inherently and adversely affected hydroelectric power generation through the cessation of peaking operations and affect hydroelectric power, flood risk management, and navigation through the use of potentially significant amounts of storage. For those reasons and the reasons documented in this section, nonhydroelectric power peaking was considered no further.

4.1.3.5.3.1 Lake Lanier and Buford Dam

USACE considered specifically at Lake Lanier the possibility of implementing nonhydroelectric power-peaking windows to provide 9 to 18 small pulses ranging from 3,658 cfs per day to 4,980 cfs per day (measured at the Norcross gage) for 2 to 3 days March–May each year to facilitate reproductive and rearing periods for riverine species downstream of the dam. In evaluating the feasibility of implementing the windows, USACE considered releases through the small 7-MW hydroelectric power unit (i.e., the house unit) and the jet valves installed in the sluice gates. That analysis revealed that a range of flows between 600 cfs (through just the small unit) and 1,200 cfs could be released. However, this range would be lower than the target range for an average or dry year. USACE determined that, although managing releases in that manner was potentially feasible from a purely mechanical standpoint, it would raise serious concerns regarding safety, storage, and hydroelectric power generation. The proposed operation inherently affects hydroelectric power generation both through the cessation of peaking operations and through the use of potentially significant amounts of storage. During dry springs with little to no local inflows, the target flow would require approximately 200 cfs more per day (during the week and 1,200 cfs

more per day during the weekends than the peaking operation. That equates to approximately 30,000 ac-ft of water, equivalent to a roughly 1-ft drop in the reservoir water surface elevation. The issue is compounded by the fact that the operation takes place during the refill period for the project. In light of those factors, the power-peaking measure at Lake Lanier was eliminated from further consideration.

4.1.3.5.3.2 West Point Dam and Lake

USACE also considered implementing nonhydroelectric power-peaking windows to provide 9 to 16 small pulses ranging from 8,853 cfs per day to 11,580 cfs per day for 3 to 4 days March–May each year to facilitate reproductive and rearing periods for riverine species downstream of the dam. In evaluating the feasibility of the windows, USACE considered releases through one or both of the two main units (approximately 6,800–7,800 cfs capacity each), the small unit (approximately 675 cfs capacity), or the six spillway gates (capacity of the spillway gates is based on head differential, but generally is about 800 cfs for pool levels during that time of year). Given that design, the main units could not be used to meet the target flow. Therefore, operations for a 5,000-cfs flow were also considered. While it was determined that a combination of the small unit and five to six of the spillway gates could yield the target flow of approximately 5,000 cfs, that option was rejected because of serious concerns regarding safety, downstream recreation, and storage for hydroelectric power generation and navigation.

4.1.3.5.4 Fish Passage at George W. Andrews Lock and Dam and Walter F. George Lock and Dam

In considering fish passage at projects upstream of Jim Woodruff Lock and Dam, USACE looked at existing data to identify suitable habitat for shad and other riverine species. Unfortunately, little information was available to justify the need for fish passage. Furthermore, recent otolith analysis of juvenile Alabama shad from the Apalachicola River indicated that 97 percent of the juvenile Alabama shad were spawned in the Flint River (Schaffler 2012). Therefore, fish passage at George W. Andrews Lock and Dam and Walter F. George Lock and Dam is not warranted at this time.

4.1.3.5.5 Operations to Manage Walter F. George Lake for the Eufaula Wildlife Refuge

USACE also considered a request by USFWS to cycle Walter F. George Lake between the highest levels (190 ft) in late winter/early spring to the lowest levels (185 ft) in late summer to accommodate Eufaula National Wildlife Refuge operations (see Figure 4.1-11). As proposed, the option would require operation of the reservoir at its highest pool levels during winter-spring, when flood releases are typically the greatest. That would reduce the ability of the project to attenuate approximately 87,000 ac-ft of potential downstream flooding. By holding the reservoir higher during the winter wet season, induced surcharge and damaging downstream flows are increased, resulting in bank erosion and channel modifications below the project. Similarly, to operate the project at its lowest levels during the summer is contrary to what is required to meet the highest demands for recreation, hydroelectric power, and flow augmentation. Essentially, the option would remove Walter F. George Lock and Dam from the system approach to operations across the basin and eliminate approximately 100,000 ac-ft of conservation storage that could be used to meet authorized project purposes in the summer. Given the demands of the system, including the minimum flow provisions for listed species in the Apalachicola River, the proposed operation would have significant adverse effects on the authorized project purposes and the structural stability and safety of the dam. Operations to manage Walter F. George Lake to benefit the Eufaula Wildlife Refuge operations were considered no further.

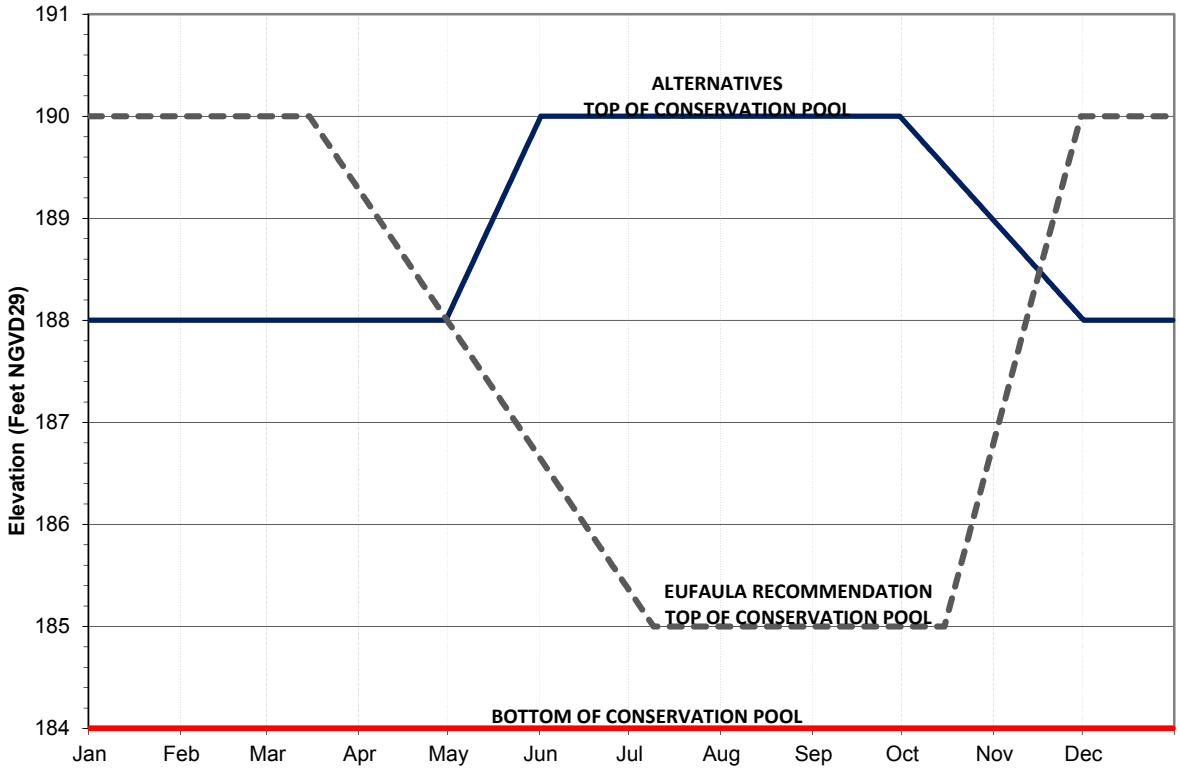

Figure 4.1-11. USFWS Proposed Operations at Walter F. George Lake

4.1.4 Water Management Measures Combined into Water Management Alternatives (Second Screening)

The measures remaining for consideration following the preliminary evaluation and screening process are listed below. These measures were combined into alternatives as described in section 4.2.

- Guide curves
  - Maintain existing guide curves
- Action Zones
  - Maintain existing action zones
  - Revised Level 1 action zones
- Drought Operations
  - Revised drought operations trigger
  - Extreme drought operations, including measures for management of usable inactive storage in Lake Lanier, West Point Lake, and Walter F. George Lake in the event that the composite conservation storage in these reservoirs becomes fully depleted during an extreme drought event in the future. These management measures are summarized in section 4.1.2.3.1 and described in detail in Exhibit B (Drought Contingency Plan) in the ACF Basin Master WCM (EIS Appendix A).
  - Revised drought operations suspension trigger
- Minimum Flows at Peachtree Creek

  - Current (750 cfs at Peachtree Creek)
  - Seasonal (750 cfs [May–Oct]/650 cfs [Nov–Apr] at Peachtree Creek)
  - Varying monthly flow
- Hydroelectric Power Generation
  - Current schedule
  - Modified schedule at Buford Dam with hydroelectric power drought operations
- Navigation
  - Current-no navigation operations
  - 4 month /5 month (7-ft channel)
  - Year-round navigation
- Basin Inflow
  - Current Basin Inflow Computational Methodology
  - Revised Method 1
  - Revised Method 2
- Fish and Wildlife Conservation
  - Lake and river fish spawn standard operating procedures
  - Fish passage lockages at Jim Woodruff Lock and Dam
- Federally Listed Threatened and Endangered Species Operations
  - May 2012 RIOP for federally listed threatened and endangered species
  - Revised ramping rate
  - Suspend ramping during prolonged low flow
  - Suspend ramping during drought
  - Revised seasonal flows
  - Monthly flows
  - Daily flows
  - Pulse flows
- Current Water Supply Operations
  - 20 mgd water withdrawals from Lake Lanier relocation contracts (50 percent return rate)
  - Releases from Buford Dam to support current withdrawals (277 mgd) (82 percent return rate)

4.2 Water Management Proposed Action and Alternatives

Management measures for water management defined in the previous section were combined to achieve objectives developed for water management of the ACF Basin. Water management alternatives were not formulated based on every conceivable combination of measures. Instead, the measures selected for inclusion in a water management alternative were those that USACE considered as potential refinements based on experience with current operations or those that were recommended by one or more stakeholders during the scoping process. As defined in section 4.1, the objectives for the Master WCM update and the WSSA to address the water management issues include the following:

- Defining action zones on a scientific basis that eliminate a disproportionate impact on reservoirs and address current system needs.
- Reducing or eliminating the chance of prematurely returning to drought operations and reducing flows below Jim Woodruff Dam below 5,000 cfs.

- Reducing or eliminating the adverse effects of system operations on federally listed threatened and endangered species.
- Improving system performance to achieve congressionally authorized project purposes.
- Increasing the reliability of navigation on the ACF system.

Table 4.2-1 presents the seven basinwide water management alternatives developed to address the objectives and ensure that flood operations would not be compromised. During evaluation of the water management alternatives, HEC-ResSim modeling was conducted to determine if each alternative met the objectives. The following sections further detail each alternative and describe a ranking process used to identify the Water Management Proposed Action Alternative. For each alternative, information is presented regarding the alternative's performance as well as a comparison to Water Management Alternative 1. It should be noted that the ability to make special releases as described in section 2.1.1.2.4.7 would be a part of any water management alternative. Such releases, however, are not subject to HEC-ResSim modeling due their unpredictable nature and duration; therefore, they are not discussed in the comparison of water management alternatives.

Table 4.2-1.
Summary of Water Management Alternatives

Water Management Measures		Water management alternatives						
		1	2	3	4	5	6	7
Guide Curves	Maintain existing guide curve	X	X	X	X	X	X	X
Action Zones	Maintain existing action zones	X						
	Revised Level 1 action zones		X	X	X	X	X	X
Drought Operations	Drought operations trigger *	Zone 4	Zone 4	Zone 4		Zone 4	Zone 4	Zone 3
	Extreme drought operations	X	X	X	X	X		X
	Drought operations suspension trigger *	Zone 1	Zone 1	Zone 1		Zone 1	Zone 3	Zone 1
Peachtree Creek Minimum Flows	Current (750 cfs)	X						
	Seasonal flow 750 cfs/650 cfs		X	X	X	X		X
	Monthly (USFWS) determination by zone						X	
Hydropower Generation	Current generation schedule	X					X	
	Modified generation schedule with drought operations		X	X	X	X		X
Navigation	Current-no navigation operations	X						
	4/5 Month		X		X	X	X	X
	Year-round			X				
Basin Inflow	Current computational method	X	X	X			X	X
	Revised Method 1				X			
	Revised Method 2					X		
Fish and Wildlife	Current fish spawn and passage	X	X	X	X	X	X	X

Water Management Measures			Water management alternatives						
			1	2	3	4	5	6	7
Listed Species Management	RIOP May 2012		X						
	Ramping Rate	Current rate**	X	X	X		X	X	X
		Revised rate				X			
		Suspend during prolonged low flow		X	X		X	X	X
		Suspend in drought*	X	X	X			X	X
	Minimum Flow Provision	Current (seasonal)**	X	X	X				X
		Revised seasonal flow					X		
		Monthly flow						X	
		Daily flow (historic exceedance)				X			
	Pulse flow						X		
Water Supply	Water supply operations: 20 mgd for relocation contracts and 277 mgd downstream withdrawal by Metro Atlanta***		X	X	X	X	X	X	X

Notes:
* Based upon composite conservation storage zones (cumulative conservation storage [by zone] for USACE ACF reservoirs [Lanier, West Point, and Walter F. George]).
**Component of the May 2012 RIOP.
*** For the purpose of comparing alternatives, currently authorized water supply withdrawals from Lake Lanier and downstream at Atlanta were factored into each water management alternative. Those authorized, currently occurring, annual average amounts are 20 mgd from Lake Lanier and 277 mgd at Atlanta.

4.2.1 Water Management Alternative 1

4.2.1.1 Description of Water Management Alternative

Water Management Alternative 1 consists of the following measures:

- Current guide curves
- Current action zones
- Current drought operations
  - Drought operations trigger-Zone 4
  - Drought operations suspension-Zone 1
  - Extreme drought operations
- Current minimum Peachtree Creek flows of 750 cfs
- Current hydropower generation schedule
- Current no-navigation operations
- Current basin inflow computational method
- Current fish spawning and fish passage operations
- Current May 2012 RIOP provisions

- Water supply operations limited to 20 mgd for relocation contracts and 277 mgd for downstream withdrawal by Metro Atlanta

The operational practices on the ACF Basin under this alternative are summarized in section 2.1.1.2.

Water Management Alternative 1 represents no change from the current management direction or level of management intensity. This alternative would represent continuation of the current water control operations at each of the federal projects in the ACF Basin. Basinwide management of all seven project purposes (i.e., flood risk management, hydroelectric power generation, navigation, fish and wildlife conservation, recreation, water quality, and water supply) is also considered in the alternative.

The CEQ regulations require detailed analysis of a No Action Alternative (40 CFR 1502.14); therefore, Water Management Alternative 1 was carried forward for further evaluation to serve as a basis of comparing performance among water management alternatives.

4.2.1.2 Performance Relative to Authorized Purposes

4.2.1.2.1 Flood Risk Management

Under Water Management Alternative 1, flood risk management operations would remain unchanged from those currently employed and would be achieved by storing damaging flood water, thus reducing downstream river levels below those that would occur without the dams in place. Of the five USACE reservoirs, only the Buford (Lake Lanier) and West Point projects were designed with space to store flood water. In addition to providing space above the conservation pool to hold flood water throughout the year, the Buford project is drawn down 1 additional foot, and the West Point project is drawn down at least 7 additional feet beginning in the fall season, through winter and into the early spring season to provide additional capacity to protect life and property within the basin. The George W. Andrews and Jim Woodruff dams operate to pass inflows, while the Walter F. George Lock and Dam project operates according to specified flood control schedules. During the principal flood season, December–April, the current regulation plan at Walter F. George Lock and Dam provides for lower lake levels to ensure lower reduced peak stages in the reservoir during major floods. During a flood event, excess water above the guide curve should be evacuated through the use of the turbines and spillways in a manner consistent with other project needs as soon as downstream flows have receded sufficiently so that releases from the reservoirs do not cause flows to exceed the bankfull discharges. This timely evacuation is necessary so that consecutive flood events will not cause flood waters to exceed allocated flood storage capacities and endanger the integrity of the dam.

4.2.1.2.2 Hydroelectric Power Generation

Under this alternative, the current hydroelectric power generation schedule shown in Table 4.1-5 would be maintained. Under Water Management Alternative 1, system annual hydropower generation is 1.049,030 MWh and system annual weekday hydropower generation is 777,458 MWh. System hydropower is the sum of generation at the four USACE power projects: Buford, West Point, Walter F. George, and Jim Woodruff. Hydropower generation that occurs at the three storage projects is shown in Table 4.2-2. Generation at Jim Woodruff Dam is primarily a byproduct of the RIOP release requirement. Peaking operation occurs only when conditions allow, perhaps 1-2 hours a day, when releases are above 6,700 cfs. The project generates power 7 days a week except when flow falls below 6,700 cfs. For these reasons, together with the fact that all water management alternatives include protected species provisions, the power generation at Jim Woodruff Dam was not considered relevant to the comparison of water management alternatives.

Table 4.2-2.
Hydropower Generation at ACF Projects for Water Management Alternative 1

Project	Annual generation (MWh)	Weekday generation (MWh)	Weekday/weekend ratio
Buford	139,014	112,651	1.51
West Point	181,153	137,693	1.37
Walter F. George	473,494	345,231	1.11

4.2.1.2.3 Navigation

Water Management Alternative 1 would continue the existing "no navigation" practices and does not include any specific measures to address the specific objective to *increase the reliability of navigation on the ACF system*. Under this water management alternative, a 9-foot navigation channel (Blountstown flow >/= 20,050 cfs) would be available 35 percent of the time and a 7-foot navigation channel (Blountstown flow >/= 16,200 cfs) would be available 50 percent of the time. Since this alternative has no specific operations for navigation, the reliability of adequate navigation flows is low. For comparison with other alternatives, note that the 7-foot channel would be fully available 20.5 percent of the time January–May and the 9-foot channel would be fully available 5.5 percent of the time, January–May.

4.2.1.2.4 Fish and Wildlife Conservation

For Water Management Alternative 1, water management activities for fish and wildlife conservation in Lake Lanier and the other reservoirs would be consistent with current practices as reflected in South Atlantic DR PDS-O-1 (May 2010) and draft USACE, Mobile District SOP 1130-2-9 (February 2005) as described in section 4.1.2.8.1. Operations to support fish spawning in reservoirs and rivers, consistent with other project purposes, and lockages to promote fish passage at Jim Woodruff Lock and Dam would continue as practiced. Operations for listed species under this alternative would be conducted in accordance with the provisions of the 2012 RIOP, as described in section 2.1.1.2.4.4.

Under this alternative, the annual maximum of growing-season (i.e., April–October) floodplain connectivity (acres) to the main channel for 30 consecutive days is 18,024 acres; the median fall rate is 0.12 feet per day; and the maximum fall rate is 2.06 feet per day. Other performance measures associated with this water management alternative are shown in Table 4.2-3.

Table 4.2-3.
Listed Species Performance Measures for Water Management Alternative 1

Flow	% of years with flow less than	Median number of days/year flow less than	Median number of consecutive days/year flow less than
< 5,000	1.4	0	0
< 6,000	30.1	0	0
< 7,000	45.2	0	0
< 8,000	60.3	6	5
< 9,000	79.5	36	12
< 10,000	93.2	60	28

No additional water control measures are included in this alternative for reservoirs in the ACF Basin to conserve storage in a manner that would reduce or eliminate the likelihood of flows from Jim Woodruff Dam below 5,000 cfs under extreme drought conditions. Therefore, Water Management Alternative 1 would not address objectives related to *flows below Jim Woodruff Lock and Dam under drought conditions, reducing the effect of operations on federally listed threatened and endangered species,* and *improving overall system performance to achieve authorized purposes.*

4.2.1.2.5 Recreation

For Water Management Alternative 1, Table 4.2-4 shows the number of weeks lake levels would be below various impact levels for the recreation season during 1939-2011 period of record as well as the percent of time below the various impact levels.

Table 4.2-4.
Recreation Water Levels for Water Management Alternative 1

	Project		
	Buford (May-Jul)	**West Point (May-Sep)**	**Walter F. George (Jun-Aug)**
Number of weeks below initial impact level (IIL) during period of record	119	300	16
Number of weeks below recreation impact level (RIL) during period of record	19	45	0
Number of days below water access limited (WAL) during period of record	0	109	0
Percent of time below IIL	13	20	2
Percent of time below RIL	2	3	0
Percent of time below WAL	0	1	0

4.2.1.2.6 Water Quality

Under Water Management Alternative 1, Buford Dam, West Point Dam, and Jim Woodruff Lock and Dam would continue to provide continuous minimum releases, in addition to meeting other project purposes and providing associated benefits. The releases would also benefit downstream water quality. At West Point Dam, a small generating unit provides a continuous release of approximately 675 cfs. In addition to these flows, Buford Dam is operated in conjunction with the downstream GPC Morgan Falls Dam to ensure a minimum in-stream flow of 750 cfs on the Chattahoochee River at Peachtree Creek to meet state water quality commitments.

4.2.1.2.7 Water Supply

Under the Water Management Alternative 1, withdrawals would be limited to 20 mgd from Lake Lanier (Buford and Gainesville relocation contracts) with a 50 percent return rate and to current withdrawals (277 mgd) downstream of Buford Dam by Metro Atlanta water providers with an 82 percent return rate, as described in section 4.1.2.9. The withdrawal value for Lake Lanier does not reflect current withdrawals, only those that are currently authorized and do not require a storage agreement. Nonetheless, these values, applied across all the water management alternatives, enable a consistent evaluation and comparison of the extent to which they would meet the other authorized project purposes and their associated environmental effects.

4.2.2 Water Management Alternative 2

4.2.2.1 Description of Water Management Alternative 2

Water Management Alternative 2 consists of the following measures:

- Current guide curves (same as Water Management Alternative 1)
- Revised Level 1 action zones
- Drought operations (same as Water Management Alternative 1)
- Seasonal flow at Peachtree Creek (750cfs [May–Oct] and 650 [Nov–Apr])
- Modified generation schedule with drought operations
- 4/5 month navigation (7-ft)
- Current basin inflow computational method (same as Water Management Alternative 1)
- Current fish spawn procedures (same as Water Management Alternative 1)
- Current fish passage procedures (same as Water Management Alternative 1)
- Listed species management
  - Current ramping rates (same as Water Management Alternative 1)
  - Suspension of ramping rates in drought (same as Water Management Alternative 1)
  - Suspension of ramping rates during prolonged low flow
  - Current minimum flow provisions at the Chattahoochee, FL USGS gage on the Apalachicola River (same as Water Management Alternative 1)
- Water supply operations limited to 20 mgd for relocation contracts and 277 mgd for downstream withdrawal by Metro Atlanta (same as Water Management Alternative 1)

In developing this alternative, USACE balanced use of storage for navigation versus the use of storage for other authorized project purposes and considered effects on other needs and requirements in the system (e.g., hydroelectric power generation, recreation). The 4-month navigation season concept includes a navigation season January–April and water releases to support a 7-ft navigation channel in the Apalachicola River, assumes no dredging of the Apalachicola River, and releases for navigation occurring during normal operation when basin composite conservation storage is above Zone 3 (within Zones 1 or 2).

This alternative was developed to specifically address the objective of *defining action zones on a scientific basis that eliminate disproportionate impact on reservoirs and address current system needs* and *increasing the reliability of navigation on the ACF system.* That objective is consistent with input received from stakeholders during public scoping. The *action zones* are shown in Figure 4.1-7, Figure 4.1-8, and Figure 4.1-9.

4.2.2.2 Performance Relative to Authorized Purposes

4.2.2.2.1 Flood Risk Management

The effects of Water Management Alternative 2 on flood risk management at Lake Lanier and West Point Lake would be expected to be the same as those for Water Management Alternative 1 (section 4.2.1.2.1). This alternative would not be expected to have any impact on flood risk management in the ACF Basin because the project guide curves remain unchanged. Thus, flood storage and associated flood operations would not be affected as they would be under Alternative 1. Revisions to the action zones considered

under Water Management Alternative 2 establish parameters for water management actions that would be taken to conserve storage when lake levels are below the guide curve.

4.2.2.2.2 Hydroelectric Power Generation

Under Water Management Alternative 2, the general hydroelectric power generation schedule would be modified for Buford Dam to be more flexible in all action zones under nondrought conditions and more constrained under drier conditions (see Table 4.2-5). Coupled with the revised Level 1 action zones, Water Management Alternative 2 would dictate more judicious use of conservation storage for hydroelectric power generation (particularly at Lake Lanier, but also at West Point Lake) under drier to drought conditions.

In a longer term and systemwide context, this management strategy would be beneficial for hydroelectric power generation, drought operations, and for other project purposes. With respect to the hydroelectric power generation project purpose, Water Management Alternative 2 would represent an overall improved condition. It supports the objectives to *define action zones on a scientific basis that eliminate disproportionate impact on reservoirs and address current system needs* and *to improve system performance to achieve congressionally authorized purposes.* Under Water Management Alternative 2 system, annual hydropower generation would be 894 MWh (0.1%) less than Water Management Alternative 1 and system annual weekday generation would be 1,802 MWh (0.2%) less.

Table 4.2-5.
Hydropower Generation at ACF Projects for Water Management Alternative 2

Project	Annual generation (MWh)	Weekday generation (MWh)	Weekday/weekend ratio
Buford	139,087	112,012	1.48
West Point	181,120	137,668	1.35
Walter F. George	473,726	345,162	1.12

4.2.2.2.3 Navigation

Assuming basin hydrologic conditions allow, a typical navigation season would begin in January of each year and continue for 4 to 5 consecutive months (January–April or May), as described in section 4.1.2.6.4. On the basis of modeling of the system over the 73-year period of record, Water Management Alternative 2 would be expected to provide a reliable 4-5 month navigation season (January–April/May) for a 7-ft channel in the Apalachicola River without an appreciable impact on other upstream water uses or project purposes. Compared to Water Management Alternative 1, this alternative provides a more dependable 7-foot navigation channel. Modeling indicates that the 7-foot channel would be fully available during the navigation season 32 (44 percent) of the modeled years (1939–2011) compared to 15 years for the Water Management Alternative 1. A 9-foot channel would be available in 3 (4 percent) of the modeled years compared to 4 years for the Water Management Alternative 1.

4.2.2.2.4 Fish and Wildlife Conservation

For Water Management Alternative 2, operations to support fish spawning in reservoirs and rivers, consistent with other project purposes, and lockages to promote fish passage at Jim Woodruff Lock and Dam would generally continue as currently practiced. Compared to the Water Management Alternative 1, implementing this alternative would be expected to provide improved conditions for fish and wildlife by

including measures to enhance ACF Basin operations (revised Level 1 action zones and the modified hydroelectric generation schedule at Buford Dam), and releases to support a 4/5-month (January–April or May) navigation season. As compared to Water Management Alternative 1, the annual maximum of growing-season (April–October) floodplain connectivity (acres) to the main channel for 30 consecutive days would be 389 acres more; the median fall rate would be 0.10 feet per day rather than 0.12; and the maximum fall rate would be 2.09 feet per day rather than 2.06. Other performance measures associated with this water management alternative are shown in Table 4.2-6.

Table 4.2-6.
Listed Species Performance Measures for Water Management Alternative 2

Flow	% of years with flow less than	Median number of days/year flow less than	Median number of consecutive days/year flow less than
< 5,000	1.4	0	0
< 6,000	34.2	0	0
< 7,000	46.6	0	0
< 8,000	64.4	7	5
< 9,000	79.5	37	12
< 10,000	91.8	58	23

4.2.2.2.5 Recreation

Under Water Management Alternative 2, the pool levels during the recreation season would be below IIL and RIL somewhat more often than under the Water Management Alternative 1 (Table 4.2-7). At West Point Lake, the lake levels during the recreation season would be below IIL and RIL more often than under the Water Management Alternative 1, but below WAL level less often. At Walter F. George Lock and Dam, pool levels would be below IIL more often than under the Water Management Alternative 1.

Table 4.2-7.
Recreation Water Levels for Water Management Alternative 2

	Project		
	Buford (May-Jul)	West Point (May-Sep)	Walter F. George (Jun-Aug)
Number of weeks below IIL during period of record	178	378	83
Number of weeks below RIL during period of record	30	63	0
Number of days below WAL during period of record	0	105	0
Percent of time below IIL	19	25	9
Percent of time below RIL	3	4	0
Percent of time below WAL	0	1	0

4.2.2.2.6 Water Quality

Under Water Management Alternative 2, Buford Dam, West Point Dam, and Jim Woodruff Lock and Dam would continue to provide continuous minimum releases, in addition to meeting other project purposes and providing associated benefits. These releases would also benefit downstream water quality. At West Point Dam, a small generating unit provides a continuous release of approximately 675 cfs. In

addition to these flows, Buford Dam is operated in conjunction with the downstream GPC Morgan Falls Dam to ensure a minimum in-stream flow of 650 cfs during November–April and 750 cfs during May–October on the Chattahoochee River at Peachtree Creek to meet state water quality commitments.

4.2.2.2.7 Water Supply

Water Management Alternative 2 would have similar implications for the water supply purpose for pertinent federal projects in the ACF Basin as described for Water Management Alternative 1 in section 4.2.1.2.7. Water supply uses of the ACF Basin below Peachtree Creek (Chattahoochee RM 300.5) would not likely be appreciably affected by Water Management Alternative 2.

4.2.3 Water Management Alternative 3

4.2.3.1 Description of Water Management Alternative 3

Water Management Alternative 3 is the same as Water Management Alternative 2 except for the navigation feature. This alternative provides navigation flows, when available, 12 months a year rather than limiting navigation to January–April/May and consists of the following measures:

- Current guide curves (same as Water Management Alternative 1)
- Revised Level 1 action zones (same as Water Management Alternative 2)
- Drought operations (same as Water Management Alternative 1)
- Seasonal flow at Peachtree Creek (750cfs [May–Oct] and 650 [Nov–Apr]) (same as Water Management Alternative 2)
- Modified generation schedule with drought operations (same as Water Management Alternative 2)
- Year-round navigation
- Current Basin Inflow Computational Method (same as Water Management Alternative 1)
- Current fish spawn procedures (same as Water Management Alternative 1)
- Current fish passage procedures (same as Water Management Alternative 1)
- Listed species management
  - Current ramping rates (same as Water Management Alternative 1)
  - Suspension of ramping rates in drought (same as Water Management Alternative 1)
  - Suspension of ramping rates during prolonged low flow (same as Water Management Alternative 2)
  - Current minimum flow provisions at Chattahoochee, FL USGS gage on the Apalachicola River (same as Water Management Alternative 1)
- Water supply operations limited to 20 mgd for relocation contracts and 277 mgd for downstream withdrawal by Metro Atlanta (same as Water Management Alternative 1)

This alternative was developed to address the objective *of increasing the reliability of navigation on the ACF system* with the intent of providing navigation on a year-round basis in the absence of dredging. It incorporates all the measures of Water Management Alternative 2 other than the 4/5-month navigation provision.

4.2.3.2 Performance Relative to Authorized Purposes

4.2.3.2.1 Flood Risk Management

The effects of Water Management Alternative 3 on flood risk management at Lake Lanier and West Point Lake would be expected to be essentially the same as for Water Management Alternative 1 (section 4.2.1.2.1). Since no guide curves are modified under this alternative, it would not likely have any impact on flood risk management in the ACF Basin.

4.2.3.2.2 Hydroelectric Power Generation

Under Water Management Alternative 3 (Table 4.2-8), the general hydroelectric power generation schedule would be the same as under Water Management Alternative 2. Under the Water Management Alternative 3 system, annual hydropower generation would be 2,575 MWh (0.2%) less than under Water Management Alternative 1 and system annual weekday generation would be 570 MWh (0.1%) less.

Table 4.2-8.
Hydropower Generation at ACF Projects for
Water Management Alternative 3

Project	Annual generation (MWh)	Weekday generation (MWh)	Weekday/weekend ratio
Buford	138,410	110,994	1.46
West Point	180,850	136,447	1.31
Walter F. George	472,212	347,726	1.18

4.2.3.2.3 Navigation

Water Management Alternative 3 is intended to provide a reliable channel (7 feet or greater) in the Apalachicola River on a year-round basis to the maximum extent practicable while continuing to meet the flow requirements in the Apalachicola River. Under this alternative, modeling indicates that the 7-foot channel would be available 58 percent of the time during the year (compared to 50 percent for Water Management Alternative 1) and fully available in the January–May navigation season 29 (40 percent) of the modeled years (1939–2011). The 9-foot channel would be available 33 percent of the time during the year (compared to 35 percent for Water Management Alternative 1) and fully available in the January–May navigation season during 5 years (7 percent).

4.2.3.2.4 Fish and Wildlife Conservation

Under this alternative, operations to support fish spawning in reservoirs and rivers, consistent with other project purposes, and lockages to promote fish passage at Jim Woodruff Lock and Dam would continue as currently practiced (see section 4.2.1.2.4).

Implementing Water Management Alternative 3 would result in more favorable conditions for fish and wildlife than Water Management Alternative 1. The annual maximum of growing-season (April–October) floodplain connectivity (acres) to the main channel for 30 consecutive days would be 1,424 acres more than under Water Management Alternative 1; the median fall rate would be 0.08 feet per day rather than 0.12; and the maximum fall rate would be 2.42 feet per day rather than 2.06. Other performance measures associated with this water management alternative are shown in Table 4.2-9.

Table 4.2-9.
Listed Species Performance Measures for Water Management Alternative 3

Flow	% of years with flow less than	Median number of days/year flow less than	Median number of consecutive days/year flow less than
< 5,000	2.7	0	0
< 6,000	39.7	0	0
< 7,000	57.5	6	4
< 8,000	68.5	19	11
< 9,000	91.8	48	24
< 10,000	93.2	74	36

4.2.3.2.5 Recreation

Under Water Management Alternative 3 (Table 4.2-10), the pool levels during the recreation season would be below the IIL and the RIL more often than under Water Management Alternative 1. At West Point Lake, the lake levels during the recreation season would be below the IIL and the RIL considerably more often than under Water Management Alternative 1, but below the WAL level less often. At Walter F. George Lock and Dam, pool levels would be below the IIL 94 weeks compared to 16 weeks under Water Management Alternative 1.

Table 4.2-10.
Recreation Water Levels for Water Management Alternative 3

	Project		
	Buford (May-Jul)	West Point (May-Sep)	Walter F. George (Jun-Aug)
Number of weeks below IIL during period of record	216	518	94
Number of weeks below RIL during period of record	45	80	1
Number of days below WAL during period of record	14	103	0
Percent of time below IIL	23	36	10
Percent of time below RIL	5	5	0
Percent of time below WAL	0	1	0

4.2.3.2.6 Water Quality

The implications of Water Management Alternative 3 relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 2 in section 4.2.2.2.6.

4.2.3.2.7 Water Supply

The implications of Water Management Alternative 3 relative to water supply purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative in section 4.2.1.2.7.

4.2.4 Water Management Alternative 4

4.2.4.1 Description of Water Management Alternative 4

Water Management Alternative 4 was specifically developed to address the objectives of *reducing or eliminating the adverse effect of system operations on federally listed threatened and endangered species* and *reducing or eliminating the chances of prematurely returning to drought operations and reducing flows below Jim Woodruff Dam below 5,000 cfs*. It is similar to Water Management Alternative 2 except for several differences regarding drought operations, basin inflow computation, and listed species management. This alternative consists of the following measures:

- Current guide curves (same as Water Management Alternative 1)
- Revised Level 1 action zones (same as Water Management Alternative 2)
- Drought operations
  - No drought operations trigger
  - No drought suspension trigger
  - Extreme drought operations (same as Water Management Alternative 1)
- Seasonal flow at Peachtree Creek (750cfs [May–Oct] and 650 [Nov–Apr]) (same as Water Management Alternative 2)
- Modified generation schedule with drought operations (same as Water Management Alternative 2)
- 4/5 month navigation (7-ft) (same as Water Management Alternative 2)
- Revised Basin Inflow Method 1
- Current fish spawn procedures (same as Water Management Alternative 1)
- Current fish passage procedures (same as Water Management Alternative 1)
- Listed species management
  - Revised ramping rates
  - Daily flow provisions at the Chattahoochee, FL USGS gage on the Apalachicola River
- Water supply operations limited to 20 mgd for relocation contracts and 277 mgd for downstream withdrawal by Metro Atlanta (same as Water Management Alternative 1)

4.2.4.2 Performance Relative to Authorized Purposes

4.2.4.2.1 Flood Risk Management

The effects of Water Management Alternative 4 on flood risk management at Lake Lanier and West Point Lake would be expected to be essentially the same as those described for Water Management Alternative 1 (section 4.2.1.2.1). Since no guide curves are modified under this alternative, it would not likely have any impact on flood risk management in the ACF Basin.

4.2.4.2.2 Hydroelectric Power Generation

Under Water Management Alternative 4 (Table 4.2-11), the general hydroelectric power generation schedule would be the same as under Water Management Alternative 2. System annual hydropower generation would be 2,384 MWh (0.2%) less than under Water Management Alternative 1 and system annual weekday generation would be 7,622 MWh (1.0%) less.

Table 4.2-11.
Hydropower Generation at ACF Projects for Water Management Alternative 4

Project	Annual generation (MWh)	Weekday generation (MWh)	Weekday/weekend ratio
Buford	138,915	110,509	1.42
West Point	180,856	135,180	1.26
Walter F. George	472,948	343,036	1.09

4.2.4.2.3 Navigation

Navigation operations for this alternative are the same as for Water Management Alternative 2, as described in section 4.1.2.6.4. Compared to Water Management Alternative 1, this alternative would provide a more dependable 7-foot navigation channel. Modeling indicates that the 7-foot channel would be fully available during the navigation season 29 (40 percent) of the modeled years (1939–2011) compared to 15 years for Water Management Alternative 1 and 32 for Water Management Alternative 2. A 9-foot channel would be available in 2 (3 percent) of the modeled years compared to 4 years for Water Management Alternative 1.

4.2.4.2.4 Fish and Wildlife Conservation

Under this alternative, operations to support fish spawning in reservoirs and rivers, consistent with other project purposes, and lockages to promote fish passage at Jim Woodruff Lock and Dam would continue as currently practiced (see section 4.2.1.2.4).

Implementing this alternative would provide somewhat more favorable conditions for fish and wildlife than Water Management Alternative 1. The annual maximum of growing-season (April–October) floodplain connectivity (acres) to the main channel for 30 consecutive days would be 317 acres more; the median fall rate would be 0.08 feet per day rather than 0.12; and the maximum fall rate would be 2.42 feet per day rather than 2.06. Other performance measures associated with this water management alternative are shown in Table 4.2-12.

Table 4.2-12.
Listed Species Performance Measures for Water Management Alternative 4

Flow	% of years with flow less than	Median number of days/year flow less than	Median number of consecutive days/year flow less than
< 5,000	1.4	0	0
< 6,000	26.0	0	0
< 7,000	49.3	0	0
< 8,000	60.3	9	8
< 9,000	80.8	28	17
< 10,000	91.8	55	27

4.2.4.2.5 Recreation

Under Water Management Alternative 4 (Table 4.2-13), the pool levels during the recreation season would be below the IIL and the RIL more often and below the WAL much more often than under Water Management Alternative 1. At Walter F. George Lock and Dam, pool levels would be below the IIL 143 weeks compared to 16 weeks under Water Management Alternative 1 and below the RIL 6 weeks as compared to no weeks.

Table 4.2-13.
Recreation Water Levels for Water Management Alternative 4

	Project		
	Buford (May-Jul)	**West Point (May-Sep)**	**Walter F. George (Jun-Aug)**
Number of weeks below IIL during period of record	236	510	143
Number of weeks below RIL during period of record	64	107	6
Number of days below WAL during period of record	185	247	0
Percent of time below IIL	25	34	16
Percent of time below RIL	7	7	1
Percent of time below WAL	3	2	0

4.2.4.2.6 Water Quality

The implications of Water Management Alternative 4 relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 2 in section 4.2.2.2.6.

4.2.4.2.7 Water Supply

The implications of Water Management Alternative 4 relative to water supply purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 1 in section 4.2.1.2.7.

4.2.5 Water Management Alternative 5

4.2.5.1 Description of Water Management Alternative 5

Water Management Alternative 5 was developed to address the objectives of *reducing or eliminating the adverse effect of system operations on federally listed threatened and endangered species* and *improving system performance to achieve congressionally authorized project purposes*. It is similar to Water Management Alternative 2 except for a revised basin inflow computation method and revisions to listed species management measures. This alternative consists of the following measures:

- Current guide curves (same as Water Management Alternative 1)
- Revised Level 1 action zones (same as Water Management Alternative 2)
- Drought operations (same as Water Management Alternative 1)
- Seasonal flow at Peachtree Creek (750cfs [May–Oct] and 650 [Nov–Apr]) (same as Water Management Alternative 2)

- Modified generation schedule with drought operations (same as Water Management Alternative 2)
- 4/5 month navigation (7-ft) (same as Water Management Alternative 2)
- Revised Basin Inflow Method 2
- Current fish spawn procedures (same as Water Management Alternative 1)
- Current fish passage procedures (same as Water Management Alternative 1)
- Listed species management
  - Current ramping rates (same as Water Management Alternative 1)
  - Suspension of ramping rates during prolonged low flow (same as Water Management Alternative 2)
  - Revised seasonal flow provisions at the Chattahoochee, FL USGS gage on the Apalachicola River
  - Pulse flow
- Water supply operations limited to 20 mgd for relocation contracts and 277 mgd for downstream withdrawal by Metro Atlanta (same as Water Management Alternative 1)

4.2.5.2 Performance Relative to Authorized Purposes

4.2.5.2.1 Flood Risk Management

The effects of Water Management Alternative 5 on flood risk management at Lake Lanier and West Point Lake would be expected to be essentially the same as for Water Management Alternative 1 (section 4.2.1.2.1). Since no guide curves are modified under this alternative, it would not likely have any impact on flood risk management in the ACF Basin.

4.2.5.2.2 Hydroelectric Power Generation

Under Water Management Alternative 5 (Table 4.2-14), the general hydroelectric power generation schedule would be the same as under Water Management Alternative 2. System annual hydropower generation would be 934 MWh (<0.1%) less than Water Management Alternative 1 and system annual weekday generation would be 1,261 MWh (0.02%) less.

Table 4.2-14.
Hydropower Generation at ACF Projects for Water Management Alternative 5

Project	Annual generation (MWh)	Weekday generation (MWh)	Weekday/weekend ratio
Buford	139,090	112,102	1.48
West Point	181,183	136,980	1.35
Walter F. George	472,789	345,593	1.13

4.2.5.2.3 Navigation

Navigation operations for this alternative would be the same as under Water Management Alternative 2, as described in section 4.1.2.6.4. It would provide a more dependable 7-foot navigation channel, with modeling indicating that the 7-foot channel would be fully available during the navigation season 28

(38 percent) of the modeled years (1939–2011) compared to 15 years for Water Management Alternative 1 and 32 for Water Management Alternative 2. A 9-foot channel would be available in 2 (3 percent) of the modeled years compared to 4 years for Water Management Alternative 1.

4.2.5.2.4 Fish and Wildlife Conservation

Under this alternative, operations to support fish spawning in reservoirs and rivers, consistent with other project purposes, and lockages to promote fish passage at Jim Woodruff Lock and Dam would continue as currently practiced (see section 4.2.2.2.4).

Implementing this alternative would provide somewhat more favorable conditions for fish and wildlife than under Water Management Alternative 1. The annual maximum of growing-season (April–October) floodplain connectivity (acres) to the main channel for 30 consecutive days would be 1,127 acres more; the median fall rate would be 0.08 feet per day rather than 0.12; and the maximum fall rate would be 2.42 feet per day rather than 2.06. Other performance measures associated with this water management alternative are shown in Table 4.2-15.

Table 4.2-15.
Listed Species Performance Measures for Water Management Alternative 5

Flow	% of years with flow less than	Median number of days/year flow less than	Median number of consecutive days/year flow less than
< 5,000	1.4	0	0
< 6,000	35.6	0	0
< 7,000	49.3	0	0
< 8,000	64.4	7	5
< 9,000	83.6	40	15
< 10,000	93.2	62	25

4.2.5.2.5 Recreation

Under Water Management Alternative 5 (Table 4.2-16), the pool levels during the recreation season would be below the IIL and the RIL more often than under Water Management Alternative 1. At West Point Lake, the lake levels during the recreation season would be below the IIL and the RIL somewhat more often, but below the WAL level slightly less often. At Walter F. George Lock and Dam, pool levels would be below the IIL 76 weeks compared to 16 weeks under Water Management Alternative 1 and 1 week below the RIL.

Table 4.2-16.
Recreation Water Levels for Water Management Alternative 5

	Project		
	Buford (May-Jul)	West Point (May-Sep)	Walter F. George (Jun-Aug)
Number of weeks below IIL during period of record	179	37	76
Number of weeks below RIL during period of record	33	54	1
Number of days below WAL during period of record	0	108	0
Percent of time below IIL	19	23	8
Percent of time below RIL	4	4	0
Percent of time below WAL	0	1	0

4.2.5.2.6 Water Quality

The implications of Water Management Alternative 5 relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 2 in section 4.2.2.2.6.

4.2.5.2.7 Water Supply

The implications of Water Management Alternative 5 relative to water supply purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 2 in section 4.2.2.2.7.

4.2.6 Water Management Alternative 6

4.2.6.1 Description of Water Management Alternative 6

Water Management Alternative 6 represents another approach to addressing the objective of *reducing or eliminating the adverse effect of system operations on federally listed threatened and endangered species*. It is similar to Water Management Alternative 2 except for a change in the drought operation suspension trigger, specification of a varying monthly flow at Peachtree Creek, current hydropower generation schedule, and revisions to listed species management. This alternative consists of the following measures:

- Current guide curves (same as Water Management Alternative 1)
- Revised Level 1 action zones (same as Water Management Alternative 2)
- Drought operations
  - Drought operations trigger Zone 4 (same as Water Management Alternative 1)
  - Drought operations suspension trigger Zone 3
- Current hydropower generation schedule (same as Water Management Alternative 1)
- Seasonal flow at Peachtree Creek (750cfs [May–Oct] and 650 [Nov–Apr]) (same as Water Management Alternative 2)
- 4/5 month navigation (7-ft) (same as Water Management Alternative 2)
- Current Basin Inflow Computational Method (same as Water Management Alternative 1)
- Current fish spawn procedures (same as Water Management Alternative 1)
- Current fish passage procedures (same as Water Management Alternative 1)
- Listed species management
  - Current ramping rates (same as Water Management Alternative 1)
  - Suspension of ramping rates in drought (same as Water Management Alternative 1)
  - Suspension of ramping rates during prolonged low flow (same as Water Management Alternative 2)
  - Current minimum flow provisions at the Chattahoochee, FL USGS gage on the Apalachicola River (same as Water Management Alternative 1)
- Water supply operations limited to 20 mgd for relocation contracts and 277 mgd for downstream withdrawal by Metro Atlanta (same as Water Management Alternative)

4.2.6.2 Performance Relative to Authorized Purposes

4.2.6.2.1 Flood Risk Management

The effects of Water Management Alternative 6 on flood risk management at Lake Lanier and West Point Lake would be expected to be essentially the same as for Water Management Alternative 1 (section 4.2.1.2.1). Since no guide curves are modified under this alternative, it would not likely have any impact on flood risk management in the ACF Basin.

4.2.6.2.2 Hydroelectric Power Generation

Under Water Management Alternative 6 (Table 4.2-17), the general hydroelectric power generation schedule would be the same as Water Management under Alternative 1. System annual hydropower generation would be 1,048,851 MWh, essentially the same as for Alternative 1, but system annual weekday generation would be 10,095 MWh (1.3%) less.

Table 4.2-17.
Hydropower Generation at ACF Projects for Water Management Alternative 6

Project	Annual generation (MWh)	Weekday generation (MWh)	Weekday/weekend ratio
Buford	138,661	105,924	1.24
West Point	181,184	135,253	1.23
Walter F. George	473,089	343,573	1.08

4.2.6.2.3 Navigation

Navigation operations for this alternative would be the same as under Water Management Alternative 2, as described in section 4.1.2.6.4. This alternative would provide a more dependable 7-foot navigation channel, with modeling indicating that the 7-foot channel would be fully available during the navigation season 31 (42 percent) of the modeled years (1939–2011) compared to 15 years for Water Management Alternative 1 and 32 for Water Management Alternative 2. A 9-foot channel would be available in 4 (5 percent) of the modeled years, the same as for Water Management Alternative 1.

4.2.6.2.4 Fish and Wildlife Conservation

Under this alternative, operations to support fish spawning in reservoirs and rivers, consistent with other project purposes, and lockages to promote fish passage at Jim Woodruff Lock and Dam would continue as currently practiced (see section 4.2.1.2.4).

Implementing this alternative would provide somewhat more favorable conditions for fish and wildlife. As compared with Alternative 1, the annual maximum of growing-season (April–October) floodplain connectivity (acres) to the main channel for 30 consecutive days would be 1,818 acres more; the median fall rate would be 0.00 feet per day rather than 0.12; and the maximum fall rate would be 2.42 feet per day rather than 2.06. Other performance measures associated with this water management alternative are shown in Table 4.2-18.

Table 4.2-18.
Listed Species Performance Measures for Water Management Alternative 6

Flow	% of Years with flow less than	Median number of days/year flow less than	Median number of consecutive days/year flow less than
< 5,000	1.4	0	0
< 6,000	27.4	0	0
< 7,000	35.6	0	0
< 8,000	49.3	0	0
< 9,000	54.8	8	7
< 10,000	64.4	27	17

4.2.6.2.5 Recreation

Under Water Management Alternative 6 (Table 4.2-19), the pool levels during the recreation season would be below the IIL and the RIL much more often and below the WAL more often than under Water Management Alternative 1. At Walter F. George Lock and Dam, pool levels would be below the IIL 151 weeks compared to 16 weeks under Water Management Alternative 1 and below the RIL 1 week as compared to no weeks.

Table 4.2-19.
Recreation Water Levels for Water Management Alternative 6

	Project		
	Buford (May-Jul)	West Point (May-Sep)	Walter F. George (Jun-Aug)
Number of weeks below IIL during period of record	253	529	151
Number of weeks below RIL during period of record	52	112	1
Number of days below WAL during period of record	55	182	0
Percent of time below IIL	27	35	16
Percent of time below RIL	6	7	0
Percent of time below WAL	1	2	0

4.2.6.2.6 Water Quality

The implications of Water Management Alternative 6 relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 2 in section 4.2.2.2.6.

4.2.6.2.7 Water Supply

The implications of Water Management Alternative 6 relative to water supply purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 2 in section 4.2.2.2.7.

4.2.7 Water Management Alternative 7

4.2.7.1 Description of Water Management Alternative 7

Water Management Alternative 7 is similar to Water Management Alternative 2 except the drought operations trigger is Zone 3 rather than Zone 4. It was developed to refine Alternative 2 and address the objective of *reducing or eliminating the chances of prematurely returning to drought operations and reducing flows below Jim Woodruff Dam below 5,000 cfs*. This alternative consists of the following measures:

- Current guide curves (same as Water Management Alternative 1)
- Revised Level 1 action zones (same as Water Management Alternative 2) (See section 4.1.2.2.2.2)
- Drought operations
  - Drought operations trigger-Zone 3 (See section 4.1.2.3.2.1)
  - Drought operations suspension trigger-Zone 1 (same as Water Management Alternative 1) (See section 4.1.2.3.2.2)
  - Extreme drought operations (same as Water Management Alternative 1)
- Seasonal flow at Peachtree Creek (750cfs [May–Oct] and 650 [Nov–Apr]) (same as Water Management Alternative 2) (See section 4.1.2.4.2)
- Modified generation schedule with drought operations (same as Water Management Alternative 2) (See section 4.1.2.5.4)
- 4/5 month navigation (7-ft) (same as Water Management Alternative 2) (See section 4.1.2.6.4)
- Current Basin Inflow Method (same as Water Management Alternative 1) (See section 4.1.2.7.1)
- Current fish spawn procedures (same as Water Management Alternative 1) (See section 4.1.2.8.1)
- Current fish passage procedures (same as Water Management Alternative 1) (See section 4.1.2.8.2)
- Listed species management
  - Current ramping rates (same as Water Management Alternative 1)
  - Suspension of ramping rates in drought (same as Water Management Alternative 1)
  - Suspension of ramping rates during prolonged low flow (same as Water Management Alternative 2) (See section 4.1.2.8.8.3)
  - Current minimum flow provisions at the Chattahoochee, FL USGS gage on the Apalachicola River (same as Water Management Alternative 1)
- Water supply operations limited to 20 mgd for relocation contracts and 277 mgd for downstream withdrawal by Metro Atlanta (same as Water Management Alternative 1)

4.2.7.2 Performance Relative to Authorized Purposes

4.2.7.2.1 Flood Risk Management

The effects of Water Management Alternative 7 on flood risk management at Lake Lanier and West Point Lake would be expected to be essentially the same as for Water Management Alternative 1 (section 4.2.1.2.1). Since no guide curves are modified under this alternative, it would not likely have any impact on flood risk management in the ACF Basin.

4.2.7.2.2 Hydroelectric Power Generation

Under Water Management Alternative 7 (Table 4.2-20), the general hydroelectric power generation schedule would be the same as under Water Management Alternative 2. System annual hydropower generation would be 801 MWh (0.1%) less than Water Management Alternative 1 and system annual weekday generation would be 754 MWh (0.1%) less.

Table 4.2-20.
Hydropower Generation at ACF Projects for Water Management Alternative 7

Project	Annual generation (MWh)	Weekday generation (MWh)	Weekday/weekend ratio
Buford	139,133	111,916	1.47
West Point	181,180	137,138	1.36
Walter F. George	472,797	346,054	1.14

4.2.7.2.3 Navigation

Navigation operations for this alternative would be the same as under Water Management Alternative 2, as described in section 4.1.2.6.4. This alternative provides a more dependable 7-foot navigation channel, with modeling indicating that the 7-foot channel would be fully available during the navigation season 32 (44 percent) of the modeled years (1939–2011) compared to 15 years for Water Management Alternative 1 and 32 for Water Management Alternative 2. A 9-foot channel would be available in 3 (4 percent) of the modeled years compared to 4 years for Water Management Alternative 1.

4.2.7.2.4 Fish and Wildlife Conservation

Under this alternative, operations to support fish spawning in reservoirs and rivers, consistent with other project purposes, and lockages to promote fish passage at Jim Woodruff Lock and Dam would continue as currently practiced (see section 4.2.1.2.4).

Implementing this alternative would provide somewhat more favorable conditions for fish and wildlife than Water Management Alternative 1. The annual maximum of growing-season (April–October) floodplain connectivity (acres) to the main channel for 30 consecutive days would be 369 acres more; the median fall rate would be 0.12 feet per day (same as for Water Management Alternative 1); and the maximum fall rate would be 2.08 feet per day rather than 2.06. Other performance measures associated with this water management alternative are shown in Table 4.2-21.

Table 4.2-21.
Listed Species Performance Measures for Water Management Alternative 7

Flow	% of years with flow less than	Median number of days/year flow less than	Median number of consecutive days/year flow less than
< 5,000	1.4	0	0
< 6,000	34.2	0	0
< 7,000	47.9	0	0
< 8,000	63.0	6	5
< 9,000	79.5	36	12
< 10,000	91.8	59	26

4.2.7.2.5 Recreation

Under Water Management Alternative 7 (Table 4.2-22), the pool levels during the recreation season would be below the IIL and the RIL more often and below the WAL much more often than under Water Management Alternative 1. At Walter F. George Lock and Dam, pool levels would be below the IIL 143 weeks compared to 16 weeks under Water Management Alternative 1 and below the RIL 6 weeks as compared to no weeks.

Table 4.2-22.
Recreation Water Levels for Water Management Alternative 7

	Project		
	Buford (May-Jul)	**West Point (May-Sep)**	**Walter F. George (Jun-Aug)**
Number of weeks below IIL during period of record	142	333	57
Number of weeks below RIL during period of record	26	46	0
Number of days below WAL during period of record	0	74	0
Percent of time below IIL	15	22	6
Percent of time below RIL	3	3	0
Percent of time below WAL	0	1	0

4.2.7.2.6 Water Quality

The implications of Water Management Alternative 7 relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Water Management Alternative 2 in section 4.2.2.2.6.

4.2.7.2.7 Water Supply

The implications of Water Management Alternative 7 relative to water supply purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Alternative 1 in section 4.2.1.2.7.

4.3 Identification of Water Management Proposed Action Alternative

To assist in identifying the water management alternative that best satisfies the objectives for the Master WCM update, USACE developed a process for ranking the performance of the alternatives based on HEC-ResSim modeling results. Performance measures defined for the various project purposes are described in the following sections. Based on the values of the performance measures resulting from HEC-ResSim modeling, the alternatives were ranked from one (best performance) to seven (worst performance). It is noted that for some performance measures, a low numeric value is preferable to a higher value while for other performance measures a high value is preferable to a lower value. The ranking process took this into account and is described in subsequent sections.

4.3.1 Flood Risk Management

As stated in section 1.4.4, any proposed measure (or alternative) considered in the update process for the Master WCM should maintain at least the current level of flood risk management. None of the water management alternatives considered would change the level of flood risk management provided by the ACF projects. Therefore, water management alternatives were not ranked for this purpose.

4.3.2 Hydroelectric Power Generation

System performance of each water management alternative in achieving the hydropower purpose was ranked on annual hydropower generation and annual weekday hydropower generation. For Buford Dam, West Point Dam, and Walter F. George Dam, in addition to annual hydropower generation and annual weekday hydropower generation, Lowest Annual Hydropower Capacity (MW) was also considered. Generation at Jim Woodruff Dam was not considered because it is a run-of-the-river plant that operates on a continuous (24/7) basis, except during low flow conditions or special maintenance outages. Table 4.3-1 lists the system annual hydropower generation and the system annual weekday hydropower generation together with the rank of each water management alternative in achieving this output. As can be seen from the table, the Water Management Alternative 1 would provide the greatest system hydropower value as well as the highest system annual weekday generation value. Considering both annual hydropower generation and annual weekday hydropower generation, Water Management Alternative 1 would provide system hydropower to a greater extent than the other water management alternatives and was ranked first. It should be noted, however, that the difference in system generation between Water Management Alternative 1 and Water Management Alternative 4 (ranked number 7) is only 0.2 percent and the difference in system weekday generation is only 1.0 percent.

Table 4.3-1.
Ranking Water Management Alternatives for Hydropower System Performance

Water management alternative	Annual system hydropower generation		Annual weekday system hydropower generation		Sum of rankings	Composite system hydropower ranking
	MWh	Rank	MWh	Rank		
1	1,049,030	1	777,458	1	2	**1**
2	1,048,136	4	775,656	5	9	**3**
3	1,046,455	7	776,888	2	9	**3**
4	1,046,647	6	769,835	6	12	**7**
5	1,048,094	5	776,197	4	9	**3**
6	1,048,851	2	767,363	7	9	**3**
7	1,048,230	3	776,704	3	6	**2**

Rankings of hydropower performance for Buford, West Point, and Walter F. George dams are shown in Table 4.3-2, Table 4.3-3, and Table 4.3-4, respectively, and the overall ranking for the hydropower purpose is shown in Table 4.3-5. To derive the overall hydropower ranking, the system and individual project rankings were summed and then ranked based on the sum.

Table 4.3-2.
Ranking Water Management Alternatives for Hydropower Performance at Buford Dam

Water management alternative	Annual hydropower generation		Annual weekday hydropower generation		Buford, Lowest Annual Hydropower Capacity [116.5 MW]		Sum of rankings	Composite hydropower ranking
	MWh	Rank	MWh	Rank	MW	Rank		
1	139,014	4	112,651	1	110.18	1	6	**1**
2	139,087	3	112,012	3	109.84	3	9	**4**
3	138,410	7	110,994	5	109.43	5	17	**5**
4	138,915	5	110,509	6	101.20	7	18	**6**
5	139,090	2	112,102	2	109.70	4	8	**3**
6	138,661	6	105,924	7	108.34	6	19	**7**
7	139,133	1	111,916	4	110.02	2	7	**2**

Table 4.3-3.
Ranking Water Management Alternatives for Hydropower Performance at West Point Dam

Water management alternative	Annual hydropower generation		Annual weekday hydropower generation		West Point, Lowest Annual Hydropower Capacity [85.5 MW]		Sum of rankings	Composite hydropower ranking
	MWh	Rank	MWh	Rank	MW	Rank		
1	181,153	4	137,693	1	85.00	3	8	**1**
2	181,120	5	136,668	4	84.99	5	14	**6**
3	180,850	7	136,447	5	85.01	1	13	**5**
4	180,856	6	135,180	7	84.94	7	20	**7**
5	181,183	2	136,980	3	84.99	4	9	**2**
6	181,184	1	135,253	6	85.00	2	9	**2**
7	181,180	3	137,138	2	84.99	5	10	**4**

Table 4.3-4.
Ranking Water Management Alternatives For Hydropower Performance at Walter F. George Dam

Water management alternative	Annual hydropower generation		Annual weekday hydropower generation		WFG, Lowest Annual Hydropower Capacity [167.6 MW]		Sum of rankings	Composite hydropower ranking
	MWh	Rank	MWh	Rank	MW	Rank		
1	473,494	1	345,231	4	166.27	3	8	**1**
2	472,726	6	345,162	5	166.26	6	17	**7**
3	472,212	7	347,726	1	166.26	4	12	**5**
4	472,948	3	343,036	7	166.32	1	11	**3**
5	472,789	5	345,593	3	166.26	7	15	**6**
6	473,089	2	343,573	6	166.27	2	10	**2**
7	472,797	4	346,054	2	166.26	5	11	**3**

Table 4.3-5.
Ranking Water Management Alternatives for Hydropower Composite Performance

Water management alternative	Composite rankings[a]				Sum of rankings	Composite hydropower ranking
	Buford Dam	West Point Dam	Walter F. George Dam	System		
1	**1**	**1**	**1**	**1**	4	**1**
2	**4**	**6**	**7**	**3**	20	**6**
3	**5**	**5**	**5**	**6**	18	**5**
4	**6**	**7**	**3**	**7**	23	**7**
5	**3**	**2**	**6**	**3**	14	**3**
6	**7**	**2**	**2**	**3**	14	**3**
7	**2**	**4**	**3**	**2**	11	**2**

Note:
[a.] From Table 4.3-2, Table 4.3-3, and Table 4.3-4 respectively.

4.3.3 Navigation

System performance of each water management alternative in providing for navigation was ranked on two criteria:

- Percent of time a 9-foot navigation channel would be available (January–May) in the Apalachicola River based on exceeding a flow of 20,050 cfs at Blountstown
- Percent of time a 7-foot navigation channel would be available (January–May) in the Apalachicola River based on exceeding a flow of 16,200 cfs at Blountstown

The percent availability of the 9-foot and 7-foot channels is shown in Table 4.3-6 together with the rank of each water management alternative in achieving the specified channel depth. As can be seen from the table, Water Management Alternative 3 would provide a 9-foot channel 6.8 percent of the time, more often than any other alternative, and was ranked first. Water Management Alternatives 2 and 7, however, would each provide a 7-foot channel more often than other alternatives. Based on the availability of both the 9-foot and 7-foot channels, Water Management Alternatives 2, 3, 6, and 7 would provide a navigable channel during January–May to a greater extent than the other water management alternatives.

Table 4.3-6.
Ranking Water Management Alternatives on Navigation Performance

Water management alternative	9-foot channel		7-foot channel		Sum of ranking	Composite navigation ranking
	Percent	Rank	Percent	Rank		
1	5.5%	2	20.5%	7	9	**5**
2	4.1%	4	43.8%	1	5	**1**
3	6.8%	1	39.7%	4	5	**1**
4	2.7%	6	39.7%	4	10	**6**
5	2.7%	6	38.4%	6	12	**7**
6	5.5%	2	42.5%	3	5	**1**
7	4.1%	4	43.8%	1	5	**1**

4.3.4 Fish and Wildlife Conservation

The degree to which a water management alternative satisfied the fish and wildlife project purpose was determined based on examination of the following six indicators:

- Percent of years with days < flow
- Median number of days per year < flow
- Median consecutive days per year < flow
- Annual maximum 30-day growing season floodplain connectivity (acres)
- Median fall rates
- Maximum fall rate

The water management alternatives were ranked for each indicator. The first three indicators above can be expressed graphically. For example, Figure 4.3-1 displays the percent of years with flow less than various values for the seven water management alternatives. For these three graphed indicators, the area under the curve was determined for each alternative and ranked with the smallest area receiving the rank of 1 and the largest area receiving the rank of 7. For the floodplain connectivity indicator, the water management alternative with the largest acreage was ranked first and the smallest acreage was ranked last. For the median and maximum fall rates indicators, the water management alternative with the smallest fall rate was ranked first. Table 4.3-7 shows the fish and wildlife conservation performance rankings.

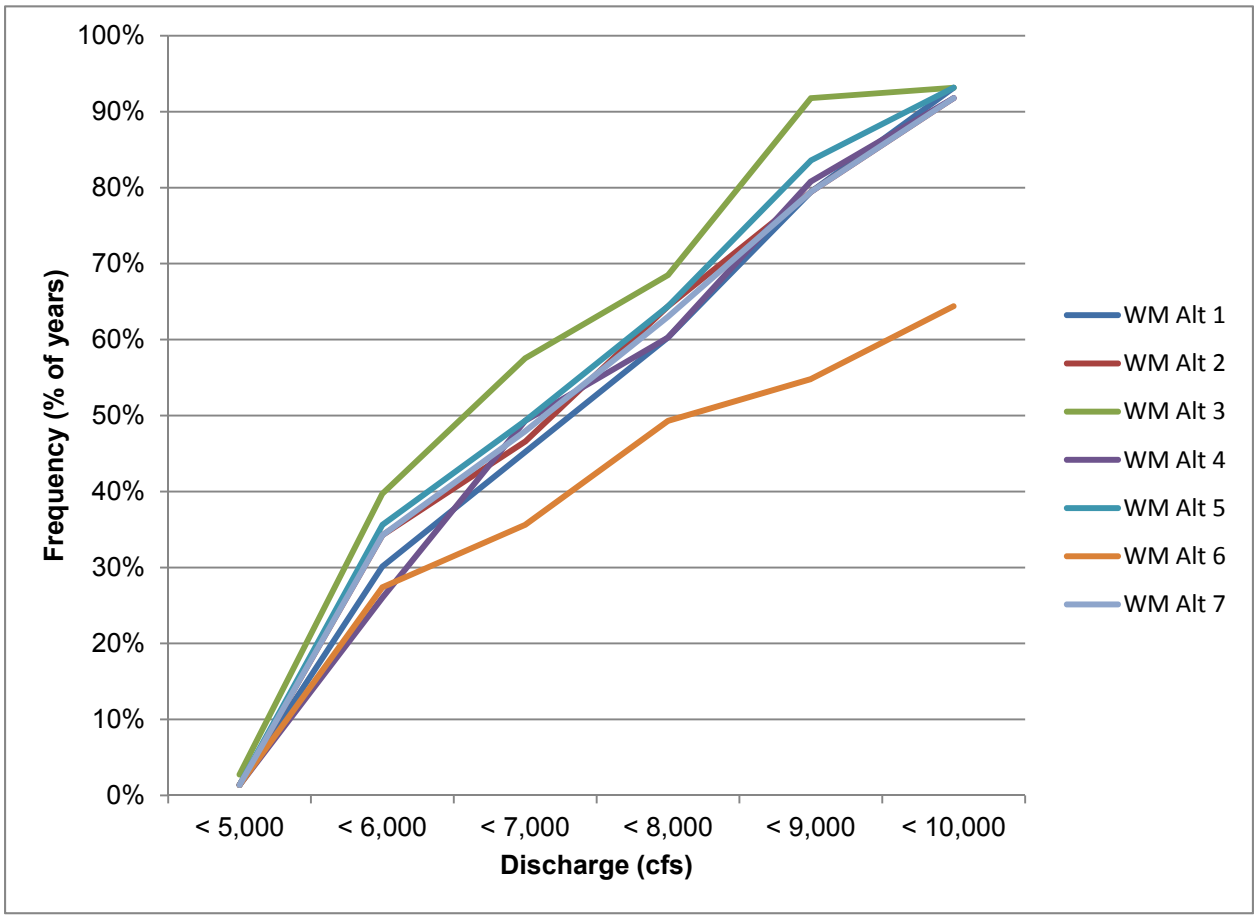

Figure 4.3-1. Percent of years with days of greater flow

Table 4.3-7.
Ranking Water Management Alternatives for Fish and Wildlife Conservation Performance

	WM Alt 1	WM Alt 2	WM Alt 3	WM Alt 4	WM Alt 5	WM Alt 6	WM Alt 7
Percent of years with days < flow	2	4	7	3	6	1	4
Median # days/yr < flow	4	4	7	2	6	1	3
Median # consecutive days/yr < flow	4	2	7	6	4	1	3
Annual maximum 30-day growing season floodplain connectivity (acres)	7	4	2	6	3	1	5
Median fall rates	7	5	2	2	2	1	6
Maximum fall rates	2	4	5	5	5	1	3
Total	26	23	30	24	26	6	24
Ranking	**5**	**2**	**7**	**3**	**5**	**1**	**3**

4.3.5 Recreation

System performance of each water management alternative in achieving the recreation purpose was based on several measures at Lake Lanier, West Point Lake, and Walter F. George Lake as follows:

- Number of weeks below IIL during the recreation season during period of record
- Number of weeks below RIL during the recreation season during period of record
- Number of days below WAL during the recreation season during period of record
- Percent of time below IIL during the recreation season
- Percent of time below RIL during the recreation season
- Percent of time below WAL during the recreation season

Table 4.3-8 illustrates the ranking of alternatives in achieving the recreation purpose at Lake Lanier. As shown in the table, the water surface elevation under the Water Management Alternative 1 falls below the initial impact line (1,066 ft) for 119 days, less than any other water management alternative. The performance of Water Management Alternative 1 at Lake Lanier is also ranked better than the other alternatives for the other performance measures. Rankings of water management alternatives for West Point and Walter F. George lakes are shown in Table 4.3-9 and Table 4.3-10, respectively.

Table 4.3-8.
Ranking Water Management Alternatives for Recreation Performance at Lake Lanier

Water management alternative	Number of weeks below IIL (1,066')		Number of weeks below RIL (1,063')		Number of days below WAL (1,060')		Percent of time below IIL (1,066')		Percent of time below RIL (1,063')		Percent of time below WAL (1,060')		Sum of rankings	Composite recreation ranking for Lake Lanier
	Weeks	Rank	Weeks	Rank	Days	Rank	%	Rank	%	Rank	%	Rank		
1	119	1	19	1	0	1	12.7	1	2.1	1	0	1	6	**1**
2	178	3	30	3	0	1	19.1	3	3	3	0	1	14	**3**
3	216	5	45	5	14	5	23.2	5	5	5	0	5	30	**5**
4	236	6	64	7	185	7	25.0	6	7	7	3	7	40	**7**
5	179	4	33	4	0	1	19.3	4	4	4	0	1	18	**4**
6	253	7	52	6	55	6	27.1	7	6	6	1	6	38	**6**
7	142	2	26	2	0	1	15.2	2	3	2	0	1	10	**2**

Table 4.3-9.
Ranking Water Management Alternatives for Recreation Performance at West Point

Water management alternative	Number of weeks below IIL (632.5')		Number of weeks below RIL (629')		Number of days below WAL (627')		Percent of time below IIL (632.5')		Percent of time below RIL (629')		Percent of time below WAL (627')		Sum of rankings	Composite recreation ranking for West Point Lake
	Weeks	Rank	Weeks	Rank	Days	Rank	%	Rank	%	Rank	%	Rank		
1	300	1	45	1	109	5	20	1	3	1	1	5	14	**2**
2	378	4	63	4	105	3	25	4	4	4	1	3	22	**4**
3	518	6	80	5	103	2	36	7	5	5	1	2	27	**5**
4	510	5	107	6	247	7	34	5	7	6	2	7	36	**6**
5	337	3	54	3	108	4	23	3	4	3	1	4	20	**3**
6	529	7	112	7	182	6	35	6	7	7	2	6	39	**7**
7	333	2	46	2	74	1	22	2	3	2	1	1	10	**1**

Table 4.3-10.
Ranking Water Management Alternatives for Recreation Performance at Walter F. George

Water management alternative	Number of weeks below IIL (187')		Number of weeks below RIL (185')		Number of days below WAL (184')		Percent of time below IIL (187')		Percent of time below RIL (185')		Percent of time below WAL (184')		Sum of rankings	Composite recreation ranking for Walter F. George Lake
	Weeks	Rank	Weeks	Rank	Days	Rank	%	Rank	%	Rank	%	Rank		
1	16	1	0	1	0	1	2	1	0	1	0	1	6	**1**
2	83	4	0	1	0	1	9	4	0	3	0	1	14	**3**
3	94	5	1	4	0	1	10	5	0	6	0	1	22	**5**
4	143	6	6	7	0	1	16	6	0	7	0	1	28	**7**
5	76	3	1	4	0	1	8	3	0	4	0	1	16	**4**
6	151	7	1	4	0	1	16	7	0	5	0	1	25	**6**
7	57	2	0	1	0	1	6	2	0	2	0	1	9	**2**

Similar rankings for the recreation purpose were developed for West Point Lake and Walter F. George Lake and a systemwide ranking of alternatives for the recreation purpose was derived as shown in Table 4.3-11.

Table 4.3-11.
Ranking Water Management Alternatives for Recreation Composite Performance

Water management alternative	Lake Lanier ranking	West Point Lake ranking	Walter F. George Lake ranking	Sum of rankings	Composite ranking
1	**1**	**2**	**1**	4	**1**
2	**3**	**4**	**3**	10	**3**
3	**5**	**5**	**5**	15	**5**
4	**7**	**6**	**7**	20	**7**
5	**4**	**3**	**4**	11	**4**
6	**6**	**7**	**6**	19	**6**
7	**2**	**1**	**2**	5	**2**

4.3.6 Water Supply

The ability of a water management alternative to satisfy the water supply purpose was based on examining six parameters reflecting the adequacy of the conservation storage of Lake Lanier to provide the 20 mgd the relocation contracts and 277 mgd downstream withdrawals as follows:

- Buford project minimum pool elevation (ft)
- Buford project percent time Storage >/= Zone 1 (%)
- Buford project years in or below Zone 3 by December 1
- Percent time refill from Zone 3 to Zone 1 by May1 the next year
- Buford project percent time at full pool by May 1 (1,071 ft)
- Percent time Buford project pool elevation > 1,066 ft during period of record

In the ResSim modeling the water supply, demand of the each water management alternative was met; the remaining storage, however, would impact the ability to meet that same demand during more severe drought conditions. Although the water supply demand was not curtailed during the modeled drought periods, there was a use of storage to meet the water supply demand in conjunction with other authorized project purposes. The demands for the other project purposes varied with each alternative and holding the water demand constant with each alternative allowed a comparison of impacts on other project purposes. As the remaining storage in Lake Lanier varied with each alternative, the yield of the remaining storage to meet the water supply demand from the lake also varied. The six parameters listed above are surrogate measures of remaining storage in the lake and capability to meet water supply demand during more severe hydrologic conditions. Consequently, there is lower risk of water supply shortage with increased available water in storage as measured by the six parameters. Therefore the higher pool elevations result in lower risk of water supply demand shortages during more severe conditions.The values for the parameters shown in Table 4.3-12 were ranked as shown in Table 4.3-13. Based on this ranking, Water Management Alternative 7 provides the best support of the water supply purpose.

Table 4.3-12.
Water Supply Performance for Water Management Alternatives at Lake Lanier

Water management alternative	Buford project minimum pool elevation (ft)	Buford project percent time storage >/= Zone 1 (%)	Buford project years in or below Zone 3 by December 1	Percent time refill from Zone 3 to Zone 1 by May 1 the next year	Buford project percent time at full pool by May 1 (1,071 ft)	Percent time Buford project pool elevation > 1,066 ft
1	1055.70	68%	14	31%	66%	76%
2	1054.00	69%	14	46%	67%	76%
3	1053.60	60%	14	46%	59%	69%
4	1045.50	61%	13	33%	47%	70%
5	1053.90	69%	13	42%	56%	76%
6	1052.00	53%	15	21%	40%	65%
7	1054.20	70%	12	55%	68%	78%

Table 4.3-13.
Ranking Water Management Alternatives for Water Supply Performance at Lake Lanier

Water management alternative	Buford project minimum pool elevation (ft) Rank	Buford project percent time storage >/= Zone 1 (%) Rank	Buford project years in or below Zone 3 by December 1 Rank	Percent time refill from Zone 3 to Zone 1 by May 1 the next year Rank	Buford project percent time at full pool by May 1 (1,071 ft) Rank	Percent time Buford project pool elevation > 1,066 ft Rank	Sum of ranks	Composite ranking
1	1	4	4	6	3	4	22	**4**
2	3	3	4	2	2	3	17	**2**
3	5	6	4	2	4	6	27	**5**
4	7	5	2	5	6	5	30	**6**
5	4	2	2	4	5	2	19	**3**
6	6	7	7	7	7	7	41	**7**
7	2	1	1	1	1	1	7	**1**

4.3.7 Water Management Proposed Action Alternative

After ranking the water management alternatives based on how well they achieved the authorized project purposes, an overall ranking of the water management alternatives was developed as shown in Table 4.3-14. The water management alternative that best balances the authorized project purposes is Water Management Alternative 7 and is the Water Management Proposed Action Alternative.

Table 4.3-14.
Composite Ranking of Water Management Alternatives

Water management alternative	Composite ranking						
	Navigation	Hydropower	Recreation	Fish & wildlife	Water supply	Sum of rankings	Composite ranking
1	**5**	**1**	**1**	**5**	**4**	16	**3**
2	**1**	**6**	**3**	**2**	**2**	14	**2**
3	**1**	**5**	**5**	**7**	**5**	23	**6**
4	**6**	**7**	**7**	**3**	**6**	29	**7**
5	**7**	**3**	**4**	**5**	**3**	22	**5**
6	**1**	**3**	**6**	**1**	**7**	18	**4**
7	**1**	**2**	**2**	**3**	**1**	9	**1**

5 Development and Description of Proposed Action and Alternatives

As discussed in section 4, the approach to formulating plans adopted in this EIS employed two phases.

- In the first phase, water management measures were identified and screened to identify the set of measures that were combined into water management alternatives. The water management alternatives were then evaluated and ranked based on performance metrics. The result of alternative formulation phase I was identifying Water Management Alternative 7 as the Water Management Proposed Action Alternative.
- In the second phase of alternative formulation, measures for considering whether and how to accommodate current and future water supply demand, up to and including the Georgia 2013 request for water supply from Lake Lanier and for downstream withdrawers, were identified and screened to identify the set of measures that were then combined with either Water Management Alternative 1 or Water Management Alternative 7 to form alternatives that were evaluated in detail. The PAA resulting from this 2-phased formulation process will consist of the Water Management Proposed Action Alternative and a proposed action alternative for providing water supply to Metro Atlanta.

5.1 Alternatives Formulation

In addition to the water management challenges identified in section 4.2, there are problems related to water supply for Metro Atlanta that will be addressed by the Master WCM update process, WSSA, and EIS. Up to 128 million gallons per day (mgd) of water is being withdrawn from Lake Lanier without storage agreements. With the exception of two relocation agreements signed in the 1950s, all contractual agreements for water supply withdrawals from Lake Lanier were terminated in 1990. There have been several attempts at resolution (e.g., MOA, Comprehensive Study, ACF Interstate River Basin Compact, court-ordered mediation, and administration-led negotiations), during which the parties (i.e., Alabama, Georgia, and Florida) informally agreed to a 'live and let live' policy, which allowed water supply providers without storage agreements to continue current withdrawals and make reasonable increases in those withdrawals until a resolution was achieved. No mutually agreeable resolution among the states has been achieved and no water supply agreements have been executed (apart from the aforementioned relocation agreements).

The state of Georgia's 2013 request indicates that withdrawals from Lake Lanier in 2040 amounting to 297 mgd are needed to satisfy the needs of communities currently withdrawing from Lake Lanier under existing or expired contracts (e.g., Gwinnett County, Gainesville, Buford, and the City of Cumming/Forsyth County) as well as communities located upstream of Lake Lanier (e.g., Dawson, Habersham, Lumpkin, and White Counties and localities in those counties). Withdrawals downstream at Atlanta are currently accommodated by releases from Buford Dam as an originally authorized project purpose; 277 mgd are withdrawn downstream, and Georgia has projected an increase of these withdrawals to 408 mgd by 2040. The draft 1989 WCM that has guided project operations does not describe operations for providing 408 mgd as part of project operations. Additionally, no water supply storage has been formally allocated in Lake Lanier, for either current or future withdrawals. Therefore, the following problems with regard to water supply have been identified and will be addressed in the WSSA, the WCM update process, and this EIS:

- Current operations accommodate withdrawals that are not reflected in current water supply storage agreements, and would require execution of a storage agreement to continue under an updated Master WCM.

- Current operations of Buford Dam do not reflect the operations for downstream municipal and industrial water supply identified in Georgia's 2013 request.
- Current operations of Buford Dam and Lake Lanier do not provide for Georgia's 2013 request for withdrawals from Lake Lanier for municipal and industrial water supply.

After identifying the water supply problems, USACE developed objectives for the WSSA to address the issues. In the context of this EIS, an "objective" is a statement of what the updated WCM and the WSSA should try to achieve. Accordingly, the following objectives have been developed:

- To improve system operation to provide for Georgia's current and 2040 water supply demand downstream of Buford Dam and withdrawals that are currently authorized from Lake Lanier.
- To determine whether, and in what amount, to reallocate storage in Lake Lanier to support environmentally sustainable withdrawals for municipal and industrial water supply while ensuring a sufficient quantity of water is available to meet other authorized project purposes of the ACF project.

5.1.1 Water Supply Measures Eliminated from Further Consideration (First Screening)

Water supply management measures eliminated from further consideration were those that did not pass the screening criteria presented in section 1.4.4. Further, in the scoping comments received, a number of specific management measures (or alternatives) were identified that were found to be outside the scope of this EIS. Specific management measures (or alternatives) identified in scoping that were eliminated from consideration for further evaluation are presented in detail in Appendix D. The scope of this EIS and WSSA with respect to water supply is limited to considering Georgia's 2013 request. Accordingly, any measure proposed during public scoping that recommended addressing the water supply needs of any other entities not included in Georgia's 2013 request were not carried further for consideration.

5.1.2 Water Supply Measures Considered for Further Evaluation

Based on the June 2011 11th Circuit Court of Appeals ruling and the USACE legal opinion of June 25, 2012, USACE has concluded that it has sufficient authority under the original Buford Dam project authorization (the 1946 River and Harbor Act), the Water Supply Act of 1958, and the 1956 Act specific to Gwinnett County, to accommodate both the current level of releases from Buford Dam and direct withdrawals from Lake Lanier for water supply (see section 3.5.2.8.2). For analytical purposes, the EIS and WSSA assume that withdrawals from Lake Lanier at either current levels or increased levels, would be accommodated by a reallocation of storage under the Water Supply Act; whether some subset of those withdrawals might be accommodated instead under the authority or the 1956 Act would not affect the impacts analysis.[6] Releases from Buford Dam at current levels or increased levels would be authorized by the 1946 River and Harbor Act. Accordingly, USACE is concurrently performing an assessment of a possible storage reallocation to accommodate *current levels* of releases and withdrawals for water supply from Lake Lanier as well as increased levels of withdrawals both downstream and from Lake Lanier as specified in Georgia's 2013 request.

[6] Unless otherwise noted, discussion throughout this EIS of a reallocation of storage to accommodate withdrawals from Lake Lanier assumes that such storage would be subject to a Water Supply Act agreement, encompassing the withdrawals that might otherwise be accommodated under an agreement pursuant to the 1956 Act.

In addressing the downstream needs for water supply, the updated Master WCM and EIS will consider two levels of water supply for downstream Atlanta:

- 277 mgd (current withdrawals)
- 408 mgd (Georgia's 2013 request)

Another source of water supply being considered by the WSSA in conjunction with potential reallocation of storage is Glades Reservoir. As discussed in section 2.1.1.1.6.10, the Hall County, Georgia, Board of Commissioners has applied for a Department of the Army permit for a proposed water supply reservoir project (Glades Reservoir) to be located in Hall County to operate as part of a public water supply system. Since this project is still in the permitting process, it is not known whether or when the project will be implemented. In considering alternative measures for water supply, however, Glades Reservoir will be taken into account together with other water supply measures to satisfy Georgia's 2013 request. The assumption that Glades Reservoir would be constructed is made for analytical purposes only and does not constitute an agency decision on the merits of the project. As stated in section 2.1.1.1.6.10, the method of operation of Glades Reservoir involves storing water pumped from the Chattahoochee River upstream of Lake Lanier, as well as natural streamflow from Flat Creek. It should be noted that the HEC-ResSim modeling of the alternatives, including water supply from Glades Reservoir, assumed that water would be transported by pipeline to Gainesville for treatment and distribution with return flows to Lake Lanier.

The measures listed below have been identified for satisfying Georgia's 2013 request for M&I water supply from Lake Lanier. Additional alternatives were considered in the economic analysis described in Appendix B and an evaluation was made to determine the next least costly alternative. Alternatives that were carried forward in this EIS include the following:

- Conservation
- Groundwater
- Desalination and pumping to the service areas
- Existing surface water sources (other than Lake Lanier)
- Reallocation from flood control pool
- Reallocation from inactive storage
- Glades Reservoir
- Reallocation from conservation pool
- Reallocation from conservation pool with Glades Reservoir

5.1.3 Water Supply Measures Eliminated from Detailed Evaluation (Second Screening)

The measures for satisfying Georgia's 2013 request for M&I water supply from Lake Lanier identified above were considered and a preliminary evaluation was performed. When deciding which measures to consider in a more detailed evaluation, USACE assessed the results of the preliminary analysis against the screening criteria described in section 1.4. The results of the preliminary evaluation and screening process are described in the following paragraphs.

5.1.3.1 Conservation

Conservation is often the first step in reducing consumption and overall demand for water supply. Water providers within the district have been implementing multiple conservation measures to reduce demand. Conservation has been an important focus of the Metropolitan North Georgia Water Planning District (MNGWPD) and is a cornerstone of their water supply plan. Measures include conservation pricing, leak

detection and repair, plumbing and toilet retrofit programs, education programs, multifamily submetering, and water recycling (e.g., car washes). In 2011 per capita water use for the metro area was 148 gpcd (gallons per capita per day). GAEPD projects water use will decrease to an average of 135 gpcd by 2040. It is unlikely that additional conservation measures would result in a significant reduction in Georgia's 2040 need. To the extent that the MNGWPD adopts additional conservation measures, Georgia's 2013 request will satisfy needs beyond 2040. A more detailed summary of MNGWPD conservation-related activities is available in Appendix G.

5.1.3.2 Groundwater

Following the Phase I ruling of the Federal District Court for the Middle District Court of Florida in July 2009, the State of Georgia created the Water Task Force to develop a contingency plan to prioritize a set of water conservation and water supply options. The report detailed options for meeting the water supply needs of current and future Lake Lanier users if water withdrawals from Lake Lanier and releases from Buford Dam were halted. The report was prepared by a collection of A-E firms and stakeholders. In the Georgia Water Task Force Report that was completed in 2009 (GWCTF 2009), groundwater was evaluated as a potential option to meet the water supply needs of the stakeholders. The potential ground water sources identified were either for non-potable reuse or were located in isolated areas and in relatively small quantities and would not be readily available to water supply systems dependent on Lake Lanier. Groundwater resources in MNGWPD are limited in quantity and are quite costly compared to other options; therefore, they are not considered adequate potential sources of water supply and were eliminated from further evaluation.

5.1.3.3 Desalinization

In the Georgia Water Task Force Report, desalinization was evaluated as a potential option to meet the water supply needs of the stakeholders. The study showed an estimated cost of approximately $21 billion over the project life. While the preliminary evaluation showed that this option could supply approximately 200 million gallons per day, this was seen as the most expensive option and, therefore, is not carried forward in this evaluation.

5.1.3.4 Existing Surface Water Sources (other than Lake Lanier)

The Georgia Water Task Force Report also evaluated the feasibility of existing surface water sources to meet the need if Lake Lanier and Buford Dam could no longer be operated for water supply. Potential sources include Lake Burton, West Point Lake, Lake Hartwell, and Nickajack Reservoir. Several of these sources would require inter-basin transfer agreements or legislation. Further, based on information in the report, none of these sources would satisfy the 2040 water supply need. All of these transfers were considered contentious or highly contentious by the stakeholders involved. Additionally, obtaining water from another USACE reservoir would require reallocation of storage. Existing surface water sources were not carried forward for further evaluation.

5.1.3.5 Reallocation from Flood Control Storage and Inactive Storage

Flood storage at Buford Reservoir exists between elevations 1071 and 1085 and consists of 598,800 ac-ft. Reallocation from the flood pool could accommodate a portion of the future demand; however, reallocation from the flood control pool will not be carried forward for further evaluation for several reasons. Reallocation from the Lanier flood pool would represent an increased flood risk because compromised downstream channel capacity and development encroachment restrict Lanier flood water releases from Buford Dam to 10,000 cfs. Because flood releases must be limited to 10,000 cfs, it is necessary to maintain maximum amount of flood storage. Additionally, a permanent incursion into the

flood pool could represent a dam safety risk due to saddle dike leaks that would increase as flood waters are retained, as well as increased guide curve elevations that could impact recreation facilities and private property resulting in significant economic impacts and increased shoreline erosion.

Reallocation from inactive storage was considered and eliminated from further consideration because the Buford Dam hydropower project is designed with head limits at the bottom of the conservation pool. Hydropower generation utilizing water from the inactive pool damages equipment and is inefficient. The design of hydropower equipment at Buford Dam is optimized to function within the head range which corresponds to the conservation pool. Operation below the minimum rated head (bottom of conservation pool, inactive pool) would result in excessive cavitation and often vibration which could damage equipment. In addition operation in this range would decrease the efficiency and output of the unit.

5.1.3.6 Glades Reservoir

As stated in Section 2.1.1.1.6.10, Glades Reservoir is estimated to have a safe yield of 72.5 mgd on an annual average daily basis. Georgia's 2013 request, however, assumed that the reservoir would yield 30-40 mgd. And, while this reservoir is not a complete solution to the region's water supply needs as identified in Georgia's 2013 request, it can be part of a more comprehensive plan. Accordingly, Glades Reservoir was combined with other water supply measures to form more complete alternatives. For analytical purposes, USACE assumed that Glades Reservoir would have a yield of 40 mgd.

5.1.4 Water Supply Measures Combined into Alternatives

Following the second screening, two measures remain for detailed evaluation. Those measures are:

- Reallocation from conservation pool
- Reallocation from conservation pool with Glades Reservoir

5.1.4.1 Return Rates

Responding to Georgia's request involved considering not only the quantity of water requested, but also the rates at which treated wastewater would be returned to Lake Lanier and downstream and alternative methods of satisfying the requested quantity of water supply. The following paragraphs describe the return rates considered for the various water supply measures.

5.1.4.1.1 Returns to Lake Lanier

Of the 128 mgd currently being withdrawn from Lake Lanier, current waste treatment infrastructure returns 37 mgd, a return rate of 29 percent (37/128=0.29). This return rate will be used for water supply option A, as shown in Table 5.1-2. For water supply options B and C, which considered a withdrawal of only 20 mgd, a 50 percent return rate was selected based on the capacity of the existing wastewater treatment infrastructure.

The analysis that accompanied Georgia's 2013 water supply request for 297 mgd assumed that in 2040, 165 mgd would be returned to Lake Lanier and its upstream tributaries resulting in a return rate of 55 percent (165/297= 0.55). This return rate was used for water supply options D and E.

Wastewater treatment plans developed by the MNGWPD identify new water treatment plants and plant expansions that in the future (2035) would return a greater volume of water to Lake Lanier than currently occurs. USACE reviewed the current wastewater infrastructure returning to Lake Lanier as published in the MNGWPD Wastewater Plan to determine the total treatment capacity of the existing treatment plants, as well as planned plant expansions and new plants, anticipated by 2035. These plants and their current

and expected expansions by 2035 are shown in Table 5.1-1. Additionally, USACE developed information regarding the percent of capacity at which the existing plants are currently operating. This analysis determined that, on average, all plants are currently operating at about 58 percent of capacity. Based on the new plants and plant expansions identified by the MNGWPD Wastewater Plan for 2035, USACE estimated that the total treatment capacity of all plants would be about 157 mgd, as shown in Table 5.1-1. Based on this analysis, achieving the 55 percent rate of return (165 mgd) indicated in Georgia's 2013 request would not be possible based on the waste treatment infrastructure expected to be in place by 2035. With the plants expected to be in-place by 2035 operating at 58 percent capacity, consistent with current operations, however, they would more realistically be capable of returning 91 mgd (157 mgd x .58=91 mgd) to Lake Lanier. This return volume was used for water supply option F, which resulted in a return rate of 30.6 percent (91/297= 0.306).

The 43 percent return rate used for water supply option G represents the maximum treatment capacity of the existing waste treatment infrastructure in 2035. Option G, however, was not carried forward for more detailed consideration because it is not reasonable to expect waste treatment plants to operate at their maximum capacities on a consistent basis. Additionally, the impacts of this alternative would fall between two other alternatives that were considered in more detail.

Table 5.1-1.
Current and 2035 Expanded Waterwater Treatment Plant Capacities above Buford Dam

Treatment Plant	County	NPDES Permit Discharge Limit (Monthly Avg mgd)	Current Plant Capacity (mgd)	2035 Expanded Plant Capacity (mgd)	Total Capacity in 2035 (mgd)
Clarkesville WPCP	Habersham	0.75	0.75		0.75
Demorest WPCP	Habersham	0.4	0.4		0.4
Cornelia WPCP	Habersham	3	3		3
Baldwin WPCP	Habersham	0.8	0.8		0.8
Cleveland WPCP	White	0.75	0.75		0.75
Dahlonega WPCP	Lumpkin	1.44	1.44		1.44
Limpkin Co. WPCP (proposed)	Lumpkin		0		0
Gainesville #2, Linwood WPCP	Hall	5	5	9	14
Gainesville #1, Flat Creek	Hall	12	12	6	18
Flowery Branch WPCP	Hall	0.4	0.91	8.09	9
Spout Springs LAS (proposed)	Hall		0.75	10.25	11
Hall County (proposed)	Hall		0	6	6
Lula WPCP (proposed)	Hall		0	1.8	1.8
F Wayne Hill	Gwinnett	40	40	25	65
Cumming Lake Lanier WRF (proposed)	Forsyth		0	15	15
Forsyth Lake Lanier WRF (proposed)	Forsyth		0	10	10
TOTAL		**64.54**	**65.8**	**91.14**	**156.94**

A preliminary evaluation of the effects of providing various levels of water supply from Lake Lanier indicated that Georgia's 2013 request for withdrawing 297 mgd and returning 55 percent, for a net withdrawal of 134 mgd, would satisfy both of the objectives identified in section 5.1. The project team also determined that the environmental effects associated with a net withdrawal of 134 mgd showed no change from the No Action Alternative or, for the most part, only slightly adverse effects. However, the return rate assumed in Georgia's request would require the waste treatment infrastructure expected to be in place by 2040 to operate at or near capacity. As stated above, this assumption seemed unreasonable. Accordingly, based on the analysis of potential future wastewater returns to Lake Lanier described above, USACE determined that a return of treated wastewater amounting to 91 mgd would be a more realistic estimate of potential wastewater returns by the future wastewater infrastructure, requiring the facilities to operate at 58 percent of capacity. Adding net withdrawals of 134 mgd (a net withdrawal that can be accommodated while satisfying other objectives) and returns of 91 mgd (the expected return in 2040) results in a figure of 225 mgd in gross withdrawal that can be supported by some combination of Lake Lanier and Glades Reservoir. Based on this rationale, water supply option H was developed whereby 20 mgd would be withdrawn from Lake Lanier under relocation contracts, storage in Lake Lanier would be reallocated to support gross withdrawals of 165 mgd, and Glades Reservoir would provide an additional 40 mgd for a total withdrawal for the ACF system above Buford Dam of 225 mgd. Under this option, the return rate would be 40.4 percent (91/225= .404).

5.1.4.1.2 Returns to the Chattahoochee River

To determine the return rate for Metro Atlanta (Buford to Whitesburg), data were obtained for withdrawals of water from the Chattahoochee River and discharges of treated wastewater to the Chattahoochee River. This comparison for 2012 yielded a return rate of 82 percent, the return rate that was used for water supply options A, B, C, and F, as shown in Table 5.1-2.

Georgia's 2013 request for 408 mgd from the Chattahoochee River also assumed that 384 mgd would be returned to the river, resulting in a return rate of 94 percent (384/408=0.94). USACE determined that this return rate was reasonable. This return rate was used for water supply options D, E, and H.

A third return rate considered was based on the maximum wastewater treatment plant capacity in 2035 (MNGWPD 2009), resulting in a return rate of 117 percent. This return rate represents the maximum treatment capacity of the existing waste treatment infrastructure in 2035 and was used with water supply option G. As noted above, this water supply option was not carried forward for more detailed consideration because it is not reasonable to expect waste treatment plants to operate at their maximum capacities on a consistent basis. Water supply options to be considered in this EIS consist of combinations of downstream withdrawals and withdrawals of various quantities from and return rates to Lake Lanier as shown in Table 5.1-2.

Table 5.1-2.
Water Supply Options Considered

Water supply option	Lake Lanier relocation (mgd)	Lake Lanier reallocation (mgd)	Lake Lanier total withdrawals (mgd)	Lake Lanier returns (mgd/% returned)	Glades Reservoir withdrawals (mgd)	Glades Reservoir returns (mgd/% returned)	Net Returns to Lake Lanier (mgd)	Storage required to support reallocation (ac-ft)	River withdrawals (mgd)	River returns (mgd/% returned
A – No Action	20	108	128	37/29%	0	0	91	124,034	277	227/82%
B – Relocation only	20	0	20	10/50%	0	0	10	n/a	277	227/82%
C – Future without project condition (w/ Glades pumping)	20	0	20	10/50%	40	20/50%	30	n/a	408	335/82%
D – GA 2013 request	20	277	297	163/55%	0	0	134	318,126	408	384/94%
E – GA 2013 request w/ Glades pumping	20	237	257	141/55%	40	22/55%	134	272,187	408	384/94%
F – GA 2013, projected return volume for 2035	20	277	297	91/30.6%	0	0	206	318,126	408	335/82%
G – GA 2013 max treatment facility capacity	20	277	297	128/43%	0	0	169	*	408	477/117%
H – Projected return volume for 2035 w/ Glades pumping	20	165	185	75/40.4%	40	16/40.4%	134	189,497	408	384/94%

Note: * Storage for this water supply option was not computed because this option was not carried forward for further consideration as explained in section 5.1.4.1.1.

5.2 Development and Description Proposed Action and Alternatives

The alternatives described in subsequent sections combine either Water Management Alternative 1 described in section 4.2.1 or Water Management Alternative 7 (i.e., the Water Management Proposed Action Alternative described in section 4.2.7) with one of the water supply options A through H shown in Table 5.1-2. The alternatives are identified by the number of the water management plan followed by the letter designating the water supply option included in the alternative. Table 5.2-1shows the combination of water management plans and water supply options considered as alternatives. An "X" in Table 5.2-1is used to indicate which water management measures are included in Water Management Alternative 1 and Water Management Alternative 7.

The following paragraphs summarize each alternative and make comparisons to Alternative 1. As a result of the comparisons of alternatives in this section, the PAA was identified. All alternatives, however, were evaluated in detail and the environmental consequences are described in section 6.

5.2.1 No Action Alternative (Alternative 1A)

5.2.1.1 Description of No Action Alternative

The No Action Alternative (NAA) combines the Water Management Alternative 1 with water supply option A as shown in Table 5.2-1 and is also referred to as Alternative 1A, or Alt1A. As stated in section 4.2.1.1, the NAA represents no change from the current management direction or level of management intensity. Alt1A would represent continuation of the current water control operations at each of the federal projects in the ACF Basin. Basinwide management of all seven project purposes (i.e., flood risk management, hydroelectric power generation, navigation, fish and wildlife conservation, recreation, water quality, and water supply) is also considered in the alternative. The CEQ regulations for implementing NEPA require detailed analysis of the NAA (40 CFR 1502.14); therefore, the alternative was carried forward for further evaluation.

5.2.1.2 Performance Relative to Authorized Purposes

5.2.1.2.1 Flood Risk Management

Under NAA, flood risk management operations would continue as they have since 1989.

Table 5.2-1.
Summary of Water Management / Water Supply Alternatives

Water Management Measures			Water management / water supply alternatives								
			1A	1B	1C	7A	7C	7D	7E	7F	7H
Guide Curves	Maintain existing guide curve		X	X	X	X	X	X	X	X	X
Action Zones	Maintain existing action zones		X	X	X						
	Revised Level 1 action zones					X	X	X	X	X	X
Drought Operations	Drought operations trigger *		Zone 4	Zone 4	Zone 4	Zone 3	Zone 3	Zone 3	Zone 3	Zone 3	Zone 3
	Extreme drought operations		X	X	X	X	X	X	X	X	X
	Drought operations suspension trigger *		Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1
Peachtree Creek Minimum Flows	Current (750 cfs)		X	X	X						
	Seasonal flow (750 cfs / 650 cfs)					X	X	X	X	X	X
Hydropower Generation	Current generation schedule		X	X	X						
	Modified generation schedule with drought operations					X	X	X	X	X	X
Navigation	Current-no navigation operations		X	X	X						
	4/5 Month					X	X	X	X	X	X
Basin Inflow	Current computational method		X	X	X	X	X	X	X	X	X
Fish and Wildlife	Current fish spawn and passage		X	X	X	X	X	X	X	X	X
Listed Species Management	RIOP May 2012		X	X	X						
	Ramping Rate	Current ramping rate**	X	X	X	X	X	X	X	X	X
		Suspend during prolonged low flow				X	X	X	X	X	X
		Suspend in drought*	X	X	X	X	X	X	X	X	X
	Current (seasonal) minimum flow provision**		X	X	X	X	X	X	X	X	X
Water Supply Options (EIS Table 5.1-1)***	A – No action		L=128 D=408			L=128 D=408					
	B – Relocation contracts only (in Lake Lanier)			L=20 D=277							
	C – Future without project condition (with Glades Reservoir pumping)				L=20 G=40 D=408		L=20 G=40 D=408				
	D – GA 2013 request							L=297 D=408			
	E – GA 2013 request (with Glades Reservoir pumping)								L=257 G=40 D=408		
	F – GA 2013 (projected return volume for 2035)									L=297 D=408	
	H – GA 2013 (projected return volume for 2035 with Glades Reservoir pumping)										L=185 G=40 D=408

Notes:* Based upon composite conservation storage zones (cumulative conservation storage [by zone] for USACE ACF reservoirs [Lanier, West Point, and Walter F. George]).

**Component of the May 2012 RIOP.

***Numbers indicate withdrawals in mgd from Lake Lanier (L), Glades Reservoir (G), and the Chattahoochee River downstream (D) of Buford Dam.

5.2.1.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,026,012 MWh and system annual weekday generation of 761,572 MWh. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-2.

Table 5.2-2.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	126,321	103,144
West Point	176,587	134,866
Walter F. George	468,218	342,138

5.2.1.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 20.5 percent of the time and a 9-foot channel would be available 2.7 percent of the time.

5.2.1.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would not be expected to drop below 5,000 cfs over the period of record and the system would be in drought operations 7 percent of the time. Extreme drought operations would not be triggered in the NAA.

5.2.1.2.5 Recreation

Table 5.2-3 shows, for each USACE project, the percent of time the reservoir level is below the various impact levels during the recreation season for the NAA.

Table 5.2-3.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	17	5	1
West Point	21	3	1
Walter F. George	3	0	0

5.2.1.2.6 Water Quality

Under the NAA Buford Dam, West Point Dam, and Jim Woodruff Lock and Dam all provide continuous minimum releases which, in addition to meeting other project purposes and providing associated benefits, also benefits downstream water quality. At West Point Dam, a small generating unit provides a continuous release of approximately 675 cfs. In addition to these flows, Buford Dam is operated in conjunction with the downstream GPC Morgan Falls Dam to ensure a minimum in-stream flow of 750 cfs on the Chattahoochee River at Peachtree Creek to meet state water quality commitments.

5.2.1.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the current need of 277 mgd for downstream withdrawals by metro Atlanta water providers and current withdrawals from Lake Lanier amounting to 128 mgd, including 20 mgd for the relocation contracts. The minimum reservoir elevation under this alternative would be 1,054.5 ft, and Lake Lanier would be in Zone 1 60 percent of the time.

5.2.2 Alternative 1B

5.2.2.1 Description of Alternative 1B

This alternative combines Water Management Alternative 1 with water supply option B as shown in Table 5.2-1 and is also referred to as Alternative 1B – or Alt1B. Water management under this alternative would continue in accordance with the existing (No Action) water management plan described in section 4.2.1.1. Additionally, this alternative assumes that no water withdrawals from Lake Lanier occur other than the amounts associated with the relocation contracts.

5.2.2.2 Performance Relative to Authorized Project Purposes

5.2.2.2.1 Flood Risk Management

Under this alternative, flood risk management operations would continue as they have since 1989.

5.2.2.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,049,030 MWh and system annual weekday generation of 777,458 MWh. This is an increase over the NAA resulting from the elimination of all water supply withdrawals from Lake Lanier other than those associated with relocation contracts. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-4.

Table 5.2-4.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	139,014	112,651
West Point	181,153	137,693
Walter F. George	473,494	345,231

5.2.2.2.3 Navigation

Under Alt1B, a 7-foot channel would be available in the Apalachicola River 20.5 percent of the time and a 9-foot channel would be available 5.5 percent of the time as compared to 20.5 percent and 2.7 percent, respectively, under the NAA.

5.2.2.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would be less than 5,000 cfs 0.1 percent of the time (compared to no occurrences for the NAA) and the system would be in drought operations 1 percent

of the time (compared to 7 percent for the NAA). Extreme drought operations would not be triggered in either the NAA or this alternative, Alt1B.

5.2.2.2.5 Recreation

In general, recreational opportunities would be restricted less often under this alternative than under the NAA. Table 5.2-5 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-5.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	13	2	0
West Point	20	3	1
Walter F. George	2	0	0

5.2.2.2.6 Water Quality

The implications of Alt1B relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for NAA in section 5.2.1.2.4.

5.2.2.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the current need of 277 mgd for downstream withdrawals by metro Atlanta water providers and withdrawals from Lake Lanier amounting to 20 mgd for the relocation contracts. The minimum reservoir elevation under this alternative would be 1,055.7 ft as compared to 1,054.5 ft for the NAA. Lake Lanier would be in Zone 1 68 percent of the time, 8 percent greater than for the NAA.

5.2.3 Alternative 1C

5.2.3.1 Description of Alternative 1C

This alternative combines Water Management Alternative 1 with water supply option C as shown in Table 5.2-1 and is also referred to as Alternative 1C (Alt1C). This alternative would limit withdrawals form Lake Lanier to 20 mgd for the relocation contracts and releases would be made from Buford Dam to support downstream withdrawals of the estimated 2040 need of 408 mgd.

5.2.3.2 Performance Relative to Authorized Purposes

5.2.3.2.1 Flood Risk Management

Under this alternative, flood risk management operations would continue as they have since 1989.

5.2.3.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,040,489 MWh and system annual weekday generation of 769,953 MWh. This is an increase over the NAA resulting from the

elimination of all water supply withdrawals from Lake Lanier other than those associated with relocation contracts together with increase in downstream releases from Buford Dam to meet the 2040 demand for Atlanta. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-6.

Table 5.2-6.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	136,067	108,316
West Point	178,685	136,324
Walter F. George	470,633	343,702

5.2.3.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 20.5 percent of the time and a 9-foot channel would be available 2.7 percent of the time, the same as for the NAA.

5.2.3.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would not be expected to drop below 5,000 cfs over the period of record (same as the NAA) and the system would be in drought operations 6 percent of the time (compared to 7 percent for the NAA). Extreme drought operations would not be triggered in either the NAA or this alternative.

5.2.3.2.5 Recreation

In general, recreational opportunities would be restricted slightly less often under this alternative than under the NAA. Table 5.2-7 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-7.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	16	5	1
West Point	20	2	1
Walter F. George	2	0	0

5.2.3.2.6 Water Quality

The implications of Alt1C relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for the NAA in section 5.2.1.2.4.

5.2.3.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the 2040 need for downstream withdrawals of 408 mgd by Atlanta and for withdrawals from Lake Lanier amounting to

20 mgd for the relocation contracts. The minimum reservoir elevation under this alternative would be 1,054.7 ft as compared to 1,054.5 ft for the NAA. Lake Lanier would be in Zone 1 for 63 percent of the time, 3 percent more time than for the NAA.

5.2.4 Alternative 7A

5.2.4.1 Description of Alternative 7A

This alternative combines the Water Management Alternative 7 with water supply option A as shown in Table 5.2-1 and is referred to as Alternative 7A – or Alt7A.

5.2.4.2 Performance Relative to Authorized Purposes

5.2.4.2.1 Flood Risk Management

Under Alt7A, flood risk management operations would continue as they have since 1989.

5.2.4.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,024,311 MWh and system annual weekday generation of 759,940 MWh, which is a decrease over the NAA attributable to the hydropower generation provisions of the Water Management Alternative 7. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-8.

Table 5.2-8.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	126,411	102,299
West Point	176,244	133,981
Walter F. George	467,086	342,518

5.2.4.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 42.7 percent of the time and a 9-foot channel would be available 2.7 percent of the time. Due to the provision for the 4/5 month navigation season provided by Water Management Alternative 7, the availability of the 7-foot channel would be increased by 22 percentage points.

5.2.4.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Chattahoochee River would be less than 5,000 cfs 0.1 percent of the time (compared to no occurrences for the NAA) and the system would be in drought operations 16 percent of the time (compared to 7 percent for the NAA). Extreme drought operations would be triggered one time for this alternative compared to zero for the NAA.

5.2.4.2.5 Recreation

In general, recreational opportunities would be restricted more often under this alternative than under the NAA due to the provisions of the Water Management Alternative 7, most notably the 4/5-month navigation provision. Table 5.2-9 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-9.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	19	5	1
West Point	22	3	1
Walter F. George	5	0	0

5.2.4.2.6 Water Quality

Under Alt7A, Buford Dam, West Point Dam, and Jim Woodruff Lock and Dam would continue to provide continuous minimum releases which, in addition to meeting other project purposes and providing associated benefits, would also benefit downstream water quality. At West Point Dam, a small generating unit provides a continuous release of approximately 675 cfs. In addition to these flows, Buford Dam is operated in conjunction with the downstream GPC Morgan Falls Dam to ensure a minimum in-stream flow of 650 cfs during November–April and 750 cfs during May–October on the Chattahoochee River at Peachtree Creek to meet state water quality commitments.

5.2.4.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the current need for downstream withdrawals of 277 mgd by Atlanta and current withdrawals from Lake Lanier amounting to 128 mgd for the relocation contracts and the unauthorized withdrawals. The minimum reservoir elevation under this alternative would be 1,053.1 ft as compared to 1,054.5 ft under the NAA. Lake Lanier would be in Zone 1 63 percent of the time, 3 percent more time than for the NAA.

5.2.5 Alternative 7C (Future Without Project Condition [FWOPC] Alternative)

5.2.5.1 Description of Alternative 7C

This alternative combines the Water Management Alternative 7 with water supply option C as shown in Table 5.2-1 and is referred to as the Future Without Project Condition (FWOPC) alternative, or Alternative 7C – or Alt7C. It is the condition expected to exist in the future in the absence of reallocation of storage under the 1958 Water Supply Act for those communities currently withdrawing water from Lake Lanier under expired agreements. If storage was not reallocated from Lake Lanier for water supply, it is reasonable to assume that Glades Reservoir would be constructed and contribute 40 mgd to the water supply need. The assumption that Glades Reservoir would be constructed is made for analytical purposes only and does not constitute an agency decision on the merits of the project[7]. This alternative would also

[7] As of August 2015, USACE Savannah District Regulatory Division is considering a permit application for construction of Glades Reservoir.

provide for releases to accommodate the anticipated 2040 water supply needs for communities currently withdrawing from the Chattahoochee River. Alt7C provides the basis from which reallocation alternatives considered in the WSSA were formulated.

5.2.5.2 Performance Relative to Authorized Purposes

5.2.5.2.1 Flood Risk Management

Under this alternative, flood risk management operations continue as they have since adoption of the draft WCM in 1989.

5.2.5.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,152,416 MWh and system annual weekday generation of 859,016 MWh. This is an increase over the NAA resulting from the elimination of all water supply withdrawals from Lake Lanier other than those associated with relocation contracts together with increase in downstream releases from Buford Dam to meet the 2040 demand for Atlanta and the 4/5-month navigation operations associated with Alternative 7. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-10.

Table 5.2-10.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	136,243	107,873
West Point	178,679	135,842
Walter F. George	582,610	433,895

5.2.5.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 43.8 percent of the time and a 9-foot channel would be available 2.7 percent of the time. The 7-foot channel would be available more frequently under this alternative than under the NAA because of the 4/5-month navigation provision of the Water Management Alternative 7.

5.2.5.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would not be expected to drop below 5,000 cfs over the period of record (same as for the NAA) and the system would be in drought operations 16 percent of the time (compared to 7 percent for the NAA). Extreme drought operations would not be triggered in either the NAA or this alternative.

5.2.5.2.5 Recreation

In general, recreational opportunities would be restricted somewhat less often at Lake Lanier and somewhat more often at Walter F. George Lake under this alternative than under the NAA due to the lack of water supply withdrawals from Lake Lanier and the 4/5 month navigation provision of Water Management Alternative 7. Table 5.2-11 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-11.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	15	4	1
West Point	21	2	0
Walter F. George	5	0	0

5.2.5.2.6 Water Quality

The implications of Alt7C relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Alt7A in section 5.2.4.2.6.

5.2.5.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the 2040 need for downstream withdrawals of 408 mgd by Atlanta and withdrawals from Lake Lanier amounting to 20 mgd for the relocation contracts. The minimum reservoir elevation under this alternative would be 1,052.9 ft compared to 1,054.5 ft for the NAA. Lake Lanier would be in Zone 1 65 percent of the time, 5 percent more time than for the NAA.

5.2.6 Alternative 7D

5.2.6.1 Description of Alternative 7D

This alternative combines Water Management Alternative 7 with water supply option D as shown in Table 5.2-1 and is referred to as Alternative 7D – or Alt7D. It includes the following features:

- Withdrawals from Lake Lanier under relocation contracts (20 mgd)
- Georgia's 2013 request for reallocation of storage in Lake Lanier sufficient to provide gross water supply withdrawals of 277 mgd
- Releases from Buford Dam to support downstream withdrawals of the estimated 2040 need of 408 mgd
- Water Management Proposed Action Alternative (i.e., Water Management Alternative 7)
- Return rate to Lake Lanier of 55 percent specified in Georgia's 2013 request

5.2.6.2 Performance Relative to Authorized Purposes

5.2.6.2.1 Flood Risk Management

Under this alternative, flood risk management operations would continue as they have since 1989.

5.2.6.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,132,329 MWh and system annual weekday generation of 967,361 MWh. This is an increase over the NAA resulting from an increase in downstream releases from Buford Dam to meet the 2040 demand for Atlanta and the

4/5-month navigation operations associated with Water Management Alternative 7. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-12.

Table 5.2-12.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	119,623	96,160
West Point	175,459	133,691
Walter F. George	466,311	342,207

5.2.6.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 42.5 percent of the time and a 9-foot channel would be available 2.7 percent of the time.

5.2.6.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would be less than 5,000 cfs 0.2 percent of the time (compared to no occurrences for the NAA) and the system would be in drought operations 16 percent of the time (compared to 7 percent for the NAA). Extreme drought operations would be triggered two times for this alternative compared to zero for the NAA.

5.2.6.2.5 Recreation

In general, recreational opportunities would be restricted more often at Lake Lanier and Walter F. George Lake under this alternative compared to the NAA. Table 5.2-13 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-13.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	22	5	2
West Point	21	2	1
Walter F. George	5	0	0

5.2.6.2.6 Water Quality

The implications of Alt7D relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Alt7A in section 5.2.4.2.6.

5.2.6.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the 2040 need for downstream withdrawals of 408 mgd by Atlanta and withdrawals from Lake Lanier amounting to

297 mgd for the relocation contracts and the 2040 need for communities withdrawing from the reservoir. The minimum reservoir elevation under this alternative would be 1,050.3 ft compared to 1,054.5 ft under the NAA. Lake Lanier would be in Zone 1 58 percent of the time, 2 percent less than for the NAA.

5.2.7 Alternative 7E

5.2.7.1 Description of Alternative 7E

This alternative combines the Water Management Alternative 7 with water supply option E as shown in Table 5.2-1 and is referred to as Alternative 7E – or Alt7E. It is similar to Alt7D except that the reallocation of storage in Lake Lanier would be reduced to support 237 mgd. An additional 40 mgd would be available from Glades Reservoir. The return rate to Lake Lanier would be 55 percent.

5.2.7.2 Performance Relative to Authorized Purposes

5.2.7.2.1 Flood Risk Management

Under this alternative, flood risk management operations would continue as they have since 1989.

5.2.7.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,312,363 MWh and system annual weekday generation of 967,301 MWh. This is an increase over the NAA resulting from an increase in downstream releases from Buford Dam to meet the 2040 demand for Atlanta and the 4/5-month navigation operations associated with the Water Management Alternative 7. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-14.

Table 5.2-14.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	108,282	86,959
West Point	175,475	133,691
Walter F. George	466,330	342,197

5.2.7.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 42.5 percent of the time and a 9-foot channel would be available 2.7 percent of the time.

5.2.7.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would be less than 5,000 cfs 0.2 percent of the time (compared to no occurrences for the NAA) and the system would be in drought operations 18 percent of the time (compared to 7 percent for the NAA). Extreme drought operations would be triggered two times for this alternative compared to zero for the NAA.

5.2.7.2.5 Recreation

In general, recreational opportunities would be restricted more often at Lake Lanier and Walter F. George Lake under this alternative than under the NAA. Table 5.2-15 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-15.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	22	5	2
West Point	21	2	1
Walter F. George	5	0	0

5.2.7.2.6 Water Quality

The implications of Alt7E relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Alt7A in section 5.2.4.2.6.

5.2.7.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the 2040 need for downstream withdrawals of 408 mgd by Atlanta and withdrawals from Lake Lanier amounting to 257 mgd for the relocation contracts and the 2040 need for communities withdrawing from the reservoir. The minimum reservoir elevation under this alternative would be 1,050.2 ft compared to 1,054.5 ft under the NAA. Lake Lanier would be in Zone 1 58 percent of the time, 2 percent less time than for the NAA.

5.2.8 Alternative 7F

5.2.8.1 Description of Alternative 7F

This alternative combines the Water Management Alternative 7 with water supply option F as shown in Table 5.1-2 and is referred to as Alternative 7F – or Alt7F. It is identical to Alt7D except that the return rate to Lake Lanier would be 30.6 percent.

5.2.8.2 Performance Relative to Authorized Purposes

5.2.8.2.1 Flood Risk Management

Under this alternative, flood risk management operations would continue as they have since 1989.

5.2.8.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,282,552 MWh and system annual weekday generation of 948,339 MWh. This is an increase over the NAA resulting from an increase in downstream releases from Buford Dam to meet the 2040 demand for Atlanta and the 4/5-month navigation operations associated with the Water Management Alternative 7. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-16.

Table 5.2-16.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	119,553	96,121
West Point	168,023	129,017
Walter F. George	457,751	336,813

5.2.8.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 38.4 percent of the time and a 9-foot channel would be available 2.7 percent of the time.

5.2.8.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would not be expected to drop below 5,000 cfs over the period of record (same as under the NAA) and the system would be in drought operations 25 percent of the time (compared to 7 percent for the NAA). Extreme drought operations would be triggered two times for this alternative compared to zero for the NAA.

5.2.8.2.5 Recreation

In general, recreational opportunities would be restricted more often at Lake Lanier, West Point Lake, and Walter F. George Lake under this alternative than under the NAA. Table 5.2-17 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-17.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	31	14	6
West Point	24	2	0
Walter F. George	4	0	0

5.2.8.2.6 Water Quality

The implications of Alt7F relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Alt7A in section 5.2.4.2.6.

5.2.8.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the 2040 need for downstream withdrawals of 408 mgd by Atlanta and withdrawals from Lake Lanier amounting to 297 mgd for the relocation contracts and the 2040 need for communities withdrawing from the reservoir. The minimum reservoir elevation under this alternative would be 1,046.3 ft compared to 1,054.5 ft under the NAA. Lake Lanier would be in Zone 1 49 percent of the time, 11 percent less time than for the NAA.

5.2.9 Alternative 7H (Proposed Action Alternative)

5.2.9.1 Description of Alternative 7H

This alternative combines the Water Management Alternative 7 with water supply option H as shown in Table 5.2-1 and is referred to as Alternative 7H – or Alt7H.

This alternative consists of the following:

- Water Management Alternative 7
- Withdrawals from Lake Lanier under relocation contracts (20 mgd)
- Reallocation of storage in Lake Lanier sufficient to provide gross water supply withdrawals of 165 mgd
- Constructing Glades Reservoir and providing 40 mgd to Hall County/Gainesville
- Releases from Buford Dam to support downstream withdrawals of the estimated 2040 need of 408 mgd
- Return rate to Lake Lanier of 40.4 percent (see Table 5.1-2 and section 5.1.4.1)

5.2.9.2 Performance Relative to Authorized Purposes

5.2.9.2.1 Flood Risk Management

Under this alternative, flood risk management operations would continue as they have since 1989.

5.2.9.2.2 Hydroelectric Power Generation

Project operations under this alternative produce system annual generation of 1,309,555 MWh and system annual weekday generation of 965,394 MWh. This is an increase over the NAA resulting from an increase in downstream releases from Buford Dam to meet the 2040 demand for Atlanta and the 4/5-month navigation operations associated with the Water Management Alternative 7. Annual and weekday generation at Buford, West Point, and Walter F. George dams is shown in Table 5.2-18.

Table 5.2-18.
Hydroelectric Power Generation by Project

Project	Annual generation (MWh)	Annual weekday generation (MWh)
Buford	136,243	107,873
West Point	175,454	133,669
Walter F. George	466,292	342,194

5.2.9.2.3 Navigation

Under this alternative, a 7-foot channel would be available in the Apalachicola River 42.5 percent of the time and a 9-foot channel would be available 2.7 percent of the time.

5.2.9.2.4 Fish and Wildlife Conservation

Under this alternative, flows in the Apalachicola River would be less than 5,000 cfs 0.2 percent of the time (compared to no occurrences under the NAA) and the system would be in drought operations 18 percent of the time (compared to 7 percent under the NAA). Extreme drought operations would be triggered two times for this alternative compared with zero for the NAA.

5.2.9.2.5 Recreation

In general, recreational opportunities would be restricted somewhat more often at Lake Lanier, West Point Lake, and Walter F. George Lake under this alternative than under the NAA. Table 5.2-19 shows for each USACE project the percent of time the reservoir level is below the various impact levels during the recreation season.

Table 5.2-19.
Percent of Time Below Established Recreational Impact Levels During the Recreation Season

Project	Percent of time below Initial Impact Level	Percent of time below Recreation Impact Level	Percent of time below Water Access Limited Level
Buford	22	5	2
West Point	22	2	0
Walter F. George	5	0	0

5.2.9.2.6 Water Quality

The implications of Alt7H relative to water quality purposes associated with federal projects in the ACF Basin would be essentially the same as those described for Alt7A in section 5.2.4.2.6.

5.2.9.2.7 Water Supply

Under this alternative, releases from Buford Dam would be sufficient to provide for the 2040 need for downstream withdrawals of 408 mgd by Atlanta and withdrawals from Lake Lanier amounting to 185 mgd for the relocation contracts and a portion of the 2040 need for communities withdrawing from the reservoir. The minimum reservoir elevation under this alternative would be 1,050.23 ft compared to 1,054.5 ft under the NAA. Lake Lanier would be in Zone 1 58 percent of the time, 2 percent less time than under the NAA.

5.3 Rationale for Selecting the Proposed Action Alternative (PAA)

The following paragraphs describe the rationale for selecting the Alternative 7H as the Proposed Action Alternative (PAA) in lieu of the other alternatives considered in detail. The description of plan effects uses information found in section 6 (Environmental Consequences), particularly the summary of change and summary of effects tables.

The NAA was not selected as the PAA because it does not address either the established objectives for water management, as described in section 4.1, or the established objectives for water supply, as described in section 5.1. The NAA would not update the WCM to include a drought contingency plan, or increase reliability of navigation, and would only accommodate the current water supply needs for communities currently withdrawing from Lake Lanier and from the Chattahoochee River. The NAA, however, is carried forward for detailed evaluation in accordance with NEPA to provide a basis for assessing the impacts of alternatives that would provide for different levels of reallocation of storage in Lake Lanier for water supply.

The Proposed Action Alternative (PAA) (Alternative 7H) would satisfy the water management objectives (section 4.1) and a portion of the established objectives for water supply, as described in section 5.1. The PAA would update the WCM to include a drought contingency plan, increase the reliability of navigation, and other changes to improve system performance for authorized project purposes, including listed species. The PAA would also satisfy a portion (185 mgd out of 297 mgd requested) of the anticipated 2040 water supply needs for communities relying on Lake Lanier and all the 2040 needs for communities currently withdrawing from the Chattahoochee River. Compared to the NAA, the PAA results in some slightly adverse to adverse effects to lake levels at Lake Lanier and Walter F. George Lake; flow conditions below Buford Dam and below Walter F. George Dam; some water quality parameters; land use; some listed-species parameters; hydroelectric power generation; and recreation. More conservative "drought operations", including more operational restrictions, would occur more frequently under the PAA; however, this operation would likely prevent more severe drought conditions from occurring than under the NAA. Effects on navigation are substantially beneficial. The PAA has the least overall adverse effects lake levels, stream flow conditions, water quality, and other natural resource and socioeconomic resource considerations of all the alternatives that fully or partially meet both the water management and water supply objectives.

Alternative 1B was not selected as the PAA because it does not address either the established objectives for water management, as described in section 4.1, or the established objectives for water supply, as described in section 5.1. Alt1B would not update the WCM to include a drought contingency plan, or increase reliability of navigation, would accommodate only the current water supply needs for communities currently withdrawing from Lake Lanier, and would accommodate only the current water supply needs for communities currently withdrawing from the Chattahoochee River. Alt1B, however, is carried forward for detailed evaluation. A comparison of the effects of Alt1B compared to the NAA shows the effects on the ACF basin of the current level of water supply withdrawals for Lake Lanier.

Alternative 1C was not selected as the PAA because it does not address either the established objectives water management, as described in section 4.1, and only partially satisfies the established objectives for water supply, as described in section 5.1. Alt1C would not update the WCM to include a drought contingency plan, or increase reliability of navigation and would not accommodate any water supply needs for communities currently withdrawing from Lake Lanier (other than relocation contracts). This alternative would accommodate, however, the anticipated 2040 water supply needs for communities currently withdrawing from the Chattahoochee River.

Alternative 7A satisfies the water management objectives (section 4.1) but it does not satisfy the established objectives for water supply, as described in section 5.1. This alternative would update the WCM to include a drought contingency plan and increase reliability of navigation but only would accommodate the current water supply needs for communities currently withdrawing from Lake Lanier. Additionally, this alternative would not accommodate the anticipated 2040 water supply needs for communities currently withdrawing from the Chattahoochee River. A comparison of the effects of Alt7A and the NAA shows the effects of the changes in the water management operations. Based on this comparison, some slightly adverse to adverse effects can be noted to lake levels at Walter F. George, flow conditions below Buford Dam and below Walter F. George Dam, drought operations, some water quality parameters, land use, some listed-species parameters, hydroelectric power generation, and recreation. Slightly beneficial to beneficial effects can be noted to lake levels at Lake Lanier and West Point Lake and to some listed species parameters. Effects on navigation are substantially beneficial. Because this alternative does not satisfactorily satisfy the water supply objectives, this alternative was not selected as the PAA.

Alternative 7C satisfies the water management objectives (section 4.1), but it does not satisfy the established objectives for water supply, as described in section 5.1. This alternative would update the WCM to include a drought contingency plan or increase reliability of navigation but would not

accommodate any water supply needs for communities currently withdrawing from Lake Lanier (other than relocation contracts), but it would accommodate the anticipated 2040 water supply needs for communities currently withdrawing from the Chattahoochee River. This alternative is the "future without project condition", as required by USACE planning regulations, and is used in the WSSA to determine the benefits of water supply reallocation and the effects of reallocation on other project purposes. The effects of this alternative are similar to Atl7A. Additionally, this alternative would have substantially adverse effects to some water quality parameters in the Atlanta to West Point reach and on riverine fish and aquatic resources due to water quality impacts associated with wastewater discharges in the Metro Atlanta area. Because this alternative does not satisfactorily satisfy the water supply objectives, this alternative was not selected as the PAA.

Alternative 7D satisfies both the water management objectives (section 4.1) and the established objectives for water supply, as described in section 5.1, and thus meets the anticipated 2040 water supply needs for communities relying on Lake Lanier and the water supply needs for communities currently withdrawing from the Chattahoochee River. The effects of this alternative are similar to Alt7C. The effects of this alternative on water quality parameters become slightly more adverse than the Alt7C and would be attributable to the additional water withdrawn from Lake Lanier. As noted in section 5.1.4.1, the return rate associated with Georgia's 2013 request was determined by the project team to be unattainable. Accordingly, other return rates were investigated and this alternative was not selected as the PAA.

Alternative 7E is essentially the same as Alt 7D, except that Glades Reservoir would provide a portion of Georgia's 2040 need for water supply from Lake Lanier in Alt7E. Alt7E would satisfy both the water management objectives (section 4.1) and the established objectives for water supply, as described in section 5.1, and thus meets both the anticipated water supply needs for communities relying on Lake Lanier and those currently withdrawing water from the Chattahoochee River. The effects of Alt7E are essentially the same as Alt 7D. Both alternatives use the return rate associated with Georgia's 2013 request. Accordingly, other return rates were investigated and this alternative was not selected as the PAA.

Alternative 7F is similar to Alt7D but uses a lower return rate based on an analysis of the expected discharge volumes of wastewater treatment infrastructure expected to be in-place by 2035. Alternative 7F satisfies both the water management objectives (section 4.1) and the established objectives for water supply, as described in section 5.1, and thus meets both the anticipated water supply needs for communities relying on Lake Lanier and those currently withdrawing water from the Chattahoochee River. Effects of this alternative are similar as for Alt7E, except that lake levels at Lake Lanier are substantially adverse, flow conditions in the Chattahoochee River become more adverse, hydropower losses become adverse and recreation impacts become substantially adverse. More conservative "drought operations", including more operational restrictions, would occur much more frequently under Alt 7F; however, this operation would likely prevent more severe drought conditions from occurring than under the NAA. Due to the adverse effects of this alternative, it was not selected as the PAA.

5.4 Description of the Proposed Action Alternative

Under the PAA, USACE would continue to operate projects in the ACF Basin in a balanced manner to achieve all authorized project purposes, while continuously monitoring the total system water availability to ensure that project purposes can at least be minimally satisfied during critical drought periods. The intent would be to maintain a balanced use of conservation storage rather than to maintain the pools at or above certain predetermined elevations; however, in times of high-flow conditions, flood risk management regulation would supersede all other project functions. At all times, USACE would seek to conserve the water resources entrusted to its regulation authority. The PAA is consistent with USACE's legal opinion which sets forth the following:

- USACE has the legal authority under the RHA of 1946 to release water from Buford Dam sufficient to accommodate Georgia's requested downstream withdrawals of 408 mgd.
- Withdrawals of 20 mgd from Lake Lanier are authorized under relocation agreements and the 1956 Act (Public Law 84-841).
- USACE has discretion under the Water Supply Act of 1958 to accommodate additional net withdrawals of 170 mgd from Lake Lanier (including withdrawals of 277 mgd and returns of 107 mgd to the reservoir), because accommodating those withdrawals and returns would not fundamentally depart from Congressional intent for the Buford Project and the ACF system.

The following sections describe the PAA.

5.4.1 Guide Curves and Action Zones

Under the PAA, USACE would not modify any guide curves of the ACF projects but would modify the action zones for Lake Lanier, West Point Lake, and Walter F. George Lake. The zones are used to manage the lakes at the highest level possible while balancing the needs of all the authorized purposes. Zone 1, the highest in each lake, defines a reservoir condition where all authorized project purposes can be met. As lake levels decline, Zones 2 through 4 define increasingly critical system status where purposes can no longer fully be met. The action zones also provide guidance on meeting minimum hydroelectric power needs at each project.

The revised action zones were derived considering numerous factors, including the ability of the reservoirs to refill (considering hydrology, watershed size, and physical constraints of each reservoir), recreation effects and hazard levels, and the proportionality of zone drawdown between projects. Other factors or activities might cause the lakes to operate differently than the action zones are described, including exceptional flood risk management measures, fish spawn operations, approved deviations, maintenance and repair of turbines, emergency situations (such as a drowning and chemical spills), draw-downs because of shoreline maintenance, releases made to free grounded barges, and other special circumstances.

The storage projects (Lanier, West Point, and Walter F. George) would be operated to maintain their respective lake level in the same action zones concurrently. Because of the hydrologic and physical characteristics of the river system and factors mentioned above, however, there might be periods when one lake would be in a higher or lower zone than another. When that occurs, USACE would conduct operations to bring the lakes back into balance with each other as soon as conditions allow. By doing so, effects within the river basin would be shared equitably among the projects. The action zones for the Proposed Action are shown in Figure 5.4-1, Figure 5.4-2, and Figure 5.4-3. A more complete discussion of action zones of the PAA may be found in section VII of the Master Manual and each project manual found in Appendix A.

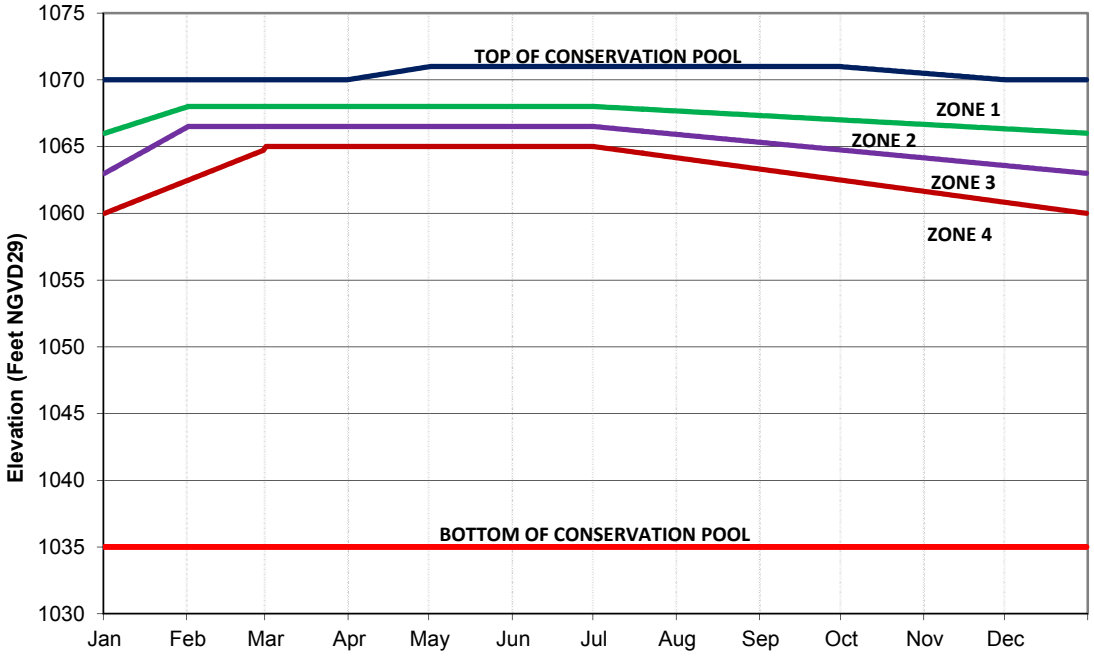

Figure 5.4-1. Lake Lanier Water Control Action Zones for the Proposed Action Alternative

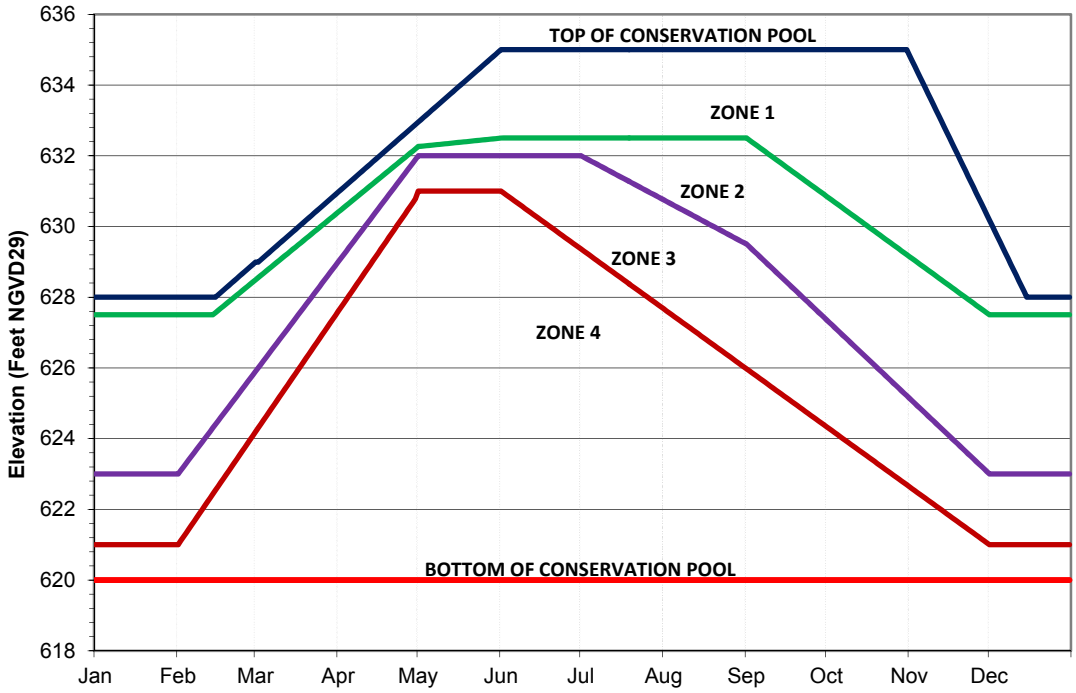

Figure 5.4-2. West Point Lake Water Control Action Zones for the Proposed Action Alternative

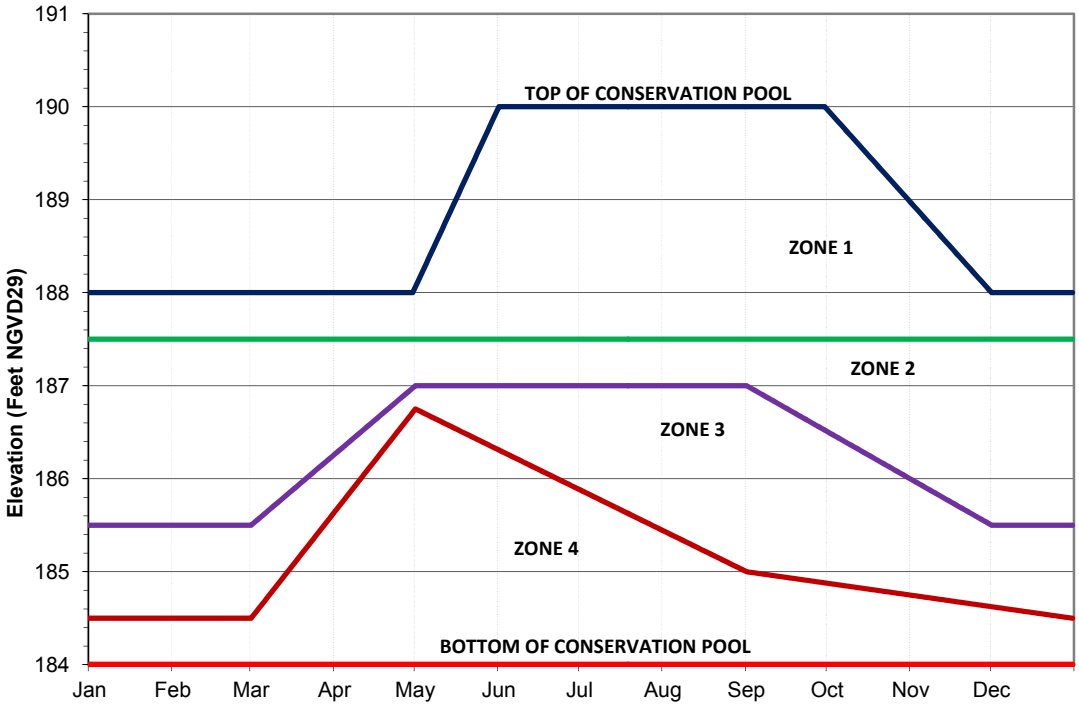

Figure 5.4-3. Walter F. George Lake Water Control Action Zones for the Proposed Action Alternative

5.4.2 Drought Operations

The drought plan included in the PAA specifies a minimum release from Jim Woodruff Dam and would temporarily suspend the normal minimum release and maximum fall rate provisions of the listed species operation, described in section 5.4.6, until composite conservation storage in the basin could be replenished to a level that could support them. Under the drought plan, minimum discharge would be determined in relation to the composite conservation storage. The drought plan would be triggered when the composite conservation storage falls below the bottom of Zone 2 into Zone 3 (Figure 5.4-4). At that time, all the provisions for composite conservation storage Zones 1 through 3 (seasonal storage limitations, maximum fall rate schedule, and minimum flow thresholds) would be suspended, and management decisions would be based on the provisions of the drought plan. The drought plan would include the option for a temporary waiver from the water control plan to allow temporary storage above the winter pool guide curve at the Walter F. George and West Point projects to provide additional conservation storage for future needs, if conditions in the basin dictate the need for such action.

The drought plan of the Proposed Action Alternative prescribes two minimum releases on the basis of composite conservation storage in Zones 3 and 4 and an additional zone referred as the Drought Zone. The Drought Zone delineates a volume of water roughly equivalent to the inactive storage in Lake Sidney Lanier, West Point Lake, and Walter F. George Lake, plus Zone 4 storage in Lake Sidney Lanier. The Drought Zone line was adjusted to include a smaller volume of water at the beginning and end of the calendar year. When the composite conservation storage is within Zone 4 and above the Drought Zone, the minimum release from Jim Woodruff Dam would be 5,000 cfs and all basin inflow above 5,000 cfs that is capable of being stored may be stored. Once the composite conservation storage falls below the Drought Zone, the minimum release from Jim Woodruff Dam would be 4,500 cfs and all basin inflow above 4,500 cfs that is capable of being stored may be stored. When transitioning from a minimum

release of 5,000 to 4,500 cfs, fall rates would be limited to 0.25 ft/day drop. The 4,500 cfs minimum release would be maintained until composite conservation storage returns to a level above the top of the Drought Zone, at which time the 5,000 cfs minimum release would be reinstated. The drought plan provisions would remain in place until conditions improve such that the composite conservation storage reaches Zone 1. At that time, the temporary drought plan provisions would be suspended and all the other provisions of the basin water control plan would be reinstated. During the drought contingency operations a monthly monitoring plan that tracks composite conservation storage in order to determine water management operations (the first day of each month will represent a decision point) would be implemented to determine which operational triggers are applied. In the event the composite conservation storage has not recovered to Zone 1 by 1 March, drought operations would be extended to the end of March, unless all the federal reservoirs are full.

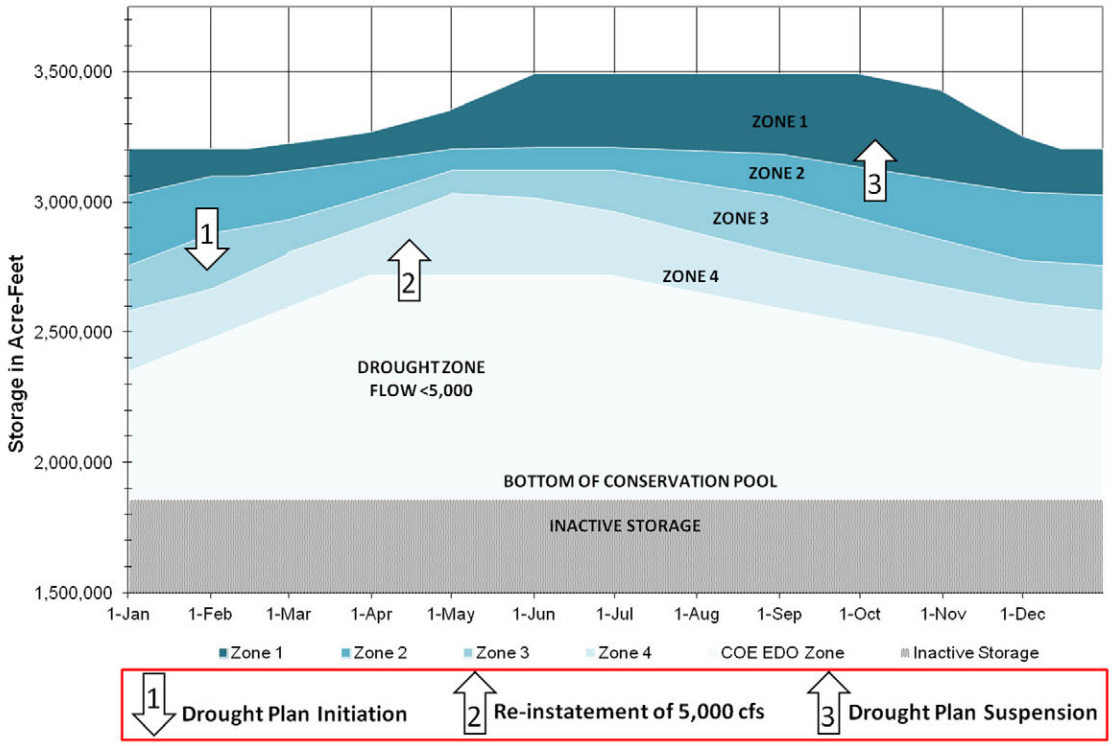

Figure 5.4-4. Composite Conservation Storage Zones and Drought Plan Triggers

5.4.2.1 Extreme Drought Operations

When the remaining composite conservation storage is about 10 percent of the total capacity, additional emergency actions might be necessary. When conditions have worsened to that extent, use of the inactive storage must be considered. For example, such an occurrence could be contemplated in the second or third year of a drought. Inactive storage zones have been designated for the three federal projects with significant storage (Figure 5.4-5). Table 5.4-1 shows the inactive storage capacity within each inactive storage zone for each project. The use of inactive storage during extreme drought conditions would be based on the following actions:

(1) Inactive storage availability would be identified to meet specific critical water use needs within existing project authorizations.

(2) Emergency uses would be identified in accordance with emergency authorizations and through stakeholder coordination. Typical critical water use needs within the basin are associated with public health and safety.

(3) Weekly projections of the inactive storage water availability to meet the critical water uses from Buford Dam downstream to the Apalachicola River would be used when making water control decisions regarding withdrawals and water releases from the USACE reservoirs.

(4) The inactive storage action zones would be instituted as triggers to meet the identified priority water uses (releases will be restricted as storage decreases). Figure 5.4-5 lists the typical critical water uses for each inactive storage zone.

(5) Dam safety considerations would always remain the highest priority. The structural integrity of the dams due to static head limitations (Jim Woodruff, 38.5 feet; George W. Andrews, 26 feet; Walter F. George, 88 feet) would be maintained.

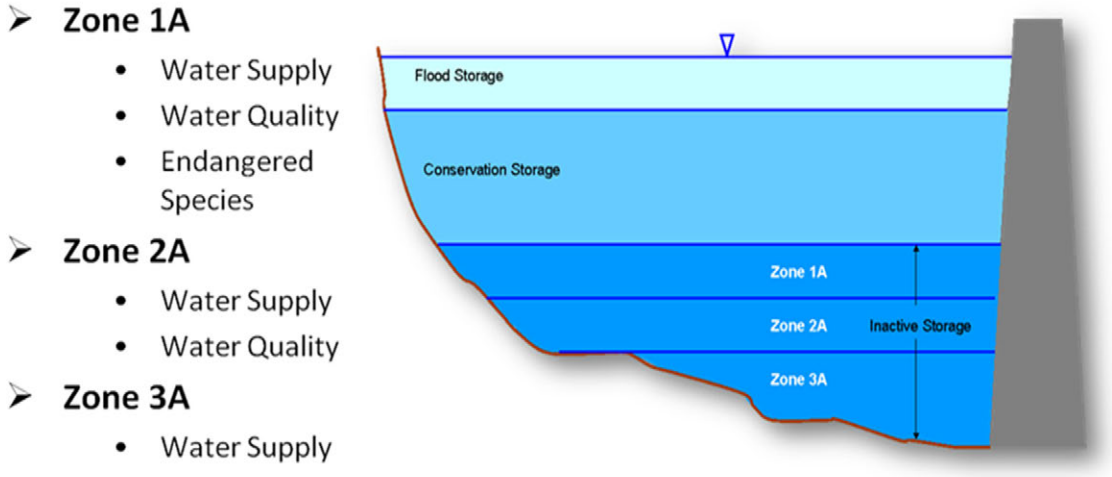

Figure 5.4-5. Inactive Storage Zones and Typical Water Use Needs

Table 5.4-1. Reservoir Inactive Storage Zone Capacities (ac-ft)

Project	Zone 1A	Zone 2A	Zone 3A	Unusable Inactive
Buford Dam	532,078	234,699	100,823	0
West Point Dam	53,620	138,331	33,344	73,101
Walter F. George Dam	314,799	178,501	0	196,700
Total	901,589	554,345	134,869	266,062

5.4.3 Flood Risk Management

When developing the PAA, flood risk management capabilities and capacities of reservoirs were not reduced. The flood operations described in section 2.1.1.2.4.1 would remain unchanged.

5.4.4 Hydroelectric Power Generation

The Proposed Action Alternative would result in changes to hydroelectric power generation operations at West Point Dam, Walter F. George Lock and Dam, or Jim Woodruff Dam to call for a more flexible generation schedule in all action zones under non-drought conditions and a more constrained generation schedule under drier conditions. The Buford, West Point, and Walter F. George Projects are operated as peaking plants, and provide electricity during the peak demand periods of each day and week. Hydroelectric power peaking involves increasing the discharge for a few hours each day to near the full capacity of one or more of the turbines. Typically, the Buford, West Point, and Walter F. George Projects provide generation five days a week at plant capacity throughout the year, as long as their respective lake levels are above Zone 4 and drought operations have not been triggered. For example, demand for peak hydroelectric power at Buford Dam typically occurs on weekdays from 5:00 a.m. to 9:00 a.m. Central time and from 3:00 p.m. to 10:00 p.m. between 1 October and 31 March, and on weekdays from 1:00 p.m. to 7:00 p.m. between 1 April and 30 September. The typical hours represent releases that normally meet water system demands and provide the capacity specified in power marketing arrangements. During dry periods, generation could be eliminated or limited to conjunctive releases. Typical, but not required, hours of operation by action zone are depicted in Table 5.4-2.

Table 5.4-2.
Typical hours of peaking hydroelectric power generation by federal project

Action zone	Buford Dam (hours of operation) normal ops/drought ops	West Point Dam (hours of operation)	Walter F. George Dam (hours of operation)
Zone 1	3/2	4	4
Zone 2	2/1	2	2
Zone 3	2/1	2	2
Zone 4*	0	0	0

*While hydropower would still be generated in Zone 4, it could not be generated on a regular peaking schedule under severe drought conditions

5.4.5 Navigation

When supported by ACF Basin hydrologic conditions, the PAA would provide a reliable navigation season. The water management objective for navigation is to ensure a predictable minimum navigable channel in the Apalachicola River for a continuous period that is sufficient for navigation use.

Assuming basin hydrologic conditions allow, a typical navigation season would begin in January of each year and continue for 4 to 5 consecutive months (January through April or May). Figure 5.4-6 graphically represents the navigation season and its relationship to composite conservation storage. During the navigation season, the flows at the USGS gage at Blountstown, Florida, should be adequate to provide a minimum channel depth of 7 feet. The most recent channel survey and discharge-stage rating was used to determine the flow required to sustain a minimum navigation depth during the navigation season. Flows of 16,200 cfs provide a channel depth of 7 feet. Flows of 20,600 cfs provide a channel depth of 9 feet. USACE's capacity to support a navigation season would be dependent on actual and projected system-wide conditions in the ACF Basin before and during January, February, March, April, and May. Those conditions include the following:

- A navigation season can be supported only when ACF Basin composite conservation storage is in Zone 1 or Zone 2.
- A navigation season will not be supported when the ACF Basin composite conservation storage is in Zone 3 and below. Navigation support will resume when basin composite conservation storage level recovers to Zone 1.

- A navigation season will not be supported when drought operations are in effect. Navigation will not be supported until the ACF Basin composite conservation storage recovers to Zone 1.
- The determination to extend the navigation season beyond April will depend on ACF Basin inflows, recent climatic and hydrologic conditions, meteorological forecasts, and basin-wide model forecasts. On the basis of an analysis of those factors, USACE will determine if the navigation season will continue through part or all of May.
- Down-ramping of flow releases will adhere to the Jim Woodruff Dam fall rate schedule (see Table 5.4-3) for federally listed threatened and endangered species during the navigation season.
- Releases that augment the flows to provide a minimum 7-foot navigation depth will also be dependent on navigation channel conditions that ensure safe navigation.

When it becomes apparent that, because of diminishing inflows, downstream flows and depths must be reduced, notices would be issued to project users to give barge owners and other waterway users sufficient time to make arrangements to light load or remove their vessels before action is taken at Jim Woodruff Lock and Dam to reduce releases.

Although special releases would not be standard practice, they could occur for a short duration to assist navigation during the navigation season. For instance, releases can be requested to achieve up to a 9-foot channel. USACE would evaluate such request on a case-by-case basis, subject to applicable laws and regulations and the conditions above.

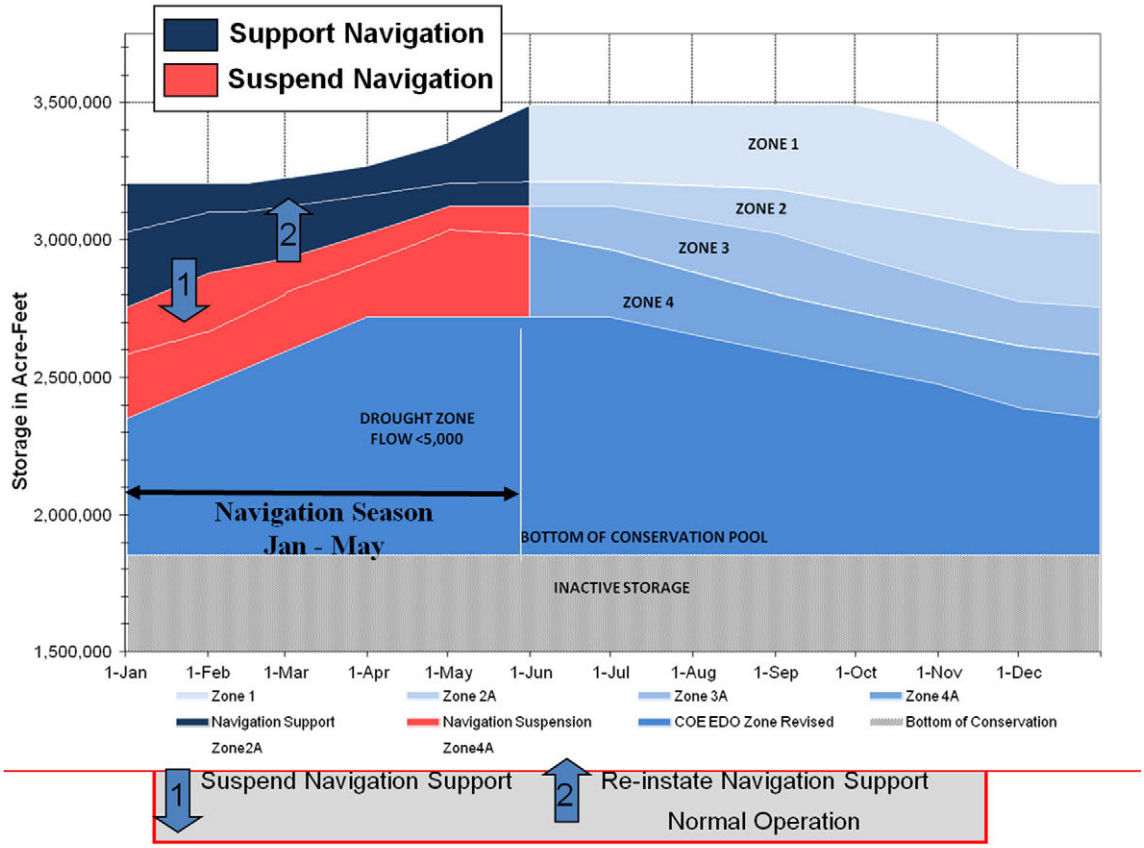

Figure 5.4-6. Composite Conservation Storage for Navigation

5.4.6 Fish and Wildlife Conservation

Under the PAA, fish spawn or fish passage operations would continue as described in section 2.1.1.2.4.4.

Federally-Listed Species—Under the PAA, USACE would continue to make releases for federally-listed, threatened. and endangered species below Jim Woodruff Dam on the basis of seasonal requirements (spawning, non-spawning, and winter), composite conservation storage, and basin inflows as discussed in section 2.1.1.2.4.4, with several modifications.

Release requirements dictated by composite conservation storage (Figure 5.4-4) would be in accordance with the revised action zones discussed above in section 5.4.1.

USACE would manage releases from Jim Woodruff Dam to support the federally-protected Gulf sturgeon and mussel species (fat threeridge, purple bankclimber, and Chipola slabshell) in the Apalachicola River. Daily releases to provide support for fish and wildlife conservation from Jim Woodruff Dam are dictated by two parameters: a minimum discharge (measured in cfs) and a maximum fall rate [measured in feet per day (ft/day)].

Minimum discharges from Jim Woodruff Dam would vary according to composite conservation storage (Figure 5.4-4), basin inflow per the 7-day moving average and by month. Table 5.4-3 shows these minimum releases, which are measured as a daily average flow in cfs at the USGS gage at Chattahoochee, Florida. During normal and above normal hydrological conditions within the basin, releases greater than the minimum release provisions could occur consistent with the maximum fall rate schedule described below, or as needed to achieve other project purposes, such as hydroelectric power generation or flood risk management.

During the spawning period (March to May) USACE would operate Jim Woodruff Dam to avoid potential Gulf sturgeon take. Potential Gulf sturgeon take is defined as an 8-foot or greater drop in Apalachicola River stage over the last 14-day period (i.e., considering if today's stage is greater than 8 feet lower than the stage of any of the previous 14 days) when flows are less than 40,000 cfs. When composite conservation storage falls below the bottom of Zone 2 into Zone 3, the drought contingency operations would be triggered.

During the non-spawning period (June to November), one set of four basin inflow thresholds and corresponding releases would exist according to composite conservation storage in Zones 1–3. When composite conservation storage falls below the bottom of Zone 2 into Zone 3, the drought contingency operations would be triggered.

During the winter season (December to February), only one basin inflow threshold and corresponding minimum release (5,000 cfs) would exist while in composite conservation storage Zones 1–4. That would provide the greatest opportunity to refill the storage reservoirs. No basin inflow storage restrictions are in effect as long as this minimum flow is met under such conditions.

When composite conservation storage falls below the bottom of Zone 2 into Zone 3, the drought contingency operations are triggered. Within Zone 4, the minimum flow is the same as in Zone 3. When the composite conservation storage drops further into the Drought Zone, Extreme Drought Operations (EDO) begin and the minimum flow from Jim Woodruff Dam is reduced to 4,500 cfs. A description of the drought operations is provided in section 5.4.2.

Table 5.4-3.
Jim Woodruff Lock and Dam, Apalachicola River Minimum Discharge for Federally-Listed Species by Month and by Basin Inflow (BI) Rates

Months	Composite conservation storage zone	Basin inflow (BI)[a] (cfs)	Min. Releases from Jim Woodruff Lock and Dam[b] (cfs)	BI available for storage[a]
March–May	Zones 1 and 2	≥ 34,000	= 25,000	Up to 100% BI>25,000
		≥ 16,000 and < 34,000	= 16,000+50% BI > 16,000	Up to 50% BI>16,000
		≥ 5,000 and < 16,000	= BI	
		< 5,000	= 5,000	
	Zone 3	≥ 39,000	= 25,000	Up to 100% BI>25,000
		≥ 11,000 and < 39,000	= 11,000+50% BI > 11,000	Up to 50% BI>11,000
		≥ 5,000 and < 11,000	= BI	
		< 5,000	= 5,000	
June–November	Zones 1, 2, and 3	≥ 22,000	= 16,000	Up to 100% BI>16,000
		≥ 10,000 and < 22,000	= 10,000+50% BI > 10,000	Up to 50% BI>10,000
		≥ 5,000 and < 10,000	= BI	
		< 5,000	= 5,000	
December–February	Zones 1, 2, and 3	≥ 5,000	= 5,000	Up to 100% BI > 5,000
		< 5,000	= 5,000	
If Drought Triggered	Zone 3	NA	= 5,000[d]	Up to 100% BI > 5,000
At all times	Zone 4	NA	= 5,000	Up to 100% BI > 5,000
At all times	Drought Zone	NA	= 4,500[e]	Up to 100% BI > 4,500

Notes:

a. Basin inflow for composite conservation storage in Zones 1, 2, and 3 is calculated using the 7-day moving average basin inflow. Basin inflow for composite conservation storage in Drought Operations, Zones 3 and 4 or lower (Drought Zone) is calculated using the one-day basin inflow.

b. Consistent with safety requirements, flood risk management purposes, and equipment capabilities.

c. Drought plan is triggered when the composite conservation storage falls into Zone 3, the first day of each month represents a decision point.

d. Once drought operation triggered, reduce minimum flow to 5,000 cfs following the maximum ramp rate schedule.

e. Once composite storage falls below the top of the Extreme Drought Zone ramp down to a minimum release of 4,500 cfs at rate of 0.25 ft/day based on the USGS gage at Chattahoochee, Florida (02358000).

The federally-listed species operations of the PAA include a fall rate, also called down-ramping rate, defined as the vertical drop in river stage (water surface elevation) that occurs over a given period of time. The fall rates are expressed in units of ft/day measured at the USGS Chattahoochee, Florida, gage as the difference between the daily average river stage on consecutive calendar days. Rise rates (e.g., today's average river stage is higher than yesterday's) are not addressed. The maximum fall rate schedule is provided in Table 5.4-4. When composite conservation storage falls into Zone 3, the drought operations described in section 5.4.2 would be implemented, the maximum fall rate schedule would be suspended and more conservative drought contingency operations begin. Down-ramping rates are also suspended during periods of prolonged low flow (flows less than 7,000 cfs for a period of more than 30 consecutive days). A prolonged low flow period would be considered over and down-ramping rates would be reinstated when flows are greater than 10,000 cfs for 30 consecutive days. Unless extreme drought operations are triggered, fall rates under drought contingency and prolonged low flow operations would be managed to match the fall rate of the basin inflow.

Table 5.4-4.
Maximum Down-Ramping (Fall) Rate

Approximate release range (cfs)	Maximum fall rate (ft/day)
> 30,000 [a]	No ramping restriction [b]
> 20,000 and ≤ 30,000 [a]	1.0 to 2.0
Exceeds Powerhouse Capacity (~ 16,000) and ≤ 20,000 [a]	0.5 to 1.0
Within Powerhouse Capacity and > 10,000 [a]	0.25 to 0.5
Within Powerhouse Capacity and ≤ 10,000 [a]	0.25 or less

Notes:
[a.] Consistent with safety requirements, flood risk management purposes, and equipment capabilities.
[b.] For flows greater than 30,000 cfs, it is not reasonable or prudent to attempt to control the down-ramping rate, and no ramping rate is required.

5.4.7 Recreation

Under the PAA, operations for recreation would remain the same as current operations. Recreation benefits would be maximized at the lakes to the extent possible consistent with meeting other project purposes by maintaining full or nearly full pools during the primary recreation season which are the warm summer months. In response to meeting other authorized project purposes, lake levels could decline during the primary recreation period, particularly during drier than normal years. Recreation impact levels have been identified for various lake elevations at each of the reservoir projects (see section 2.1.1.2.4.5 and Table 2.1-7). Recreational impact levels are not applicable to the George W. Andrews project due to the lack of conservation storage and the run-of-river operation at the project.

When pool levels must be lowered, the rates at which the draw-downs occur are as steady as possible. The action zones at Lake Sidney Lanier and West Point Lake are drawn down to correlate the line between Zone 2 and Zone 3 near the IIL at the beginning of the recreation season (May through early September). This is an attempt to maximize the time these projects are above the IIL during the recreation season.

5.4.8 Water Quality

Under the PAA, Buford, West Point, and Jim Woodruff dams would provide continuous minimum flow releases that would benefit the water quality immediately downstream of the dams. There would be no minimum flow provisions downstream of Walter F. George Dam. However, when low dissolved oxygen values are observed below the dam, spillway gates would be opened until the dissolved oxygen readings return to an acceptable level. Occasional special releases would also be made at Buford Dam to ensure adequate dissolved oxygen and water temperature at the Buford Fish Hatchery downstream of the dam.

At Buford Dam, the small turbine generator would run continuously to provide a minimum flow from the dam, which would range from approximately 500 to 700 cfs, depending on head conditions. This minimum flow from Buford Dam would help meet the seasonal minimum flow requirements of 650 cfs and 750 cfs at Atlanta, Georgia, in the Chattahoochee River just upstream of the confluence with Peachtree Creek. At West Point Dam, the minimum flow requirement is 670 cfs and a similar small generating unit would provide a continuous release of approximately 675 cfs. A varying minimum flow from 4,500 to 25,000 cfs, dependent upon basin conditions, would be maintained as a release from the Jim Woodruff Dam to the Apalachicola River, which would assure an adequate water supply for downstream industrial use and water quality. Walter F. George Dam has two siphons on each spillway gate. The siphon discharge could range from about 15 cfs up to 200 cfs when all 12 are in use. Typically, the siphon tubes would be opened continuously from May through the end of September and all 12 would

be used at full capacity. The siphons would provide a gravity-fed, typically continuous, minimum flow that would benefit dissolved oxygen levels below the dam.

5.4.9 Water Supply

Under the PAA, the cities of Gainesville and Buford would continue to withdraw water directly from Lake Sidney Lanier under relocation agreements at rates not exceeding 8 (net) and 2 mgd, respectively. Additionally, pursuant to the Water Supply Act of 1958, the PAA would reallocate 189,497 acre-feet in Lake Sidney Lanier for water supply. The amount of storage is estimated to yield 165 mgd during the critical drought (i.e., during the worst drought on record at the time the agreement was executed). The severity and frequency of droughts change over time, therefore, the yield of this storage may change over time. For the purpose of managing water supply storage, USACE would employed a storage accounting methodology that applies a proportion of inflows and losses, as well as direct withdrawals by specific users, to each account. The amount of water that may actually be withdrawn is ultimately dependent on the amount of water available in the storage account, which will naturally change over time.

Under the PAA releases from Buford Dam would be made to accommodate downstream water demands. Peaking hydroelectric power generation generally accommodates most water supply needs of communities currently withdrawing from the Chattahoochee River; however, under the 1946 Rivers and Harbors Act, generation might occur at non-peaking times to meet the downstream water supply needs, not to exceed 408 mgd.

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6 Environmental Consequences

This section of the EIS describes the environmental and socioeconomic effects of proposed updates to water management operations at USACE reservoirs in the ACF Basin and water supply storage options related to operations at Buford Dam and Lake Lanier. The affected environment described in Section 2 serves as a baseline from which potential environmental and socioeconomic effects likely to result from these proposed changes were determined.

The Reservoir System Simulation (HEC-ResSim) model was used to simulate water management operations alternatives and water supply storage options in the ACF Basin. The HEC-ResSim software developed by the USACE Institute for Water Resources, Hydrologic Engineering Center, is a decision support tool that meets the needs of modelers performing reservoir project studies as well as meeting the needs of reservoir regulators during real-time events. It models reservoir operations at one or more reservoirs for a variety of operational goals and constraints. The software simulates reservoir operations for flood risk management, low flow augmentation and water supply for planning studies, detailed reservoir regulation plan investigations, and real-time decision support. HEC-ResSim can represent both large- and small-scale reservoirs and reservoir systems through a network of elements (i.e., junctions, routing reaches, diversion, and reservoirs) that the user builds. The software can simulate single events or a full period of record using available time-steps. The ACF Basin analysis used HEC-ResSim Version 3.2.

HEC-ResSim has a graphical user interface designed to follow Windows® software development standards. The model's interface can be learned without extensive tutorials. Familiar data entry features make model development relatively easy, and localized *mini plots* graph the data entered in most tables so that errors can be quickly identified and corrected. A variety of default plots and reports, along with tools to create customized plots and reports, facilitate output analysis.

HEC-ResSim provides a realistic view of the physical river/reservoir system using a map-based schematic. The program's user interface allows the user to draw the network schematic as a stick figure or as an overlay on one or more geo-referenced maps of the watershed. HEC-ResSim represents a system of reservoirs as a network composed of four types of physical elements: junctions, routing reaches, diversions, and reservoirs. By combining those elements, the HEC-ResSim modeler is able to build a network capable of representing anything from a single reservoir on a single stream to a highly developed and interconnected system like the ACF Basin. A reservoir is the most complex element of the reservoir network and is composed of a pool and a dam. HEC-ResSim assumes that the pool is level (i.e., it has no routing behavior), and its hydraulic behavior is completely defined by an elevation-storage-area table. The real complexity of HEC-ResSim's reservoir network begins with the dam.

The USACE reservoirs in the ACF Basin are constructed and operated for one or more of the following purposes: flood risk management, hydropower generation, navigation, recreation, water supply, water quality, and fish and wildlife conservation. Those purposes typically define the goals and constraints that describe the reservoir's release objectives. Other factors that might influence the objectives include time of year, hydrologic conditions, water temperature, current pool elevation (or zone), and simultaneous operations by other reservoirs in a system. HEC-ResSim uses an original rule-based description of the operational goals and constraints that reservoir operators must consider when making release decisions.

To evaluate the recommended operational plan with multiple water supply storage options for the ACF Basin, USACE determined that the 73-year hydrologic period of record (1939–2011) would provide a reasonable range of future hydrologic conditions by which to assess and compare the effects of alternatives plans to current project operations (the NAA). The HEC-ResSim model for the ACF Basin includes the following basic assumptions that apply to the simulations:

- All the current USACE and non-USACE reservoir projects would be in place and operational over the entire period of record. Simulated project operations for water management alternatives and water supply options would follow current operations practices (applicable to the NAA) or would occur as prescribed for each different water management alternative/water supply option.
- For the NAA, diversions (withdrawals and returns for water supply) throughout the ACF Basin were simulated using 2007 levels over the entire hydrologic period of record. Net withdrawal values (withdrawals minus returns) in 2007 represent the greatest annual amount of water diversion in the ACF Basin during the period of simulation and, consequently, the year of greatest stress on the system from water withdrawals for human use. Starting with average monthly values for each diversion, average daily values were calculated for each month (by dividing by the number of days), resulting in a year of daily values. The simulation applied these values to hydrologic conditions for each year in the period of record.
- For the PAA and other alternatives with future water supply withdrawal options associated with Lake Lanier and the Chattahoochee River between Buford Dam and Peachtree Creek, withdrawals and returns were simulated as follows. Each alternative includes a potential set of withdrawal and return values for Lake Lanier and for the Chattahoochee River downstream of Buford Dam (one of which is specifically based upon Georgia's January 2013 request). Sections 4.1.2.9 and 5.1.2 and Appendix E (HEC-ResSim Modeling Report) describe the withdrawal and return assumptions for each alternative in more detail. For the balance of the ACF Basin outside Metro Atlanta, year 2007 withdrawal and return values were simulated as described above for the NAA.
- The model includes operations for five Georgia Power Company (GPC) dams in the ACF Basin (Morgan Falls, Bartletts Ferry, Goat Rock, Oliver, and North Highlands).
- The model includes assumed operations for the proposed Glades water supply reservoir (Hall County, Georgia) and Bear Creek water supply reservoir (south Fulton County, Georgia). Both proposed reservoirs are located in Metro Atlanta and are currently undergoing review as part of the section 404 permit process.

Appendix E (HEC-ResSim Modeling Report) presents further information on model assumptions and other applicable information on the HEC-ResSim model for the ACF Basin.

The water quality effects associated with the water management alternatives and water supply storage options in the ACF Basin were analyzed with the HEC-5Q model developed by the USACE Hydrologic Engineering Center. For the simulation of water quality conditions under the various alternatives, HEC-5Q inputs included in-stream flows, tributary flows and water quality data, withdrawals, reservoir operations, and other point and nonpoint source flows and quality loads to the system. The HEC-5Q model was linked with the HEC-ResSim model through an input of flows by reach. In addition to the BASINS model loadings developed in previous modeling efforts, observed data was used to represent the nonpoint inputs to the HEC-5Q model for the period of record from 2001 through 2011. The HEC-5Q model also included nontributary inflows, wastewater treatment dischargers, and cooling water returns. Inputs for wastewater treatment discharges were based on discharge monitoring reports (DMRs). When DMRs were not available, permitted limits, concentrations representative of the type of discharge, or an average of DMRs was used. The point source inputs considered only dischargers that contributed more than 1 mgd.

The water quality effects on the mainstems of the ACF Basin were examined with HEC-5Q. The operation of USACE reservoirs would not be expected to affect tributaries in the basin. A principal benefit of the HEC-5Q model is its ability to simulate the entire riverine and reservoir system in a single model. It can perform a holistic examination of the basin from top to bottom and simulate the watershed inflows, reservoirs, and river segments. Modeled output produced in this way allows for a clear, longitudinal presentation of conditions to facilitate comparison between various operations scenarios.

The model inputs, assumptions, and calibration for application of HEC-5Q to the Master Manual update are presented in the HEC-5Q modeling report in Appendix K.

For each natural resource and socioeconomic resource area discussed in this section, an impact matrix table summarizes the expected environmental consequences for each alternative, compared to existing conditions under the NAA. The impact matrix for each resource area includes relevant parameters and/or indicators upon which to base the assessment of effects. The following terms characterize or define the various levels of impact presented in each impact matrix:

- No change – any positive or negative impacts would be negligible, amounting to no effective change.
- Slightly adverse/slightly beneficial – impact would be perceptible and measurable, but would not have an appreciable effect.
- Adverse/beneficial – the impact would be clearly detectable and would have an appreciable effect.
- Substantially adverse/substantially beneficial – impact would result in a highly noticeable effect.

The general assessment of environmental consequences in the impact matrix for each natural and socioeconomic resource area is supported in the EIS by more detailed information and analysis, both qualitative and quantitative. In some cases, pertinent appendices include additional details for reference by the reader.

Compliance with federal laws and executive orders (EOs) relevant to this EIS are summarized in Table 6-1. Sections of this EIS referenced in the table provide detailed discussion of compliance with and applicability to the pertinent federal laws and EOs.

Whereas most of the laws listed in Table 6-1 focus on a single or limited number of resource areas, the Coastal Zone Management Act (CZMA), 16 U.S.C. 1451–1464, encompasses a broad range of resource area considerations in coastal areas, as defined in federally approved state coastal zone management programs. The Florida portion of the ACF Basin lies within the purview of the Florida Coastal Management Program (FCMP). The PAA is subject to review for federal consistency with the enforceable policies of the FCMP, in accordance with the CZMA and pertinent implementing regulations. USACE has reviewed the PAA and determined that it would be consistent with the enforceable policies of the FCMP to the maximum extent practicable. The assessment and determination of consistency are included as Appendix L of the EIS.

The USACE Environmental Operating Principles (EOPs), summarized in section 3.2, are applicable to all USACE activities, including the update of the ACF Master Manual. The EOPs were fully considered in development of the PAA and the other alternatives.

Table 6-1.
Environmental Compliance with Applicable Laws and EOs

Applicable authority	Status of compliance[a]	Remarks
Federal laws		
Archeological and Historical Preservation Act, 16 U.S.C. 469	Partial compliance	See section 6.7.
Archeological Resources Protection Act, 16 U.S.C. 470aa-470ll	Partial compliance	See section 6.7.
The Clean Water Act, 33 U.S.C. 1344 *et seq.*; also known as the Federal Water Pollution Control Act of 1972	Partial compliance	Water quality certification under section 401 of the CWA would not be applicable to the PAA. Compliance with water quality standards is described in section 6.1.2.
Clean Air Act, 42 U.S.C. 7401	Partial compliance	See section 2.7.
Coastal Zone Management Act of 1972 as amended P.L. 92-583, 16 U.S.C. 1451-1464	Partial compliance	No change to the coastal zone would be expected based on the analysis in the EIS. The PAA would be consistent with the FCMP to the maximum extent practicable. See Appendix L.
Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9601-9675	Not applicable	The PAA would not be expected to have an effect on hazardous and toxic materials. See section 2.11.
Emergency Wetlands Resources Act of 1986, 16 U.S.C. 3901-3932	Partial compliance	See section 6.4.1
Endangered Species Act, 16 U.S.C. 1531	Partial compliance	See section 6.4.
Fish and Wildlife Coordination Act, 16 U.S.C. 661 – 667e	Partial compliance	See section 6.4.
Federal Land Policy and Management Act of 1976, 43 U.S.C. 1701-1784	Partial compliance	See section 6.3.
Magnuson-Stevens Fishery Conservation Management Act, as amended by the Sustainable Fisheries Act of 1996 (P.L. 104-267; 16 U.S.C. 1801)	Partial compliance	See section 6.4.2.3.
Marine Protection, Research, and Sanctuaries Act of 1972 33 U.S.C. 1401-1445, 16 U.S.C. 1431 *et seq*. and 33 U.S.C. 1271	Not applicable	No ocean dredged material disposal would be expected under the PAA.
Migratory Bird Treaty Act, 16 U.S.C. 701-719c	Partial compliance	See section 6.4.1.
NEPA, P.L. 91-190	Partial compliance	The subsequent sections consider impacts on the human environment from the PAA.
The National Historic Preservation Act, 16 U.S.C. 470 *et seq.*	Partial compliance	See section 6.7.
Noise Control Act of 1972 as amended, 42 U.S.C. 4901 *et seq*.	Partial compliance	See section 2.8.
North American Wetlands Conservation Act, 16 U.S.C. 4401 *et seq*.	Partial compliance	See section 6.4.1.
Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901-6992k	Not applicable	The PAA would not be expected to have an effect on hazardous and toxic materials. See section 2.11.

Applicable authority	Status of compliance[a]	Remarks
Safe Drinking Water Act as amended, 42 U.S.C. 300f *et seq*, 6939b and 15 U.S.C. 1261 *et seq*.	Partial compliance	Section 6.1.2.
Toxic Substances Control Act of 1976, 15 U.S.C. 2601	Not applicable	The PAA would not be expected to have an effect on hazardous and toxic materials. See section 2.11.
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001	Partial compliance	See section 6.2.
Water Pollution Control Act Amendments of 1961, P.L. 87-88	Partial compliance	See section 6.1.2.
Executive Orders		
EO 11988: Floodplain Management	Partial compliance	See section 2.1.1.2.4.1.
EO 11990: Protection of Wetlands	Partial compliance	See section 6.4.1.
EO 12088: Federal Compliance with Pollution Control Standards	Partial compliance	The subsequent sections consider impacts on the human environment from the PAA.
EO 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Partial compliance	See section 6.5.8.
EO 13045: Protection of Children from Environmental Health Risks and Safety Risks	Partial compliance	See section 6.5.9.
EO 13061: American Heritage Rivers	Partial compliance	See section 1.4.
EO 13101: Greening the Government Through Waste Prevention	Not applicable	
EO 13123: Greening the Government Through Efficient Energy Management	Not applicable	
EO 13148: Greening the Government Through Leadership in Environmental Management	Not applicable	
EO 13175: Consultation and Coordination with Indian Tribal Governments	Partial compliance	See section 6.7.
EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds	Partial compliance	See section 6.4.1.

Note: *This EIS and the Record of Decision, when complete, will be compliant with applicable laws and EOs.

6.1 Water Resources

6.1.1 Water Quantity Environmental Consequences

This section describes the expected effects of the water management alternatives/water supply options for the Master Manual update relative to water quantity considerations. It focuses on the extent of physical change in water resource parameters in the ACF Basin that result from the various alternatives and provide the principal basis for the evaluation of other natural and socioeconomic resource impacts presented in the subsequent sections. The water resource parameters include lake-level conditions, streamflow conditions, conservation storage volumes, drought operation occurrences, navigation flows/channel depth availability, and water surface profiles/water intake structure viability.

Figures included in this section describe and compare the effects of the alternatives. In a number of cases, model outputs for two or more of the plans were nearly identical for a portion of the plot (or curve) or

over the entire range. For the set of curves applicable to each parameter (e.g., median daily water surface elevation at a specific reservoir), the nine alternatives evaluated in the EIS were plotted on two figures for easier reading. The curves for each alternative are plotted in the following order: the NAA (Alternative 1A [shortened to Alt1A]), Alt1B, Alt1C, Alt7A, and Alt7C on the first of two figures and the NAA, Alt7D, Alt7E, Alt7F, and the PAA (Alt7H) on the second of two figures. The NAA curve appears on both figures. The appearance of fewer than five curves on a figure indicates that the data for one or more of the alternatives are identical or nearly identical to another. If two or more plots are identical or nearly identical, the last curve plotted is the one that appears on the figure. The text associated with each figure provides specific clarification as necessary.

6.1.1.1 Lake Levels and Conservation Storage

As described in section 2.1.1.1.6, the guide curve for each lake with conservation storage (excluding run-of-river projects) depicts the desired operating level for the top of the conservation pool at any point during the year. The actual level for the top of conservation pool at any point in time depends on the amount of rainfall and associated basin inflow, evaporation from the lake, and releases from the dams to meet project purposes. The USACE reservoirs in the ACF Basin with conservation storage also have action zones within the conservation pool, also described in section 2.1.1.1.6. The action zones prescribe progressively more restrictive guidelines for management of downstream releases to conserve storage as rainfall and basin inflows decrease during periods of drought and as lake levels decline.

This section summarizes the effects of the recommended water management plan and water supply storage alternatives for USACE reservoirs in the ACF Basin. The following analysis focuses on the physical effects of the alternatives on lake-level conditions and conservation storage values over the modeled period of record. The analysis includes comparison of lake-level conditions under the various alternatives to predetermined *performance measures*. It describes impact thresholds for recreation facilities, access, and use of the USACE lakes in the ACF Basin under various hydrologic conditions over the modeled period of record. Based on the model results, this section describes the likely impacts of water management/water supply alternatives on lake levels and associated conservation storage conditions at pertinent USACE reservoirs. The section addresses the effects of the NAA (Alt1A), Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA (Alt7H) on lake-level conditions in the basin, beginning with the most upstream USACE reservoir (Lake Lanier) to the most downstream USACE reservoir (Lake Seminole).

Figures depicting "median" lake-level conditions in the basin provide a representative characterization of "normal" conditions for evaluation and comparison among alternatives. The median value represents the point at which 50 percent of the values are higher and 50 percent are lower. In addition, figures depicting the 90 percent exceedance level have been included, meaning that the values presented for each day would be exceeded 90 percent of the time in the simulation over the period of record. The 90 percent exceedance value would be representative of extremely dry conditions in the basin and low basin inflow to the reservoirs. Figures depicting lake levels under wetter conditions (e.g., 10 or 25 percent exceedance levels) for the alternatives under consideration have not been included in this EIS because they generally indicate minor or no differences among the alternatives.

Interpretation of the model results as presented in Figure 6.1-1 through Figure 6.1-18 and the tabulated information in Table 6.1-1 provide the basis for the description of effects on lake levels and conservation storage in the ACF Basin. Table 6.1-1 provides a qualitative assessment of the expected effects of the alternatives on lake-level and conservation storage (where applicable) conditions at reservoirs on the mainstem rivers in the ACF Basin. The only effect expected to rise to the "substantially adverse" level would be for Alt7F at Lake Lanier. The following paragraphs provide further details regarding the changes associated with the various alternatives compared to the NAA.

Table 6.1-1.
Summary of Change in Lake-Level Conditions of the Alternatives from the No Action Alternative during the Modeled Period of Record from 1939–2011

Lake levels / storage	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	Beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly adverse	Substantially adverse	Slightly adverse
West Point Lake	Baseline	No change	No change	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial
Walter F. George Lake	Baseline	No change	No change	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
George W. Andrews Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE Reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.1.1.1.1 Buford Dam and Lake Lanier

Buford Dam and Lake Lanier and its operations are described in section 2.1.1.1.6.1. This section describes the effects of operations under Water Management Alternative 1 (Alt1) and the proposed action Water Management Alternative 7 (Alt7), in combination with water supply options A, B, C, D, E, F, and H.

Figure 6.1-1 through Figure 6.1-6 and Table 6.1-2 and Table 6.1-3 present model results for Lake Lanier operations over the simulated period of hydrologic record for Alt1A (NAA) and for proposed revisions to the Master WCM as defined in Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and Alt7H (PAA). The figures present results for median pool levels (daily), 90-percent exceedance pool levels (daily), percent of days exceeded for pool levels, number of years that impact thresholds (recreation) are reached (annual and summer season), and percent of time reservoir storage in each action zone. In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (e.g., median daily pool level) are presented in two figures with half of the alternatives presented on each figure. Using the results from these figures, and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

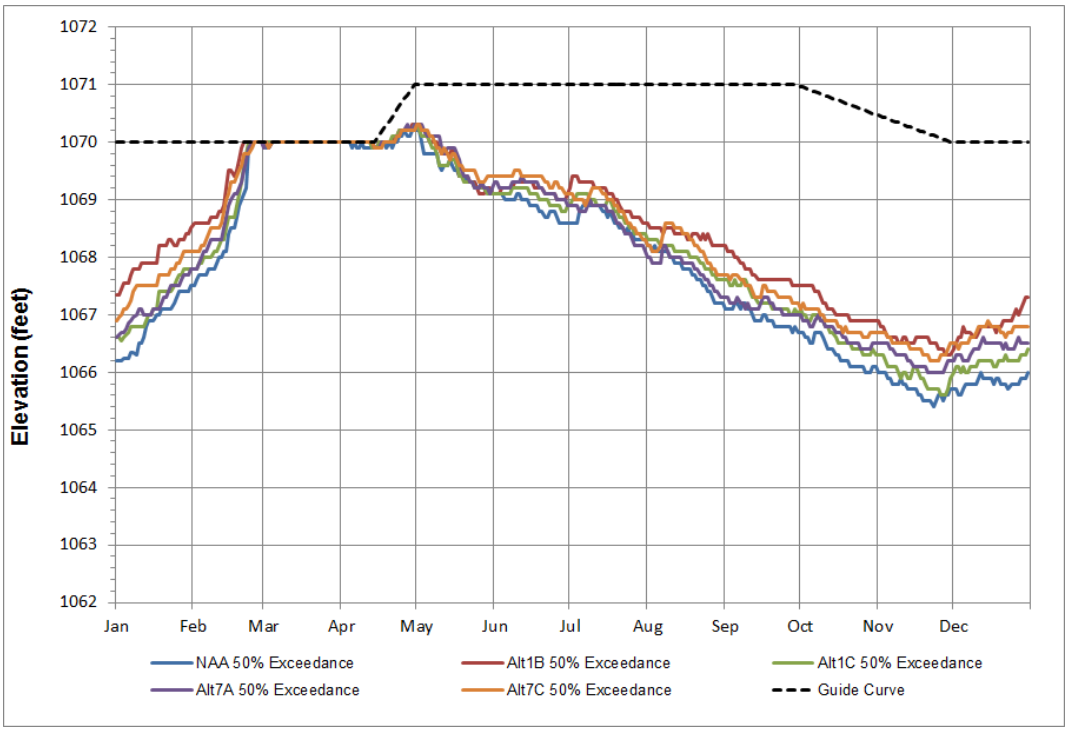


Figure 6.1-1. Lake Lanier, Median Daily Water Surface Elevation over Modeled Period of Record (1939–2011) for NAA and Alternatives 1B, 1C, 7A, and 7C

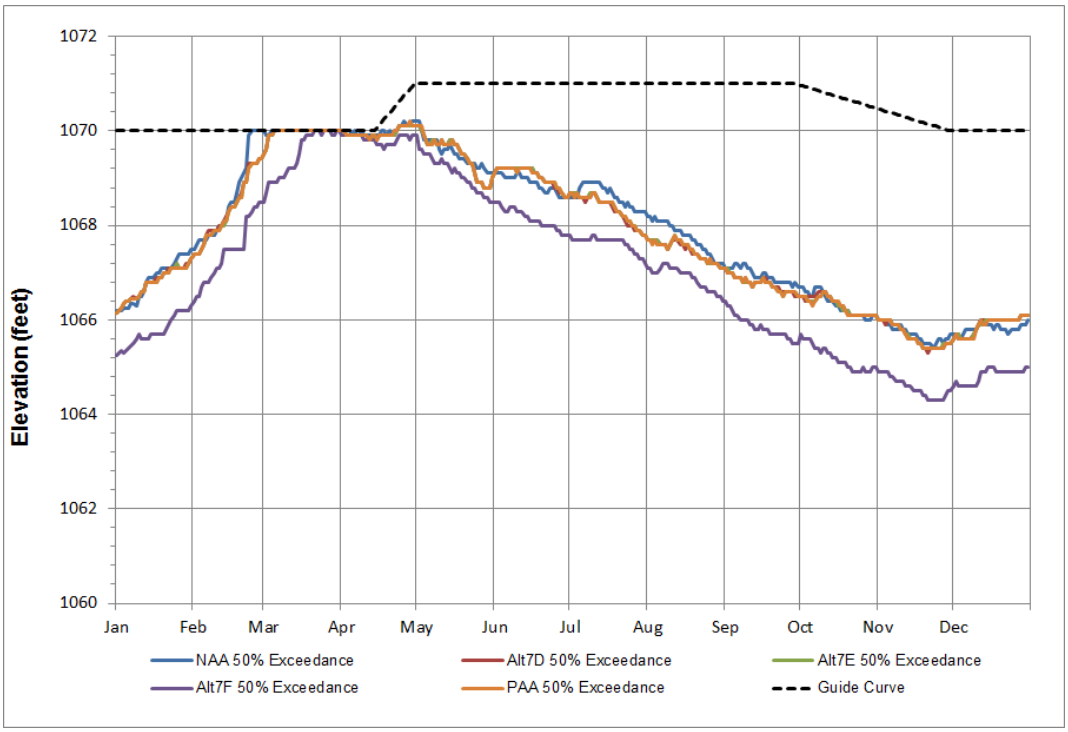


Figure 6.1-2. Lake Lanier, Median Daily Water Surface Elevation over Modeled Period of Record (1939–2011) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

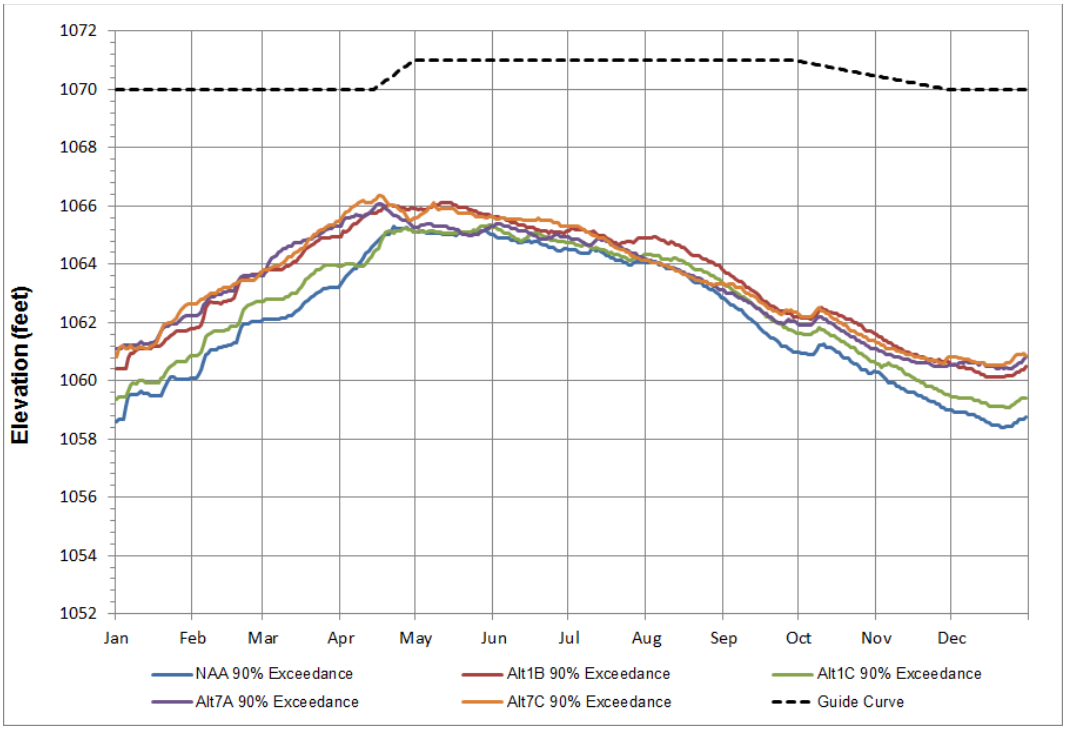


Figure 6.1-3. Lake Lanier, Daily Water Surface Elevations that Would Be Exceeded 90 Percent of the Time over Modeled Period of Record (1939–2011) for NAA and Alternatives 1B, 1C, 7A, and 7C

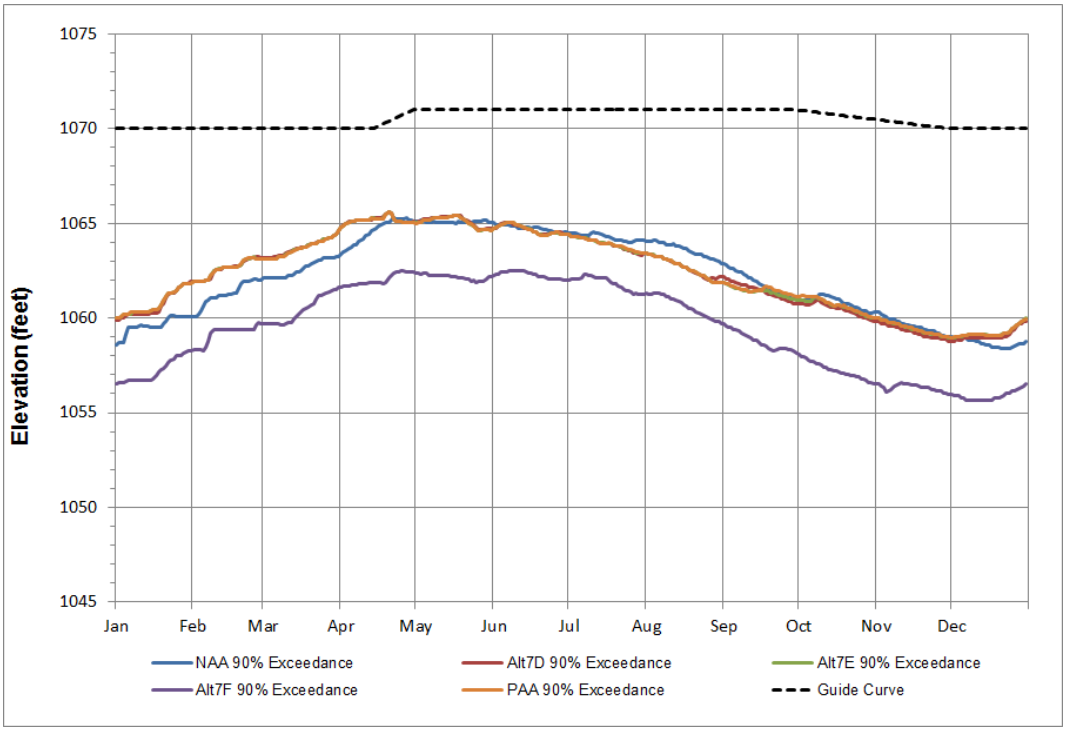


Figure 6.1-4. Lake Lanier, Daily Water Surface Elevations that Would Be Exceeded 90 Percent of the Time over Modeled Period of Record (1939–2011) for NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

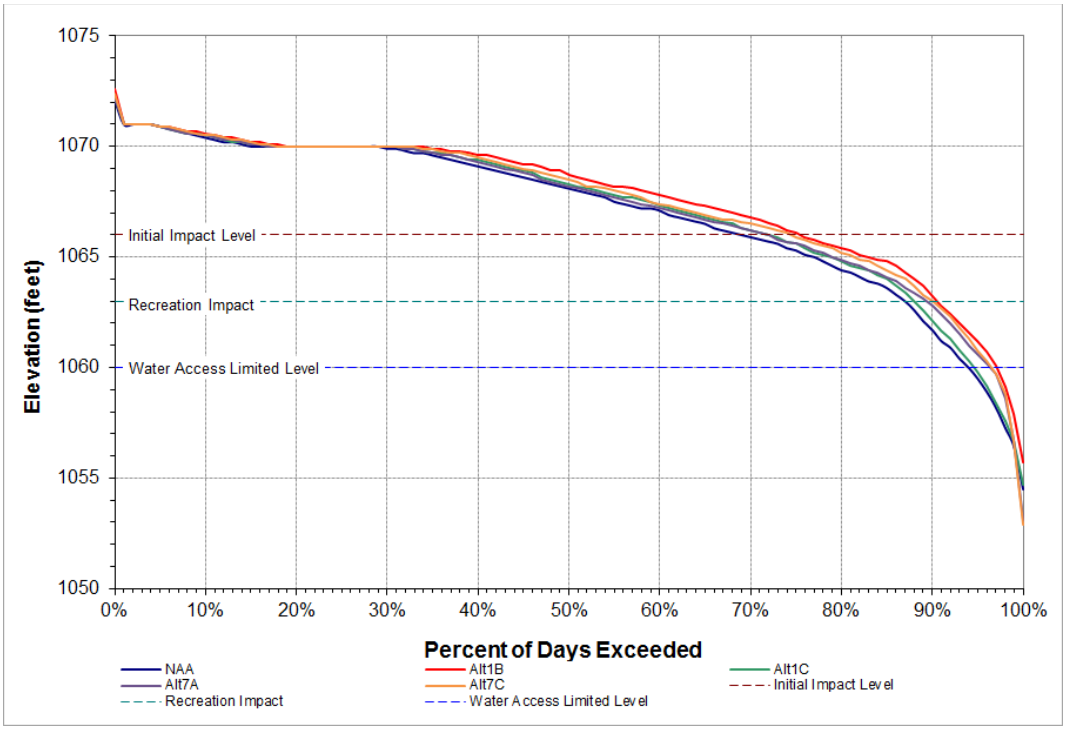


Figure 6.1-5. Lake Lanier, Daily Water Surface Elevations—Percent of Days Exceeded over Modeled Period of Record (1939–2011) for NAA and Alternatives 1B, 1C, 7A, and 7C

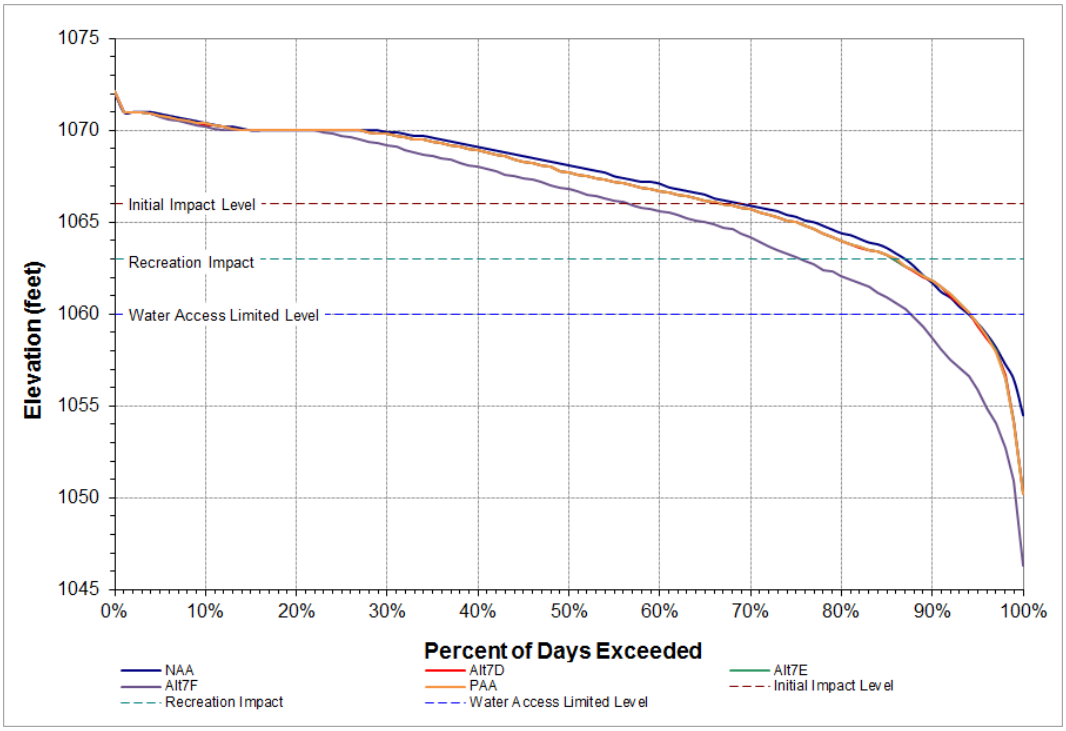


Figure 6.1-6. Lake Lanier, Daily Water Surface Elevations—Percent of Days Exceeded over Modeled Period of Record (1939–2011) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

Table 6.1-2.
Number of Years the Lake Lanier Pool Would Drop below Designated Impact Levels over Modeled Period of Record (1939–2011) for NAA and Alternatives 1B, 1C, 7A, 7C, 7D, 7E, 7F, and 7H (PAA)

Alternative	Time interval analyzed for each year	Initial impact level (elev. 1066 ft)	Recreation impact level (elev. 1063 ft)	Water access limited level (elev. 1060 ft)
NAA	Jan–Dec (12 months)	54	23	17
	Peak Recreation May–Sep (5 months)	32	14	6
Alt1B	Jan–Dec (12 months)	49	19	14
	Peak Recreation May–Sep (5 months)	26	9	1
Alt1C	Jan–Dec (12 months)	53	21	16
	Peak Recreation May–Sep (5 months)	29	12	6
Alt7A	Jan–Dec (12 months)	50	23	11
	Peak Recreation May–Sep (5 months)	29	13	4
Alt7C	Jan–Dec (12 months)	48	22	10
	Peak Recreation May–Sep (5 months)	28	12	4
Alt7D	Jan–Dec (12 months)	58	29	16
	Peak Recreation May–Sep (5 months)	36	17	6
Alt7E	Jan–Dec (12 months)	59	29	15
	Peak Recreation May–Sep (5 months)	36	17	6
Alt7F	Jan–Dec (12 months)	69	46	21
	Peak Recreation May–Sep (5 months)	47	26	15
PAA (Alt7H)	Jan–Dec (12 months)	60	29	15
	Peak Recreation May–Sep (5 months)	36	17	6

Table 6.1-3.
Percent of Time the Lake Lanier Pool Would Be in the Revised Action Zone over Modeled Period of Record (1938-2011) for NAA and Alternatives 1B, 1C, 7A, 7C, 7D, 7E, 7F, and 7H (PAA)

	Lake Lanier Action Zone			
Alternative	Zone 1	Zone 2	Zone 3	Zone 4
NAA (Alt1A)	56%	21%	9%	15%
Alt1B	64%	17%	8%	10%
Alt1C	59%	20%	8%	13%
Alt7A	59%	18%	13%	11%
Alt7C	62%	17%	11%	10%
Alt7D	53%	19%	13%	15%
Alt7E	53%	19%	13%	15%
Alt7F	44%	18%	14%	24%
PAA (Alt7H)	53%	19%	13%	15%

6.1.1.1.1.1 No Action Alternative

As described in section 5.2.1, the NAA (Alt1A) represents continuation of the current water control operations and current withdrawals/returns in the ACF Basin.

The median daily pool elevation at Lake Lanier over the period of record (Figure 6.1-1) would range from slightly above 1,066 ft in early January to 1,070 ft (winter guide curve elevation) by late February. In March and April, the pool elevation would be at or slightly below the guide curve, peaking at about 1,070.4 ft in early May. Thereafter, the pool elevation would gradually decline at a relatively consistent rate to about 1,065.5 ft by the end of November, then trending slightly upward to an elevation of 1,066 ft by the end of December. Except for late February through the end of May, the median daily pool elevation ranges from about 1 ft to 4.5 ft below the guide curve (Figure 6.1-1).

For the NAA, water surface elevations at the 90-percent exceedance level (indicative of extreme drought conditions in the basin) would likely range from about elevation 1,058.6 ft in January (11.4 ft below the winter guide curve) to about 1,065.2 (about 6 ft below the summer guide curve elevation) in early May (Figure 6.1-3). Thereafter, pool levels would gradually decline back to about 1,058.6 ft by the end of December.

Figure 6.1-5 provides information on the percentage of days over the modeled period of record that Lake Lanier would be expected to exceed a range of water surface elevations, including elevations that indicate specific levels of potential impact on resources and/or public uses of the lake. Section 2.1.1.1.6 defines and describes three specific impacts levels at Lake Lanier and the general effects on public use and water-based recreation activities that are expected to occur when the water surface elevation in the lake declines to those levels. They are the *Initial Impact Level* (IIL), *Recreation Impact Level* (RIL), and *Water Access Limited Level* (WAL). Corresponding impact levels have also been defined for West Point Lake and Walter F. George Lake. For the NAA, Lake Lanier water surface elevations would equal or exceed the winter guide curve elevation (1,070 ft) 29 percent of the time. Lake elevations would be expected to decline below the IIL (1,066 ft) 31 percent of the time, below the RIL (1,063 ft) 12 percent of the time, and below the WAL (1,060 ft) only 6 percent of the time. Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be 1,054.5 ft, about 15.5 ft below the winter guide curve elevation (1,070 ft).

Table 6.1-2 depicts the number of years over the modeled period of record during which Lake Lanier water surface elevations would drop below the three impact levels for public use and recreational activities—at some point during the entire year and at some point during the peak recreation season (May–September). The year is included in the count if, at any time during any year, the model outputs indicate that lake levels would decline below a specific impact level, regardless of the duration. The table summarizes the number of occurrences at the project based on a review of the model outputs over all months of the year and during the peak recreation season at the project. Sustained use of Lake Lanier for boating, fishing, and other activities occurs throughout the year as weather conditions permit. Considering all months of the year, Lake Lanier would be expected to decline below the IIL in 54 of 73 years in the period of record, below the RIL in 23 of 73 years, and below the WAL in 17 of 73 years. Considering only the months of the peak recreation season, Lake Lanier would be expected to decline below the IIL in 32 of 73 years, below the RIL in 14 of 73 years, and below the WAL in 6 of 73 years.

As a reflection of conservation storage conditions in Lake Lanier over the period of record, Table 6.1-3 depicts the percent of time that the Lake Lanier pool elevation would be in the respective action zones within the conservation pool. NAA (Alt1A) was modeled using the current action zone configuration. However, for comparing the model results to alternatives that include revised action zones, the model outputs for the NAA are presented in terms of the storage volumes associated with the revised action zones. For the NAA, Lake Lanier would be in Zone 1 for about 56 percent of the time, Zone 2 for about

21 percent of the time, Zone 3 for about 9 percent of the time, and Zone 4 for about 15 percent of the time.

6.1.1.1.1.2 Alternative 1B

Per section 5.2.2, Alt1B reflects current water management operations, current levels of withdrawal for water supply downstream of Buford Dam, and withdrawals from Lake Lanier that would be limited to existing relocation contracts (20 mgd for cities of Buford and Gainesville, Georgia).

As depicted in Figure 6.1-1, median daily water surface elevations in Lake Lanier for Alt1B over the modeled period of record would have a similar annual trend to those for the NAA. In the spring, the pool levels would be nearly the same as the NAA, and between June and late February, the pool levels would be higher for Alt1B than the NAA, ranging from about 0.4 ft to about 1.4 ft higher.

Daily water surface elevations at the 90-percent exceedance level for Alt1B would follow the same general trend as the NAA but would be higher than the NAA throughout all months of the year, ranging from about 0.5 ft to 2 ft higher (Figure 6.1-3). This improvement in water surface elevation conditions at Lake Lanier for Alt1B would be attributable to the limiting withdrawals from Lake Lanier to existing relocation contracts.

Water surface elevations for Alt1B, over the modeled period of record would be expected to decline below the IIL 24 percent of the time (31 percent for NAA), below the RIL 9 percent of the times (12 percent for NAA), and below the WAL 2 percent of the time (6 percent for NAA) (Figure 6.1-5). These values represent a substantial improvement compared to the NAA (Figure 6.1-5). Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be elevation 1,055.7 ft, about 14.3 ft below the winter guide curve elevation.

Considering all months of the year, water surface elevations at Lake Lanier under Alt1B would be expected to decline below the IIL in 49 of 73 years (54 years for NAA), below the RIL in 19 of 73 years (23 years for NAA), and below the WAL in 14 of 73 years (17 years for NAA). For the months of the peak recreation season, water surface elevations would be expected to decline below the IIL in 26 of 73 years (32 years for NAA), below the RIL in 9 of 73 years (14 years for NAA), and below the WAL in 1 of 73 years (6 years for NAA) (Table 6.1-2). These values for Alt1B would represent a substantial reduction in the number of years over the period of record during which water surface elevations at Lake Lanier would decline below these impact levels.

Table 6.1-3 illustrates that the pool elevations in Lake Lanier would be in Zone 1 for 64 percent of the time compared to 56 percent for the NAA. The percent of time in zones 2, 3, and 4 would all decrease compared to the NAA, with the most noteworthy reduction occurring in Zone 4, from 15 percent of the time for the NAA to 10 percent for Alt1B.

6.1.1.1.1.3 Alternative 1C

Per section 5.2.3, Alt1C reflects current water management operations, provision for estimated 2040 water supply withdrawal demands downstream of Buford Dam (408 mgd) for Metro Atlanta, Lake Lanier withdrawals limited to existing relocation contracts, and construction/operation of Glades Reservoir to provide 40 mgd to Hall County/Gainesville, Georgia.

Alt1C would likely have similar effects on water surface elevations in Lake Lanier as the NAA. Median daily water surface elevations (Figure 6.1-1) would be slightly higher than the NAA (from zero to about 0.4 ft), with similar differences for daily water surface elevations at the 90-percent exceedance level (Figure 6.1-3). The duration curves for Alt1C and the NAA are essentially the same (Figure 6.1-5). Consequently, the differences in the percent of days that water surface elevations would likely decline below designated impact levels for public use and recreational activities would be negligible compared to the NAA. Similarly, the differences between Alt1C and NAA in the number of years that lake levels would decline below IIL, RIL, and WAL would be minor (Table 6.1-2). Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be 1054.7 ft, about 15.3 ft below the winter guide curve elevation. The percent of time that Lake Lanier would be in Zone 1 under Alt1C would slightly increase compared to the NAA (59 versus 56 percent); with slight reductions in the percent of time lake levels would be within zones 2, 3, and 4 (Table 6.1-3).

6.1.1.1.1.4 Alternative 7A

As indicated in section 5.2.4, Alt7A is similar to Alt1A, except that water management updates in Water Management Alt7 (described in section 4.9) rather than the current water management operations are included.

Figure 6.1-1, median daily water surface elevations in Lake Lanier for Alt7A would follow a similar pattern to the NAA, except that they would be slightly higher in the fall and winter months (ranging from about 0.4 ft to 0.6 ft higher than the NAA). At the 90-percent exceedance level, Alt7A would result in lake levels that would be notably higher than the NAA for the months of September through April (ranging about 0.4 ft to about 2.4 ft higher) (Figure 6.1-3).

The duration curve for Alt7A is slightly higher than under the NAA for less frequent occurrences. Consequently, the percent of days that water surface elevations would be expected to decline below designated impact levels for public use and recreational activities would be slightly lower than the NAA (Figure 6.1-5). The difference between Alt7A and the NAA with respect to the number of years that lake levels would drop below IIL, RIL, and WAL is considered minor (Table 6.1-2), with one exception. The number of years that lake levels would likely drop below WAL (the most extreme impact level) would decrease from 17 (NAA) to 11 (Alt7A), based on a full 12-month period of analysis, and from 6 years (NAA) to 4 years (Alt7A) for the peak recreation season.

Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be 1,053.1 ft, about 16.9 ft below the winter guide curve elevation. The percent of time that Lake Lanier would be in Zone 1 under Alt1C would slightly increase compared to the NAA (59 versus 56 percent). A noteworthy reduction in the percent of time in Zone 4 would be expected for Alt7A (11 percent) compared to NAA (15 percent) in exchange for a greater percentage of time in the higher Zone 3 (Table 6.1-3).These changes would principally be attributable to recommended updates and refinements in water management operations.

6.1.1.1.1.5 Alternative 7C

As indicated in section 5.2.5, Alt7C reflects recommended updates to current water management operations (Water Management Alternative 7), provision for estimated 2040 water supply withdrawal demands downstream of Buford Dam (408 mgd) for Metro Atlanta, Lake Lanier withdrawals limited to existing relocation contracts, and construction/operation of Glades Reservoir.

Compared to the NAA, Alt7C would be expected to have similar effects as described for Alt7A in section 6.1.1.1.1.4. Median and 90-percent exceedance daily water surface elevations at Lake Lanier for Alt7C are similar to Alt7A (Figure 6.1-1 and Figure 6.1-3), except that Alt7C elevations at the median and

90-percent exceedance levels would be slightly higher than for Alt7A (generally less than 0.4 ft) from August through late February.

Water surface elevations for Alt7C, over the modeled period of record would be expected to decline below the IIL 24 percent of the time (31 percent for NAA), below the RIL 10 percent of the times (12 percent for NAA), and below the WAL 3 percent of the time (6 percent for NAA) (Figure 6.1-5). The difference between Alt7C and the NAA with respect to the number of years that lake levels would drop below IIL, RIL, and WAL is considered minor (Table 6.1-2), with one exception. The number of years that lake levels would likely drop below WAL would decrease from 17 (NAA) to 10 (Alt7C), based on a full 12-month period of analysis, and from 6 years (NAA) to 4 (Alt7C) for the peak recreation season (May–September). Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be 1,052.9 ft, about 17.1 ft below the winter guide curve elevation.

Table 6.1-3 indicates that the pool elevations in Lake Lanier would be in Zone 1 for 62 percent of the time compared to 56 percent for the NAA. The percent of time in zones 2 and 4 would decrease and would slightly increase for Zone 3, compared to the NAA. The most noteworthy reduction in percent of time would be for Zone 4, from 15 percent of the time for the NAA to 10 percent for Alt7C.

6.1.1.1.1.6 Alternative 7D

Alt7D includes the following components (see section 5.2.6):

- Updated water management operations (Water Management Alternative 7)
- Water withdrawals for estimated 2040 demands for Metro Atlanta downstream of Buford Dam (408 mgd)
- Water withdrawals from Lake Lanier per existing relocation contracts; and storage reallocation in Lake Lanier for gross water withdrawals of 277 mgd with an estimated return rate of 55 percent to the lake (per Georgia's updated 2013 request)

Implementing Alt7D would likely result in effects on water surface elevations and conservation storage in Lake Lanier similar to effects under the NAA. The curves for Lake Lanier depicting median water surface elevation (Figure 6.1-2) and daily water surface elevations at the 90-percent exceedance level (Figure 6.1-4) are essentially the same, except that median daily water surface elevations in July through early September would likely range up to 0.5 ft lower than the elevations under the NAA. The duration curves for Alt7D and the NAA (Figure 6.1-6) are similar, except above the 97-percent exceedance level, where Alt7D would likely result in a substantially lower lake level than the NAA.

Over the modeled period of record, the lowest water surface elevation that Lake Lanier would be likely to reach under Alt7D would be 1,050.3 ft, about 19.7 ft below the winter guide curve. The number of years the Lake Lanier pool levels would likely drop below IIL, RIL, and WAL would be similar to the NAA. For Alt7D, pool levels would likely drop below IIL and RIL slightly more often than the NAA (see Table 6.1-2). Alt7D would likely result in pool levels in zones 1 and 2 for a slightly lower percent of time than the NAA and a slightly greater percent of time in Zone 3 (Table 6.1-3).

6.1.1.1.1.7 Alternative 7E

This alternative is identical to Alt7D except that the reallocation of storage in Lake Lanier would be reduced to support 237 mgd and an additional 40 mgd would be available from Glades Reservoir (see section 5.2.7).

Compared to the NAA, Alt7E would essentially have the same effects on water surface elevations and conservation storage in Lake Lanier as described for Alt7D in section 6.1.1.1.1.6. The model outputs for Alt7E and Alt7D are nearly identical, as reflected by the various curves and tables presented in Figure 6.1-2, Figure 6.1-4, Figure 6.1-6, Table 6.1-2, and Table 6.1-3.

6.1.1.1.1.8 Alternative 7F

Alt7F is identical to Alt7D except that the return rate to Lake Lanier would be 31 percent instead of 55 percent (see sections 5.2.8 and 5.1.4.1).

Median daily water surface elevations at Lake Lanier over the modeled period of record for Alt7F would likely be the lowest among all the alternatives (Figure 6.1-2). Median daily water surface elevations would generally range from about 1.0 ft to 1.4 ft lower than the NAA. Daily water surface elevations at the 90-percent exceedance level would generally range from 3 ft to 4 ft lower than the NAA during all months of the year (Figure 6.1-4). These changes in median and 90-percent exceeded lake levels represent a substantial change compared to the NAA.

As depicted in Figure 6.1-6, water surface elevations for Alt7F at Lake Lanier would be expected to decline below the IIL 43 percent of the time (30 percent for NAA), below the RIL 24 percent of the time (12 percent for NAA), and below the WAL 12 percent of the time (5 percent for NAA). Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be elevation 1046.3 ft, more than 23.7 ft below the winter guide curve elevation and 8.2 ft lower than the NAA.

Considering all months of the year, water surface elevations at Lake Lanier under Alt7F would be expected to decline below the IIL in 69 of 73 years (54 years for NAA), below the RIL in 46 of 73 years (23 years for NAA), and below the WAL in 21 of 73 years (17 years for NAA). For the months of the peak recreation season, water surface elevations would be expected to decline below the IIL in 47 of 73 years (32 years for NAA), below the RIL in 26 of 73 years (14 years for NAA), and below the WAL in 15 of 73 years (6 years for NAA) (Table 6.1-2). These values for Alt1B would represent a substantial increase in the number of years over the period of record during which water surface elevations at Lake Lanier would decline below these impact levels. Table 6.1-3 indicates that the pool elevations in Lake Lanier for Alt7F would be in Zone 1 for 44 percent of the time (56 percent for NAA) and in Zone 2 for 18 percent of the time (21 percent for the NAA). The percent of time in zones 3 and 4 would substantially increase compared to the NAA. The most substantial increase would occur in Zone 4, from 24 percent of the time for Alt7F to 15 percent of the time for the NAA.

6.1.1.1.1.9 Alternative 7H (PAA)

The PAA is identical to Alt7F, except that the storage reallocation in Lake Lanier would be reduced to support 165 mgd, and the overall return rate to Lake Lanier would be 40 percent (see sections 5.2.9 and 5.1.4.1).

Implementing the PAA would likely result in effects on water surface elevations and conservation storage in Lake Lanier similar to the result from the NAA. The curves for Lake Lanier depicting median water surface elevation (Figure 6.1-2) and daily water surface elevations at the 90-percent exceedance level (Figure 6.1-4) are essentially the same, except that median daily water surface elevations in July through early September would likely range up to 0.5 ft lower than the NAA. The duration curves for the PAA and NAA (Figure 6.1-6) are similar, except above the 97-percent exceedance level, where the PAA would likely result in a substantially lower lake level than the NAA.

Over the modeled period of record, the lowest water surface elevation that Lake Lanier would be likely to reach under the PAA would be 1,050.3 ft, about 19.7 ft below the winter guide curve. The number of years that Lake Lanier pool levels would likely drop below IIL, RIL, and WAL would be similar to the NAA. For the PAA, pool levels would likely drop below IIL and RIL slightly more often than the NAA (see Table 6.1-2). The PAA would likely result in pool levels in zones 1 and 2 for a slightly lower percent of time than the NAA and a slightly greater percent of time in Zone 3 (Table 6.1-3).

6.1.1.1.2 West Point Dam and Lake

West Point Dam and Lake and its operations are described in detail in section 2.1.1.1.6.3. This section describes the effects of operations under the water management alternatives, Alt1 and Alt7, combined with water supply options A, B, C, D, E, F, and H.

Figure 6.1-7 through Figure 6.1-12 and Table 6.1-4 present model outputs for West Point Lake operations over the modeled period of hydrologic record for existing conditions (or the NAA) along with the results for proposed revisions to the Master Manual as defined by Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and PAA. The figures present results for median pool levels (daily), 90-percent exceedance pool levels (daily), percent of days exceeded for pool levels, and number of years that impact thresholds (recreation) are reached (summer season). Table 6.1-4 tabulates the results for the number of years that impact thresholds are reached (annual and peak recreation). In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (i.e., median daily pool level) are presented in two figures with half of the alternatives presented on each figure. Using the results from these figures and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

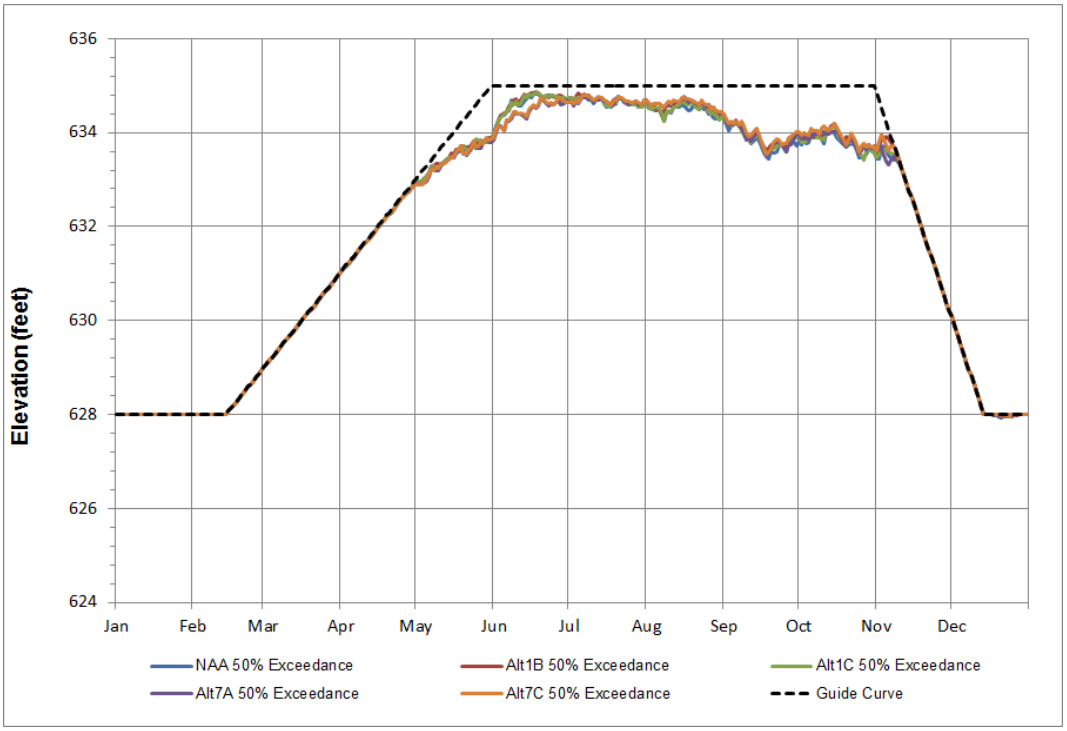


Figure 6.1-7. West Point Lake, Median Daily Water Surface Elevation over Modeled Period of Record (1939–2011) for the NAA and Alternatives 1B, 1C, 7A, and 7C

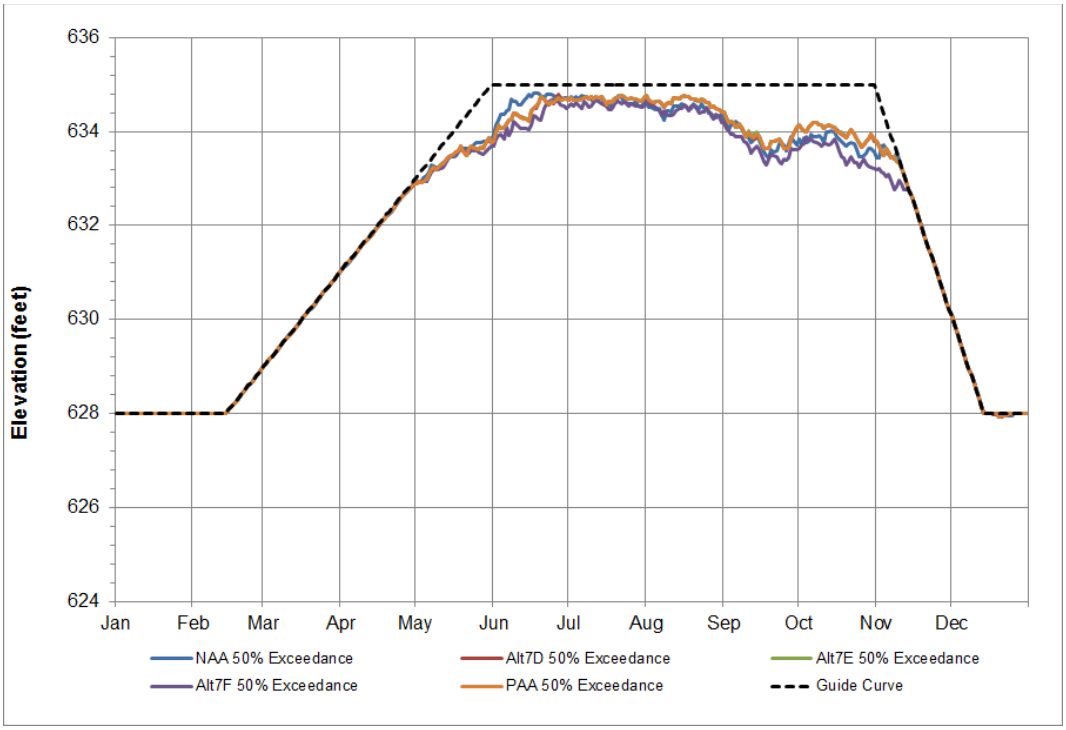


Figure 6.1-8. West Point Lake, Median Daily Water Surface Elevation over Modeled Period of Record (1939–2011) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

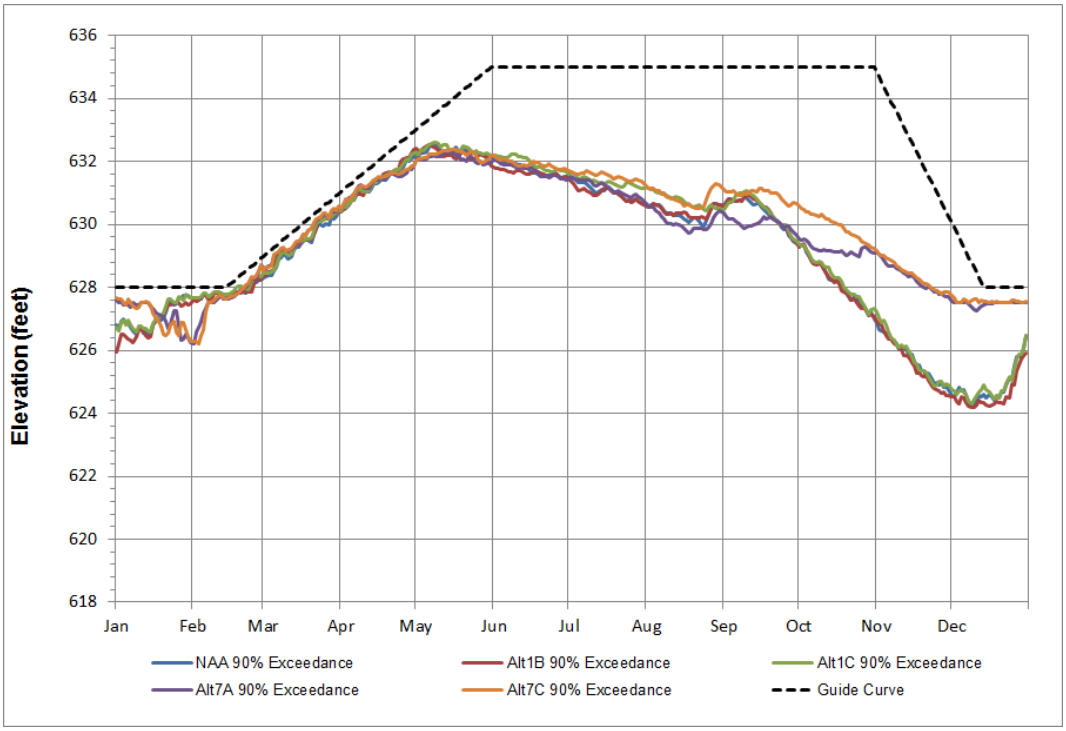


Figure 6.1-9. West Point Lake, Daily Water Surface Elevations that Would Be Exceeded 90 Percent of the Time over Modeled Period of Record (1939–2011) for the NAA and Alternatives 1B, 1C, 7A, and 7C

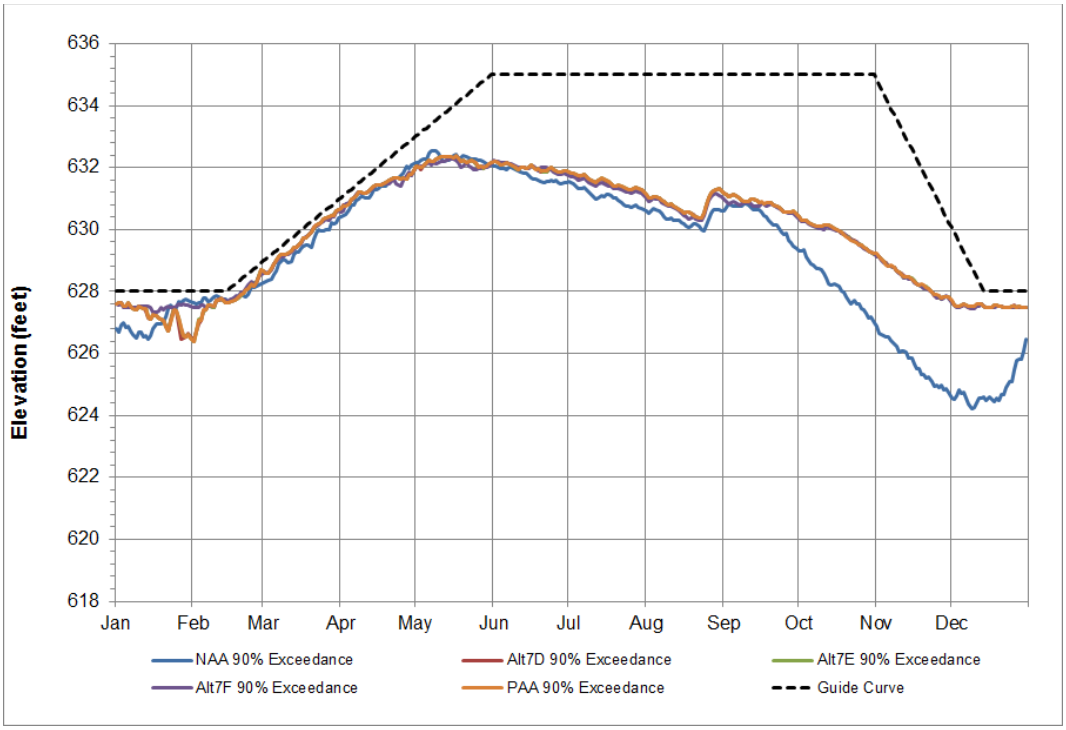


Figure 6.1-10. West Point Lake, Daily Water Surface Elevations that Would Be Exceeded 90 Percent of the Time over Modeled Period of Record (1939–2011) for NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

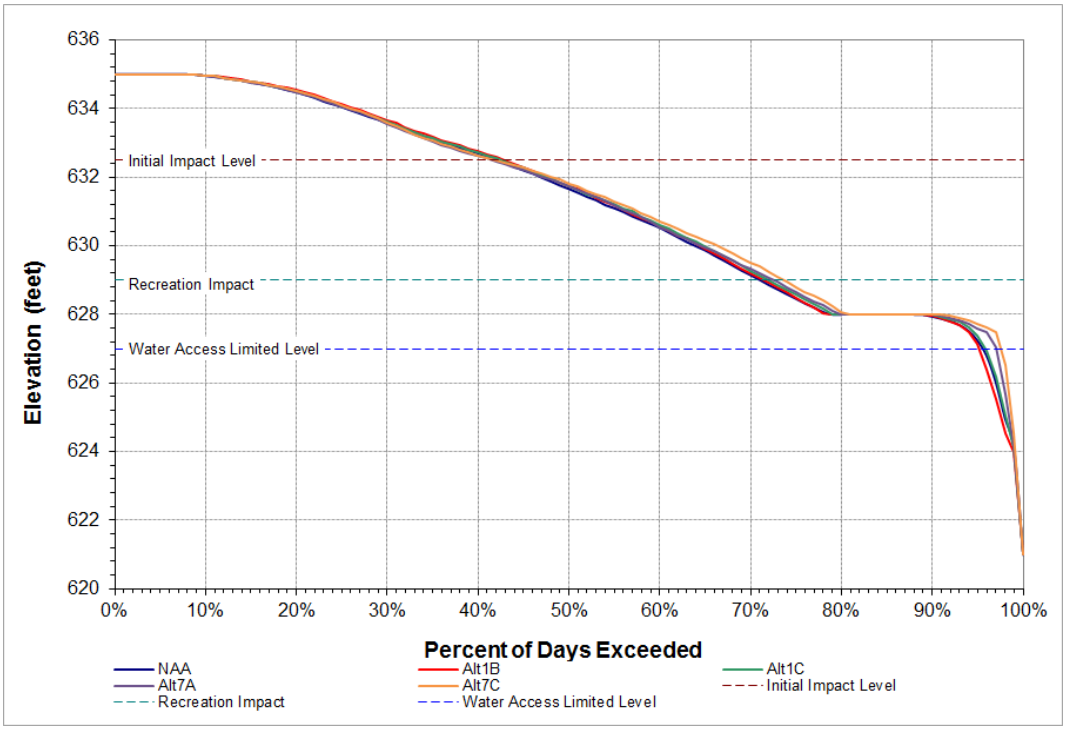


Figure 6.1-11. West Point Lake, Daily Water Surface Elevations—Percent of Days Exceeded over Modeled Period of Record (1939–2011) for NAA and Alternatives 1B, 1C, 7A, and 7C

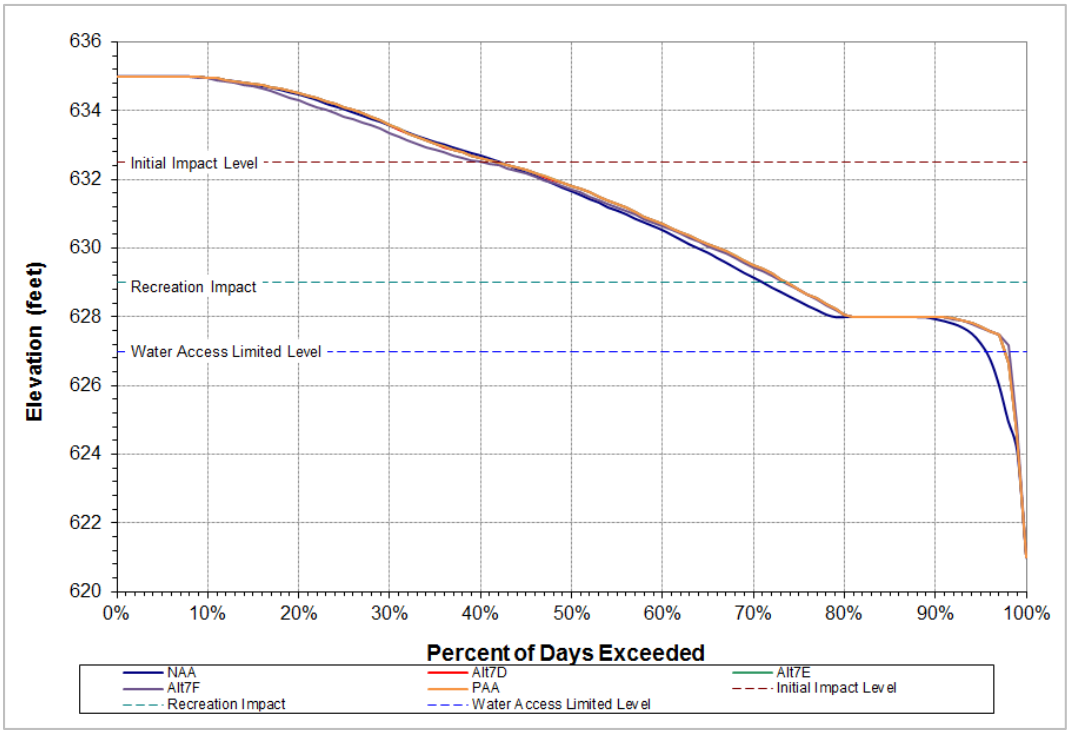


Figure 6.1-12. West Point Lake, Daily Water Surface Elevations—Percent of Days Exceeded over Modeled Period of Record (1939–2011) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

Table 6.1-4.
Number of Years West Point Lake Water Surface Elevation Would Drop below Impact Thresholds for Recreation Use during the Modeled Period of Record (1939–2011)

Alternative	Time interval analyzed for each year	Initial Impact level (elev. 632.5 ft)	Recreation Impact level (elev. 629 ft)	Water access limited level (elev. 627 ft)
No Action Alternative	Jan–Dec (12 months)	73	73	22
	Peak Recreation May–Sep (5 months)	38	6	3
Alt1B	Jan–Dec (12 months)	73	73	20
	Peak Recreation May–Sep (5 months)	36	6	4
Alt1C	Jan–Dec (12 months)	73	73	20
	Peak Recreation May–Sep (5 months)	38	4	3
Alt7A	Jan–Dec (12 months)	73	73	16
	Peak Recreation May–Sep (5 months)	42	8	3
Alt7C	Jan–Dec (12 months)	73	73	15
	Peak Recreation May–Sep (5 months)	40	4	2
Alt7D	Jan–Dec (12 months)	73	73	12
	Peak Recreation May–Sep (5 months)	44	4	2

Alternative	Time interval analyzed for each year	Initial Impact level (elev. 632.5 ft)	Recreation Impact level (elev. 629 ft)	Water access limited level (elev. 627 ft)
Alt7E	Jan–Dec (12 months)	73	73	11
	Peak Recreation May–Sep (5 months)	44	4	2
Alt7F	Jan–Dec (12 months)	73	73	11
	Peak Recreation May–Sep (5 months)	47	4	2
PAA	Jan–Dec (12 months)	73	73	11
	Peak Recreation May–Sep (5 months)	44	4	2

6.1.1.1.2.1 No Action Alternative

The median daily pool elevation at West Point Lake over the period of record (Figure 6.1-7) would closely follow the guide curve (top of conservation pool) from the months of January through April, thereafter increasing to a peak median pool elevation of 634.8 ft in mid-June (slightly below the guide curve elevation of 635 ft). From mid-June, the median daily water elevation would gradually decline through the summer months and into the early fall by as much as about 1.4 ft below the guide curve. By early November, the median water surface elevation under the NAA would intersect the guide curve during the fall drawdown period. The water surface elevation would gradually continue to decline through November and December, generally consistent with the fall drawdown and winter guide curve levels.

For the NAA, water surface elevations at the 90-percent exceedance level would likely range from 0.15 ft to 2.9 ft below the guide curve for the months of January through May. From June through December, the water surface elevations would gradually decline from an elevation of about 632 ft in early June to about 624.5 ft in early December. For the NAA, median water surface elevations would be over 4 ft below the guide curve elevation from August through early September, about 5.7 ft below on October 1, and about 8 ft below on November 1 (Figure 6.1-9).

Figure 6.1-11 provides information on the percentage of days over the modeled period of record that West Point Lake would be expected to exceed a range of water surface elevations that indicate specific levels of potential impact on resources and/or public uses of the lake. For the NAA, West Point Lake water surface elevations would be expected to decline below the IIL (632.5 ft) on about 56 percent of the days, below the RIL (629 ft) on 28 percent of the days, and below the WAL (627 ft) on 4 percent of the days. Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be 621 ft, about 7 ft below the winter guide curve elevation (628 ft).

Table 6.1-4 depicts the number of years over the modeled period of record during which West Point Lake water surface elevations would drop below the three previously defined impact levels at some point during the entire year and during the summer recreation season (May–September). The year is included in the count if, at any time during any year, the model outputs indicate that lake levels would decline below a specific impact level, regardless of the duration. Considering all months of the year, West Point Lake would be expected to decline below the IIL in 73 of 73 years, below the RIL in 73 of 73 years, and below the WAL level in 22 of 73 years. Since the winter guide curve elevation (628 ft) is lower than the IIL (632.5 ft) and the RIL (629 ft), it is clear why pool levels analyzed over all months of the year would be expected to decline below the IIL and RIL in all years over the period of record. However, if only the months of the peak recreation season are considered (May–September), West Point Lake would be

expected to decline below the IIL in 38 of 73 years, below the RIL in 6 of 73 years, and below the WAL in 3 of 73 years.

6.1.1.1.2.2 Alternative 1B

Alt1B would essentially have the same effects on water surface elevations in West Point Lake as the NAA. The model outputs for the Alt1B, as reflected by the various curves and tables presented herein (Figure 6.1-7, Figure 6.1-9, Figure 6.1-11, and Table 6.1-4) are nearly identical in many respects and only slightly different in others. For example, Table 6.1-4 indicates that water surface elevations in the peak summer recreational season for Alt1B would be likely to decline below the IIL in 36 of 73 years (38 for the NAA), below the RIL in 6 of 73 years (same as the NAA), and below the WAL in 4 of 73 years (3 for the NAA).

6.1.1.1.2.3 Alternative 1C

Alt1C would essentially have the same effects on water surface elevations in West Point Lake as the NAA. The model outputs for the Alt1C, as reflected by the various curves and tables presented herein (Figure 6.1-7, Figure 6.1-9, Figure 6.1-11, and Table 6.1-4) are nearly identical in many respects and only slightly different in others. For example, Table 6.1-4 indicates that water surface elevations in the peak summer recreational season for Alt1C would likely decline below the IIL in 38 of 73 years (same as the NAA), below the RIL in 4 of 73 years (6 for the NAA), and below the WAL in 3 of 73 years (same as the NAA).

6.1.1.1.2.4 Alternative 7A

Figure 6.1-7 indicates that median daily water surface elevations in West Point Lake would follow a similar pattern as NAA. At the 90-percent exceedance level, Alt7A would follow a pattern similar to the NAA from early February through August. In late January and early September, Alt7A would likely be up to 1 ft lower than the NAA. From October through mid-January, Alt7A would represent a substantial improvement in lake-level conditions over the NAA, ranging from minor improvement up to about 3 ft higher during late November and most of December (Figure 6.1-9). This improvement would be attributed to the differences in water management alternatives. This characteristic is prevalent in all the subsequent alternatives that include Water Management Alternative 7.

Alt7A would represent a slight improvement in the percent of days that the water surface elevations would be likely to decline below the designated impact levels compared to the NAA (Figure 6.1-11). Under Alt7A, lake levels would exceed the RIL about 1 percent more often and the WAL, about 2 percent more often than the NAA. Table 6.1-4 indicates that water surface elevations in the peak summer recreational season for Alt7A would likely decline below the IIL in 42 of 73 years (38 for the NAA), below the RIL in 8 of 73 years (6 for the NAA), and below the WAL in 3 of 73 years (same as the NAA).

6.1.1.1.2.5 Alternative 7C

Compared to the NAA, median daily water surface elevations in West Point Lake under Alt7C would follow a similar pattern as described for Alt7A (Figure 6.1-7). At the 90-percent exceedance level (Figure 6.1-9), Alt7C would follow a pattern similar to the one described for the NAA from early February through June. From July through mid-January, Alt7C would represent an increase in water surface elevation compared to the NAA, varying from about 1 ft in August to as much as about 3 ft in December. This overall improvement would largely be attributable to water management measures included in Alt7C that are not part of the NAA, as discussed in Section 4.

For Alt7C, lake elevations would be below the IIL on 58 percent of the days over the period of record (56 percent for the NAA), below the RIL on 26 percent of the days (28 percent for the NAA), and below WAL on 2 percent of the days (4 percent for the NAA) (Figure 6.1-11). Under Alt7C, water surface elevations would decline to the lower levels less often than under the NAA. The lowest expected water surface elevation over the period of record would be about elevation 621 ft, which is about the same as for the NAA. Table 6.1-4 indicates that water surface elevations in the peak summer recreational season for Alt7C would likely decline below the IIL in 40 of 73 years (38 for the NAA), below the RIL in 4 of 73 years (6 for the NAA), and below the WAL in 2 of 73 years (3 for the NAA).

6.1.1.1.2.6 Alternative 7D

Median daily water surface elevations in West Point Lake for Alt7D (Figure 6.1-8) would closely match those for the NAA throughout the year. Alt7D pool elevations would tend to be slightly higher than NAA values from September through early November.

At the 90-percent exceedance level, water surface elevations under Alt7D would be similar to those for the NAA from mid-February through June. From June through early September, Alt7D would provide for a slight improvement in lake-level conditions compared to the NAA (from zero to about 0.5 ft). From October through mid-January, Alt 7D would represent a substantial improvement in lake-level conditions compared to the NAA, ranging from minor improvement up to about 3.2 ft higher during late November and most of December (Figure 6.1-10).

For Alt7D, lake elevations would be below the IIL on 57 percent of the days over the period of record (56 percent for the NAA), below the RIL on 26 percent of the days (28 percent for the NAA), and below WAL on 2 percent of the days (4 percent for the NAA) (Figure 6.1-12). Under Alt7D, water surface elevations would decline to the lower levels less often than under the NAA. The lowest expected water surface elevation over the period of record would be about elevation 621 ft, which is about the same as for the NAA. Table 6.1-4 indicates that water surface elevations in the peak summer recreational season for Alt7D would likely decline below the IIL in 44 of 73 years (38 for the NAA), below the RIL in 4 of 73 years (6 for the NAA), and below the WAL in 2 of 73 years (3 for the NAA). Compared to the NAA, Alt7D would result in slightly more years when lake levels decline below the IIL, but fewer occurrences at the more severe RIL and WAL levels.

6.1.1.1.2.7 Alternative 7E

Compared to the NAA, Alt7E would essentially have the same effects on water surface elevations in West Point Lake as described for Alt7D. Both alternatives would have effects similar to those for the NAA. The model outputs for Alt7E and Alt7D are nearly identical, as reflected by the various curves and tables presented Figure 6.1-8, Figure 6.1-10, Figure 6.1-12, and Table 6.1-4.

6.1.1.1.2.8 Alternative 7F

Compared to the NAA, median daily water surface elevations and water surface elevations at the 90-percent exceedance level in West Point Lake for Alt7F (Figure 6.1-8 and Figure 6.1-10) would be essentially the same as those described for Alt 7D.

Lake elevations would be below the IIL on 59 percent of the days over the period of record (56 percent for the NAA), below the RIL on 26 percent of the days (28 percent for the NAA), and below WAL on 2 percent of the days (4 percent for the NAA) (Figure 6.1-12). Under Alt7F, water surface elevations would decline to the lower levels less often than under the NAA. The lowest expected water surface elevation over the period of record would be about elevation 621 ft, which is about the same as for the NAA. Table 6.1-4 indicates that water surface elevations in the peak summer recreational season for

Alt7F would likely decline below the IIL in 47 of 73 years (38 for the NAA), below the RIL in 4 of 73 years (6 for the NAA), and below the WAL in 2 of 73 years (3 for the NAA). Compared to the NAA, Alt7F would result in slightly more years when lake levels decline below the IIL, but fewer occurrences at the more severe RIL and WAL levels.

6.1.1.1.2.9 Alternative 7H (PAA)

As indicated in Figure 6.1-8, median daily water surface elevations in West Point Lake under the PAA would be the same as under the NAA between mid-November and early May, both curves closely following the guide curve during the period. Median lake levels in May and June under the NAA would be slightly higher than under the PAA. Between July and October, the PAA would provide a slight improvement in water surface elevations (zero to 0.4 ft) compared to the NAA.

At the 90-percent exceedance level, water surface elevations under the PAA would essentially be the same as under the NAA from mid-February through June. From June through early September, the PAA would provide for a slight improvement in lake-level conditions compared to the NAA (from zero to about 0.5 ft). From October through mid-January, the PAA would represent a substantial improvement in lake-level conditions compared to the NAA, ranging from minor improvement up to about 3.2 ft higher during late November and most of December (Figure 6.1-10).

For the PAA, lake elevations would be below the IIL on 56 percent of the days over the period of record (same as the NAA), below the RIL on 27 percent of the days (28 percent for the NAA), and below WAL on 2 percent of the days (4 percent for the NAA) (Figure 6.1-12). Under the PAA, water surface elevations would decline to the lower levels less often than under the NAA. The lowest expected water surface elevation over the period of record would be about elevation 621 ft, which is about the same as for the NAA. Table 6.1-4 indicates that water surface elevations in the peak summer recreational season for the PAA would likely decline below the IIL in 44 of 73 years (38 for the NAA), below the RIL in 4 of 73 years (6 for the NAA), and below the WAL in 2 of 73 years (3 for the NAA). Compared to the NAA, the PAA would result in slightly more years when lake levels decline below the IIL, but fewer occurrences at the more severe RIL and WAL levels.

6.1.1.1.3 Walter F. George Lock and Dam and Lake

Walter F. George Lake (locally known in Alabama as Lake Eufaula) and its operations are described in detail in section 2.1.1.1.6.5. The lake was formed by the multipurpose Walter F. George Lock and Dam project on the Chattahoochee River. This section describes the effects of operations under the water management alternatives, Alt1 and Alt7, and water supply options A, B, C, D, E, F, and H.

Figure 6.1-13 through Figure 6.1-18, and Table 6.1-5 present model outputs for Walter F. George Lake operations over the modeled period of hydrologic record for existing conditions (reflected in the NAA) along with the results for proposed revisions to the Master Manual as defined in Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and PAA. The figures present results for median pool levels (daily), 90-percent exceedance pool levels (daily), and percent of days exceeded for pool levels. In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (i.e., median daily pool level) is presented in two figures with half of the alternatives presented on each figure. Using the results from the figures and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

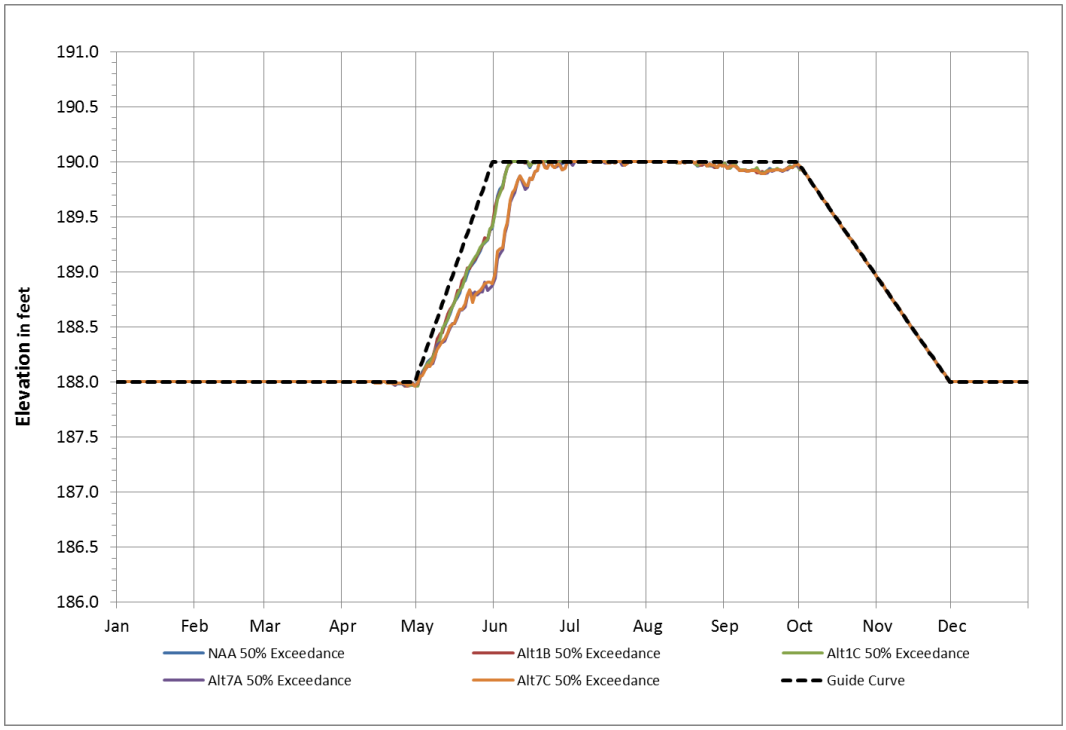


Figure 6.1-13. Walter F. George Lake, Median Daily Water Surface Elevation over Modeled Period of Record (1939–2011) for the NAA and Alternatives 1B, 1C, 7A, and 7C

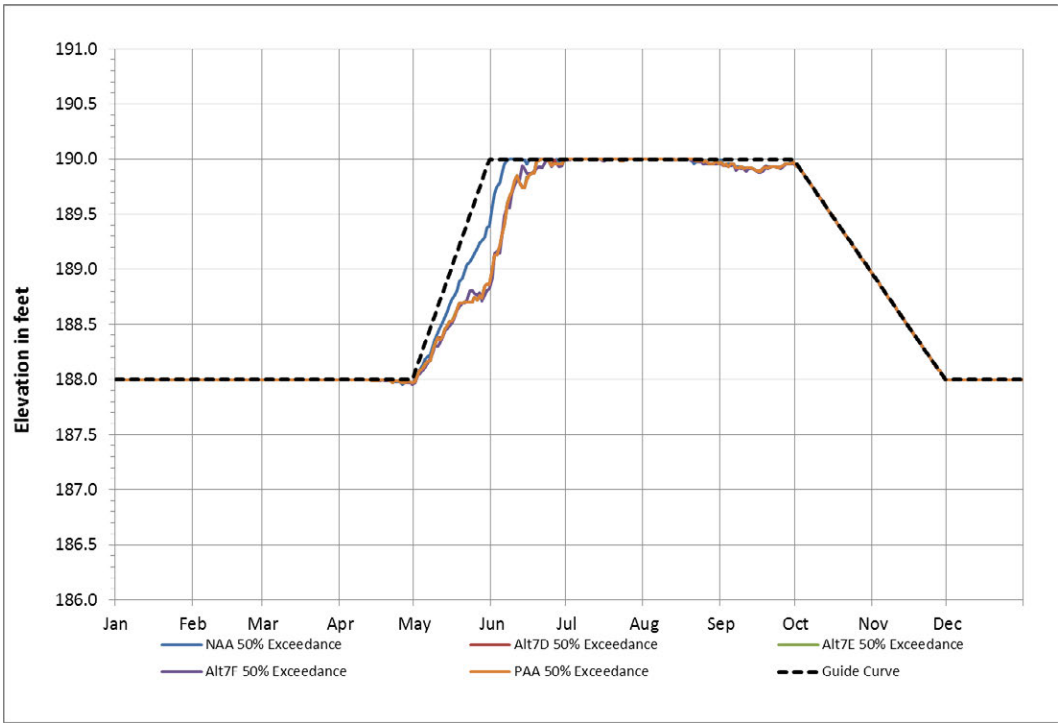


Figure 6.1-14. Walter F. George Lake, Median Daily Water Surface Elevation over Modeled Period of Record (1939–2011) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

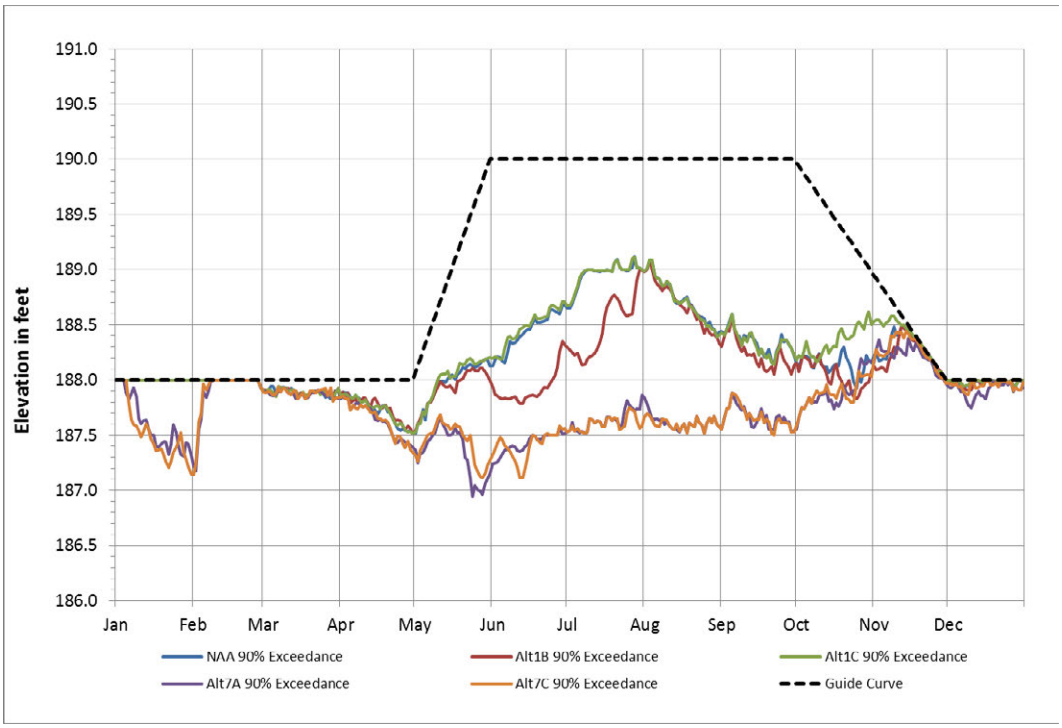


Figure 6.1-15. Walter F. George Lake, Daily Water Surface Elevations that Would Be Exceeded 90 Percent of the Time over Modeled Period of Record (1939–2011) for the NAA and Alternatives 1B, 1C, 7A, and 7C

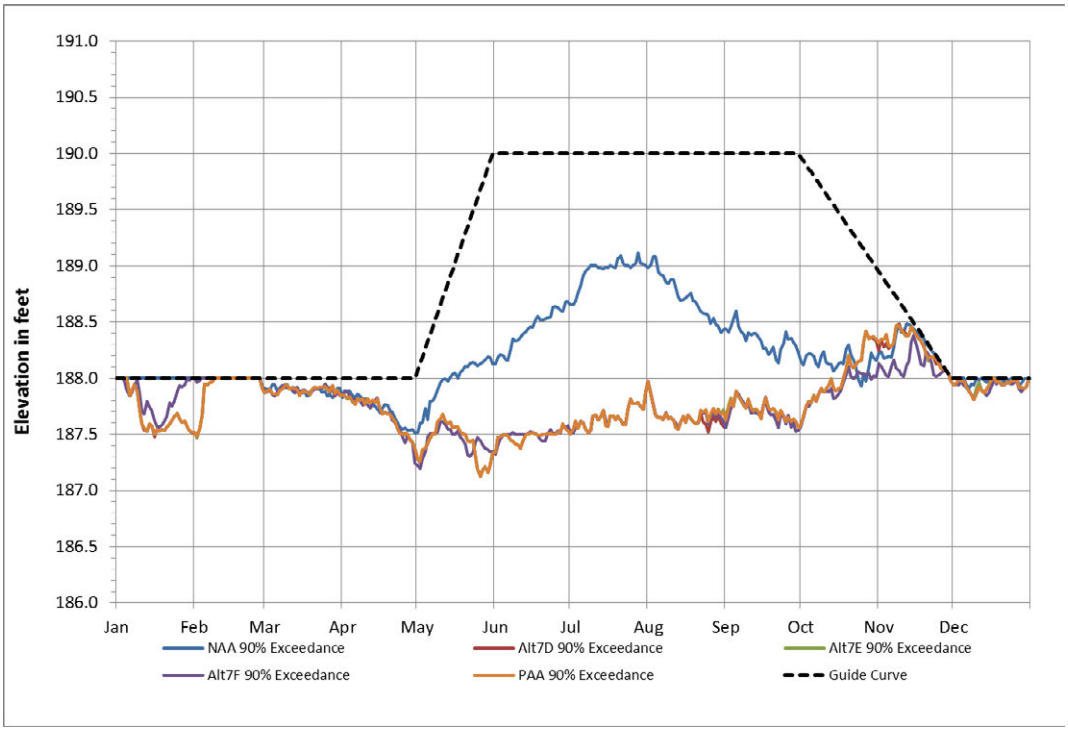


Figure 6.1-16. Walter F. George Lake, Daily Water Surface Elevations that Would Be Exceeded 90 Percent of the Time over Modeled Period of Record (1939–2011) for NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

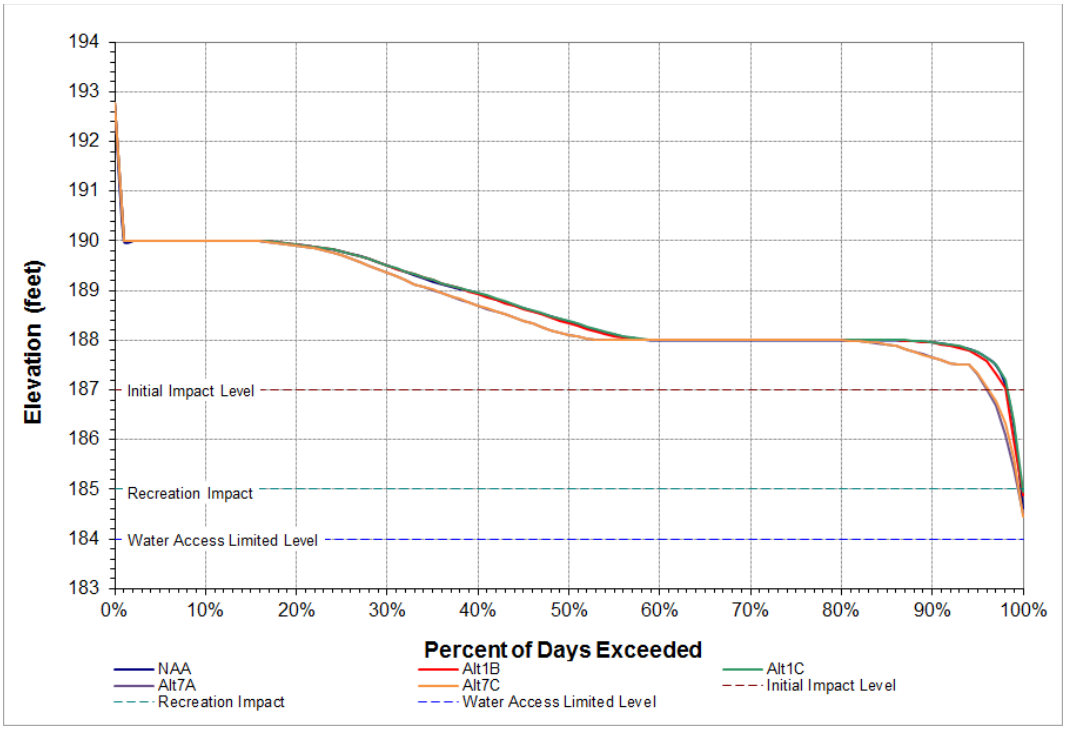


Figure 6.1-17. Walter F. George Lake, Daily Water Surface Elevations—Percent of Days Exceeded over Modeled Period of Record (1939–2011) for the NAA and Alternatives 1B, 1C, 7A, and 7C

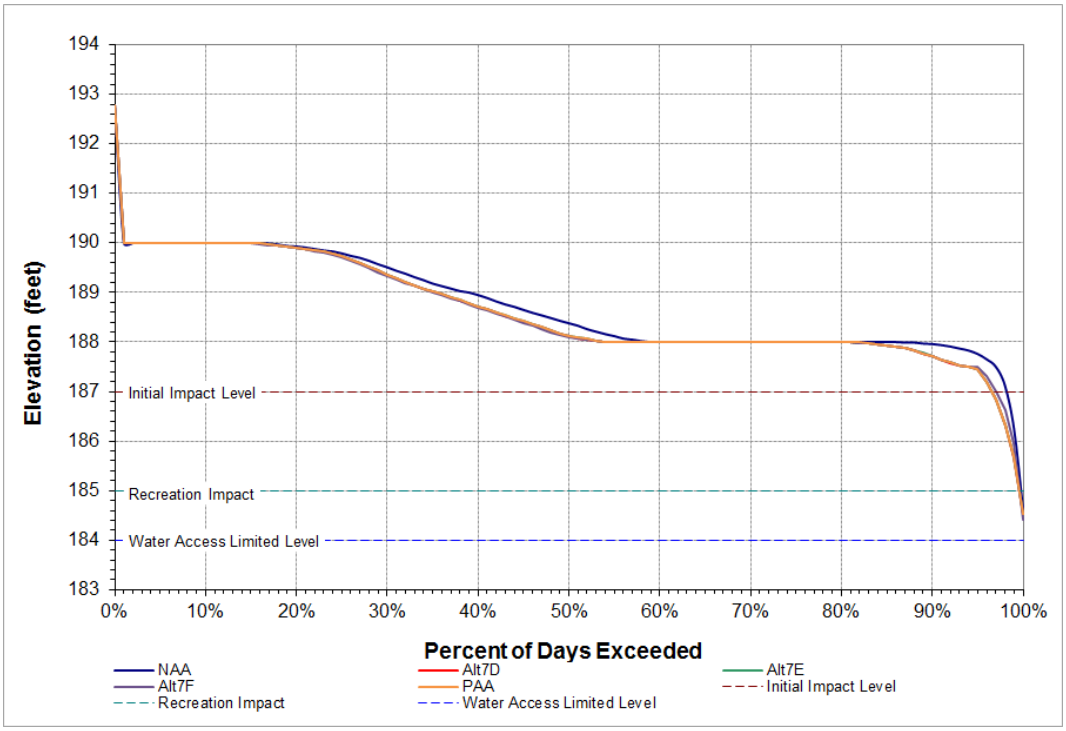


Figure 6.1-18. Walter F. George Lake, Daily Water Surface Elevations—Percent of Days Exceeded over Modeled Period of Record (1939–2011) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

Table 6.1-5 summarizes the number of years over the 73-year modeled period of record that Walter F. George Lake levels would drop below each of the three established impact thresholds for public use of the lake.

Table 6.1-5.
Number of Years Walter F. George Lake Water Surface Elevation Would Drop below Impact Thresholds for Recreation Use during 73-year Modeled Period of Record (1939–2011)

Alternative	Time interval analyzed for each year	Initial impact level (elev. 187 ft)	Recreation impact level (elev. 185 ft)	Water access limited level (elev. 184 ft)
NAA	Jan–Dec (12 months)	5	1	0
	Peak Recreation Jun–Aug (3 months)	3	0	0
Alt1B	Jan–Dec (12 months)	7	2	0
	Peak Recreation Jun–Aug (3 months)	4	0	0
Alt1C	Jan–Dec (12 months)	5	1	0
	Peak Recreation Jun–Aug (3 months)	3	0	0
Alt7A	Jan–Dec (12 months)	19	2	0
	Peak Recreation Jun–Aug (3 months)	6	1	0
Alt7C	Jan–Dec (12 months)	18	2	0
	Peak Recreation Jun–Aug (3 months)	7	0	0
Alt7D	Jan–Dec (12 months)	20	2	0
	Peak Recreation Jun–Aug (3 months)	6	0	0
Alt7E	Jan–Dec (12 months)	20	2	0
	Peak Recreation Jun–Aug (3 months)	6	0	0
Alt7F	Jan–Dec (12 months)	17	2	0
	Peak Recreation Jun–Aug (3 months)	4	0	0
PAA	Jan–Dec (12 months)	20	2	0
	Peak Recreation Jun–Aug (3 months)	6	0	0

6.1.1.1.3.1 No Action Alternative

The median daily pool elevation at Walter F. George Lake over the modeled period of record would follow the guide curve from January through April. Beginning in early May, the median daily elevation would gradually increase at a rate slightly less than the guide curve elevation, essentially reaching the summer guide curve elevation (190 ft) by about mid-June. For the balance of the year (mid-June–December), the median water surface elevation would remain at, or just below, the guide curve elevation. (Figure 6.1-13).

For the NAA, water surface elevations at the 90-percent exceedance level would be essentially the same as the guide curve from January through February, declining to about elevation 187.5 (0.5 ft below the guide curve) by early May. From June through about mid-November, the 90-percent exceeded water surface elevations would fluctuate from about 1 to 2 ft below the guide curve, peaking at about elevation 189 ft in July. From mid-November through December, the 90-percent exceeded water surface elevation would match the guide curve (Figure 6.1-15).

For the NAA, Walter F. George Lake water surface elevations would be expected to decline below the IIL (187 ft) about 2 percent of the time and below the RIL (185 ft) less than 1 percent of the time, but never below the WAL (184 ft). Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be elevation 184.6 ft, about 3.4 ft below the winter guide curve elevation (188 ft) (Figure 6.1-17).

Table 6.1-5 depicts the number of years over the modeled period of record during which Walter F. George Lake water surface elevations would drop below IIL, RIL, and WAL. Considering all months of the year, Walter F. George Lake would be expected to decline below the IIL in 5 of 73 years, below the RIL in 1 of 73 years, and none below the WAL. Considering only the months of the peak recreation season (June–August), Walter F. George Lake would be expected to decline below the IIL in 3 of 73 years and not drop below the RIL or the WAL over the period of record.

6.1.1.1.3.2 Alternative 1B

Figure 6.1-13 shows that the median daily water surface elevations in Walter F. George Lake for Alt1B over the modeled period of record would be essentially the same as for the NAA. At the 90-percent exceedance level, the water surface elevations would be the same as for the NAA from January through May and would decline below the NAA by about 0.5 to 1 ft from May through July. From August through December, the water surface elevations for Alt1B would be about the same as for the NAA, except that they would be up to 0.5 ft lower than the NAA from mid-October through mid-November (Figure 6.1-15).

For Alt1B, Walter F. George Lake water surface elevations would be expected to decline below the IIL (187 ft) about 2 percent of the time and below the RIL (185 ft) less than 1 percent of the time, but never below the WAL (184 ft). This would represent no change from the NAA. Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be elevation 184.9 ft, about 3.1 ft below the winter guide curve elevation (188 ft) (Figure 6.1-17).

For all 12 months of the year over the period of record, Walter F. George Lake would be expected to decline under Alt1B below the IIL in 7 of 73 years (5 for the NAA) and below the RIL in 2 of 73 years (1 for the NAA), but not drop below the WAL (Table 6.1-5). Based only upon the months of the peak recreation season (June–August), Walter F. George Lake would be expected to decline below the IIL in 4 of 73 years (3 for the NAA), but not drop below the RIL or the WAL (same as the NAA) (Table 6.1-5). The results for Alt1B represent a slight increase in the number of years that lake levels would likely decline below IIL and RIL levels compared to the NAA.

6.1.1.1.3.3 Alternative 1C

At both the median and 90-percent exceeded levels, Alt1C would have nearly the same effects on water surface elevations in Walter F. George Lake as the NAA (Figure 6.1-13 and Figure 6.1-15). The only exception would be that Alt1C would likely produce higher water surface elevations (up to about 0.5 ft) at the 90-percent exceeded level for the period October through mid-November compared to the NAA, which would represent a slight improvement under drought conditions.

For Alt1C, Walter F. George Lake water surface elevations would be expected to decline below the IIL (187 ft) about 2 percent of the time and below the RIL (185 ft) less than 1 percent of the time, but never below the WAL (184 ft). This would represent no change from the NAA. Over the modeled period of record, the lowest water surface elevation that the lake would be expected to reach would be elevation 185 ft, about 3 ft below the winter guide curve elevation (188 ft) (Figure 6.1-17).

For all 12 months of the year and for the peak recreation season over the modeled period of record, Alt1C would represent no change from the NAA with respect to the number years when water surface elevations in Walter F. George Lake would likely decline below IIL, RIL, and WAL elevations (Table 6.1-5).

6.1.1.1.3.4 Alternative 7A

The median daily water surface elevations under Alt7A would closely match those for the NAA, except during the transition period (May–mid-June) from the winter to summer guide curve elevations. During that period, Alt7A levels would be lower than for the NAA by variable amounts, ranging from minimal up to about 0.5 ft (Figure 6.1-13).

At the 90-percent exceedance level, the water surface elevations under Alt7A would likely decline below NAA levels in January and early February by up to about 0.8 ft, thereafter being nearly the same as the NAA levels through April. From May through October, Alt7A daily water surface elevations at the 90-percent exceedance level would range slightly above or below elevation 187.5 ft and would be from about 0.3 to 1.5 ft below NAA levels during that period. During the months of November and December, the 90-percent exceedance elevations for Alt7A and the NAA would be about the same (Figure 6.1-15). Those levels for Alt7A would represent a substantial change from the NAA levels under extreme drought conditions.

For Alt7A, Walter F. George Lake water surface elevations would be expected to decline below the IIL about 4 percent of the time (2 percent for the NAA) and below the RIL about 1 percent of the time (less than 1 percent for the NAA), and never below the WAL (same as the NAA). This would represent a slight increase in the percent of time below the IIL compared to the NAA. Over the modeled period of record, the lowest water surface elevation that the lake would likely reach would be elevation 184.5 ft, about 3.5 ft below the winter guide curve (188 ft) (Figure 6.1-17).

For all 12 months of the year over the modeled period of record, Walter F. George Lake would be expected to decline under Alt7A below the IIL in 19 of 73 years (5 for the NAA) and below the RIL in 2 of 73 years (1 for the NAA), but not drop below the WAL (Table 6.1-5). Based only upon the months of the peak recreation season (June–August), Walter F. George Lake would be expected to decline below the IIL in 6 of 73 years (3 for the NAA) and below the RIL in 1 of 73 years, but not to drop below the WAL level (same as the NAA) (Table 6.1-5). These results for Alt7A represent a substantial increase in the number of years that lake levels would likely decline below IIL compared to the NAA. These effects are attributable to systemwide water management measures included in the plan from Water Management Alternative 7, including seasonal navigation flows, revised action zones, and drought operations.

6.1.1.1.3.5 Alternative 7C

Compared to the NAA, Alt7C would have nearly the same effects on water surface elevations in Walter F. George Lake as described in detail for Alt7A in section 6.1.1.1.3.4. Median daily water surface elevations, daily water surface elevations at the 90-percent exceedance level, water surface elevation percent of days exceeded, and number of years below recreation impact levels for Alt7C are presented in Figure 6.1-13, Figure 6.1-15, Figure 6.1-17, and Table 6.1-5.

6.1.1.1.3.6 Alternative 7D

Compared to the NAA, Alt7D would have nearly the same effects on water surface elevations in Walter F. George Lake as described in detail for Alt7A in section 6.1.1.1.3.4. Median daily water surface elevations and daily water surface elevations at the 90-percent exceedance level for Alt7D are presented in Figure 6.1-14 and Figure 6.1-16 as compared to the NAA.

For Alt7D, Walter F. George Lake water surface elevations would be expected to decline below the IIL about 3 percent of the time (2 percent for the NAA) and below the RIL about 1 percent of the time (less than 1 percent for the NAA), but never drop below the WAL (same as the NAA). This would represent a slight increase in the percent of time below the IIL compared to the NAA. Over the modeled period of record, the lowest water surface elevation that the lake would likely reach would be elevation 184.5 ft, about 3.5 ft below the winter guide curve (188 ft) (Figure 6.1-18).

For all 12 months of the year over the modeled period of record, Walter F. George Lake would be expected to decline below the IIL in 20 of 73 years (5 for the NAA) and below the RIL in 2 of 73 years (1 for the NAA), but not drop below the WAL (Table 6.1-5). Based only upon the months of the peak recreation season (June–August), Walter F. George Lake would be expected to decline below the IIL in 6 of 73 years (3 for the NAA) and not drop below the RIL and WAL levels (same as the NAA) (Table 6.1-5). These results for Alt7D represent a substantial increase in the number of years that lake levels would likely decline below IIL compared to the NAA. These effects are attributable to systemwide water management measures included in the plan from Water Management Alternative 7, including seasonal navigation flows, revised action zones, and drought operations.

6.1.1.1.3.7 Alternative 7E

Compared to the NAA, Alt7E would have nearly the same effects on water surface elevations in Walter F. George Lake as described in detail for Alt7A in section 6.1.1.1.3.4. Median daily water surface elevations and daily water surface elevations at the 90-percent exceedance level for Alt7E are presented in Figure 6.1-14 and Figure 6.1-16.

For Alt7E, Walter F. George Lake water surface elevations would be expected to decline below the IIL about 3 percent of the time (2 percent for the NAA) and below the RIL about 1 percent of the time (less than 1 percent for the NAA), but never below the WAL (same as the NAA). This would represent a slight increase in the percent of time below the IIL compared to the NAA. Over the modeled period of record, the lowest water surface elevation that the lake would likely reach would be elevation 184.5 ft, about 3.5 ft below the winter guide curve (188 ft) (Figure 6.1-18).

For all 12 months of the year over the modeled period of record, Walter F. George Lake would be expected to decline below the IIL in 20 of 73 years (5 for the NAA) and below the RIL in 2 of 73 years (1 for the NAA), but not below the WAL (Table 6.1-5). Based only upon the months of the peak recreation season (June–August), Walter F. George Lake would be expected to decline below the IIL in 6 of 73 years (3 for the NAA) and not drop below the RIL and WAL levels (same as the NAA) (Table 6.1-5). These results for Alt7D represent a substantial increase in the number of years that lake levels would likely decline below IIL compared to the NAA. These effects are attributable to systemwide water management measures included in the plan from Water Management Alternative 7, including seasonal navigation flows, revised action zones, and drought operations.

6.1.1.1.3.8 Alternative 7F

Compared to the NAA, Alt7F would have similar effects on water surface elevations in Walter F. George Lake as described in detail for Alt7A in section 6.1.1.1.3.4. Median daily water surface elevations and daily water surface elevations at the 90-percent exceedance level for Alt7F are presented in Figure 6.1-14 and Figure 6.1-16. Median daily water surface elevations would be nearly the same for Alt7F and for Alt7A, and there would be only minor differences between Alt7F and Alt7A for the 90-percent exceeded daily water surface elevation values. Those slight differences would occur in the months of January and May through June where the Alt7F values would be higher than Alt7A values (and slightly closer to the NAA values) and in November where the Alt7F values would be slightly lower than Alt7A values (and slightly farther from the NAA values).

For Alt7F, Walter F. George Lake water surface elevations would be expected to decline below the IIL about 2 percent of the time (same as the NAA) and below the RIL about 1 percent of the time (less than 1 percent for the NAA), but never below the WAL (same as the NAA). This would represent a slight increase in the percent of time below the IIL compared to the NAA. Over the modeled period of record, the lowest water surface elevation that the lake would likely reach would be elevation 184.4 ft, about 3.6 ft below the winter guide curve (188 ft) (Figure 6.1-18).

For all 12 months of the year over the modeled period of record, Walter F. George Lake would be expected to decline below the IIL in 17 of 73 years (5 for the NAA) and below the RIL in 2 of 73 years (1 for the NAA), but not below the WAL (Table 6.1-5). Based only upon the months of the peak recreation season (June–August), Walter F. George Lake would be expected to decline below the IIL in 4 of 73 years (3 for the NAA) and not drop below the RIL and WAL levels (same as the NAA) (Table 6.1-5). The results for Alt7F represent a substantial increase in the number of years that lake levels would likely decline below IIL compared to the NAA (but slightly fewer occurrences than for Alt7D, 7E, or the PAA). The increased number of occurrences are largely attributable to systemwide water management measures included in the plan from Water Management Alternative 7, including seasonal navigation flows, revised action zones, and drought operations.

6.1.1.1.3.9 Alternative 7H (PAA)

The median daily water surface elevations under Alt7H (PAA) would closely match those for the NAA, except during the transition period (May–mid-June) from the winter to summer guide curve elevations. During this period, PAA elevations would be lower than for the NAA by variable amounts, ranging from minimal up to about 0.5 ft (Figure 6.1-14).

At the 90-percent exceedance level, the water surface elevations under the PAA would likely decline below NAA levels in January and early February by up to about 0.8 ft, thereafter being nearly the same as NAA levels through April. From May through October, the PAA daily water surface elevations at the 90-percent exceedance level would range slightly above or below elevation 187.5 ft and would be from about 0.3 to 1.5 ft below NAA levels during that period. During the months of November and December, the 90-percent exceedance elevations for the PAA and the NAA would be about the same (Figure 6.1-16). The levels for the PAA would represent a substantial change from the NAA levels under extreme drought conditions.

For the PAA, Walter F. George Lake water surface elevations would be expected to decline below the IIL about 4 percent of the time (2 percent for the NAA) and below the RIL about 1 percent of the time (less than 1 percent for the NAA), but never below the WAL (same as the NAA). This would represent a slight increase over the NAA. Over the modeled period of record, the lowest water surface elevation that the lake would likely reach would be elevation 184.5 ft, about 3.5 ft below the winter guide curve (188 ft) (Figure 6.1-18).

Based upon model outputs for all 12 months of the year over the period of record, Walter F. George Lake would be expected to decline under the PAA below the IIL in 20 of 73 years (5 for the NAA) and below the RIL in 2 of 73 years (1 for the NAA), but not below the WAL (Table 6.1-5). Based only upon the months of the peak recreation season (June–August), Walter F. George Lake would be expected to decline below the IIL in 6 of 73 years (3 for the NAA) and not drop below the RIL and WAL levels (same as the NAA) (Table 6.1-5). The results for the PAA represent a substantial increase in the number of years that lake levels would likely decline below IIL compared to the NAA. These effects are attributable to systemwide water management measures included in the plan from Water Management Alternative 7, including seasonal navigation flows, revised action zones, and drought operations.

6.1.1.1.4 George W. Andrews Lock and Dam and Lake

The George W. Andrews Lock and Dam and its operations are described in detail in section 2.1.1.1.6.6. It is a run-of-river project, primarily for navigation, that passes releases from Walter F. George Dam and any intervening local inflows into the headwaters of Lake Seminole. George W. Andrews Lake operates at elevation 102 ft, with minor variations. For brief periods during extreme flood conditions, the elevation could be much higher (highest known flood elevation was 125.8 ft in March 1929 prior to the lock and dam construction). George W. Andrews Lake has no conservation storage.

6.1.1.1.4.1 No Action Alternative

Under the NAA, lake-level conditions would continue at George W. Andrews Lake as described above.

6.1.1.1.4.2 Alternatives 1B, IC, 7A, 7C, 7D, 7E, 7F, and 7H

Implementing the alternatives would not have any effect on lake-level conditions in George W. Andrews Lake.

6.1.1.1.5 Jim Woodruff Lock and Dam and Lake Seminole

Jim Woodruff Lock and Dam is described in detail in section 2.1.1.1.6.7. The project is essentially a run-of-river project that passes any waters released from George W. Andrews Lock and Dam of the Chattahoochee River, flows entering from the Flint River, and any local inflows to the lake. Lake Seminole normally operates at elevation 77.0 ft. Lake elevations can vary between elevation 76.0 ft and 77.8 ft, depending on inflow. The lake has no dedicated conservation storage.

6.1.1.1.5.1 No Action Alternative

Under the NAA, lake-level conditions in Lake Seminole would continue as described above.

6.1.1.1.5.2 Alternatives 1B, 1C, 7A, 7C, 7D, 7E, 7F, and 7H

Implementing these alternatives would not have any effect on lake-level conditions in Lake Seminole.

6.1.1.1.6 Non-USACE Reservoirs

Non-USACE reservoirs on the mainstem rivers in the ACF Basin are described in section 2.1.1.1.6.2, section 2.1.1.1.6.4, section 2.1.1.1.6.8, and section 2.1.1.1.6.9. These include the GPC reservoirs on the Chattahoochee and Flint rivers and Warwick Dam (Lake Blackshear) operated by the Crisp County Power Commission on the Flint River.

6.1.1.1.6.1 No Action Alternative

Under the NAA, the structures and/or operations of non-USACE (GPC) reservoirs on the mainstem of the Chattahoochee River would not change. Reregulation of Buford Dam releases at Morgan Falls Dam to meet minimum flow requirements at Peachtree Creek would continue as currently conducted in accordance with existing agreements. Appreciable drawdown of Bull Sluice Lake at the Morgan Falls Dam would be expected on many weekends to augment Buford Dam releases and basin inflows below Buford Dam to meet the minimum flow requirements at Peachtree Creek. The NAA would not affect the structures and operations at Warwick Dam (Lake Blackshear) by the Crisp County Power Commission and at Lake Worth Dam by GPC, both on the mainstem of the Flint River.

6.1.1.1.6.2 Alternatives 1B, 1C, 7A, 7C, 7D, 7E, 7F, and 7H

Implementing any of these alternatives would not have an appreciable effect on lake-level conditions at the non-USACE (GPC) reservoirs on the mainstem of the Chattahoochee River compared to the NAA. Morgan Falls Dam would continue to operate to reregulate releases from Buford Dam to ensure that continuous minimum flow requirements at Peachtree Creek are met. These alternatives would not affect lake-level conditions at the reservoir projects on the mainstem of the Flint River.

6.1.1.2 Flow Conditions Downstream of USACE Reservoirs

This section summarizes the effects of alternative water management plans and water supply options for USACE projects in the ACF Basin on streamflow conditions in the basin. Based on HEC-ResSim outputs over the modeled period of record, this section describes the changes in stream flow conditions that would likely occur under Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and Alt7H (PAA) compared to the NAA. The section addresses three specific reaches of the Chattahoochee River (i.e., Buford Dam to West Point Lake, West Point Dam to Walter F. George Lake, and Walter F. George Lock and Dam to Jim Woodruff Lock and Dam) and the Apalachicola River downstream of Jim Woodruff Lock and Dam. None of the water management alternatives/water supply options addressed in this EIS would affect streamflow conditions in the Flint River Basin. The focus of this section is on changes in the quantity and timing of downstream flows as a function of reservoir operations under each of the alternatives. The discussion summarizes the water quantity-related considerations that may, in turn, affect important recreation, infrastructure, and other resources, as well as assess the extent to which streamflows would meet or exceed established flow requirements and specifically defined, but nonmandatory, flow needs in the ACF Basin. These other resource effects resulting from changes in streamflow conditions are addressed in more detail in other pertinent sections of the EIS. For example, while changes in streamflow conditions under the alternatives would likely affect water quality conditions in the basin, those effects are specifically addressed in section 6.1.2.

Figures depicting "median" flow conditions in the basin provide a representative characterization of "normal" conditions for evaluation and comparison among alternatives. The median value represents the point at which 50 percent of the values are higher and 50 percent are lower. In addition, figures depicting the 90-percent exceedance level have been included, which means that the values presented for each day would be exceeded 90 percent of the time in the simulation over the period of record. The 90-percent exceedance value would be representative of extremely dry conditions in the basin and low basin inflow to the reservoirs. Figures depicting flows under wetter conditions (e.g., 10 or 25 percent exceedance levels) for the alternatives under consideration have not been included in this EIS, because they generally indicate minor or no differences among the alternatives.

Interpretation of the model results as presented in Figure 6.1-19 through Figure 6.1-56 and the tabulated information in Table 6.1-6 provide the basis for the description of effects on streamflow conditions in the

ACF Basin. Table 6.1-6 provides a qualitative assessment of the expected effects of the alternatives on streamflow conditions in the mainstem rivers in the ACF Basin.

Table 6.1-6.
Summary of Change in Streamflow Conditions of the Alternatives from the No Action Alternative during the Modeled Period of Record from 1939–2011

Flow condition	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Buford Dam to Bull Sluice Lake (Morgan Falls)	Baseline	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Adverse	Slightly adverse
Morgan Falls Dam to West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	Slightly adverse	Slightly adverse
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	Adverse	No change
Walter F. George Lock and Dam to Jim Woodruff Lock and Dam	Baseline	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.1.1.2.1 Mandatory USACE Minimum Flow Requirements and Nonmandatory Flow Targets/Goals Established by Others in the ACF Basin

There are a number of mandatory minimum flow requirements established for the USACE projects in the ACF Basin. In addition, other agencies and entities have identified flow targets or goals at various points in the basin that are nonmandatory with respect to USACE project operations. In cooperation with these other entities, USACE operations will generally support these targets or goals as long as authorized project purposes are not adversely affected. The following paragraphs summarize these flow requirements and targets/goals. The subsequent assessment of flow conditions under the various alternatives references and further discusses these mandatory flow requirements and nonmandatory flow targets and goals, where appropriate.

Continuous minimum releases of 600 cfs are required from Buford Dam in accordance with the project authorization (see sections 2.1.1.1.6.1 and 2.1.1.2.4.6). A small service generator at the project provides for these releases. When that service generator is inoperable, minimum flow releases would temporarily occur through the sluice gate. Similarly, continuous minimum releases of 675 cfs are required from West Point Dam in accordance with the project authorization (see sections 2.1.1.1.6.3 and 2.1.1.2.4.6). A small service generator at the project provides for these releases. When that service generator is inoperable, minimum flow releases would temporarily occur by opening a spillway gate.

Specific provisions of the revised interim operations plan (RIOP), a product of USACE consultation with the USFWS under section 7 of the Endangered Species Act, establish release requirements at Jim Woodruff Lock and Dam. Section 2.1.1.2.4.4 discusses the detailed provisions and requirements in the RIOP for releases under various hydrologic conditions. Generally, the minimum flow requirement at Jim Woodruff Lock and Dam would be 5,000 cfs. The RIOP contains specific provisions to temporarily reduce releases to 4,500 cfs under extreme drought operations (EDO).

USACE currently operates Buford Dam per agreement among USACE, GPC, and the Georgia Environmental Protection Division (GAEPD) to support a minimum flow of 750 cfs in the Chattahoochee River at its juncture with Peachtree Creek in Metro Atlanta (see section 2.1.1.2.4.6). Based upon scoping

input from GAEPD, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and Alt7H (PAA) include provision for seasonal minimum flows at Peachtree Creek of 750 cfs (May–October) and 650 cfs (November–April).

The four GPC dams on the middle Chattahoochee River downstream of West Point Lake (i.e., Bartletts Ferry, Goat Rock, Oliver, and North Highlands) have established minimum flow targets in their FERC licenses (see section 2.1.1.1.6.4), hereafter referred to as *FERC targets* or *FERC target flows*. Below the North Highlands Dam at Columbus, Georgia, the established FERC targets are as follows: an instantaneous target minimum flow release of 800 cfs, or inflow, whichever is less; a daily average target minimum flow of 1,350 cfs, or inflow, whichever is less; and a weekly average target minimum flow of 1,850 cfs, or inflow, whichever is less. Releases from West Point Lake may influence how and the extent to which these flow targets are met by GPC, but the FERC target flows place no mandatory requirements on USACE project operations.

During scoping activities for this EIS, the Alabama Office of Water Resources and Southern Nuclear Operating Company both identified a daily average flow need of 2,000 cfs at Columbia, Alabama, just downstream of George W. Andrews Lock and Dam considered necessary to sustain continuous power generation operations at the Farley Nuclear Plant (hereafter referred to as the *Farley flow need*). This is a nonmandatory flow target with respect to USACE operations. However, USACE strongly considers this expressed need in conducting project operations in the basin.

The Chattahoochee River National Recreation Area (CRNRA) is an important recreation resource in the ACF Basin (see section 2.1.1.2.4.5, section 2.4.3, and section 2.6.6). Releases from Buford Dam directly affect water-based recreation activities within the CRNRA. Investigations conducted as part of the MAAWRS in the 1980s and, subsequently, during the ACF Basin Comprehensive Study in the 1990s evaluated flow needs in the CRNRA for a variety of recreational pursuits, including wade and float fishing, low-power and nonpower boat fishing, wading, rafting, and canoeing. Nestler et al. (1985) developed optimum flow levels for those recreational pursuits in support of the MAAWRMS effort, which are summarized in Table 6.1-7 for the various segments of the CRNRA.

Table 6.1-7.
Optimum Flows (in cfs) within the Boundaries of the CRNRA for Various Recreational Activities

	Chattahoochee River reach		
Recreation activity	**Buford Dam to RM 342.0 (above McGinnis Ferry Road)**	**RM 342.0 to Morgan Falls Dam**	**Morgan Falls Dam to Peachtree Creek**
Wade fishing	750	750	750
Tube fishing	1,000	1,000	1,000
Boat fishing (nonpower)	1,500	1,500	1,500
Boat fishing (low-power)	2,500	3,500	5,000
Water contact wading (shoal areas)	750	750	750
Rafting (novice)	1,250–5,000	1,500–5,000	1,750–3,500
Rafting (mid-level)	7,000	7,000	7,000
Canoeing (novice)	1,500	1,750	2,000
Canoeing (mid-level)	7,000	7,000	7,000

Source: Nestler et al. 1985

Subsequently, CH2M Hill (2000) developed a recreation flow preference for the National Park Service (NPS). Key findings from that report are summarized in Table 6.1-8. The results were generally consistent with the optimum flows developed by Nestler et al. (1985).

Table 6.1-8.
Flow Preferences of Expert Recreation User Groups in the CRNRA

Expert user group	Primary concerns[a]	Flow preference[b]
Powerboat fishing (Group 1)	Higher flows allow better river access for motorized boats, but fishing is better at lower flows	1,000 to 1,200 cfs
Wade- and tube-fishing (Group 2)	Maintaining healthy fish habitat relative to water quality, food base, and releases to scour accumulated sediment; access is better at lower flows	1,000 to 1,200 cfs
Nonmotorized boating (Group 3)		
Shell rowing	Morgan Falls impoundment is only suitable location in CRNRA for shell rowing; medium to high flows preferred	1,000 to 1,200 cfs
Kayaking and canoeing	Medium to high flows create more challenging hydraulics; preferred section is Powers Ferry (RM 306.5) to U.S. Highway 41 (RM 303.8); Devil's Race Course (RM 305.5) is most popular destination	6,000 cfs

Source: CH2M Hill 2000.
Notes:
[a.] As identified in discussions with expert users.
[b.] Based on comments and video observation feedback from expert users.

The NPS noted in its January 2010 scoping comments for this EIS and reiterated in its January 2013 re-scoping comments that these previous studies document the need for *baseline* flows above 1,000 cfs to support basic recreational use of the CRNRA. In addition to recreational impacts, the NPS indicated that flows lower than this threshold could restrict the ability of law enforcement and emergency personnel to use the river for patrol and rescue operations. The NPS also maintains that sustained, low flow conditions that could be encountered during an extended drought period would promote increased exotic vegetation growth in Bull Sluice Lake above Morgan Falls Dam, further affecting recreational uses in that portion of the CRNRA.

6.1.1.2.2 Buford Dam to West Point Lake

Figure 6.1-19 through Figure 6.1-36 present model outputs for flow conditions at three locations in the Chattahoochee River between Buford Dam and West Point Lake: immediately downstream of Buford Dam (RM 348.1), at the river's juncture with Peachtree Creek (RM 300.5), and at Whitesburg, Georgia (RM 259.9). Flow conditions at the three locations were examined to assess changes that would be expected under the water management alternatives/water supply options considered in detail for the ACF Basin (i.e., Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and PAA) compared to the NAA. The figures present model results for median daily flows, daily flows at the 90-percent exceedance level, and duration curves depicting the percent of days exceeded for the range of daily flow values. In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (i.e., magnitude of flow conditions) is presented in two figures with half of the alternatives presented on each figure. Using the results from these figures and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

Flow values below Buford Dam over the modeled period of record are considered representative of conditions from the dam downstream to Bull Sluice Lake, the reservoir formed by the GPC Morgan Falls Dam. Flow values at Peachtree Creek and Whitesburg are considered representative of flow conditions between Morgan Falls Dam and the headwaters of West Point Lake.

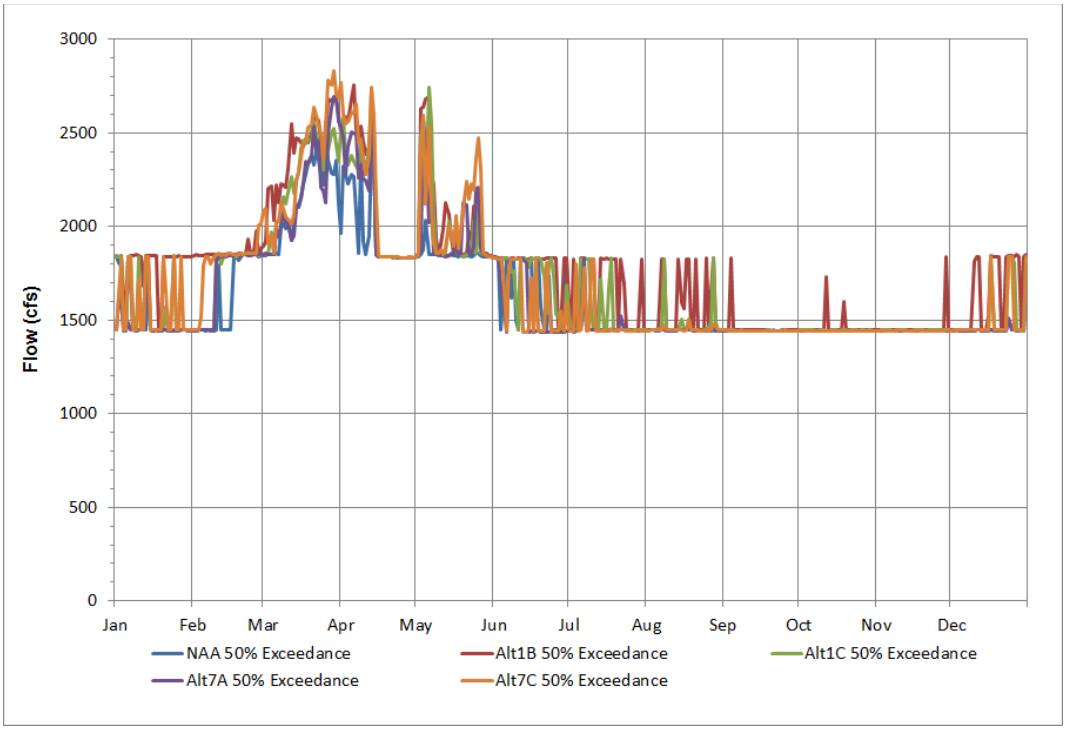


Figure 6.1-19. Chattahoochee River—Median Daily Flows below Buford Dam, Georgia (RM 348.1) for the NAA and Alternatives 1B, 1C, 7A, and 7C

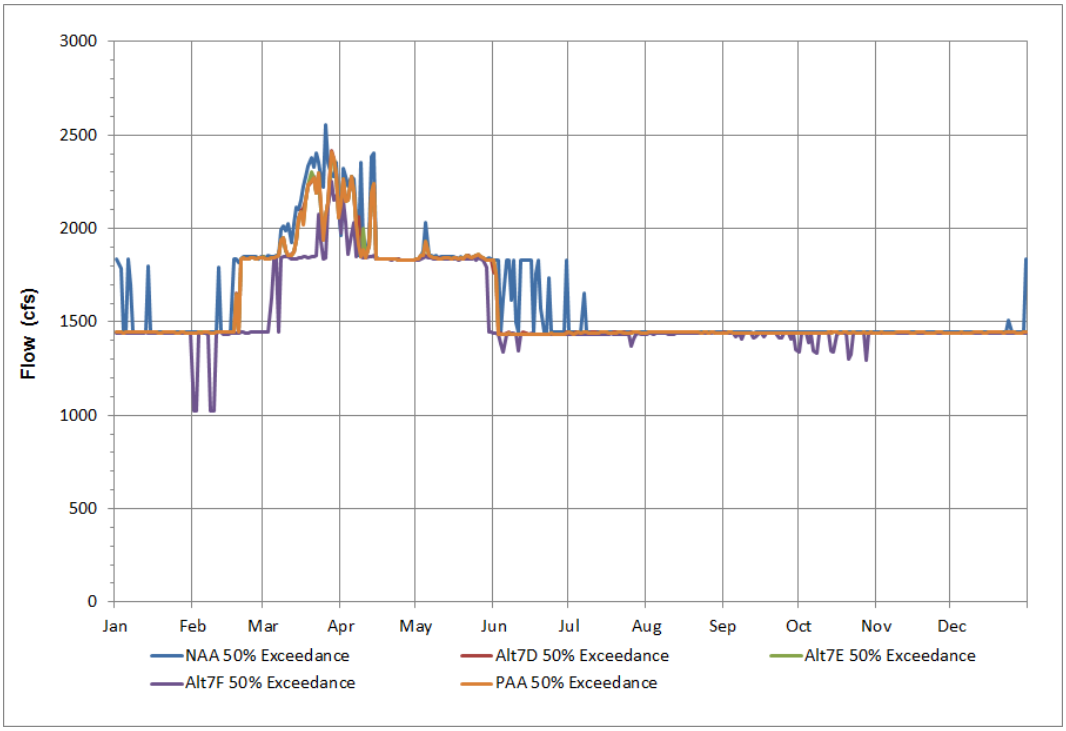


Figure 6.1-20. Chattahoochee River—Median Daily Flows below Buford Dam, Georgia (RM 348.1) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

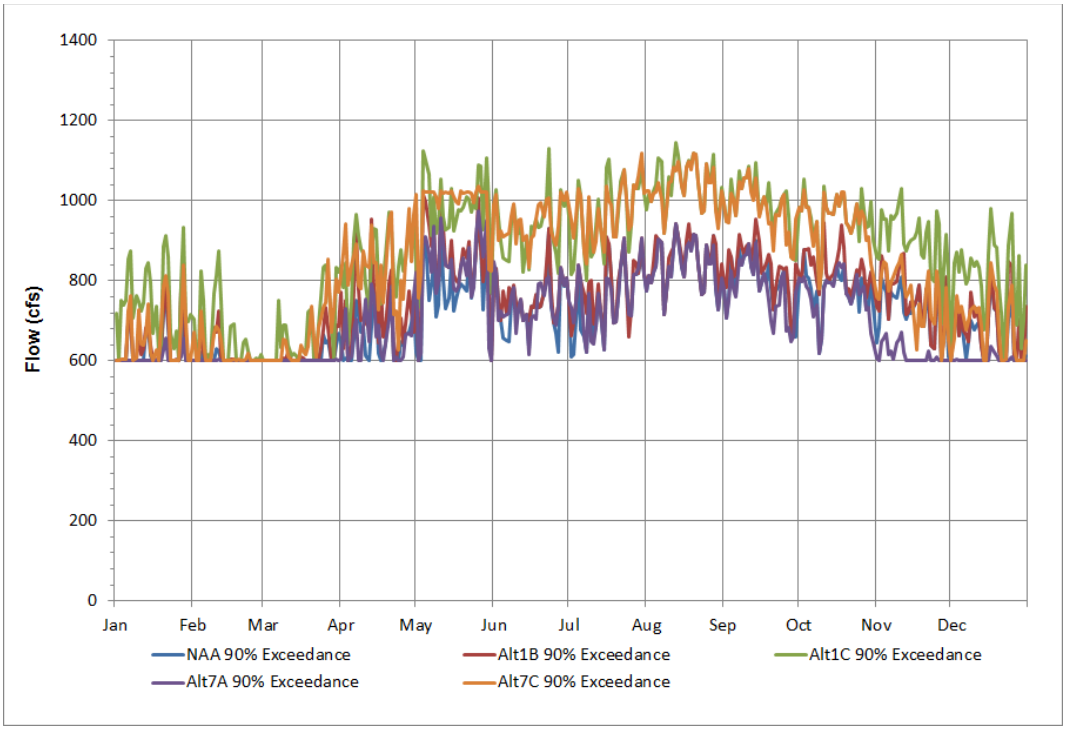


Figure 6.1-21. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level below Buford Dam, Georgia (RM 348.1) for the NAA and Alternatives 1B, 1C, 7A, and 7C

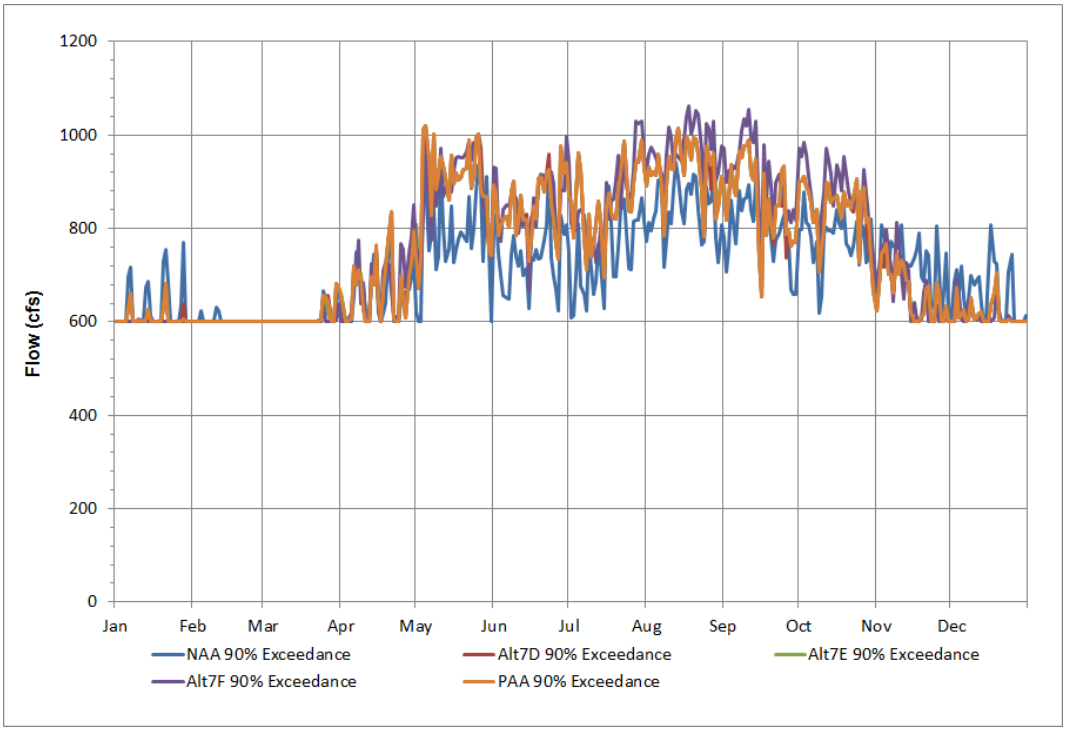


Figure 6.1-22. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level below Buford Dam, Georgia (RM 348.1) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

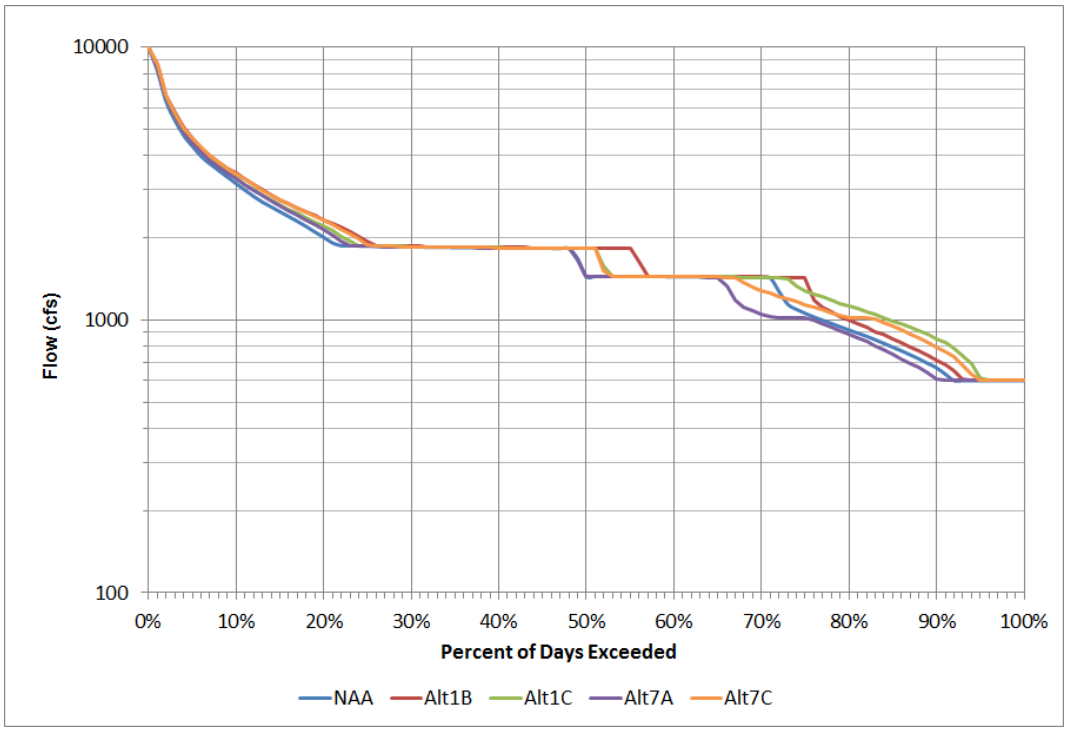


Figure 6.1-23. Chattahoochee River Flows below Buford Dam, Percent of Days Exceeded for the NAA and Alternatives 1B, 1C, 7A, and 7C

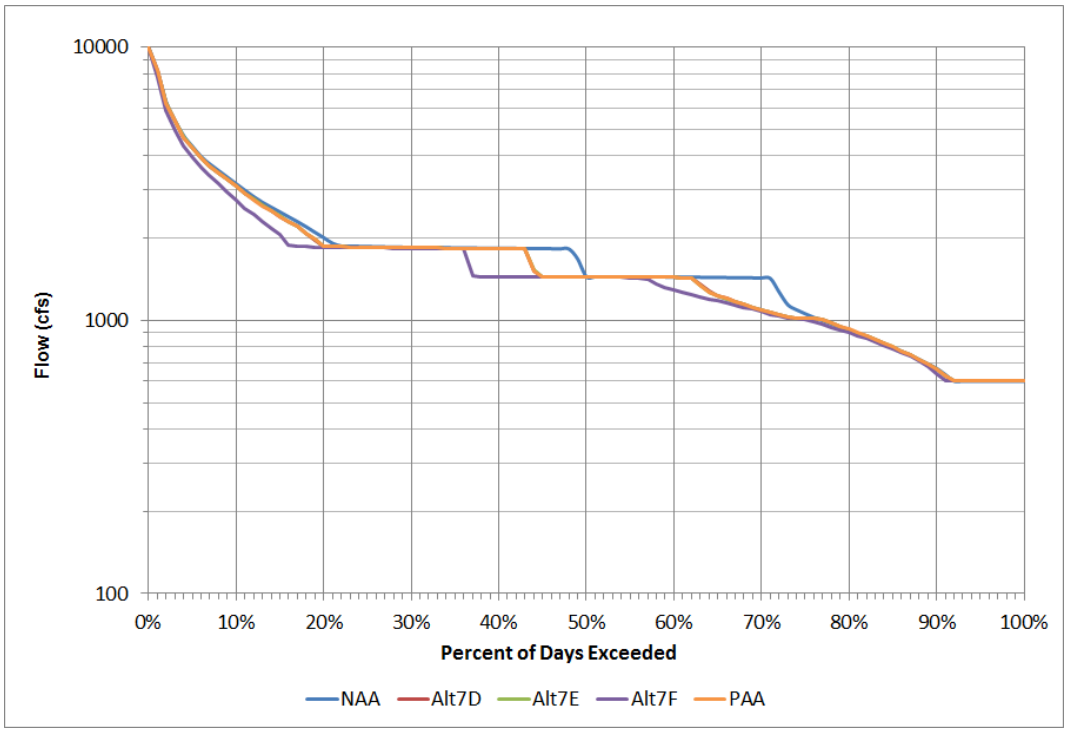


Figure 6.1-24. Chattahoochee River Flows below Buford Dam, Percent of Days Exceeded for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

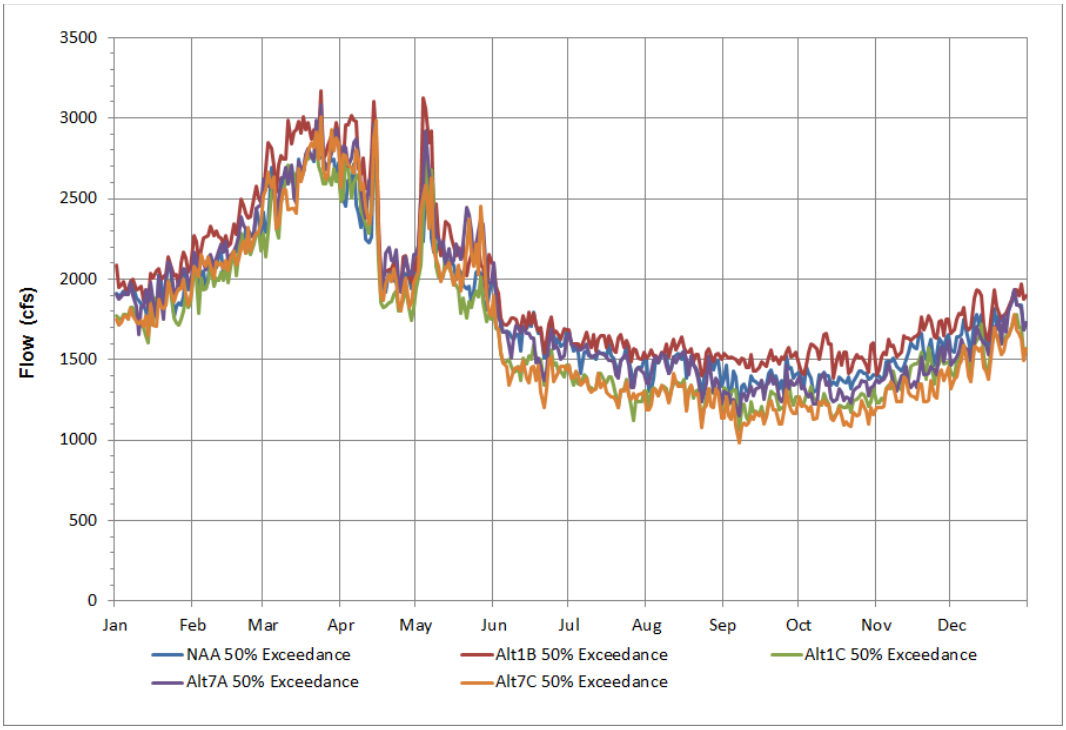


Figure 6.1-25. Chattahoochee River—Median Daily Flows at Atlanta (Peachtree Creek), Georgia (RM 300.5) for the NAA and Alternatives 1B, 1C, 7A, and 7C

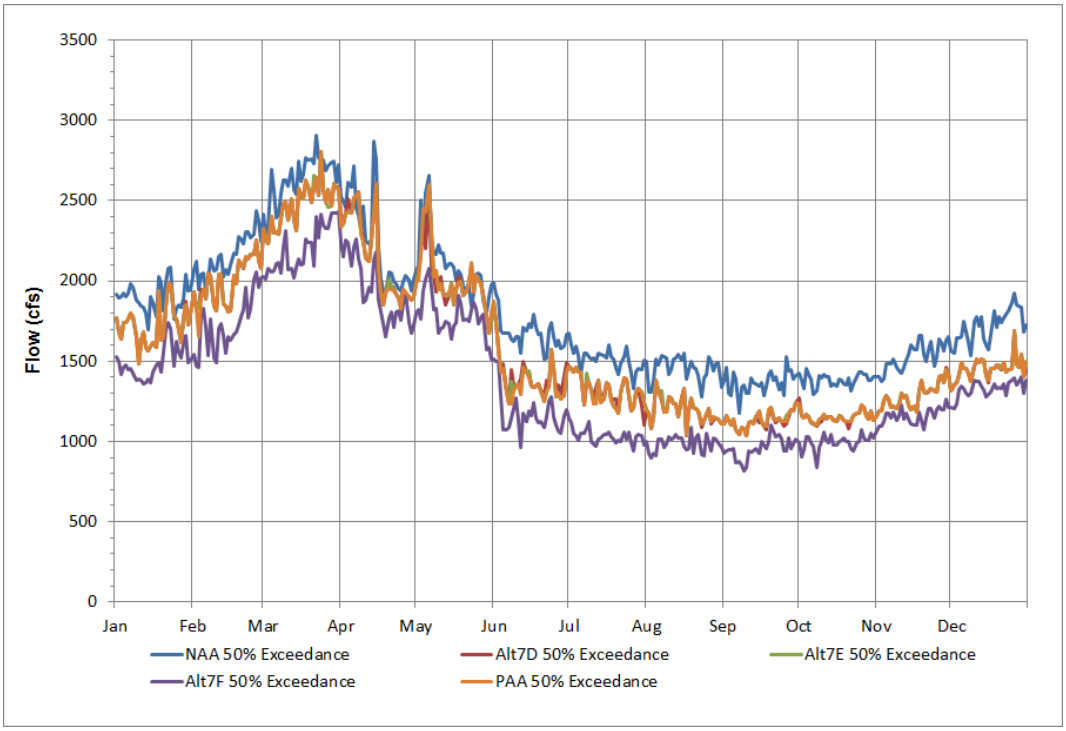


Figure 6.1-26. Chattahoochee River—Median Daily Flows at Atlanta (Peachtree Creek), Georgia (RM 300.5) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

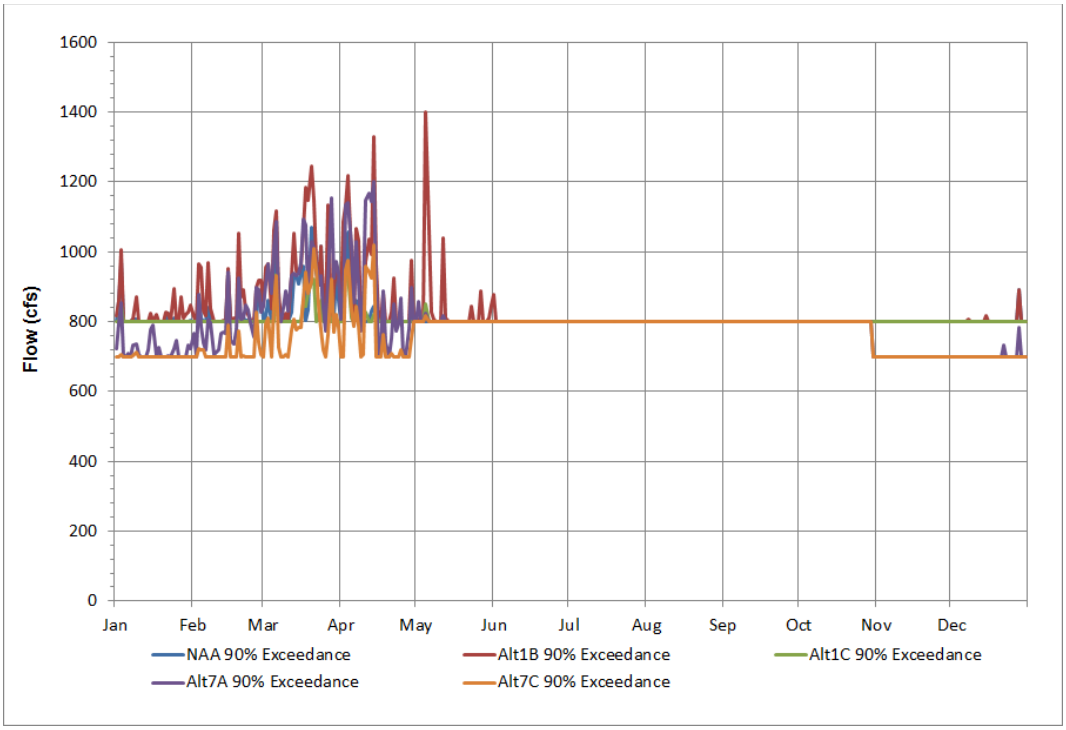


Figure 6.1-27. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level at Atlanta (Peachtree Creek), Georgia (RM 300.5) for the NAA and Alternatives 1B, 1C, 7A, and 7C

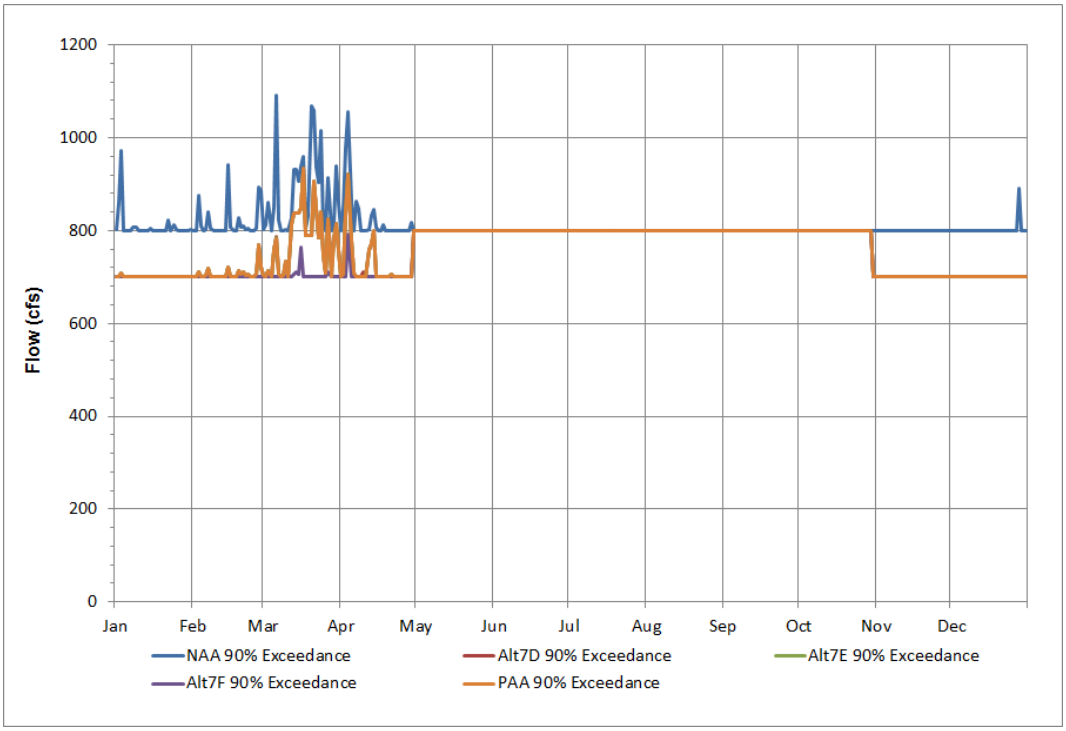


Figure 6.1-28. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level at Atlanta (Peachtree Creek), Georgia (RM 300.5) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

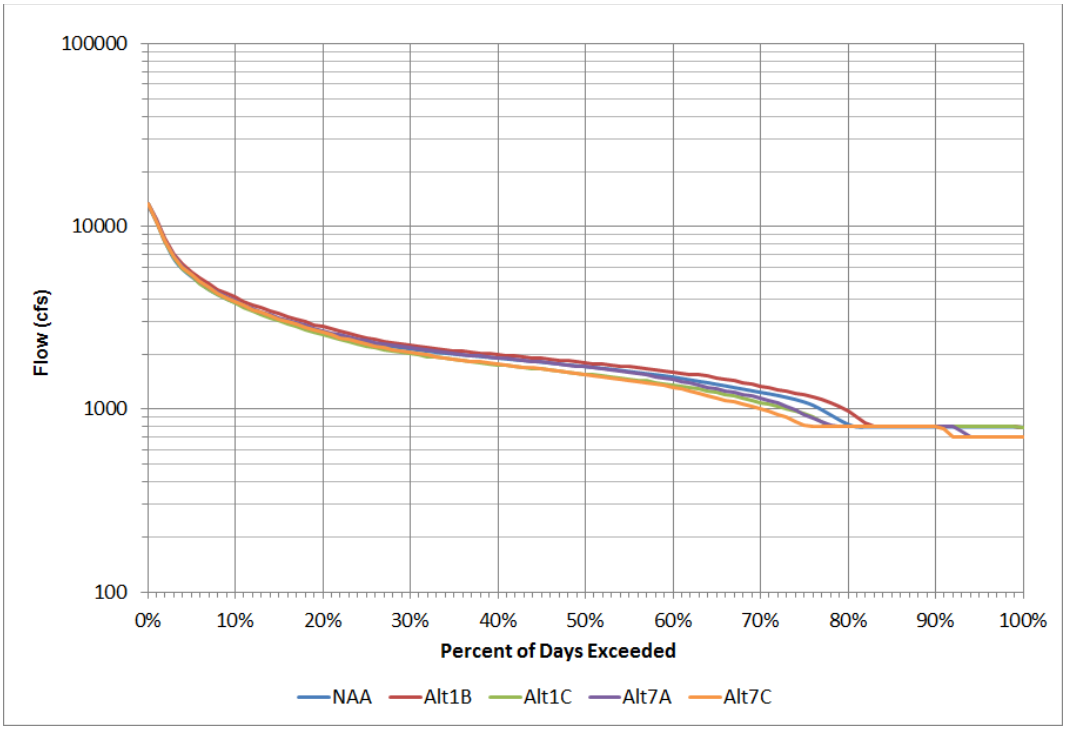


Figure 6.1-29. Chattahoochee River Flows at Atlanta (Peachtree Creek), Percent of Days Exceeded for the NAA and Alternatives 1B, 1C, 7A, and 7C

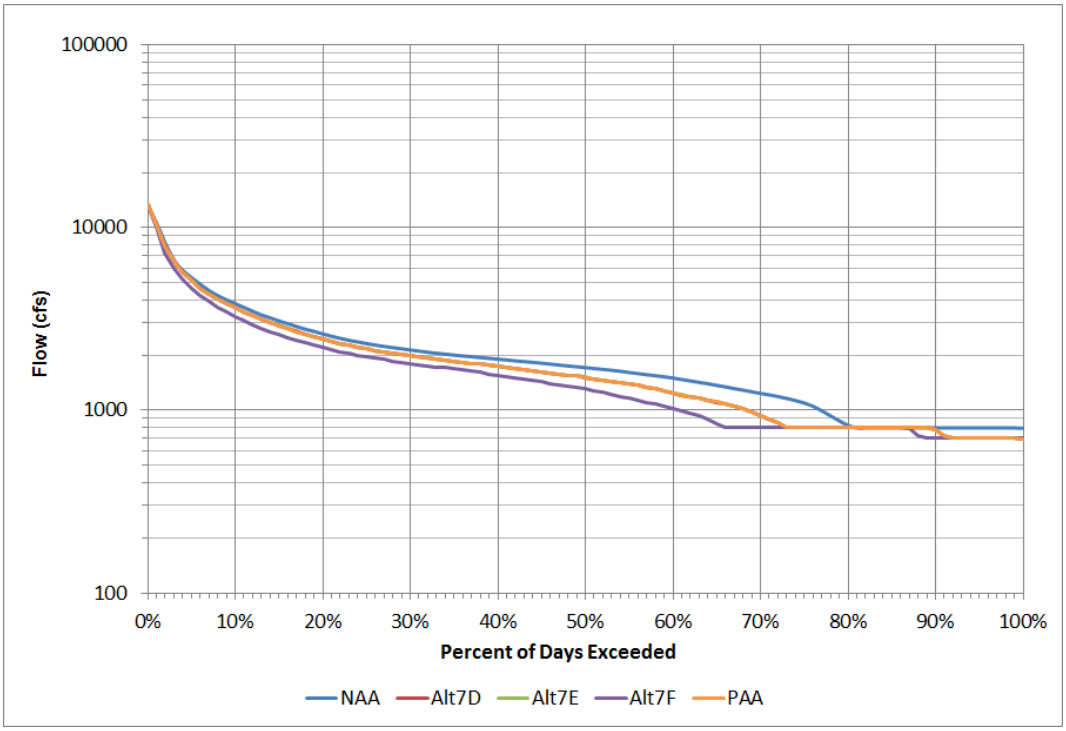


Figure 6.1-30. Chattahoochee River Flows at Atlanta (Peachtree Creek), Percent of Days Exceeded for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

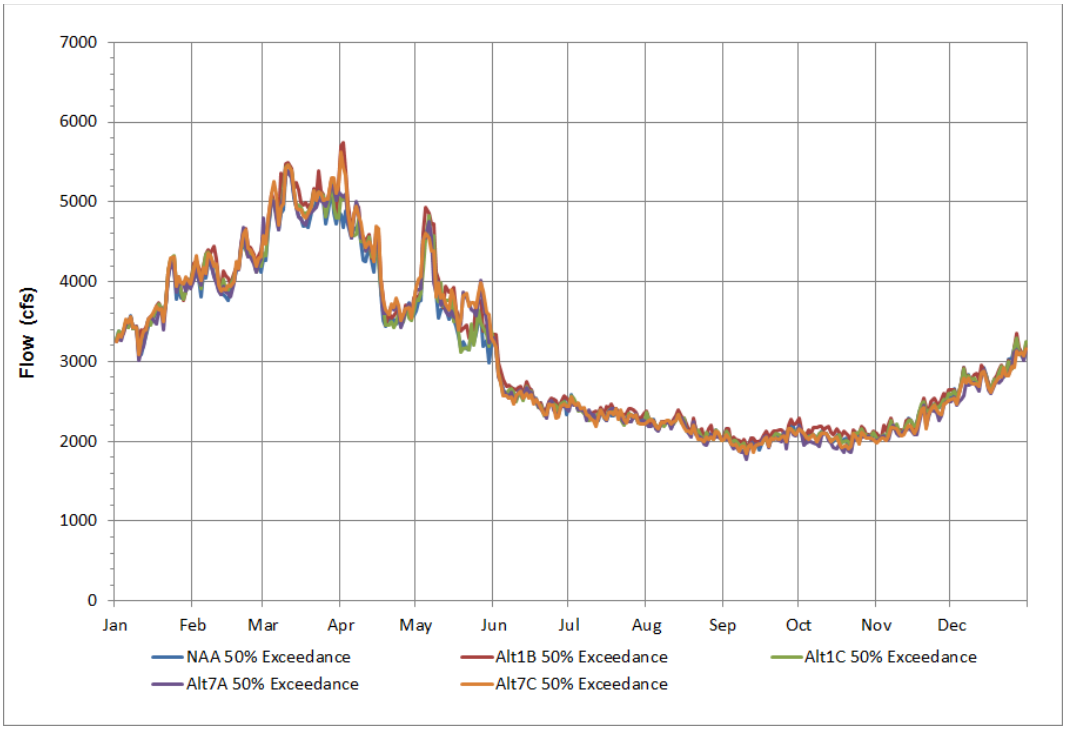


Figure 6.1-31. Chattahoochee River—Median Daily Flows at Whitesburg, Georgia (RM 259.9) for the NAA and Alternatives 1B, 1C, 7A, and 7C

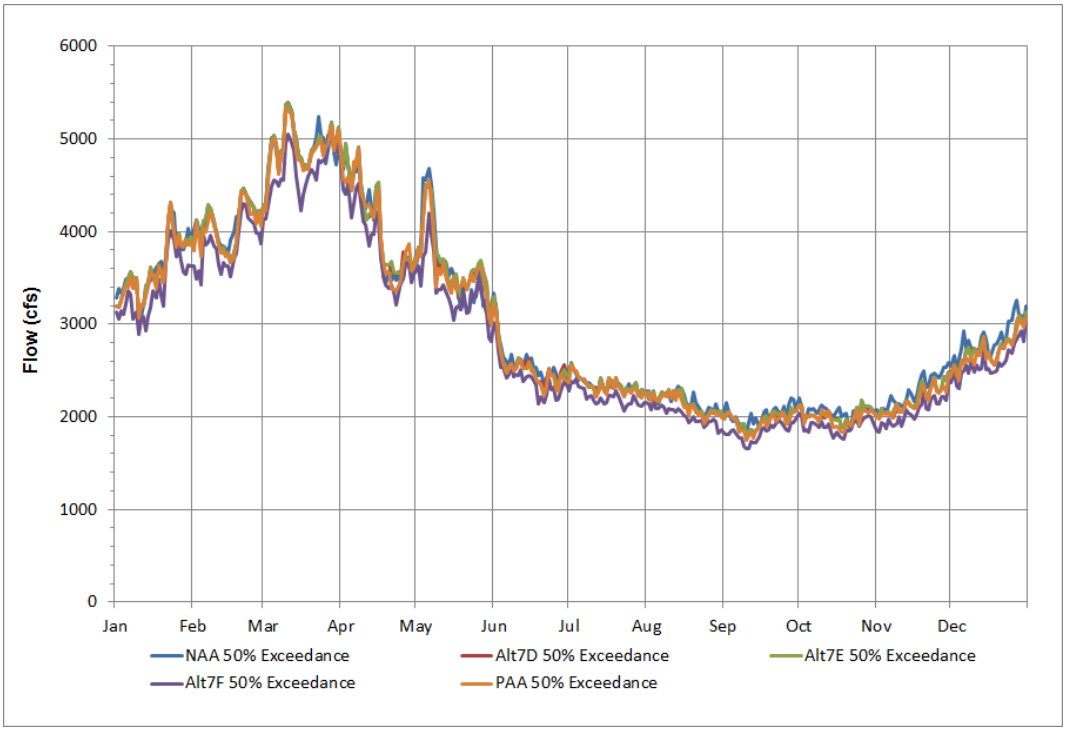


Figure 6.1-32. Chattahoochee River—Median Daily Flows at Whitesburg, Georgia (RM 259.9) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

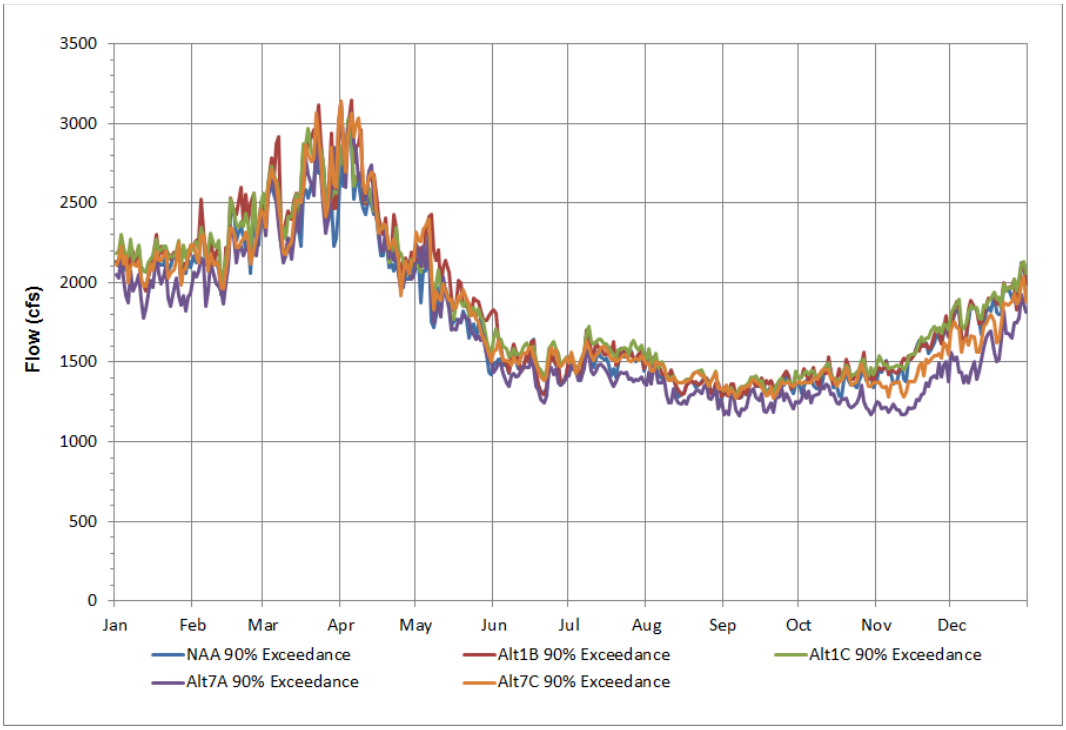


Figure 6.1-33. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level at Whitesburg, Georgia (RM 259.9) for the NAA and Alternatives 1B, 1C, 7A, and 7C

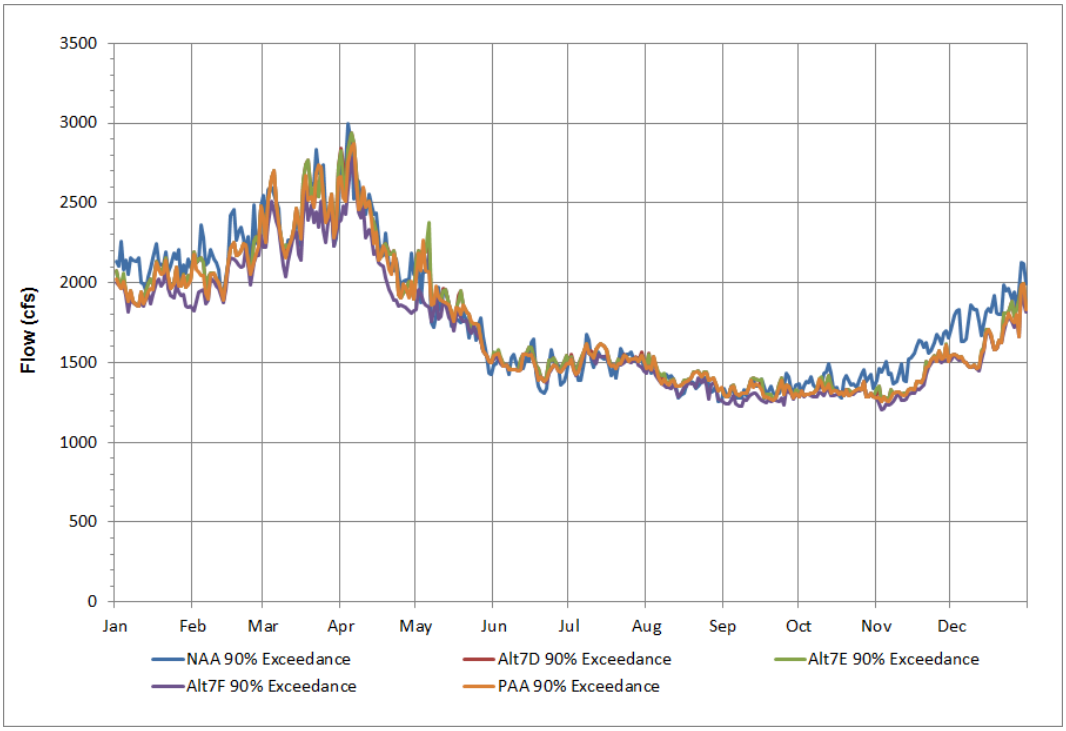


Figure 6.1-34. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level at Whitesburg, Georgia (RM 259.9) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

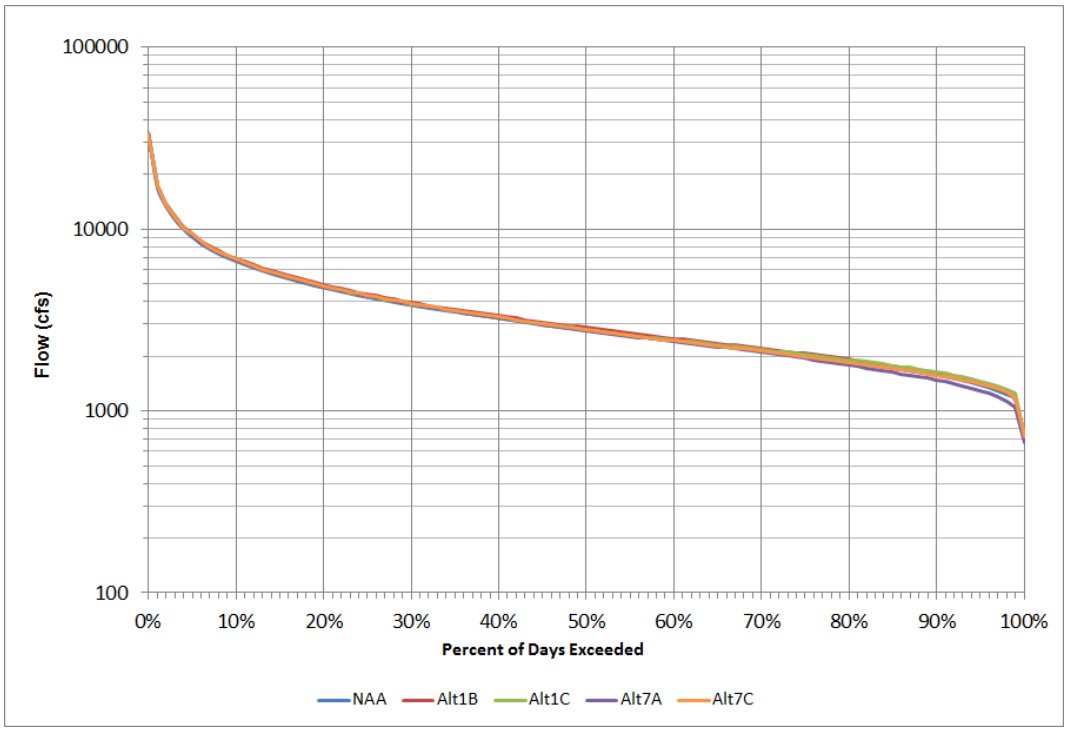


Figure 6.1-35. Chattahoochee River Flows at Whitesburg, Georgia, Percent of Days Exceeded for the NAA and Alternatives 1B, 1C, 7A, and 7C

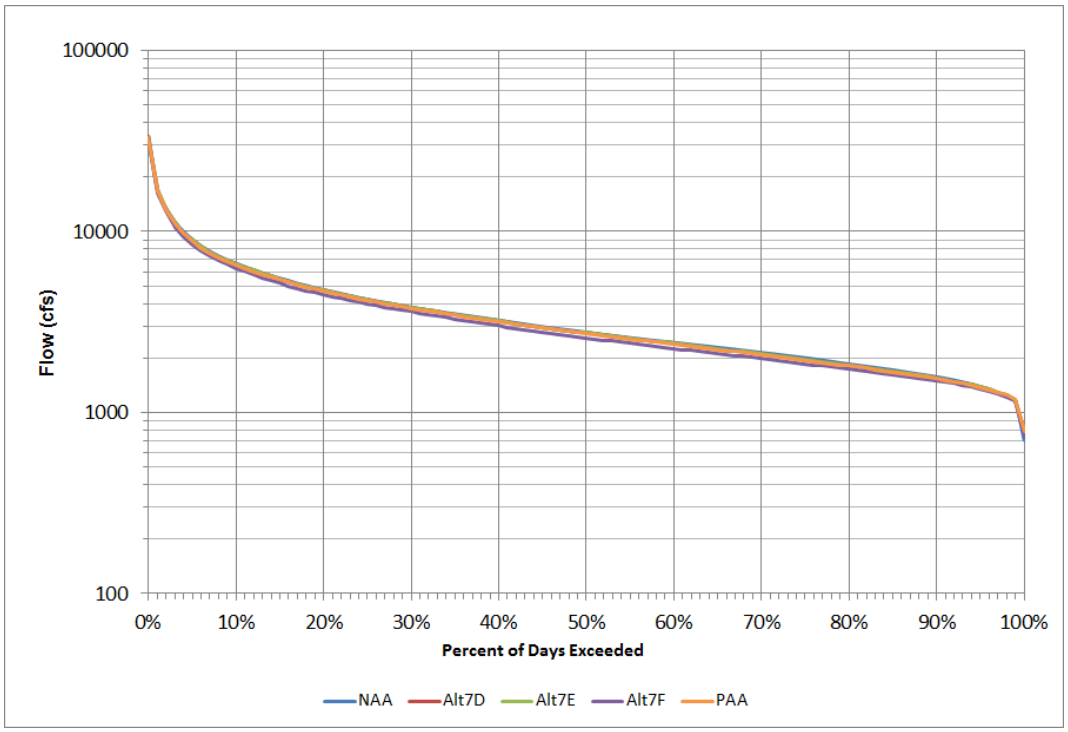


Figure 6.1-36. Chattahoochee River Flows at Whitesburg, Georgia, Percent of Days Exceeded for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.1.2.2.1 No Action Alternative

Under the NAA, minimum releases at Buford Dam continue to equal or exceed 600 cfs at all times per the project authorization. Median daily flows between the months of June and mid-February would likely be about 1,450 cfs, occasionally ranging as high as about 1,800 cfs during that period. From mid-February through May, median daily flows would typically be about 1,800 cfs, occasionally ranging up to about 2,400 cfs in March and early April (Figure 6.1-19). Daily flows below Buford Dam at the 90-percent exceedance level (indicative of drought conditions) would typically be at the minimum flow of 600 cfs during January through March and vary between 600 and 900 cfs through the balance of the year (Figure 6.1-21). Daily minimum flows of 600 cfs would occur no more than about 8 percent of the days over the period of record, and daily flows would exceed 1,000 cfs on about 76 percent of the days (Figure 6.1-23).

Flow conditions in the river under the NAA necessary to pursue water-based recreation activities in the CRNRA downstream to Bull Sluice Lake (based on criteria established in the previously referenced studies) would continue to be available most of the time. The general exception would be for infrequent and relatively brief periods of extreme high flow conditions during major flood events. Conditions below Buford Dam vary widely, even over a 24-hour period, because of the inherent nature of peak hydroelectric power operations. Flows in the Chattahoochee River below Buford Dam can range from less than 1,000 cfs to 10,000 cfs in a short period due to peak power generation. The extreme daily fluctuation (or pulsing effect) in releases from Buford Dam is more noteworthy at the upper end of the CRNRA nearer to Buford Dam. The fluctuation progressively declines as peak flows move downstream and are eventually reregulated, or smoothed out, by operations at Morgan Falls Dam at RM 312.5. Appropriate communication mechanisms and warning systems are in place to accommodate recreation use in the upper portion of the CRNRA immediately downstream of Buford Dam in a manner that is compatible with the daily fluctuations. Under the NAA, flow conditions between Buford Dam and Morgan Falls Dam are compatible for most recreation activities identified in Table 6.1-7 and are within the general range of optimum flow levels presented in Table 6.1-8 most of the time.

At Peachtree Creek (RM 300.5), median daily flows under the NAA (Figure 6.1-25) would be in the range of about 1,800 cfs in January, peaking at about 2,800 cfs in March, and declining to about 2,000 cfs in late April as conservation storage in Lake Lanier is replenished. Following a brief increase to about 2,500 cfs in early May, median flows would gradually decline to about 1,300 cfs by September and gradually increase again to about 1,700 cfs by the end of December. At the 90-percent exceedance level (reflecting extreme drought conditions), daily flows at Peachtree Creek (Figure 6.1-27) would consistently occur at the currently established minimum flow level of 750 cfs (modeled as 800 cfs in HEC-ResSim) throughout the year, except for intermittent periods from January through April ranging as high as 1,200 cfs. Per agreement among USACE, GPC, and GAEPD, USACE makes releases at Buford Dam, with reregulation of those releases as necessary at the GPC Morgan Falls Dam, sufficient to maintain a minimum flow of 750 cfs at Peachtree Creek at all times, including weekends.

Under the NAA, flows at or below 1,000 cfs within the boundary of the CRNRA are more likely to be encountered on weekends when releases for hydroelectric power operations at Buford Dam are limited to those necessary to maintain a minimum flow of 750 cfs in the river at Peachtree Creek. Sustained periods of flow at this level may occur during periods of severe drought when peaking hydroelectric power operations would likely be significantly curtailed, or suspended, under drought operations to conserve storage in Lake Lanier. Daily minimum flows of 750 cfs would occur no more than about 19 percent of the days over the period of record, and daily flows would exceed 1,000 cfs on about 77 percent of the days (Figure 6.1-29). According to the NPS, a daily average flow of 1,000 cfs would provide a baseline level of flow to support most water-based recreational uses in the lower portion of the CRNRA below Morgan Falls Dam.

At Whitesburg (RM 259.9), median daily flows under the NAA would follow a similar seasonal pattern to flows upstream at Peachtree Creek (Figure 6.1-31). Flows would be in the range of about 3,200 cfs in January, peaking at about 5,000 cfs in March, and declining to about 3,400 cfs in late April. Following a brief increase to about 4,600 cfs in early May, median daily flows would gradually decline to about 2,000 cfs by September and gradually increase again to about 3,200 cfs by the end of December. For the NAA at the 90-percent exceedance level, daily flows would range from about 2,200 cfs in January to a peak of about 3,000 cfs in early April, thereafter gradually declining to about 1,300 cfs in August through October before returning to 3,000 cfs by the end of December (Figure 6.1-33). The flow-duration curve for Whitesburg (Figure 6.1-35) indicates that flows would be expected to exceed 1,146 cfs during 99 percent of days over the period of record, and the lowest modeled flow expected over the period of record would be 706 cfs.

6.1.1.2.2.2 Alternative 1B

Alt1B would likely result in slightly improved flow conditions between Buford Dam and West Point Lake compared to the NAA.

Immediately downstream of Buford Dam, median daily flows under Alt1B (Figure 6.1-19) would be similar to the NAA, except that they would tend to be about 400 cfs higher in the period from December through late February and in parts of July and August. Flows would be similar but slightly higher than the NAA from March through May. At the 90-percent exceedance level, daily flows for Alt1B would be nearly the same as the NAA, except that they would be slightly higher in March through April and in the fall months (Figure 6.1-21). For Alt1B, daily minimum flows of 600 cfs would occur no more than about 6 percent of the days over the period of record (8 percent for NAA), and daily flows would exceed 1,000 cfs on about 79 percent of the days (76 percent for NAA) (Figure 6.1-23).

For Alt1B, releases at Buford Dam would equal or exceed 600 cfs continuously and would occur as necessary, with reregulation of flow at Morgan Falls Dam, to maintain a minimum flow of 750 cfs at Peachtree Creek at all times, including weekends.

For Alt1B, median daily flows at Peachtree Creek (Figure 6.1-25) would be slightly higher throughout the year (typically from less than 100 cfs up to about 300 cfs higher). At the 90-percent exceedance level, daily flows would equal those under the NAA during June through December (Figure 6.1-27). Alt1B would have intermittently higher flows values than NAA (about 50 to 600 cfs higher) during January through May. Daily minimum flows of 750 cfs would occur no more than about 17 percent of the days over the period of record (19 percent for NAA), and daily flows would exceed 1,000 cfs on about 79 percent of the days (77 percent for NAA) (Figure 6.1-29).

As summarized above for Buford Dam releases and at Peachtree Creek, slight increases in flow under Alt1B compared to the NAA would represent a minor improvement in flow conditions with respect to NPS-recommended goals for recreation flows for the CRNRA.

At Whitesburg, Alt1B would likely result in no appreciable change in flow conditions in the Chattahoochee River compared to the NAA (see Figure 6.1-31, Figure 6.1-33, and Figure 6.1-35). Median daily flows from March through May would be slightly higher.

6.1.1.2.2.3 Alternative 1C

Alt1C would likely result in slightly improved flow conditions between Buford Dam and West Point Lake compared to the NAA.

Immediately downstream of Buford Dam, median daily flows under Alt1C (Figure 6.1-19) would be similar to the NAA, except that flows would be intermittently about 400 cfs higher in the period from mid-December through January and slightly higher than the NAA from March through May. At the 90-percent exceedance level, daily flows for Alt1C would typically be about 100 to 200 cfs higher than for the NAA throughout the year (Figure 6.1-21). For Alt1C, daily minimum flows of 600 cfs would occur no more than about 4 percent of the days over the period of record (8 percent for NAA), and daily flows would exceed 1,000 cfs on about 84 percent of the days (76 percent for NAA) (Figure 6.1-23).

For Alt1C, releases at Buford Dam would equal or exceed 600 cfs continuously and would occur as necessary, with reregulation of flow at Morgan Falls Dam, to maintain a minimum flow of 750 cfs at Peachtree Creek at all times, including weekends.

For Alt1C, median daily flows at Peachtree Creek (Figure 6.1-25) would be slightly lower throughout the year compared to the NAA. The differences would consistently range from about 100 to 200 cfs lower. At the 90-percent exceedance level (Figure 6.1-27), there would be no discernable difference between daily flows for Alt1C and the NAA. Daily minimum flows of 750 cfs would occur no more than about 21 percent of the days over the period of record (19 percent for NAA), and daily flows would exceed 1,000 cfs on about 74 percent of the days (77 percent for NAA) (Figure 6.1-29).

As summarized above for Buford Dam releases and at Peachtree Creek, slight increases in modeled flow values below Buford Dam under Alt1C (compared to the NAA) would represent a minor improvement in flow conditions in the upper portion of the CRNRA relative to NPS-recommended goals for recreation flows in the area. Conversely, slightly decreased flow values at Peachtree Creek under Alt1C would potentially represent a minor adverse effect relative to the NPS-recommended goals.

At Whitesburg, Alt1C would likely result in no appreciable change in flow conditions in the Chattahoochee River compared to the NAA (see Figure 6.1-31, Figure 6.1-33, and Figure 6.1-35). Median daily flows from March through May would be slightly higher.

The differences in flow conditions between Buford Dam and Peachtree Creek for Alt1C compared to the NAA are attributable to differences in water withdrawals rates for Metro Atlanta water utilities downstream of Buford Dam. The NAA assumes current withdrawals for those utilities (277 mgd), and Alt1C assumes estimated 2040 demands per Georgia's 2013 request (408 mgd). As modeled, Buford Dam releases would be sufficient to meet the respective downstream water demands while continuing to provide for 750 cfs minimum flows at Peachtree Creek. Accordingly, flow values below Buford Dam are notably higher for Alt1C than for the NAA (above the water withdrawal points) and slightly lower at Peachtree Creek (downstream of the pertinent water withdrawal points).

6.1.1.2.2.4 Alternative 7A

The differences in flow conditions between Alt7A and the NAA between Buford Dam and West Point Lake would be minor.

Under Alt7A, median daily flow conditions just below Buford Dam would be nearly the same as under the NAA, except for a few days from mid-February through May, when Alt7A flows would likely be 300 to 500 cfs higher (Figure 6.1-19). Similarly, flows at the 90-percent exceedance level would nearly be the same for Alt7A and the NAA, except that Alt7A would be slightly lower in November through December (Figure 6.1-21). For Alt1A, daily minimum flows of 600 cfs would occur no more than about 10 percent of the days over the period of record (8 percent for NAA), and daily flows would exceed 1,000 cfs on about 75 percent of the days (76 percent for NAA) (Figure 6.1-23).

For Alt7A, releases at Buford Dam would equal or exceed 600 cfs continuously and would occur as necessary, with reregulation of flow at Morgan Falls Dam, to maintain a minimum flow of 750 cfs at Peachtree Creek from May through October and 650 cfs from November through April.

For Alt7A, median daily flows at Peachtree Creek (Figure 6.1-25) would be about the same as the NAA throughout the year. They would tend to be slightly higher from late January through May and slightly lower from September through mid-December. At the 90-percent exceedance level (Figure 6.1-27), the only appreciable difference between Alt7A and NAA daily flows would be that Alt7A would be about 100 cfs lower from November through February because of the change in the prescribed minimum flow at Peachtree Creek from 750 to 650 cfs during that portion of the year. Daily minimum flows of 650 cfs would occur about 6 percent of the days over the period of record and minimum flows of 750 cfs would occur about 16 percent of the time. Thus, about 22 percent of the time flows would equal the seasonal minimum flow level (compared to 19 percent of the time at the 750 cfs minimum flow level for the NAA). Daily flows would exceed 1,000 cfs on about 73 percent of the days (77 percent for NAA) (Figure 6.1-29).

As summarized above for Buford Dam releases and at Peachtree Creek, slight decreases in modeled flow values at both locations under Alt7A compared to the NAA would represent a minor decline in flow conditions in the CRNRA relative to NPS-recommended goals for recreation flows in the area.

At Whitesburg, Alt7A would likely result in no appreciable change in flow conditions in the Chattahoochee River compared to the NAA (see Figure 6.1-31, Figure 6.1-33, and Figure 6.1-35). Median daily flows in April and May would likely be slightly higher.

6.1.1.2.2.5 Alternative 7C

Compared to the NAA, model results for flow conditions between Buford Dam and West Point Lake under Alt7C would be nearly the same as those described for Alt1C in section 6.1.1.2.2.3. The only exception would be that revised water management measures under Alt7C would account for slightly lower modeled flows than for Alt1C immediately below Buford Dam from December through April such that Alt7C flows would more closely resemble NAA flows during that period. This effect is primarily associated with the proposed seasonal minimum flow at Peachtree Creek (650 cfs vs. 750 cfs) and, to a lesser extent, the revised action zones in Lake Lanier. Similar minor differences were also evident in model results at Peachtree Creek. Further downstream at Whitesburg, no appreciable differences in flow conditions between Alt7C and Alt1C were evident compared to the NAA.

6.1.1.2.2.6 Alternative 7D

For Alt7D, minor adverse changes in flow conditions between Buford Dam and West Point Lake would be expected in comparison to the NAA.

Median daily flows for Alt7D immediately downstream of Buford Dam would closely match those for the NAA with a couple of specific minor exceptions (Figure 6.1-20). From June through mid-February, median flows would be virtually constant at about 1,450 cfs without any intermittent increases as in the NAA. In addition, Alt7D flows would be slightly lower in March and early April compared to the NAA. At the 90-percent exceedance level, daily flows for Alt7D would be about the same as the NAA from January through April, slightly higher than the NAA in May through October (by variable amounts up to about 150 cfs), and slightly lower in November and December (by variable amounts up to 150 cfs) (Figure 6.1-22). For Alt7D, daily minimum flows of 600 cfs would occur no more than about 8 percent of the days over the period of record (same as for NAA), and daily flows would exceed 1,000 cfs on about 77 percent of the days (76 percent for NAA) (Figure 6.1-24).

For Alt7D, releases at Buford Dam would equal or exceed 600 cfs continuously and would occur as necessary, with reregulation of flow at Morgan Falls Dam, to maintain a minimum flow of 750 cfs at Peachtree Creek from May through October and 650 cfs from November through April.

At Peachtree Creek, median daily flows for Alt7D would be lower throughout the year than for the NAA, generally ranging from about 100 to 300 cfs lower, with the larger differences tending to occur in the fall months (Figure 6.1-26). At the 90-percent exceedance level (Figure 6.1-28), daily flows for Alt7D would equal those for the NAA from May through November and would generally be about 100 cfs lower than the NAA from November through April. Daily minimum flows of 650 cfs would occur about 9 percent of the days over the period of record and minimum flows of 750 cfs would occur about 18 percent of the time under Alt7D. Thus, about 27 percent of the time, flows would equal the seasonal minimum flow value (compared to 19 percent of the time at the 750 cfs minimum flow level for the NAA). Daily flows would exceed 1,000 cfs on about 68 percent of the days (77 percent for NAA) (Figure 6.1-30).

As summarized above for Buford Dam releases and at Peachtree Creek, minor but notable decreases in modeled flow values at both locations under Alt7D compared to the NAA would represent a minor detrimental effect on flow conditions in the CRNRA relative to NPS-recommended goals for recreation flows in the area.

At Whitesburg, Alt7D would likely result in no appreciable change in flow conditions in the Chattahoochee River compared to the NAA (see Figure 6.1-32, Figure 6.1-34, and Figure 6.1-36). Median daily flows in September through December would tend to be marginally lower, and daily flows at the 90 percent exceedance level would be slightly lower in November and December.

6.1.1.2.2.7 Alternative 7E

Compared to the NAA, model results for flow conditions under Alt7E between Buford Dam and West Point Lake closely match those described for Alt7D. The effects on flow conditions would be expected to be the same as presented for Alt7D in section 6.1.1.2.2.6.

6.1.1.2.2.8 Alternative 7F

For Alt7F, minor adverse changes in flow conditions between Buford Dam and West Point Lake would be expected in comparison to the NAA.

Median daily flows for Alt7F immediately downstream of Buford Dam would closely match those for the Alt7D, except that they would tend to be even lower than Alt7D from mid-February through mid-April (Figure 6.1-20). At the 90-percent exceedance level, daily flows for Alt7F would be about the same as the Alt7D, except that they would be slightly higher than Alt7D from mid-August through October (Figure 6.1-22). For Alt7D, daily minimum flows of 600 cfs would occur no more than about 8 percent of the days over the period of record (same as for NAA), and daily flows would exceed 1,000 cfs on about 75 percent of the days (76 percent for NAA) (Figure 6.1-24).

For Alt7F, releases at Buford Dam would equal or exceed 600 cfs continuously and would occur as necessary, with reregulation of flow at Morgan Falls Dam, to maintain a minimum flow of 750 cfs at Peachtree Creek from May through October and 650 cfs from November through April.

At Peachtree Creek, median daily flows for Alt7F would follow a similar seasonal pattern to Alt7D, except that Alt7F flows would be slightly lower throughout the year (Figure 6.1-26). At the 90-percent exceedance level (Figure 6.1-28), daily flows for Alt7F would nearly equal those for Alt7D, except they would tend to be lower than for Alt7D during March and April. Daily minimum flows of 650 cfs would occur about 11 percent of the days over the period of record and minimum flows of 750 cfs would occur

about 22 percent of the time under Alt7F. Thus, about 33 percent of the time flows would equal the seasonal minimum flow value (compared to 27 percent of the time for Alt7D and 19 percent for the NAA). Daily flows would exceed 1,000 cfs on about 60 percent of the days (69 percent for Alt7D and 77 percent for NAA) (Figure 6.1-30).

As summarized above, appreciable decreases in modeled flow values at Peachtree Creek under Alt7F compared to Alt7D and the NAA would represent a minor detrimental effect on flow conditions in the CRNRA compared to NPS-recommended goals for recreation flows in the area.

At Whitesburg, Alt7F would likely result in minor decreases in flow conditions in the Chattahoochee River compared to Alt7D and the NAA (see Figure 6.1-32, Figure 6.1-34, and Figure 6.1-36). Median daily flows would tend to be marginally lower throughout the year. Daily flows at the 90-percent exceedance level would be slightly lower throughout the year.

6.1.1.2.2.9 Alternative 7H (PAA)

For the PAA, minor adverse changes in flow conditions between Buford Dam and West Point Lake would be expected in comparison to the NAA.

Median daily flows for the PAA immediately downstream of Buford Dam would closely match those for the NAA with a couple of specific minor exceptions (Figure 6.1-20). From June through mid-February, median flows would be virtually constant at about 1,450 cfs without any intermittent increases as under the NAA. In addition, the PAA flows would be slightly lower in March and early April compared to the NAA. At the 90-percent exceedance level, daily flows for the PAA would be about the same as the NAA from January through April, slightly higher than the NAA in May through October (by variable amounts up to about 150 cfs), and slightly lower in November and December (by variable amounts up to 150 cfs) (Figure 6.1-22). For the PAA, daily minimum flows of 600 cfs would occur no more than about 8 percent of the days over the period of record (same as for NAA), and daily flows would exceed 1,000 cfs on about 77 percent of the days (76 percent for NAA) (Figure 6.1-24).

For the PAA, releases at Buford Dam would equal or exceed 600 cfs continuously and would occur as necessary, with reregulation of flow at Morgan Falls Dam, to maintain a minimum flow of 750 cfs at Peachtree Creek from May through October and 650 cfs from November through April.

At Peachtree Creek, median daily flows for the PAA would be lower throughout the year than for the NAA, generally ranging from about 100 to 300 cfs lower, with the larger differences tending to occur in the fall months (Figure 6.1-26). At the 90-percent exceedance level (Figure 6.1-28), daily flows for the PAA would equal those for the NAA from May through October and would generally be about 100 cfs lower than the NAA from November through April. Daily minimum flows of 650 cfs would occur about 9 percent of the days over the period of record and minimum flows of 750 cfs would occur about 18 percent of the time under the PAA. Thus, about 27 percent of the time flows would equal the seasonal minimum flow value (compared to 19 percent of the time at the 750 cfs minimum flow level for the NAA). Daily flows would exceed 1,000 cfs on about 68 percent of the days (77 percent for NAA) (Figure 6.1-30).

As summarized above for Buford Dam releases and at Peachtree Creek, minor but notable decreases in modeled flow values at both locations under the PAA compared to the NAA would represent a slightly adverse effect on flow conditions in the CRNRA relative to NPS-recommended goals for recreation flows in the area.

At Whitesburg, the PAA would likely result in no appreciable change in flow conditions in the Chattahoochee River compared to the NAA (see Figure 6.1-32, Figure 6.1-34, and Figure 6.1-36). Median daily flows in September through December would tend to be marginally lower, and daily flows at the 90-percent exceedance level would be slightly lower in November and December.

6.1.1.2.3 West Point Dam to Walter F. George Lake

Figure 6.1-37 through Figure 6.1-46 present model outputs for flow conditions at two locations in the Chattahoochee River between West Point Dam and Walter F. George Lake. The locations are below West Point Dam and at Columbus, Georgia. Flow conditions at these locations are considered representative of conditions that would occur within that reach of the Chattahoochee River. Flows conditions were examined to assess changes that would be expected under the water management alternatives/water supply options considered in detail for the ACF Basin under Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and PAA compared to the NAA. The figures present model results for median daily flows, daily flows at the 90-percent exceedance level, and flow duration. In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (i.e., magnitude of flow conditions) is presented in two figures with half of the alternatives presented on each figure. Using the results from these figures and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

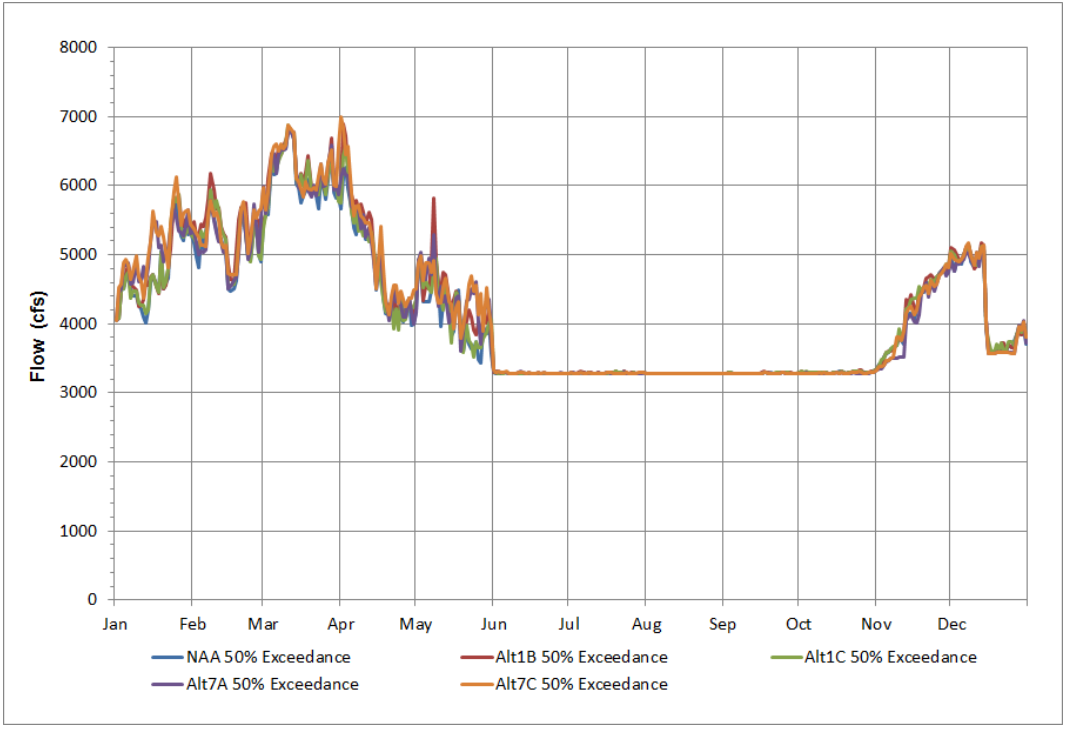


Figure 6.1-37. Chattahoochee River—Median Daily Flows below West Point Dam, Georgia (RM 201.4) for the NAA and Alternatives 1B, 1C, 7A, and 7C

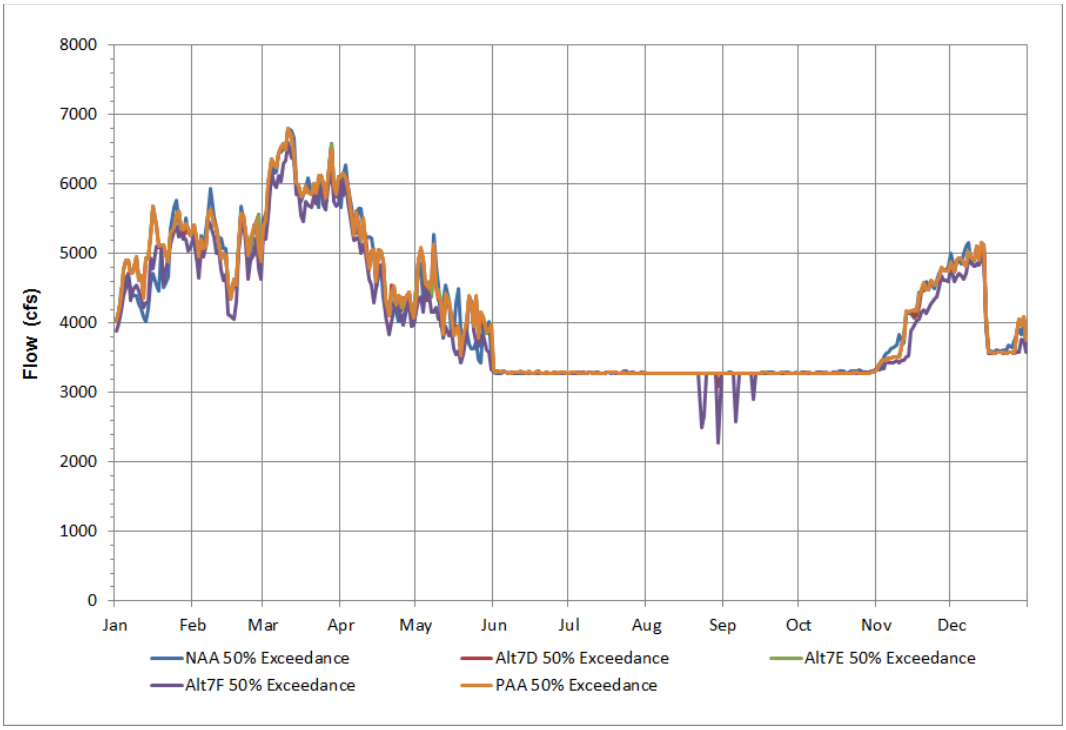


Figure 6.1-38. Chattahoochee River—Median Daily Flows below West Point Dam, Georgia (RM 201.4) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

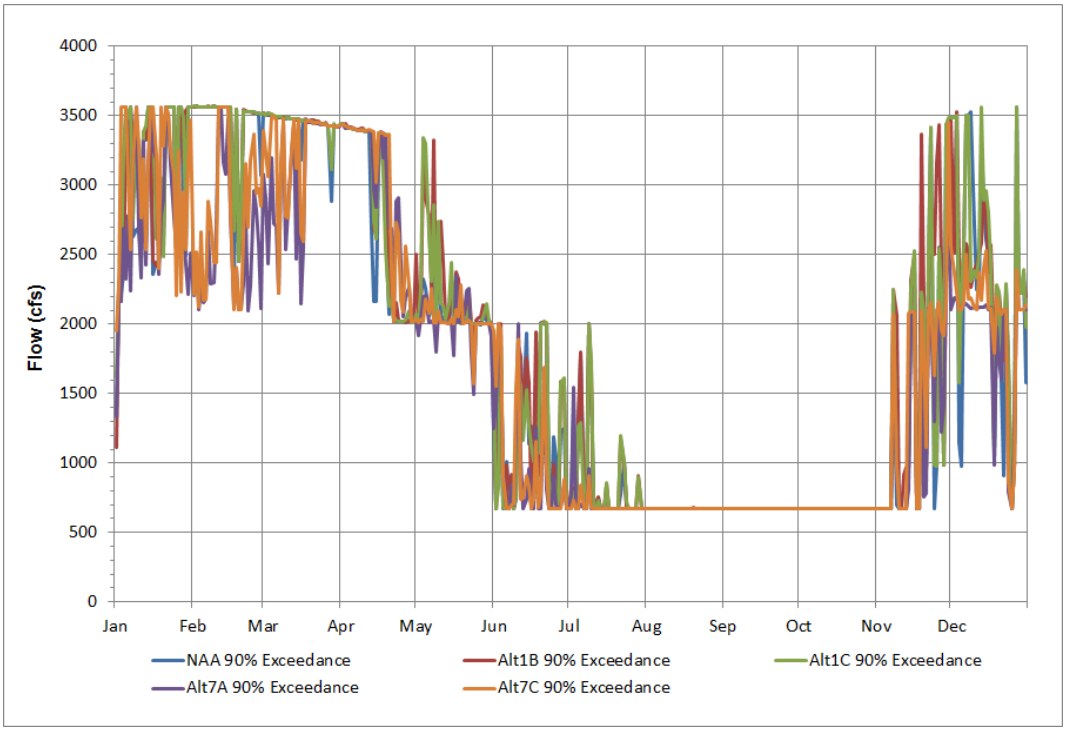


Figure 6.1-39. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level below West Point Dam, Georgia (RM 201.4) for the NAA and Alternatives 1B, 1C, 7A, and 7C

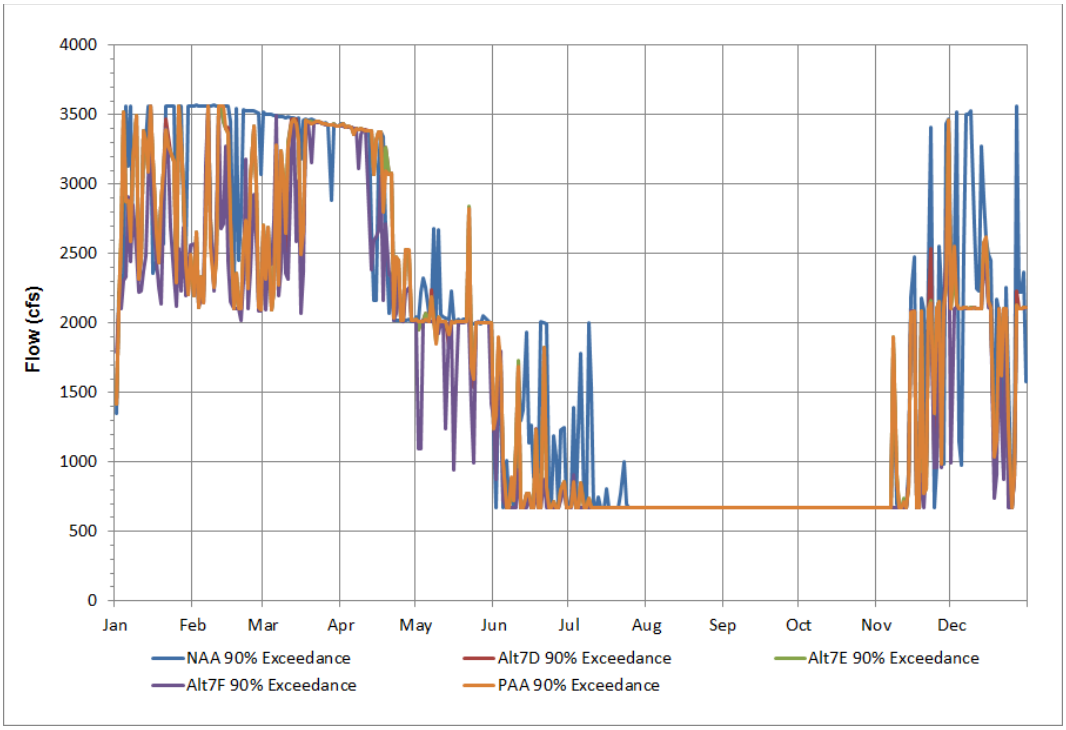


Figure 6.1-40. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level below West Point Dam, Georgia (RM 201.4) for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

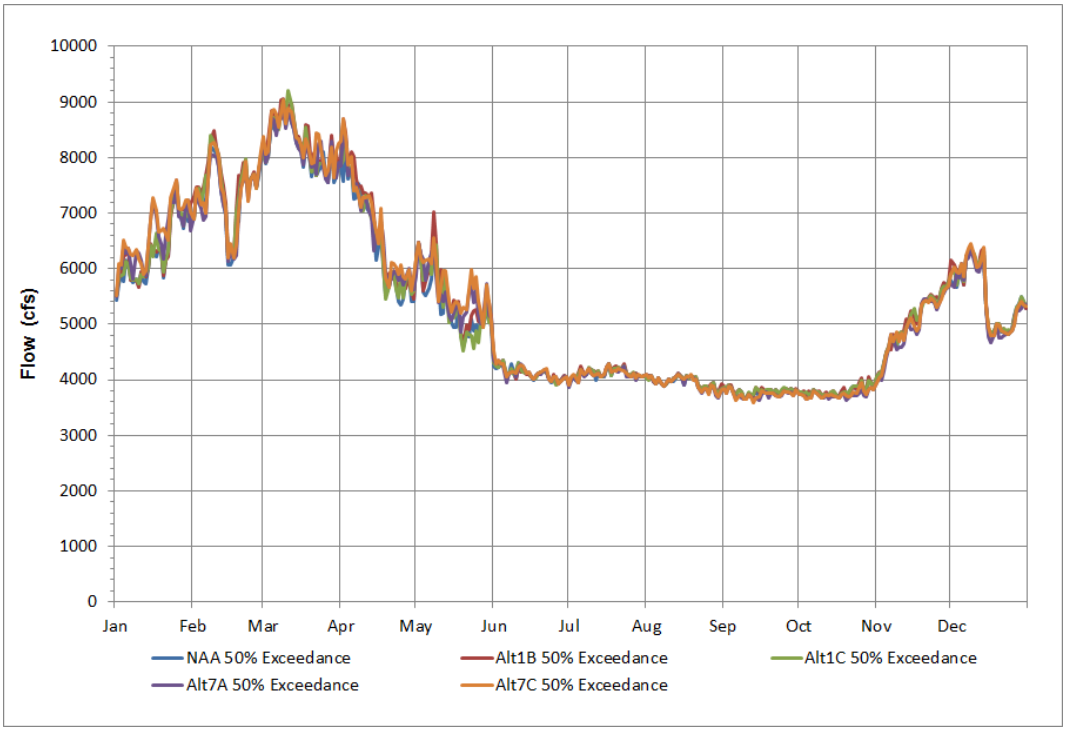


Figure 6.1-41. Chattahoochee River—Median Daily Flows at Columbus, Georgia, for NAA and Alternatives 1B, 1C, 7A, and 7C

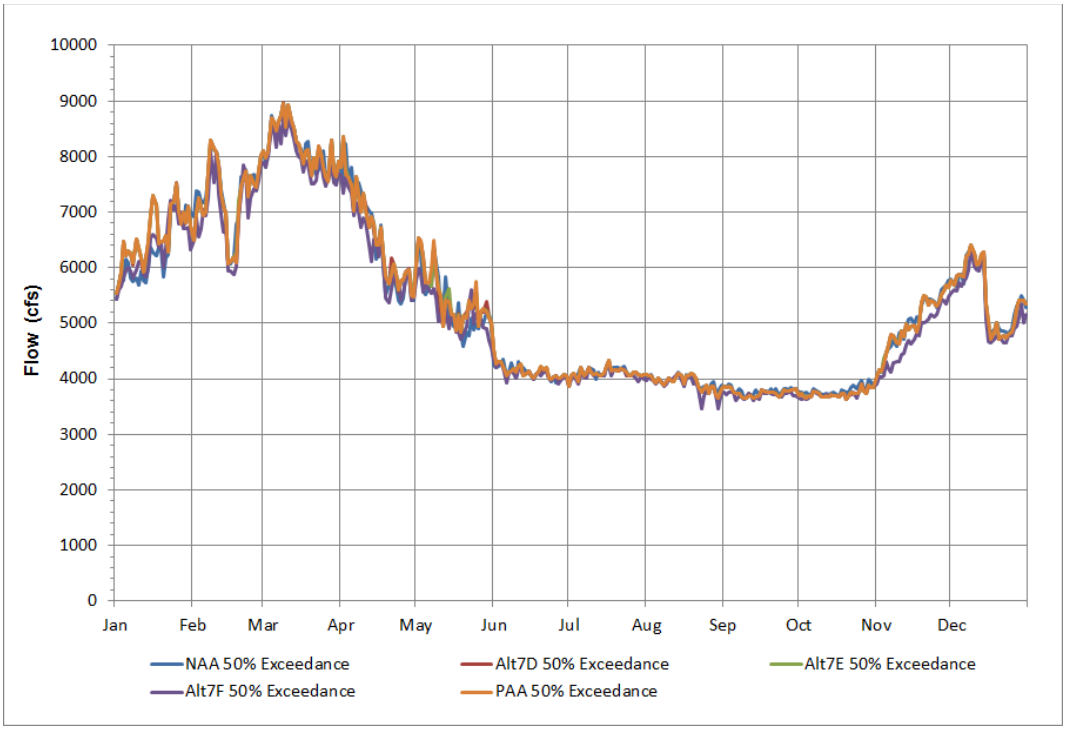


Figure 6.1-42. Chattahoochee River—Median Daily Flows at Columbus, Georgia for NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

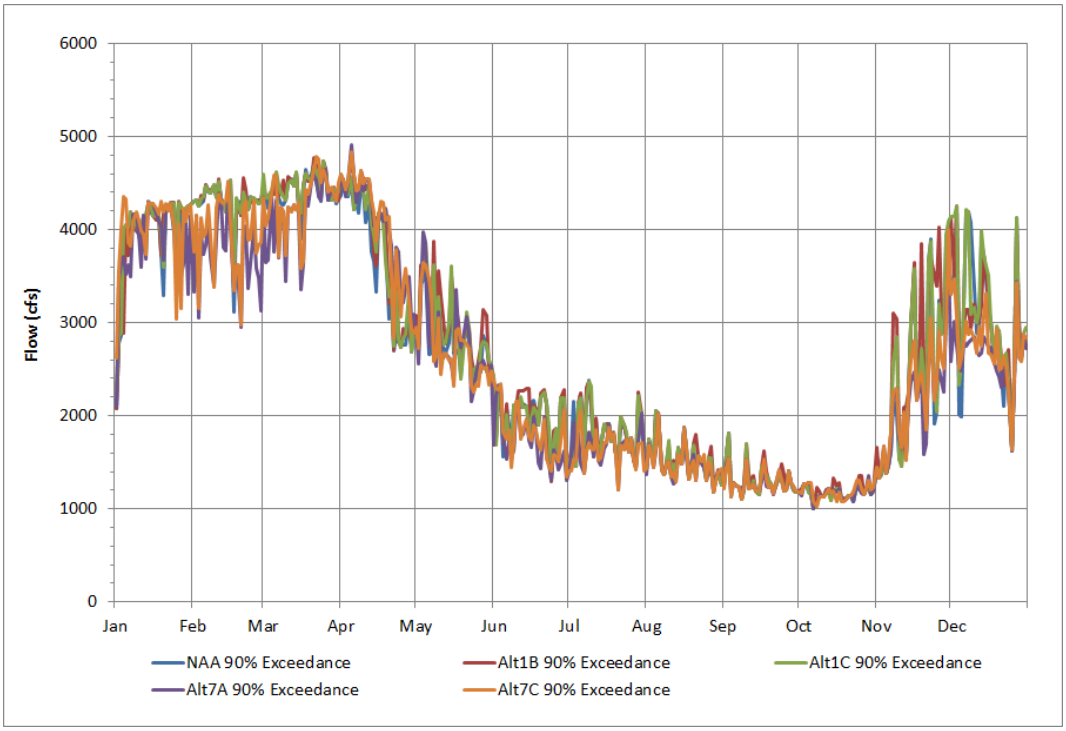


Figure 6.1-43. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level at Columbus, Georgia, for NAA and Alternatives 1B, 1C, 7A, and 7C

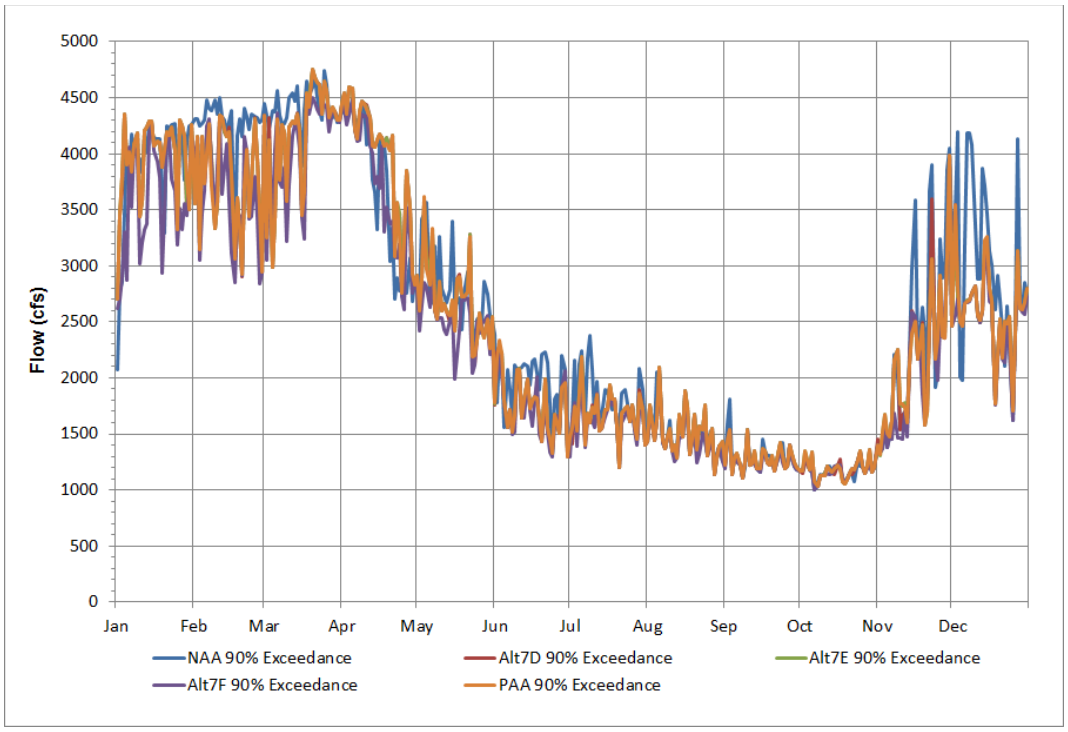


Figure 6.1-44. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level at Columbus, Georgia, for NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

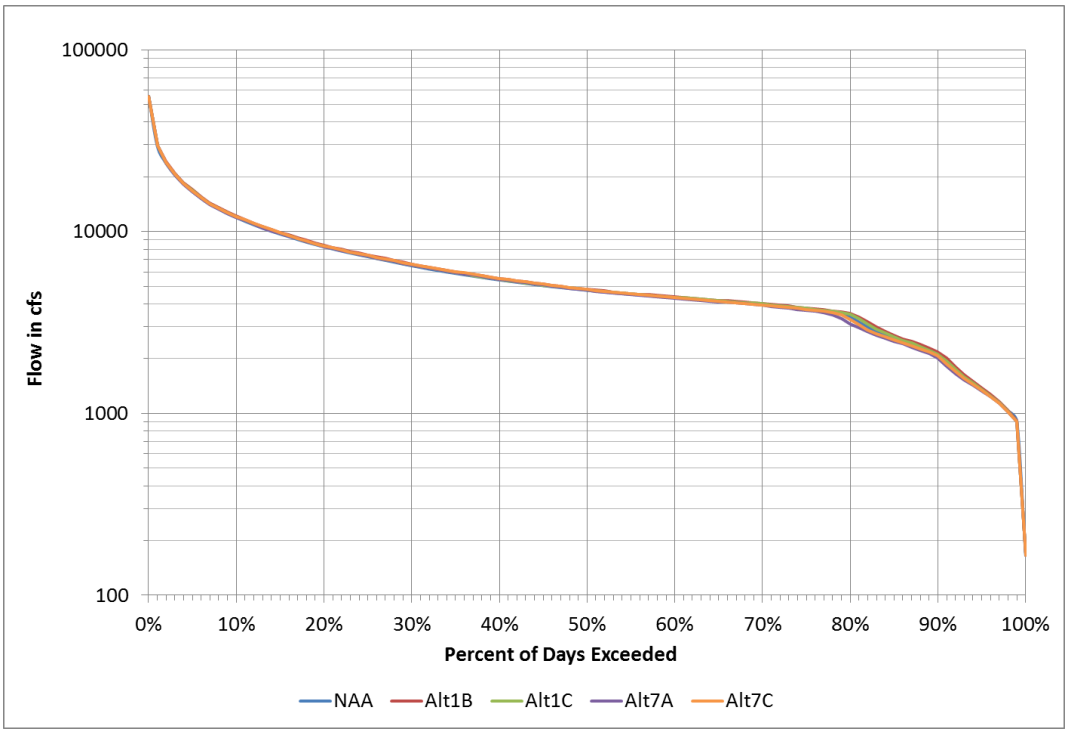


Figure 6.1-45. Chattahoochee River Flows at Columbus, Georgia, Percent of Days Exceeded for the NAA and Alternatives 1B, 1C, 7A, and 7C

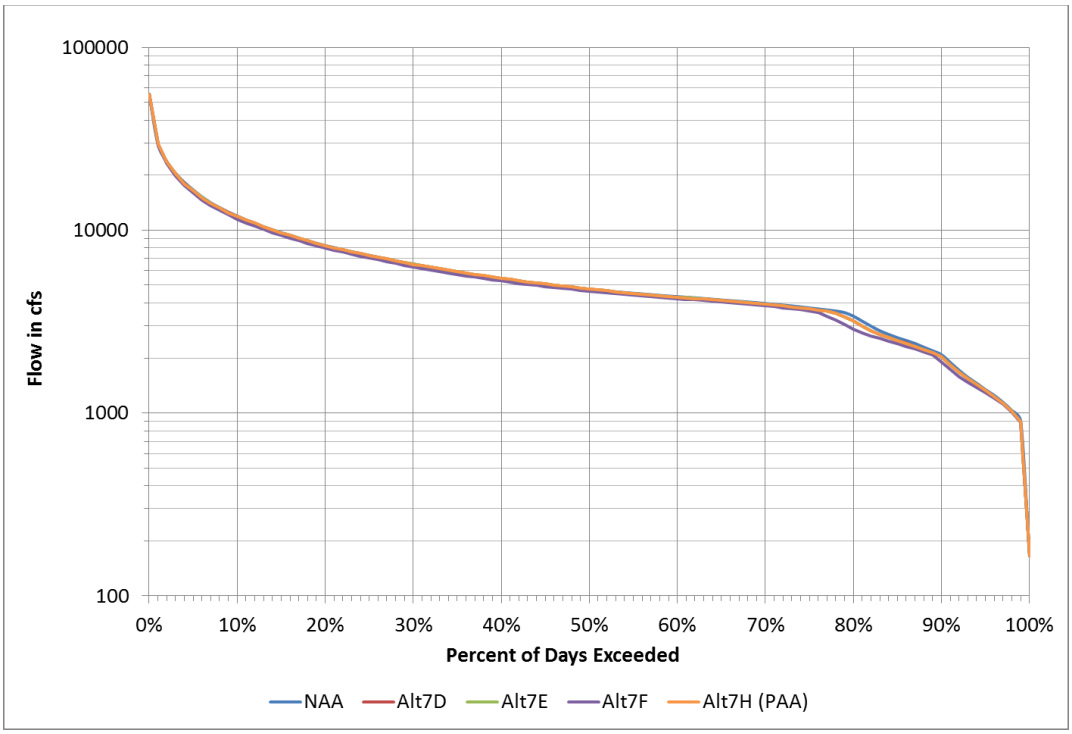


Figure 6.1-46. Chattahoochee River Flows at Columbus, Georgia, Percent of Days Exceeded for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.1.2.3.1 No Action Alternative

Under the NAA, West Point Dam would continuously release a minimum of 675 cfs per the project authorization. Median daily flows downstream of West Point Dam from June through November would consistently be about 3,300 cfs. From December through May, median daily flows would vary from about 3,600 cfs (December) up to about 6,900 cfs in March (Figure 6.1-37). Daily flows at the 90-percent exceedance level below West Point Dam (indicative of drought conditions) would typically be at the minimum flow of 675 cfs from July through early November and generally vary between about 2,000 and 3,500 cfs through the balance of the year (Figure 6.1-39). Daily minimum flows of 675 cfs would occur no more than about 10 percent of the days over the period of record.

At Columbus, median daily flows under the NAA (Figure 6.1-41) would follow a seasonal pattern similar to flows downstream of West Point Dam but of larger magnitude. The median daily flows would be steady from June through October, ranging from slightly above to slightly below 4,000 cfs. From November through May, median daily flows would vary from about 5,000 cfs (December) up to a peak at about 9,000 cfs in March. At the 90-percent exceedance level (reflecting extreme drought conditions), daily flows at Columbus (Figure 6.1-43) would range between about 1,000 and 2,000 cfs from June through mid-November and between 2,000 and 4,600 cfs during the balance of the year. Based on a review of HEC-ResSim model outputs over the modeled period of record, the daily average flows would be expected to equal or exceed the established daily average FERC minimum flow target of 1,350 cfs on 95 percent of the days over the modeled period of record (Figure 6.1-45). Instances of daily flows below 1,350 cfs would generally be attributable to low basin inflows that cannot support the FERC flow target see section 6.1.1.2.1). These instances could occur at any time during the year, depending on hydrologic conditions in the basin, but they would most likely occur for brief periods in the summer or early fall. GPC's ability to meet the FERC flow target at Columbus with releases from the North Highlands Dam is

somewhat dependent upon operations at West Point Dam. Therefore, close coordination of USACE and GPC operations on the Chattahoochee River is required, particularly during periods of low basin inflow.

6.1.1.2.3.2 Alternative 1B

Immediately downstream of West Point Dam, median daily flows under Alt1B (Figure 6.1-37) would closely match those for the NAA, except that they would be marginally higher from January through May. Daily flows at the 90-percent exceedance level for Alt1B would closely match those for the NAA, except for a few instances from January through May where Alt1B flows are likely to be slightly higher (Figure 6.1-39). For Alt1B, daily minimum flows of 675 cfs would occur no more than 9 percent of the days over the period of record (10 percent for NAA). Minor differences between Alt1B and the NAA would be attributable to assumptions regarding water supply withdrawals and returns at Lake Lanier.

For Alt1B, median daily flows at Columbus (Figure 6.1-41) would closely match those for the NAA, except that Alt1B flows would be slightly higher than the NAA flows from December through May (from zero to 600 cfs). At the 90-percent exceedance level (Figure 6.1-43), daily flows for Alt1B would be nearly equal to those for the NAA. HEC-ResSim model outputs indicate that daily flows for Alt1B would be expected to equal or exceed the FERC daily average target flow of 1,350 cfs on 95 percent of the days over the modeled period of record, about the same as for the NAA (Figure 6.1-45).

6.1.1.2.3.3 Alternative 1C

Compared to the NAA, Alt1C would essentially have the same effects as described for Alt1B on median daily flows (Figure 6.1-37) and daily flows at the 90-percent exceedance level (Figure 6.1-39) downstream of West Point Dam. Daily minimum flows of 675 cfs would occur no more than 9 percent of the days over the period of record under Alt1C (10 percent for NAA).

The patterns in median daily flows (Figure 6.1-41) and daily flows at the 90-percent exceedance level (Figure 6.1-43) at Columbus for Alt1B, compared to the NAA, would be similar to those described for Alt1B as presented in section 6.1.1.2.3.2. HEC-ResSim model outputs indicate that daily flows for Alt1C would be expected to equal or exceed the FERC daily average target flow of 1,350 cfs on 95 percent of the days over the modeled period of record, about the same as for the NAA (Figure 6.1-45).

6.1.1.2.3.4 Alternative 7A

Downstream of West Point Dam, median daily flows under Alt7A (Figure 6.1-37) would be equivalent to the NAA from June through December. From January through May, the flow values for Alt7A would follow a pattern similar to the NAA but would tend to range slightly higher than the NAA values in January and May. Daily flows at the 90-percent exceedance level for Alt7A would be nearly equivalent to the NAA from May through November, and they would tend to be lower than NAA flows by variable amounts from December through April (Figure 6.1-39). For Alt7A, daily minimum flows not exceeding 675 cfs would occur on same percent of the days over the period of record as the NAA (10 percent).

For Alt7A, median daily flows at Columbus (Figure 6.1-41) would be nearly equivalent to NAA flows in all months, except that Alt7A flows would be slightly higher in the months of January and May. At the 90-percent exceedance level, daily flows under Alt7A would be nearly equivalent to those under the NAA from June through November, with some instances of slightly lower flows for Alt7A. From December through March, Alt7A flows would be lower than NAA flows, ranging from minimal amounts up to as much as 1,000 cfs occasionally. In April and May, Alt7A flows would be slightly higher than for the NAA (Figure 6.1-43). HEC-ResSim model outputs indicate that daily flows would be expected to equal or exceed the FERC daily average target flow of 1,350 cfs on 94 percent of the days over the modeled period of record (95 percent for the NAA) (Figure 6.1-45).

Under Alt7A, slightly higher median flows in January and May between West Point Dam and the headwaters of Walter F. George Lake, compared to the NAA, would reflect additional releases from upstream reservoirs to support downstream navigation target flows during those months. At the 90-percent exceedance level (indicative of severe drought conditions), lower flows in the late winter/early spring months under Alt7A reflects limited releases from upstream reservoirs due to revised action zones and drought management activities to conserve storage to the extent practicable.

6.1.1.2.3.5 Alternative 7C

Compared to the NAA, the effects of Alt7C on flow conditions between West Point Dam and Walter F. George Lake would essentially be the same as described for Alt7A (Figure 6.1-37, Figure 6.1-39, Figure 6.1-41, and Figure 6.1-43). For Alt7C, daily flows below West Point Dam at the minimum level of 675 cfs would occur on 10 percent of the days over the period of record, the same percentage as the NAA. HEC-ResSim model outputs indicate that daily flows at Columbus would be expected to equal or exceed the FERC daily average target flow of 1,350 cfs on 94 percent of the days over the modeled period of record (compared to 95 percent for the NAA) (Figure 6.1-45).

6.1.1.2.3.6 Alternative 7D

Downstream of West Point Dam, median daily flows for Alt7D would be nearly the same as those for the NAA, except that they would tend to be slightly higher in January, late April, and May (Figure 6.1-38). Daily flows at the 90-percent exceedance level for Alt7D would be nearly equivalent to the NAA from mid-March through mid-November and generally lower than the NAA by variable amounts from mid-November through mid-March (Figure 6.1-40). In the months of March and April, daily flows at the 90-percent exceedance level could be as much as about 1,400 cfs lower than the NAA for brief periods. For Alt7D, daily flows below West Point Dam at the minimum level of 675 cfs would likely occur on 10 percent of the days over the period of record (same as the NAA).

For Alt7D, median daily flows at Columbus (Figure 6.1-42) would be nearly the same as for the NAA throughout the year, except that Alt7D flows would tend to be higher on a few days in the months of January and May. At the 90-percent exceedance level (Figure 6.1-44), daily flows for Alt7D would be about the same as NAA flows from July through November and generally lower than NAA flows (by variable amounts) from December through June. Alt7D flows could drop by as much as 1,400 cfs below NAA flows for brief periods in February and March. HEC-ResSim model outputs indicate that daily flows at Columbus would be expected to equal or exceed the FERC daily average target flow of 1,350 cfs on 94 percent of the days over the modeled period of record, compared to 95 percent for the NAA (Figure 6.1-46).

The water supply options for Lake Lanier under Alt7D would not be expected to have an appreciable effect on median flow conditions downstream of West Point Dam. Differences between model results for Alt7D and the NAA are largely attributable to revisions to current water management practices included in Water Management Alternative 7, as summarized in the last paragraph of the section 6.1.1.2.3.4.

6.1.1.2.3.7 Alternative 7E

Compared to the NAA, Alt7E would have nearly identical effects on flow conditions downstream of West Point Dam and at Columbus, Georgia as described for Alt7D (Figure 6.1-38, Figure 6.1-40, Figure 6.1-42, Figure 6.1-44, and Figure 6.1-46).

6.1.1.2.3.8 Alternative 7F

For Alt7F, the median daily flows downstream of West Point Lake would be consistently equal to or lower than flows under the NAA throughout the year. In the spring months and from November to early December, flow values could range from zero to 1,000 cfs lower than the NAA values. The only exception would occur for a brief period in January when Alt7F flows would be 200 to 500 cfs higher than the NAA flows (Figure 6.1-38). Daily flows at the 90-percent exceedance level for Alt7F would tend to be the same as the NAA from mid-July through mid-November (at the minimum flow of 675 cfs). During the balance of the year, daily flows at the 90-percent exceedance level would be consistently equal to or lower than the NAA, ranging from a negligible amount up to about 1,400 cfs (Figure 6.1-40). For Alt7F, daily flows below West Point Dam at the minimum level of 675 cfs would likely occur on 11 percent of the days over the period of record (10 percent for the NAA).

For Alt7F, median daily flows at Columbus (Figure 6.1-42) would be slightly lower throughout the year than flow values for the NAA, except that flows would tend to be slightly higher for brief periods in the months of January and May. The largest differences would be expected to occur in April and November to early December. At the 90-percent exceedance level (Figure 6.1-44), daily flows under Alt7F would be equal to or lower throughout the year than those for the NAA. The biggest differences would occur between December and June, and they could range from zero up to about 1,400 cfs. HEC-ResSim model outputs indicate that daily flows at Columbus would be expected to equal or exceed the FERC daily average target flow of 1,350 cfs on about 94 percent of the days over the period of record, compared to 95 percent for the NAA (Figure 6.1-46).

Compared to the NAA, Alt7F would produce the greatest degree of change in flow conditions in the Chattahoochee River between West Point Dam and the headwaters of Walter F. George Lake of all the alternatives considered.

6.1.1.2.3.9 Alternative 7H (PAA)

Downstream of West Point Dam, median daily flows for the PAA would be nearly the same as those for the NAA, except that they would tend to be slightly higher in January, late April, and May (Figure 6.1-38). Daily flows at the 90-percent exceedance level for the PAA would be nearly equivalent to the NAA from mid-March through mid-November and generally lower for the NAA by variable amounts from mid-November through mid-March (Figure 6.1-40). In the months of March and April, daily flows at the 90-percent exceedance level could be as much as about 1,400 cfs lower than the NAA flows for brief periods. For the PAA, daily flows below West Point Dam at the minimum level of 675 cfs would likely occur on 10 percent of the days over the period of record (same as the NAA).

Median daily flows at Columbus under the PAA (Figure 6.1-42) would be nearly the same as under the NAA throughout the year, except that PAA flows would tend to be higher on few days in the months of January and May. At the 90-percent exceedance level (Figure 6.1-44), daily flows for the PAA would be about the same as NAA flows from July through November and generally lower than NAA flows (by variable amounts) from December through June. The PAA flows could drop by as much as 1,400 cfs below NAA flows for brief periods in February and March. HEC-ResSim model outputs indicate that daily flows at Columbus would be expected to equal or exceed the FERC daily average target flow of 1,350 cfs on 94 percent of the days over the modeled period of record, compared to 95 percent for the NAA (Figure 6.1-46).

The water supply options for Lake Lanier under the PAA would not be expected to have an appreciable effect on median flow conditions downstream of West Point Dam. Differences between model results for the PAA and the NAA are largely attributable to revisions to current water management practices

included in Water Management Alternative 7, as summarized in the last paragraph of the section 6.1.1.2.3.4.

6.1.1.2.4 Walter F. George Lock and Dam to Jim Woodruff Lock and Dam

Figure 6.1-47 through Figure 6.1-52 present model outputs for flow conditions below George W. Andrews Lock and Dam over the modeled period of record. The site is between Walter F. George Lock and Dam and Jim Woodruff Lock and Dam on the Chattahoochee River. Flow conditions at this location were examined to assess changes that would be expected under the water management alternatives/water supply options considered in detail for the ACF Basin under Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA compared to the NAA. Flow values at this location are considered representative of conditions in this reach of the river. The figures present model results for median daily flows, daily flows at the 90-percent exceedance level, and flow duration. In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (i.e., magnitude of flow conditions) is presented in two figures with half of the alternatives presented on each figure. Using the results from these figures, and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

As described in section 6.1.1.2.1, the Southern Nuclear Operating Company and the Alabama Office of Water Resources have indicated that a minimum average daily flow of 2,000 cfs at the Farley Nuclear Plant (a short distance downstream of George W. Andrews Lock and Dam) is necessary for the continued uninterrupted operation of the plant (see section 6.1.1.2.1). This section addresses the extent to which the Farley flow need would likely be met under each of the alternatives considered herein.

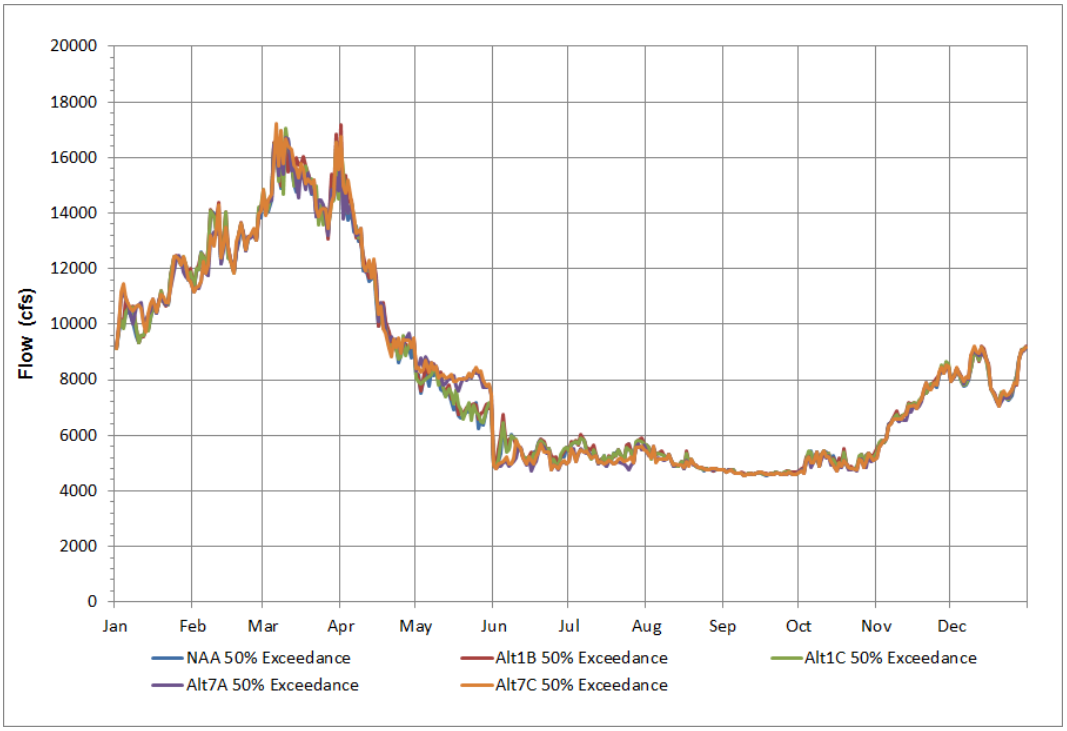


Figure 6.1-47. Chattahoochee River— Median Daily Flows below George W. Andrews Lock and Dam, Georgia, for the NAA and Alternative 1B, 1C, 7A, and 7C



Figure 6.1-48. Chattahoochee River— Median Daily Flows below George W. Andrews Lock and Dam, Georgia, for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

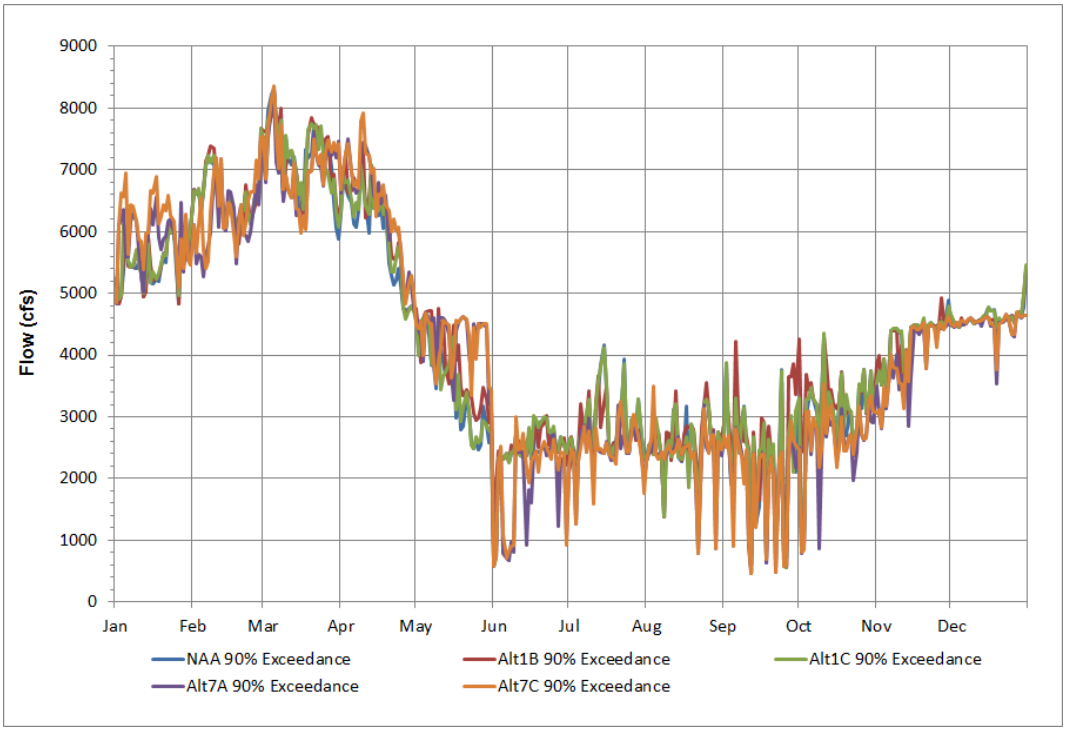


Figure 6.1-49. Chattahoochee River—Daily Flows at the 90-Percent Exceedance Level below George W. Andrews Lock and Dam for the NAA and Alternatives 1B, 1C, 7A, and 7C

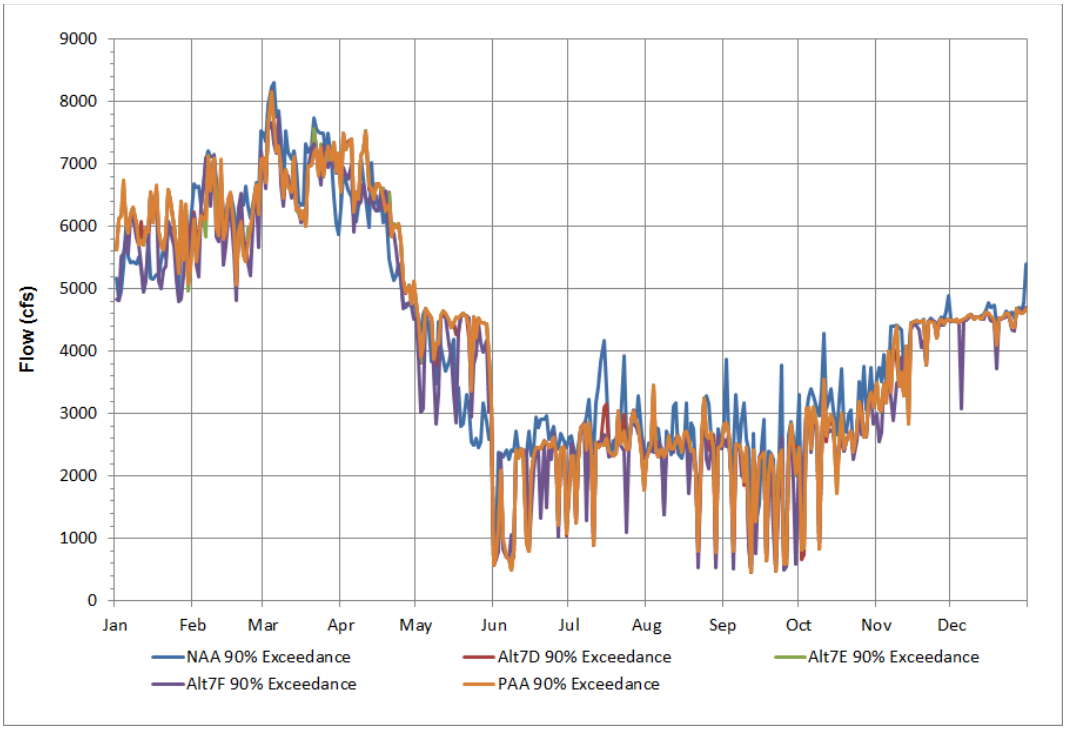


Figure 6.1-50. Chattahoochee River— Daily Flows at the 90-Percent Exceedance Level below George W. Andrews Lock and Dam for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

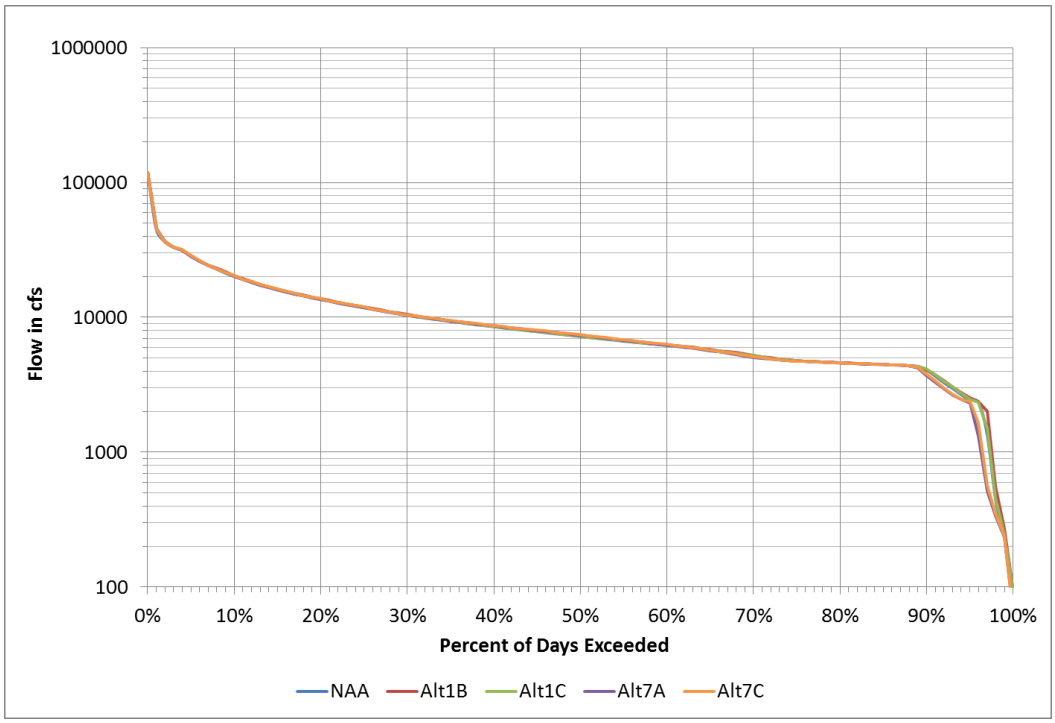


Figure 6.1-51. Chattahoochee River Flows below George W. Andrews Lock and Dam, Percent of Days Exceeded for the NAA and Alternatives 1B, 1C, 7A, and 7C

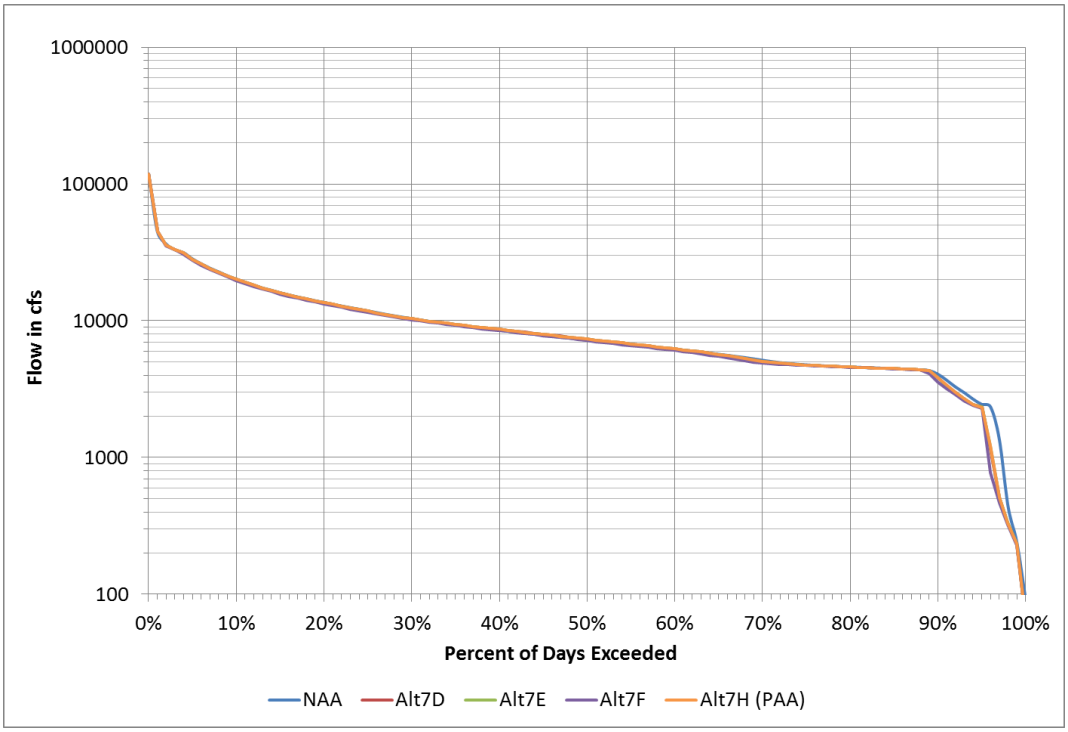


Figure 6.1-52. Chattahoochee River Flows below George W. Andrews Lock and Dam, Percent of Days Exceeded for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.1.2.4.1 No Action Alternative

Under the NAA, median daily flows from June through October would likely range between about 4,600 cfs and 6,000 cfs (Figure 6.1-47). From November through May, median daily flows would typically range between about 6,000 cfs and about 16,700 cfs. Peak median daily flow levels would occur in March.

Daily flows at the 90-percent exceedance level at George W. Andrews Lock and Dam (indicative of drought conditions) would generally fall in the range 2,000 to 3,000 cfs during the months of the year that are typically drier (June–November). During that period, median daily flows could briefly range from as low as 500 cfs to as high as 4,200 cfs. In the balance of the year (December–May), median daily flows range from about 3,000 cfs up to about 8,300 cfs, with peak flows occurring in March (Figure 6.1-49).

Based on HEC-ResSim model outputs over the simulated period of record, daily average flows equal to or exceeding the Farley flow need of 2,000 cfs would occur about 96 percent of the time (Figure 6.1-51).

6.1.1.2.4.2 Alternative 1B

For Alt1B, median daily flows would be a close match to those for the NAA (Figure 6.1-47). The differences would be negligible. At the 90-percent exceedance level, the daily flows at George W. Andrews Lock and Dam for Alt1B would closely match the daily flows for the NAA throughout the year, except that Alt1B flows would tend to be marginally higher than the NAA flows, particularly during the late spring (mid-April–May) (Figure 6.1-49).

Based on HEC-ResSim model outputs over the modeled period of record, daily average flows equal to or exceeding the Farley flow need of 2,000 cfs would occur about 97 percent of the time compared to 96 percent for the NAA (Figure 6.1-51).

6.1.1.2.4.3 Alternative 1C

The effects of Alt1C on flow conditions at George W. Andrews Lock and Dam (at both median and 90-percent exceeded flow levels) would nearly be identical to the NAA (see Figure 6.1-47, Figure 6.1-49, and Figure 6.1-51).

6.1.1.2.4.4 Alternative 7A

For Alt7A, model results for median daily flows would be a close match to NAA flows throughout the year with the following exceptions. Alt7A flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher), and Alt7A flows for June and July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (Figure 6.1-47).

At the 90-percent exceedance level, the daily flows below George W. Andrews Lock and Dam for Alt7A would be similar to the daily flows under the NAA with the following deviations. Alt7A flows would be higher in January and from April through May (from zero to about 2,000 cfs higher), and they would be slightly lower from February through March and from June through December (Figure 6.1-49).

Based on HEC-ResSim model outputs over the simulated period of record, daily average flows equal to or exceeding the Farley flow need of 2,000 cfs would occur about 95 percent of the time for Alt7A compared to 96 percent of the time for the NAA (Figure 6.1-51).

These changes in flow conditions for Alt7A below George W. Andrews Lock and Dam compared to the NAA would principally be attributable to updates to water management practices included in Water Management Alternative 7, including revised action zones in USACE reservoirs, provisions for navigation target flows when sufficient water is available, and drought management activities.

6.1.1.2.4.5 Alternative 7C

Compared to the NAA, the effects of Alt7C on flow conditions below George W. Andrews Lock and Dam would be a close match to those resulting from Alt7A, as described in section 6.1.1.2.4.4. Throughout the year, differences in median daily flows and daily flows at the 90-percent exceedance level would be negligible (Figure 6.1-47, Figure 6.1-49, and Figure 6.1-51).

6.1.1.2.4.6 Alternative 7D

Compared to the NAA, the effects of Alt7D on flow conditions below George W. Andrews Lock and Dam would be a close match to those resulting from Alt7A, as described in section 6.1.1.2.4.4. The model outputs for Alt7D and Alt7A, as reflected by the various curves presented herein (Figure 6.1-48 and Figure 6.1-50) are nearly identical.

Based on HEC-ResSim model outputs over the simulated period of record, daily average flows equal to or exceeding the Farley flow need of 2,000 cfs would occur about 95 percent of the time for Alt7D compared to 96 percent of the time for the NAA (Figure 6.1-52).

USACE assumptions regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Chattahoochee River below George W. Andrews Lock and Dam.

6.1.1.2.4.7 Alternative 7E

Compared to the NAA, the effects of Alt7E on flow conditions below George W. Andrews Lock and Dam would be nearly identical to those described for Alt7A in section 6.1.1.2.4.4 (Figure 6.1-48 and Figure 6.1-50).

Based on HEC-ResSim model outputs over the simulated period of record, daily average flows equal to or exceeding the Farley flow need of 2,000 cfs would occur about 95 percent of the time for Alt7E compared to 96 percent of the time for the NAA (Figure 6.1-52).

USACE assumptions regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Chattahoochee River below George W. Andrews Lock and Dam.

6.1.1.2.4.8 Alternative 7F

Compared to the NAA, Alt7F would essentially have the same effects on flow conditions at George W. Andrews Lock and Dam as described for Alt7A in section 6.1.1.2.4.4, except that the flows at the 90-percent exceedance level would be slightly lower for Alt7F than the flows under Alt7A. The model outputs for Alt7F and Alt7A (Figure 6.1-48 and Figure 6.1-50) are nearly identical.

Based on HEC-ResSim model outputs over the simulated period of record, daily average flows equal to or exceeding the Farley flow need of 2,000 cfs would occur about 95 percent of the time for Alt7F compared to 96 percent of the time for the NAA (Figure 6.1-52).

USACE assumptions regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Chattahoochee River below George W. Andrews Lock and Dam.

6.1.1.2.4.9 Alternative 7H (PAA)

For Alt7H (PAA), model results for median daily flows would be a close match to NAA flows throughout the year with the following exceptions. Alt7A flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher), and Alt7A flows for June and July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (Figure 6.1-48).

At the 90-percent exceedance level, the daily flows below George W. Andrews Lock and Dam for the PAA would be similar to the daily flows under the NAA with the following deviations. PAA flows would be higher in January and from April through May (from zero to about 2,000 cfs higher), and they would be slightly lower from February through March and from June through December (Figure 6.1-50).

Based on HEC-ResSim model outputs over the simulated period of record, daily average flows equal to or exceeding the Farley flow need of 2,000 cfs would occur about 95 percent of the time for the PAA compared to 96 percent of the time for the NAA (Figure 6.1-52).

USACE assumptions regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Chattahoochee River below George W. Andrews Lock and Dam.

6.1.1.2.5 Apalachicola River

Figure 6.1-53 through Figure 6.1-58 present model outputs for flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam. Flow conditions at Chattahoochee, Florida, a short distance downstream of Jim Woodruff Lock and Dam, were examined to assess changes that would be expected under the water management alternatives/water supply options considered in detail for the ACF Basin under Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA compared to the NAA.

The figures present model results for median daily flows, daily flows at the 90-percent exceedance level, and flow duration. In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (i.e., magnitude of flow conditions) is presented in two figures, with half of the alternatives presented on each figure. In addition, Table 6.1-9 provides a direct comparison of the percent of days over the modeled period of record for all of the alternatives for which the Apalachicola River flows would likely exceed five selected flow values. Using the results from these figures, the table, and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

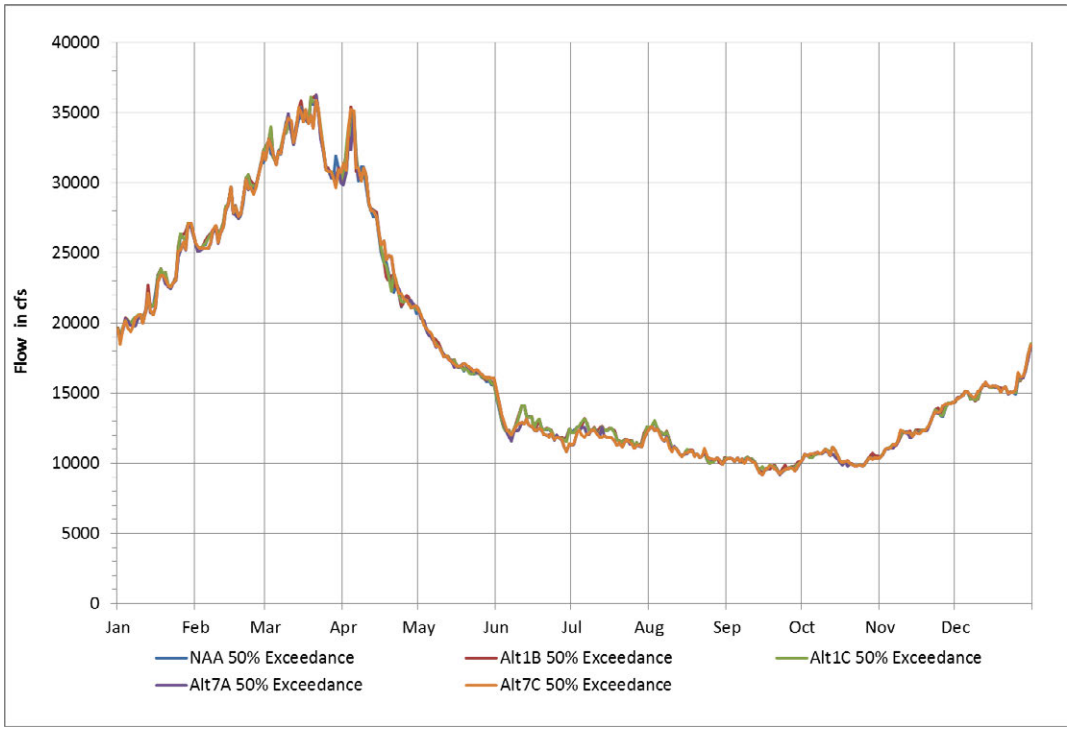


Figure 6.1-53. Apalachicola River— Median Daily Flows at Chattahoochee, Florida, for the NAA and Alternative 1B, 1C, 7A, and 7C

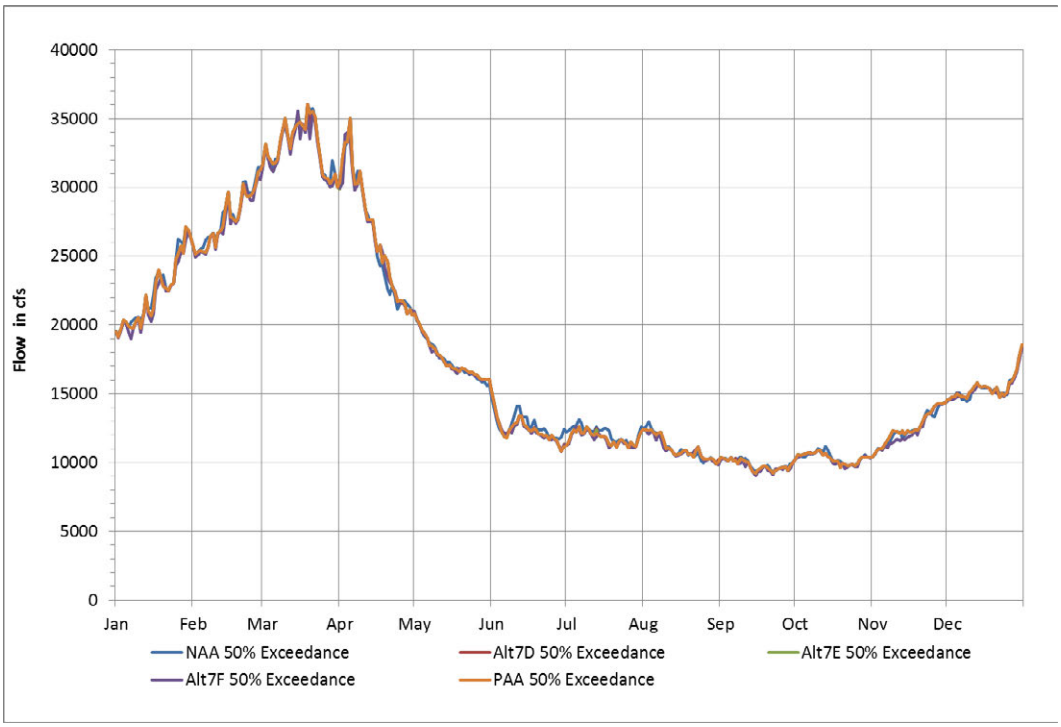


Figure 6.1-54. Apalachicola River— Median Daily Flows at Chattahoochee, Florida, for the NAA and Alternative 7D, 7E, 7F, and the PAA (7H)

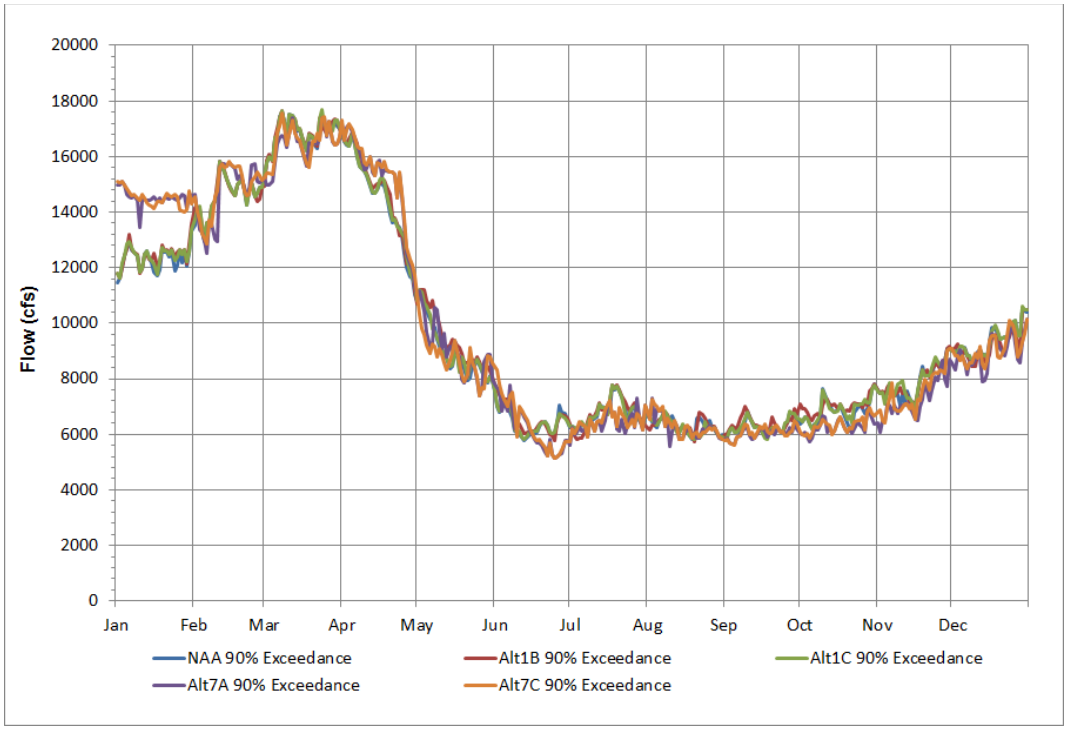


Figure 6.1-55. Apalachicola River— Daily Flows at the 90-Percent Exceedance Level at Chattahoochee, Florida, for the NAA and Alternatives 1B, 1C, 7A, and 7C

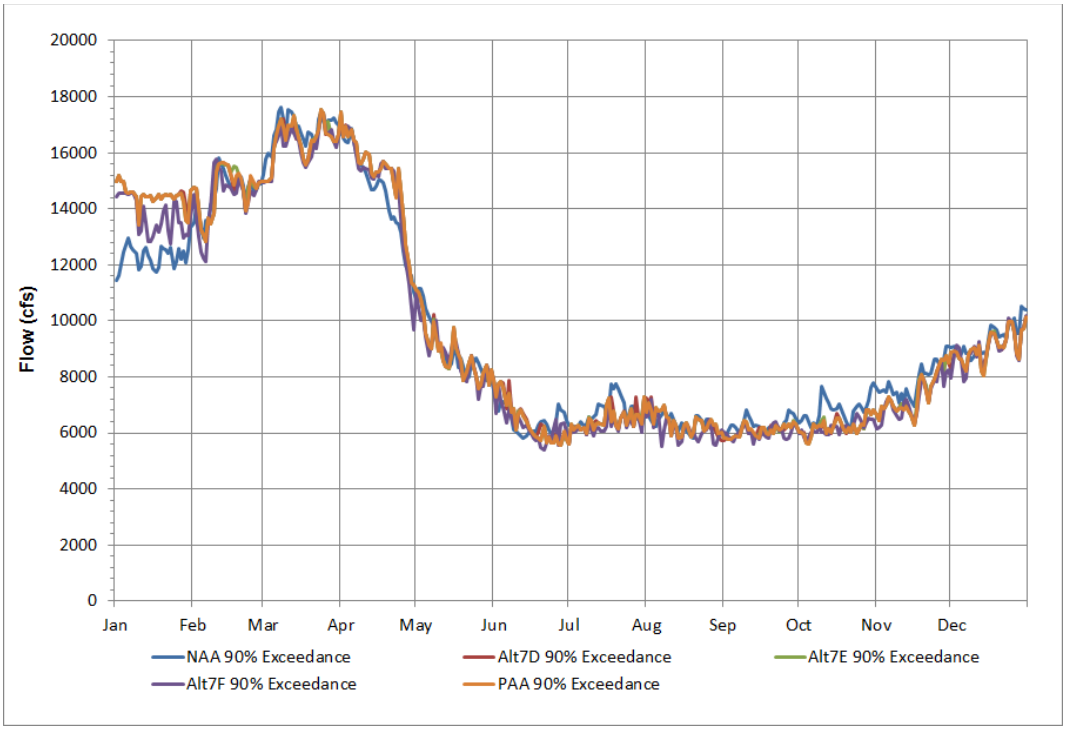


Figure 6.1-56. Apalachicola River— Daily Flows at the 90 percent exceedance level at Chattahoochee, Florida for the NAA, alternatives 7D, 7E, 7F, and 7H (PAA)

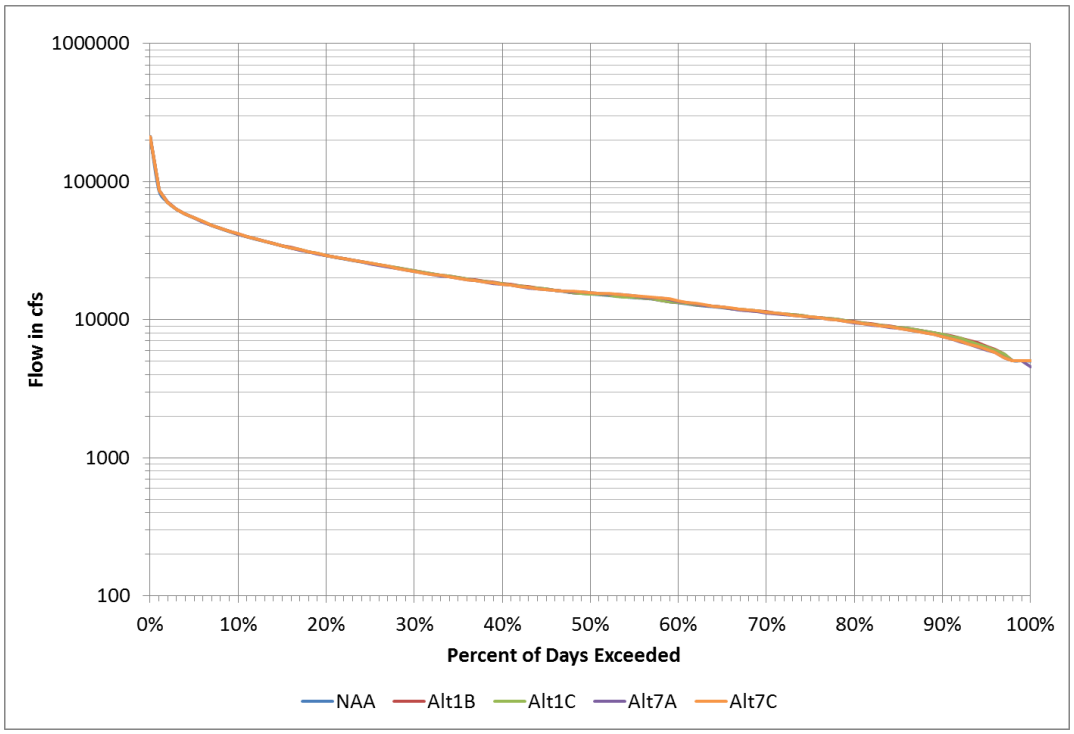


Figure 6.1-57. Apalachicola River flows below Jim Woodruff Lock and Dam (Chattahoochee, FL), percent of days exceeded for the NAA, and alternatives 1B, 1C, 7A, and 7C

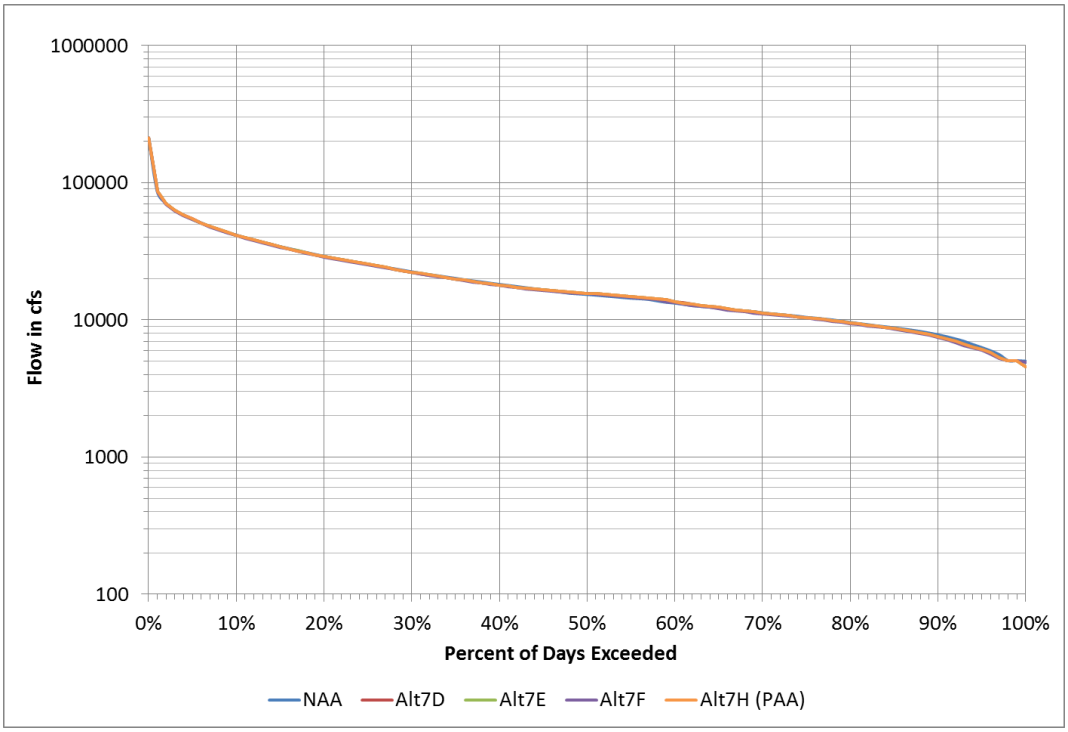


Figure 6.1-58. Apalachicola River Flows Below Jim Woodruff Lock and Dam (Chattahoochee, FL), Percent of Days exceeded for the NAA, and Alternatives 7D, 7E, 7F, and 7H (PAA)

Table 6.1-9.
Apalachicola River at Chattahoochee, Florida, Gage, Percent of Days over the Modeled Period of Record that Flows Would Equal or Exceed Selected Flow Values

Flows - Chattahoochee gage	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	Alt7H (PAA)
≥ 20,000 cfs	35.2%	35.4%	35.3%	34.8%	34.9%	34.8%	34.8%	34.5%	34.8%
≥ 16,000 cfs	47.0%	47.3%	47.2%	47.8%	48.0%	47.7%	47.7%	47.0%	47.7%
≥ 12,000 cfs	65.9%	66.4%	66.2%	66.1%	66.4%	66.2%	66.2%	65.4%	66.2%
≥ 8,000 cfs	89.9%	89.4%	89.2%	88.1%	88.3%	88.2%	88.2%	87.7%	88.2%
≥ 6,000 cfs	95.9%	96.2%	95.9%	95.2%	95.3%	95.3%	95.3%	94.9%	95.3%

The following subsections address the specific effects on flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam associated with the NAA and each of the alternatives. Each section generally concludes that the differences in flow condition in the Apalachicola River between the NAA and each alternative would be very small. Accordingly, any differences in the inflows to Apalachicola Bay from these alternatives would also be similarly small. The following paragraphs provide a general explanation regarding why the alternatives are likely to have no appreciable effects on flow conditions in the Apalachicola River compared to the NAA.

Jim Woodruff Lock and Dam

Jim Woodruff Lock and Dam has no dedicated conservation storage and essentially operates as a run-of-river reservoir project with pondage that provides limited capacity to control downstream discharges for short periods of time (see section 2.1.1.1.6.7). Under the NAA, all releases from Jim Woodruff Lock and Dam into the Apalachicola River would be governed by the operational provisions of the 2012 RIOP.

Some of the alternatives proposed only minor adjustments to the 2012 RIOP to suspend ramping rates under prolonged drought conditions. Thus, discharges from Jim Woodruff Lock and Dam under the various alternatives would not be appreciably different from each other or from the NAA unless basin inflow conditions to Lake Seminole from the Flint or Chattahoochee Rivers under these alternatives would be notably different.

Flint River Basin
The Flint River basin comprises about 50 percent of the ACF Basin drainage area upstream of Jim Woodruff Lock and Dam. Inflows to Lake Seminole from the Flint River basin pass through two non-federal run-of-river dams and are effectively uncontrolled. Consequently, Flint River basin inflows to Lake Seminole would be unaffected by the NAA or the alternatives, and the inflows to Lake Seminole from the Flint River basin over the period of record would be the same for all alternatives.

Chattahoochee River Basin
In the Chattahoochee River basin, proposed revisions to the action zones at Walter F. George Lake and further upstream at West Point Lake included in the alternatives would not have an appreciable effect on inflows into Lake Seminole compared to the NAA. This conclusion is supported by HEC-ResSim outputs for flow conditions below George W. Andrews Lock and Dam over the modeled period of record. This may be observed by comparing the flows for Alt 7A with the flows for the NAA shown in Table 6.1-9. This comparison reflects the effects associated with changes to the water management operations. Comparing flows for Alt 7H with Alt 7A reveals the additional changes in flows associated with increased water demand.

In addition, proposed revisions to water management operations at Buford Dam, including various water supply options for Lake Lanier and downstream of Buford Dam (all of which would occur in the uppermost 10 percent of the Chattahoochee River basin), would generally have an inconsequential effect on flow conditions into Lake Seminole and downstream of Jim Woodruff Lock and Dam. The absence of appreciable differences in simulated flow conditions downstream of George W. Andrews Lock and Dam among the alternatives with different water supply options supports this conclusion. Based on HEC-ResSim outputs over the modeled period of record, flow in the Apalachicola River and into the Bay would be more influenced more by hydrologic conditions in the 90 percent of the ACF Basin downstream of metropolitan Atlanta, except during severe drought conditions when flows would be supported by conservation storage in Lake Lanier and the other USACE reservoirs.

6.1.1.2.5.1 No Action Alternative

Under the NAA, median daily flows in the Apalachicola River at Chattahoochee, Florida, would range from about 10,000 cfs to 15,000 cfs in the lower flow season from June through November (Figure 6.1-53). From December through May, median daily flows would range from about 15,000 cfs to 36,000 cfs, with the peak flows typically occurring in March. Daily flows at the 90-percent exceedance level (indicative of drought conditions) would range between 6,000 cfs and 8,000 cfs from June through November and between 8,000 cfs and about 17,500 cfs from December through May, with peak flows generally occurring in March (Figure 6.1-55). Model results indicate that daily flows over the simulated period of record would equal 5,000 cfs about 3 percent of the time and would exceed that minimum level about 97 percent of the time (Figure 6.1-57). During the months of November through May, the percent of time flows would exceed 5,000 cfs would be slightly higher (98 to 100 percent), and from June through October, the percent of time that flows would exceed 5,000 cfs would be slightly lower (94 to 96 percent).

Downstream of the Chattahoochee gage, basin inflow to the Apalachicola River is essentially uncontrolled. Therefore, flows at the Chattahoochee gage plus the uncontrolled inflows from downstream tributaries to the Apalachicola River comprise virtually all of the freshwater inflow to the Apalachicola Bay.

6.1.1.2.5.2 Alternative 1B

For Alt1B, median daily flows and daily flows at the 90-percent exceedance level would closely match those for the NAA (Figure 6.1-53 and Figure 6.1-55). HEC-ResSim model outputs indicate that daily flows over the simulated period of record would equal 5,000 cfs about 3 percent of the time and would exceed 5,000 cfs about 97 percent of the time (Figure 6.1-57). The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicates that flow conditions between the NAA and Alt1B would not be appreciably different.

Alt1B would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.2.5.3 Alternative 1C

For Alt1C, median daily flows and daily flows at the 90-percent exceedance level would closely match those for the NAA (Figure 6.1-53 and Figure 6.1-55). The only exception would be that daily flows at the 90-percent exceedance level for Alt1C flows would likely be marginally lower than the NAA flows during April and early May, but these differences would be negligible. HEC-ResSim model outputs indicate that daily flows over the simulated period of record would equal 5,000 cfs about 3 percent of the time and would exceed 5,000 cfs about 97 percent of the time (Figure 6.1-57). The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicates that flow conditions between the NAA and Alt1C would not be appreciably different.

Alt1C would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.2.5.4 Alternative 7A

For Alt7A, median daily flows would closely match those for the NAA (Figure 6.1-53). Daily flows for Alt7A at the 90-percent exceedance level (Figure 6.1-55) would be similar to the NAA flows except for the following principal differences. In January and April, Alt7A flows would be higher than the NAA flows (by up to about 2,000 cfs), and Alt7A flows would be slightly lower than the NAA flows from June through December (ranging from zero to about 800 cfs lower). Overall, these would be relatively minor changes in flow conditions. HEC-ResSim model outputs indicate that daily flows over the simulated period of record would exceed 5,000 cfs about 97 percent of the time. The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. There would be one occurrence over the modeled period of record for Alt7A when daily flows would decline below 5,000 cfs for about 30 days. Otherwise, flows would be at the minimum 5,000 cfs level about 3 percent of the time (Figure 6.1-57). As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicates that flow conditions between the NAA and Alt7A would not be appreciably different.

These minor changes in flow conditions in the Apalachicola River at Chattahoochee, Florida, for Alt7A compared to the NAA would principally be attributable to updates to water management practices included in Water Management Alternative 7, including revised action zones in USACE reservoirs, provisions for navigation target flows when sufficient water is available, and drought management activities.

Alt7A would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.2.5.5 Alternative 7C

Compared to the NAA, median daily flows and daily flows at the 90-percent exceedance level for Alt7C would be nearly identical to those described for Alt7A (Figure 6.1-53 and Figure 6.1-55). Thus, the effects of Alt7C on flow conditions in the Apalachicola River compared to the NAA would be the same as described in section 6.1.1.2.5.4. HEC-ResSim model outputs indicate that daily flows over the simulated period of record would equal 5,000 cfs about 3 percent of the time and would exceed 5,000 cfs about 97 percent of the time. The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. No occurrences of daily flows below 5,000 cfs would be expected for Alt7C (Figure 6.1-57). As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicate that flow conditions between the NAA and Alt7C would not be appreciably different.

Alt7C would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.2.5.6 Alternative 7D

Compared to the NAA, median daily flows and daily flows at the 90-percent exceedance level for Alt7D would be nearly identical to those described for Alt7A in section 6.1.1.2.5.4 (Figure 6.1-54 and Figure 6.1-56). HEC-ResSim model outputs indicate that daily flows over the simulated period of record would exceed 5,000 cfs about 97 percent of the time. The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. There would be one occurrence for Alt7D over the modeled period of record when daily flows would decline below 5,000 cfs for about 60 days. Otherwise, flows would equal 5,000 cfs about 3 percent of the time (Figure 6.1-58). As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicate that flow conditions between the NAA and Alt7D would not be appreciably different.

USACE assumptions for Alt7D regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Apalachicola River below Jim Woodruff Lock and Dam.

Alt7D would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.2.5.7 Alternative 7E

For Alt7E, median daily flows and daily flows at the 90-percent exceedance level would be nearly identical to those for Alt7A (Figure 6.1-54 and Figure 6.1-56). Thus, the effects of Alt7E on flow conditions in the Apalachicola River compared to the NAA would be the same as described in section 6.1.1.2.5.4. HEC-ResSim model outputs indicate that daily flows over the simulated period of record would exceed 5,000 cfs about 97 percent of the time. The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. There would be one occurrence for Alt7E over the modeled period of record when daily flows would decline below 5,000 cfs for about 60 days. Otherwise, flows would equal 5,000 cfs about 3 percent of the time (Figure 6.1-58). As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicate that flow conditions between the NAA and Alt7E would not be appreciably different.

USACE assumptions for Alt7E regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Apalachicola River below Jim Woodruff Lock and Dam.

Alt7E would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.2.5.8 Alternative 7F

For Alt7F, median daily flows and daily flows at the 90-percent exceedance level would be nearly identical to those for Alt7A (Figure 6.1-54 and Figure 6.1-56) with the following exceptions. Alt7F flows would be slightly lower than Alt7A flows in the month of January (by about 800 to 1,500 cfs) and for much of the time between June and November (from zero to about 600 cfs). Otherwise, the effects of Alt7F on flow conditions in the Apalachicola River compared to the NAA would be the same as described in section 6.1.1.2.5.4. HEC-ResSim model outputs indicate that daily flows over the simulated period of record would exceed 5,000 cfs about 97 percent of the time. The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. There would be one occurrence for Alt7F over the modeled period of record when daily flows would decline below 5,000 cfs for about 60 days. Otherwise, flows would equal 5,000 cfs about 3 percent of the time (Figure 6.1-58). As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicate that flow conditions between the NAA and Alt7F would be slightly more pronounced than the other alternatives, but still not appreciably different.

USACE assumptions for Alt7F regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Apalachicola River below Jim Woodruff Lock and Dam. Minor reductions in flow values may be attributable to the assumptions in Alt7F regarding the percent of withdrawals returned to the ACF Basin (see section 5.1.4.1).

Alt7F would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.2.5.9 Alternative 7H (PAA)

For the PAA, median daily flows would closely match those for the NAA (Figure 6.1-54). Daily flows for the PAA at the 90-percent exceedance level (Figure 6.1-56) would be similar to the NAA flows except for the following principal differences. In January and April, PAA flows would be higher than the NAA flows by up to about 2,000 cfs and slightly lower than the NAA flows from June through December (ranging from zero to about 800 cfs lower). Overall, these would be relatively minor changes in flow conditions. HEC-ResSim model outputs indicate that daily flows over the simulated period of record would exceed 5,000 cfs about 97 percent of the time. The percent of days exceeding 5,000 cfs by month would be similar to the pattern described for the NAA. There would be one occurrence for the PAA over the modeled period of record when daily flows would decline below 5,000 cfs for about 60 days. Otherwise, flows would equal 5,000 cfs about 3 percent of the time (Figure 6.1-58). As depicted in Table 6.1-9, the percent of days exceeded over the modeled period of record for a range of flows (from 6,000 to 20,000 cfs) indicates that flow conditions between the NAA and PAA (Alt7H) would not be appreciably different.

USACE assumptions for the PAA regarding water supply withdrawal options and return flows associated with Lake Lanier and downstream from Buford Dam to Peachtree Creek do not have an appreciable effect on flow conditions in the Apalachicola River below Jim Woodruff Lock and Dam.

The PAA (Alt7H) would have no appreciable incremental effect on freshwater inflows to Apalachicola Bay compared to the NAA.

6.1.1.3 Drought Operations and Management

This section discusses the effects of incorporating a basinwide drought management plan into USACE operations in the ACF Basin. Features of current and proposed drought operations are described in section 2.1.1.2.4.4 and section 4.1.2.3, respectively. Composite conservation storage in USACE projects in the ACF Basin is a critical consideration in systemwide water management activities, particularly with respect to operations during drought conditions. Composite conservation storage values are used to manage the system and to meet flow requirements below Jim Woodruff Lock and Dam associated with federally listed threatened and endangered species conservation, which is particularly important under low flow conditions. The focus of this section is to assess the frequency and extent to which drought operations are encountered for the alternatives compared to conditions under the NAA, including the associated effects on the reservoirs (conservation storage) in the ACF Basin. The number of times that drought operations are triggered and the length of time that drought operations are in effect may have implications for other natural resource and socioeconomic resource areas (e.g., hydropower, navigation, etc.). Those effects are addressed in the pertinent resource area discussions in this section.

Table 6.1-10 provides a qualitative assessment of the effects of the alternatives relative to drought operations and management in the ACF Basin. To more specifically characterize and compare drought operations among the alternatives, the potential effects are described based on the percent of the simulated period in drought operations, the percent of time in composite Zone 4, and EDO triggered, as tabulated in Table 6.1-11. A more detailed discussion for each of the alternatives is provided in the following sections. Generally, an increase in the number of occurrences where drought operations are triggered and/or the length of time spent in drought operations indicates a more proactive approach to conserve reservoir conservation storage as drier conditions emerge in the basin.

Table 6.1-10.
Summary of Change in Drought Operations and Management of the Alternatives from the NAA during the Modeled Period of Record (1939–2011)

	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Drought Operations in the system	Baseline	Beneficial	No change	Adverse	Adverse	Adverse	Adverse	Substantially adverse	Adverse

6.1.1.3.1 No Action Alternative

Under the NAA, drought operations would be triggered three times during the 73-year simulated period of record and would be in effect about 6.7 percent of the time (Table 6.1-11), equivalent to 59 months (or about 5 years). Drought operations would be initiated when the composite conservation storage enters Zone 4 and would continue until the composite conservation storage recovers to Zone 1. The composite conservation storage level would be within Zone 4 for about 1 percent of the simulated period under the NAA. The composite conservation storage values would not be expected to decline into the Drought Zone, triggering EDO, over the period of record.

Triggering drought operations would suspend many provisions of the RIOP. Under the NAA, the minimum release rate from Jim Woodruff Lock and Dam would near 5,000 cfs during the three periods when drought operations would be triggered (Table 6.1-11). Minimum flows would not be less than 5,000 cfs from Jim Woodruff Lock and Dam since the composite conservation storage would not decline into the Drought Zone. The 5,000 cfs minimum flow would remain in place until composite conservation storage recovers into Zone 1. At that time, the temporary drought operations provisions would be suspended and all the other operational provisions reinstated.

Table 6.1-11.
Number of Years Drought Operations and EDO Are Triggered and Percent of Time in Composite Zones 3 and 4, Drought Operations, and EDO in the ACF Basin over the Modeled Period of Record (1939–2011)

Alternative	Drought operations triggered	Percent of simulated period in drought operations [a]	Percent of time in composite Zone 3[a]	Percent of time in composite Zone 4[a]	Extreme drought operations (EDO) triggered	Percent of simulated period in EDO [a]
NAA	3	6.7	11.3	0.9	0	0.0
Alt1B	1	1.3	9.6	0.1	0	0.0
Alt1C	3	6.3	10.8	0.5	0	0.0
Alt7A	21	16.3	5.7	3.3	1	0.1
Alt7C	21	15.5	5.9	2.4	0	0.0
Alt7D	21	17.6	7.0	3.6	1	0.2
Alt7E	22	18.1	6.9	3.6	1	0.2
Alt7F	17	25.1	10.8	7.4	1	0.2
PAA	22	18.1	6.9	3.6	1	0.2

Note:
[a] 1% of modeled period of record (73 years) = 267 days; 0.1% = 27 days.

6.1.1.3.2 Alternative 1B

Alt1B reflects a future condition without reallocation storage in Lake Lanier for water supply. The elimination of all water supply withdrawals from Lake Lanier other than those associated with relocation contracts would decrease the percent of time in drought operations from the NAA (Table 6.1-11). Drought operations would be triggered one time over the modeled period of record and would occur for about 1.3 percent of the simulation period, substantially less than under the NAA (6.7 percent). Therefore, the minimum flow rate of 5,000 cfs from Jim Woodruff Lock and Dam for Alt1B would occur slightly less often and for less overall time than the NAA. Similar to the NAA, EDO would not be expected to occur over the modeled period of record.

6.1.1.3.3 Alternative 1C

Model results for Alt1C indicate the effects for drought operations would be nearly the same as those for the NAA (Table 6.1-11). The difference in the percent of time in drought operations (6.7 percent for the NAA versus 6.3 percent for Alt1C) is minor. The percent of time in composite zones 3 and 4 under Alt1C would be slightly less than for the NAA (Table 6.1-11). All the features of Alt1C are the same as the NAA, except for assumptions regarding water supply withdrawals in Lake Lanier and releases necessary to meet downstream withdrawals needs in Metro Atlanta.

6.1.1.3.4 Alternative 7A

Alt7A incorporates the features of Water Management Alt7 (see section 4.9.1), which includes revised reservoir action zones and would trigger drought operations when the composite conservation storage declines into Zone 3, rather than into Zone 4, as defined for the NAA. Triggers to suspend drought operations and to initiate EDO would remain unchanged from the NAA. Drought operations provisions would be suspended when composite conservation storage recovers into Zone 1, and EDO would be triggered when the composite conservation storage falls into the Drought Zone. Alt7A assumes current water supply withdrawals in Lake Lanier and downstream of Buford Dam, as described in section 5.1.4.

By revising the reservoir action zones and changing the drought operations trigger to Zone 3 under Water Management Alt7, Alt7A would be expected to trigger drought operations 21 times over the modeled period of record, 7 times more often than the NAA (three occurrences) (see Table 6.1-11). Drought operations would be in effect 16.3 percent of the modeled period, which would be equivalent to 143 months, or a total of about 12 years of the 73-year period of record. While drought operations would be triggered more frequently and for more total time under Alt7A than under the NAA, less time over the modeled period of record would be spent in zones 3 and 4 (Table 6.1-11). Thus, composite conservation storage values and conservation storage levels in the reservoirs would tend to remain higher for a greater portion of the time. Composite conservation storage would be in zones 3 and 4 for a combined 9 percent of the modeled period for Alt7A compared to 12.2 percent for the NAA. EDO would be expected to occur one time under Alt7A and last for about 0.1 percent of the modeled period (equivalent to about 27 days), compared to no EDO occurrences under the NAA (Table 6.1-11). During EDO, minimum flows from Jim Woodruff Lock and Dam would temporarily be less than 5,000 cfs, but no less than 4,500 cfs.

6.1.1.3.5 Alternative 7C

Model results for Alt7C indicate that the effects for drought operations compared to the NAA would be nearly the same as those described for Alt7A in section 6.1.1.3.4 and summarized in Table 6.1-11. Drought operations would occur the same number of times (21) for Alt7C and Alt7A, and the percent of time in drought operations, in Zone 3, and in Zone 4 for Alt7C are each within one percentage point of the corresponding values for Alt7A. The reasons for the dramatic increase in the number of times over the period of record that drought operations would be triggered under Alt7C compared to the NAA are described in the second paragraph of section 6.1.1.3.4. As with the NAA, EDO would not be expected to occur under Alt7C.

6.1.1.3.6 Alternative 7D

Model results for Alt7D indicate that the effects for drought operations compared to the NAA would be similar to those described for Alt7A in section 6.1.1.3.4 and summarized in Table 6.1-11. Drought operations would occur the same number of times (21) for Alt7D and Alt7A, and the percent of time in drought operations, in Zone 3, and in Zone 4 for Alt7D would each be slightly higher than the corresponding values for Alt7A (by 1.3 percentage points or less). The dramatic increase in the number of times over the period of record that drought operations would be triggered under Alt7D compared to the NAA is described in the second paragraph of section 6.1.1.3.4. EDO would be expected to occur one time under Alt7D over the modeled period of record with a duration of 0.2 percent of the time (or about 54 days) compared to no occurrences for the NAA. The slightly higher drought operations values for Alt7D versus Alt7A when both are compared to the NAA are principally associated with the water supply withdrawal and return rate assumptions for Lake Lanier (see section 5.1.4.1).

6.1.1.3.7 Alternative 7E

Model results for Alt7E indicate that the effects for drought operations compared to the NAA would be similar to those described for Alt7A in section 6.1.1.3.4 and summarized in Table 6.1-11. Drought operations would occur 22 times over the modeled period of record versus 21 times for Alt7A (3 for the NAA). The significant difference in the number of times over the period of record that drought operations would be triggered under Alt7E compared to the NAA is described in the second paragraph of section 6.1.1.3.4. The percent of time in drought operations, in Zone 3, and in Zone 4 for Alt7E would each be slightly higher than the corresponding values for Alt7A. EDO would be expected to occur one time under Alt7E over the modeled period of record, the same as under Alt7A, with a slightly longer duration (0.2 percent of the time, or about 54 days), compared to no EDO occurrences under the NAA. The slightly different values for Alt7E versus Alt7A when both are compared to the NAA are principally

associated with the water supply withdrawal and return rate assumptions for Lake Lanier and the effect of the proposed Glades Reservoir (see section 5.1.4.1).

6.1.1.3.8 Alternative 7F

Alt7F would have a much greater effect with respect to the extent of drought operations than the NAA or any of the other alternatives under consideration (Table 6.1-11). For Alt7F, drought operations would be triggered far more often than for the NAA over the period of record (17 versus 3 occurrences) but less often than for Alt7A, Alt7C, Alt7D, Alt7E, and Alt7H (17 versus 21 or 22 occurrences). However, the extent to which drought operations would remain in effect under Alt7F is much longer than under the NAA and all other alternatives. Drought operations would likely be in effect about 25.1 percent of the days over the period of record under Alt7F, almost four times longer than under the NAA (6.7 percent) and 7 percentage points higher than the next highest alternatives (Alt7E and Alt7H at 18.1 percent). This would represent an equivalent of about 223 months, or 18.6 years in drought operations over the 73-year period of record. The percent of time that the projects would operate in composite storage Zone 3 for Alt7F would be about the same as for the NAA but substantially higher than for most of the other alternatives. The percent of time that the projects would be in composite storage Zone 4 under Alt7F would be more than seven times higher than under the NAA and twice as high as the next highest alternatives (Alt7E and Alt7H). EDO would be triggered one time over the modeled period of record with an expected duration of 0.2 percent of the modeled period, or about 54 days. The severity of the model results relative to drought operations for Alt7F is principally the result of assumptions for return rates for water supply withdrawals from Lake Lanier and the Chattahoochee River downstream of Buford Dam (see section 5.1.4.1).

6.1.1.3.9 Alternative 7H (PAA)

The PAA incorporates the features of Water Management Alt7 (see section 4.9.1), which includes revised reservoir action zones and would trigger drought operations when the composite conservation storage declines into Zone 3, rather than into Zone 4 as defined for the NAA. Triggers to suspend drought operations and to initiate EDO would remain unchanged from the NAA. Drought operations provisions would be suspended when composite conservation storage recovers into Zone 1, and EDO would be triggered when the composite conservation storage falls into the Drought Zone.

By revising the reservoir action zones and changing the drought operations trigger to Zone 3 under Water Management Alt7, the PAA would be expected to trigger drought operations 22 times over the modeled period of record, seven times more often than the NAA (3 occurrences) (see Table 6.1-11). Drought operations would be in effect 18.1 percent of the modeled period, which would be equivalent to 158 months, or a total of about 13 years of the 73-year period of record (versus 6.7 percent of the time for the NAA). While drought operations would be triggered more frequently and for more time under the PAA, less cumulative time over the modeled period of record would be spent in zones 3 and 4 (10.5 percent for the PAA versus 12.2 percent for the NAA) (Table 6.1-11). Thus, composite conservation storage values and conservation storage levels in the reservoirs would tend to remain higher for a longer period of the time under the PAA compared to the NAA. EDO would be expected to occur one time under the PAA and last for about 0.2 percent of the modeled period (equivalent to about 54 days) compared to no EDO occurrences under the NAA (Table 6.1-11). During EDO, minimum flows from Jim Woodruff Lock and Dam would temporarily be less than 5,000 cfs, but no less than 4,500 cfs.

6.1.1.4 Navigation Flow Targets

Section 4.1.3.4 describes the development of several options to provide sufficient flows to support a navigable channel in the Apalachicola River (for both 7-ft and 9-ft channel depths) in conjunction with

other pertinent operating parameters and constraints for the ACF Basin. In order to provide these navigation channel depths, releases from Jim Woodruff Lock and Dam must be sufficient to ensure flows at Blountstown, Florida, of 16,200 cfs (7-ft channel depth) and 20,050 cfs (9-ft channel depth). USACE analyzed the navigation options to determine which one would perform the most effectively overall. A 5-month navigation season (January–May) was selected as the best overall option to support navigation channel availability. Alt7C, Alt7D, Alt7E, Alt7F, and the PAA (Alt7H) incorporate the 5-month navigation season as a feature. The NAA, Alt1B, and Alt1C (representing alternatives that reflect current water management operations in the ACF Basin) do not include specific provisions to provide for navigation flows. However, the analysis that follows presents information on the extent to which the NAA, Alt1B, and Alt1C would incidentally provide sufficient navigation flows between January and May for comparison to the other alternatives.

The proposed navigation season is based on a critical assumption that the channel in the Apalachicola River downstream of Jim Woodruff Lock and Dam is relatively stable and would continue to support a minimum navigable depth of 7 ft and/or 9 ft when the necessary flows described above are provided. USACE would monitor channel conditions in the Apalachicola River to ensure that these flow levels actually provide the requisite navigable depths and to identify where any potential navigation constraints might exist in the river. Inflow conditions in the ACF Basin, particularly during drier seasons, as well as the actual or planned use (or both) of the channel for commercial navigation, could influence the actual length of the navigation season each year.

Water management operations in support of navigation under the proposed alternatives would be compatible with fish and wildlife conservation objectives in the Apalachicola River and with recommendations of the USFWS, in coordination with the National Marine Fisheries Service and the Florida Fish and Wildlife Conservation Commission. Releases to sustain navigable channel depths during January through May each year, when practicable, can intermittently provide increased flows in the Apalachicola River above the minimum requirements to sustain fish and wildlife. These releases also provide an incidental benefit to fisheries downstream of Jim Woodruff Lock and Dam. Section 6.4 provides more detailed discussion of the effects of proposed alternatives on fish and wildlife resources.

The following analysis focuses on the extent to which specific navigation flow targets at Blountstown, Florida, can be met on balance with other factors that may limit the ability to meet those flow targets from January through May, including basin inflow and the available conservation storage in upstream reservoirs. Representative summaries of HEC-ResSim model outputs provide the principal basis for the analysis and represent simulation of project operations under the alternatives over the modeled period of record (1939–2011).

Table 6.1-12 provides a qualitative assessment of the effects of the alternatives on navigation channel availability compared to the NAA. The general assessment is based on the interpretation of the model results in the figures and tabulated information presented below. The model results for the alternatives are discussed in more detail in the following sections.

Table 6.1-12.
Summary of Change in Channel Availability of the Alternatives from the NAA during the Modeled Period of Record (1939–2011)

Channel availability	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
7.0 ft	Baseline	No change	No change	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial
9.0 ft	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

Figure 6.1-59 through Figure 6.1-64 present model outputs for navigation operations over the modeled period of hydrologic record for the NAA along with the results for proposed revisions to the Master Manual as defined in Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and PAA. The figure presents results for percent availability of a 7-ft channel, the number of seasons the 7-ft channel will be available, and the number of navigation seasons the 7-ft channel would be available 90 percent of the time. In consideration of the number of alternatives and the ease of viewing of the results for each alternative, the results for each parameter (i.e., percent availability of 7-ft channel) is presented in two figures with half of the alternatives presented on each figure. Using the results from these figures and other information as appropriate, the relative effects associated with each alternative are discussed in subsequent subsections.

This section does not include figures depicting model results that address 9-ft channel availability. Model outputs for the NAA and all other alternatives indicate that values for the percent of time over the modeled period of record that a 9-ft channel would be available are all extremely low and vary little among alternatives (ranging from 2.7 percent to 5.5 percent). Likewise, values for the number of navigation seasons that a 9-ft channel would be fully available over the period of record are insignificantly low and vary little among the alternatives (ranging from 2 years to 4 years). Consequently, the values and differences among those values for the potential availability of 9-ft channel depths for a full January through May navigation season are inconsequential and are not discussed further in the EIS.

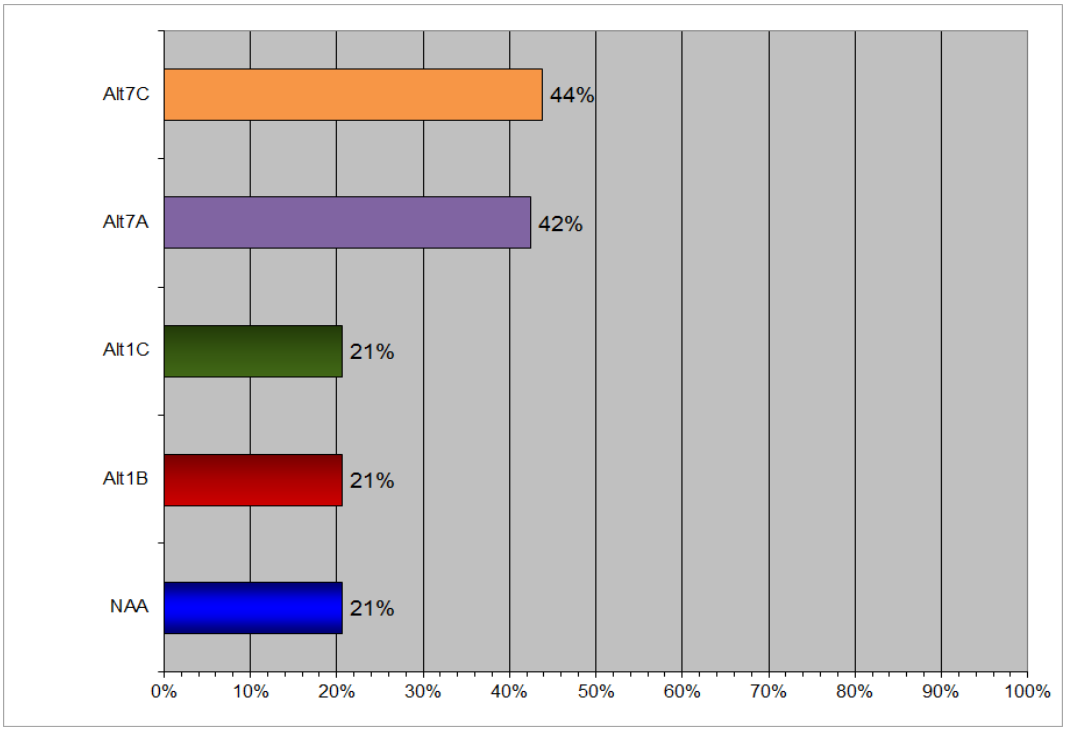


Figure 6.1-59. Percent of Years a 7-ft deep Channel was Available during the Entire Navigation Season (January–May) in the ACF Basin over the Simulated Period of Record (1939–2011) for the NAA, and Alternatives 1B, 1C, 7A, and 7C

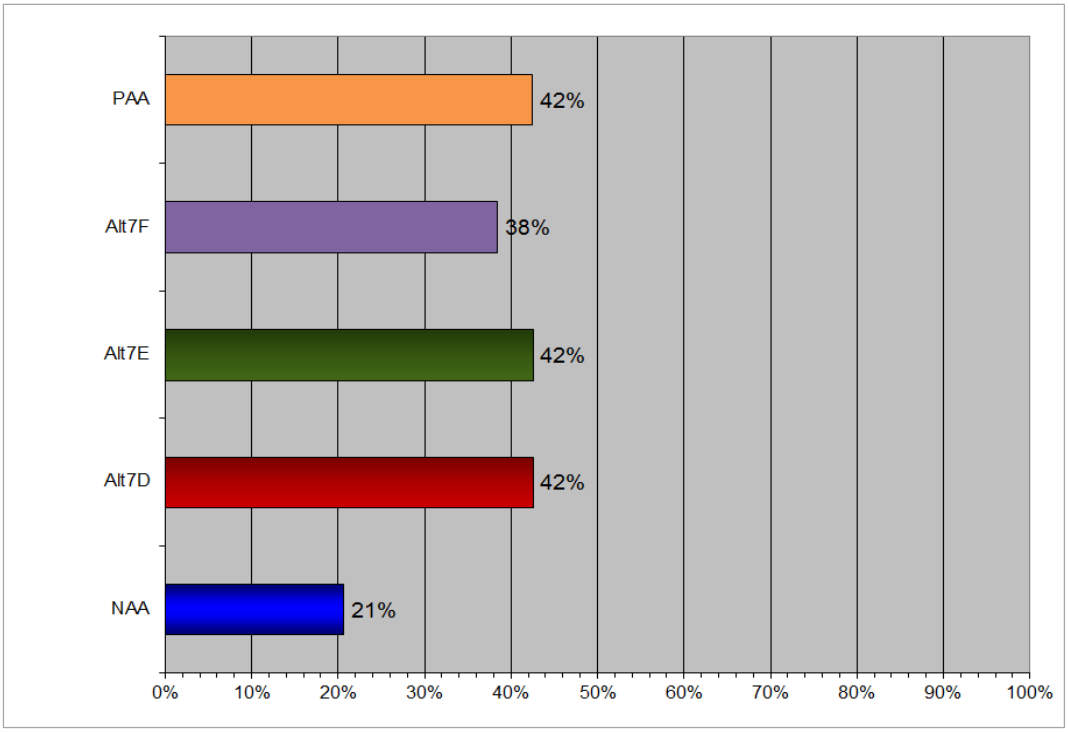


Figure 6.1-60. Percent of Years a 7-ft-deep Channel was Available during the Entire Navigation Season (January–May) in the ACF Basin over the Simulated Period of Record (1939–2011) for the NAA, and Alternatives 7D, 7E, 7F, and 7H (PAA)

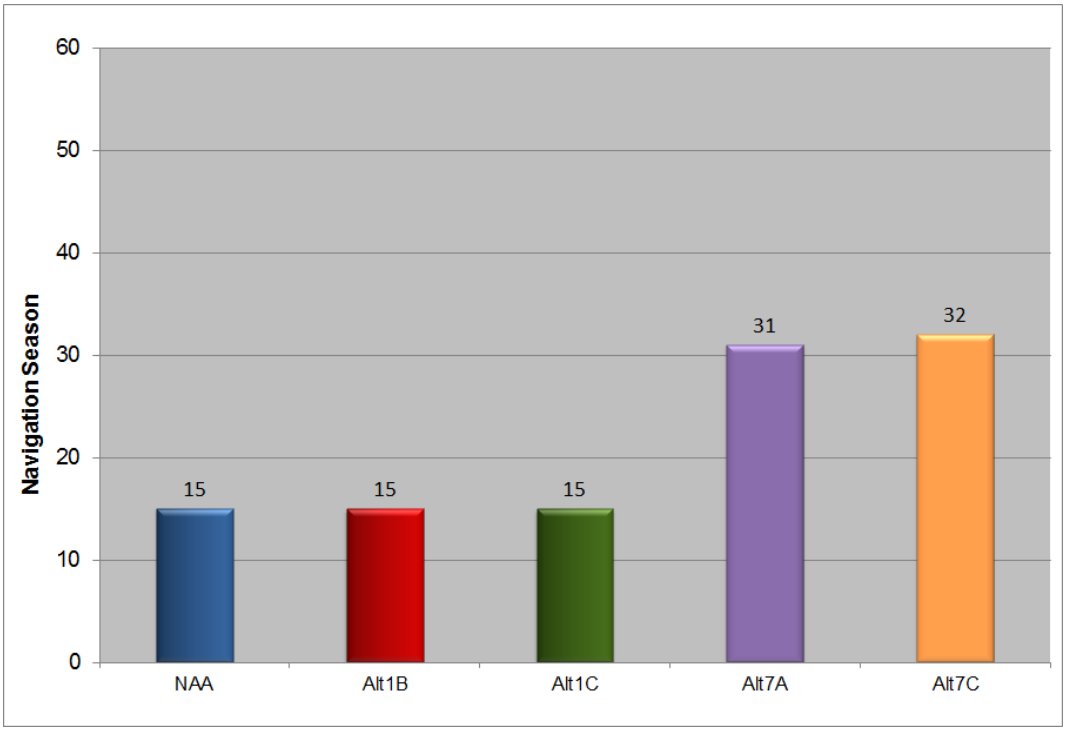


Figure 6.1-61. Number of Navigation Seasons Providing 7-ft-deep Channel (100 percent availability) in ACF Basin Projects over the Simulated Period of Record (1939–2011) for the NAA, and Alternatives 1B, 1C, 7A, and 7C

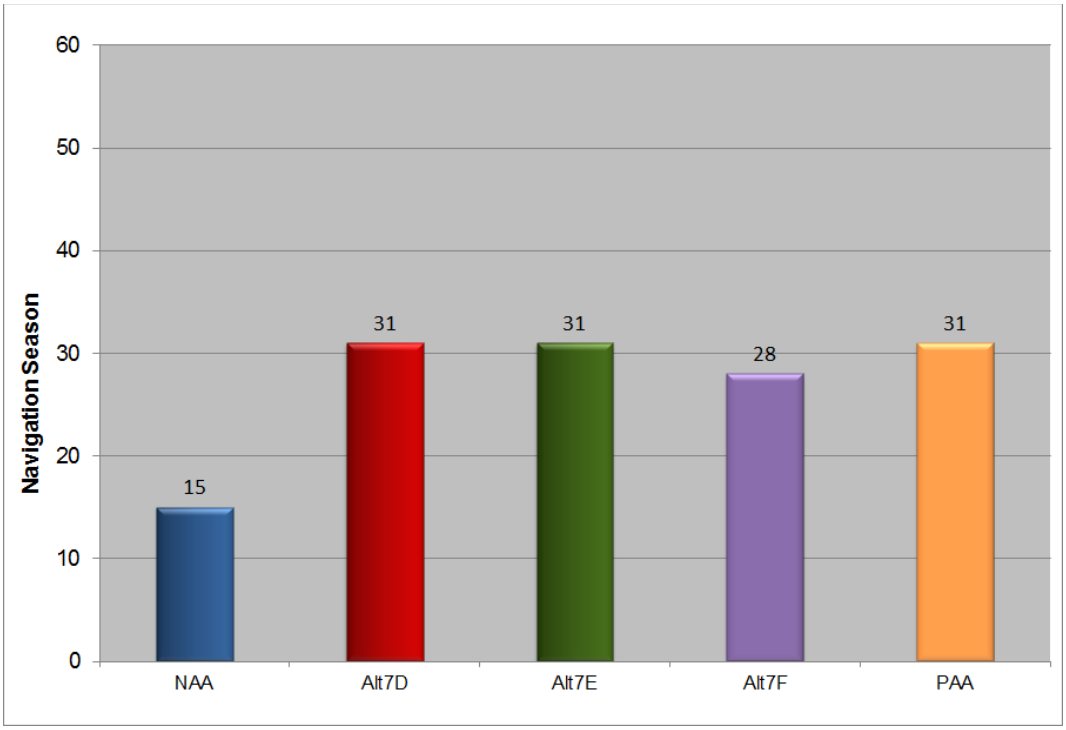


Figure 6.1-62. Number of Navigation Seasons Providing 7-ft-deep Channel (100 percent availability) in ACF Basin Projects over the Simulated Period of Record (1939–2011) for the NAA, and Alternatives 7D, 7E, 7F, and 7H (PAA)

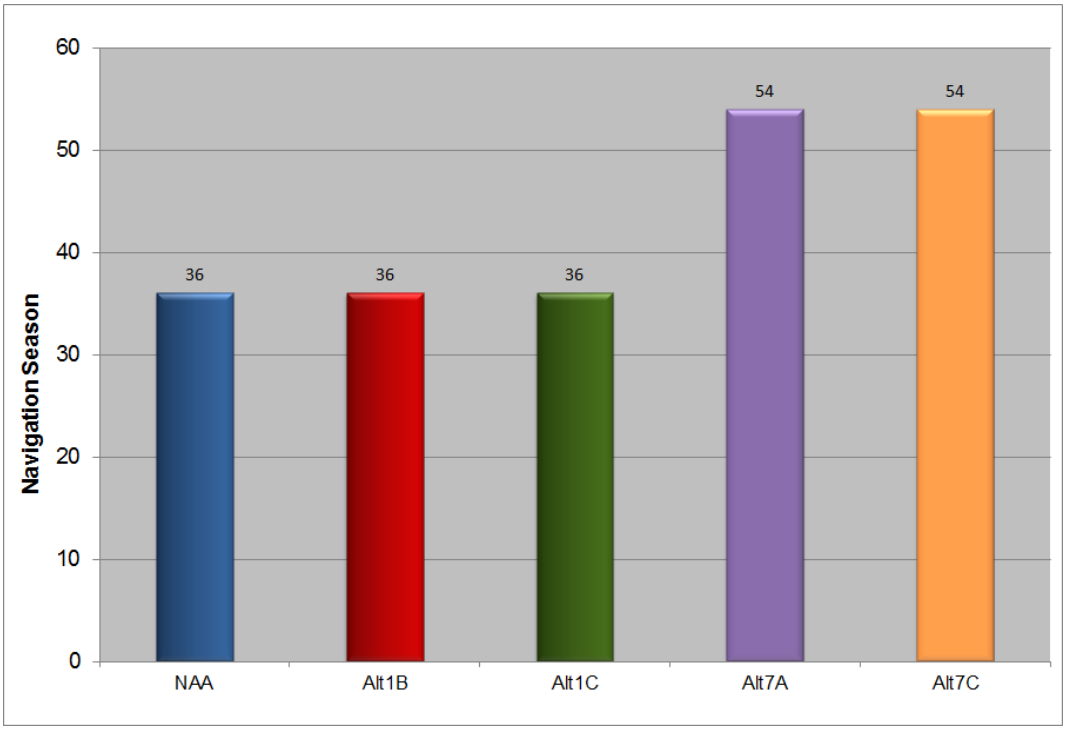


Figure 6.1-63. Number of Navigation Seasons Providing 7-ft-deep Channel (90 percent availability) in ACF Basin Projects over the Simulated Period of Record (1939–2011) for the NAA, and Alternatives 1B, 1C, 7A, and 7C

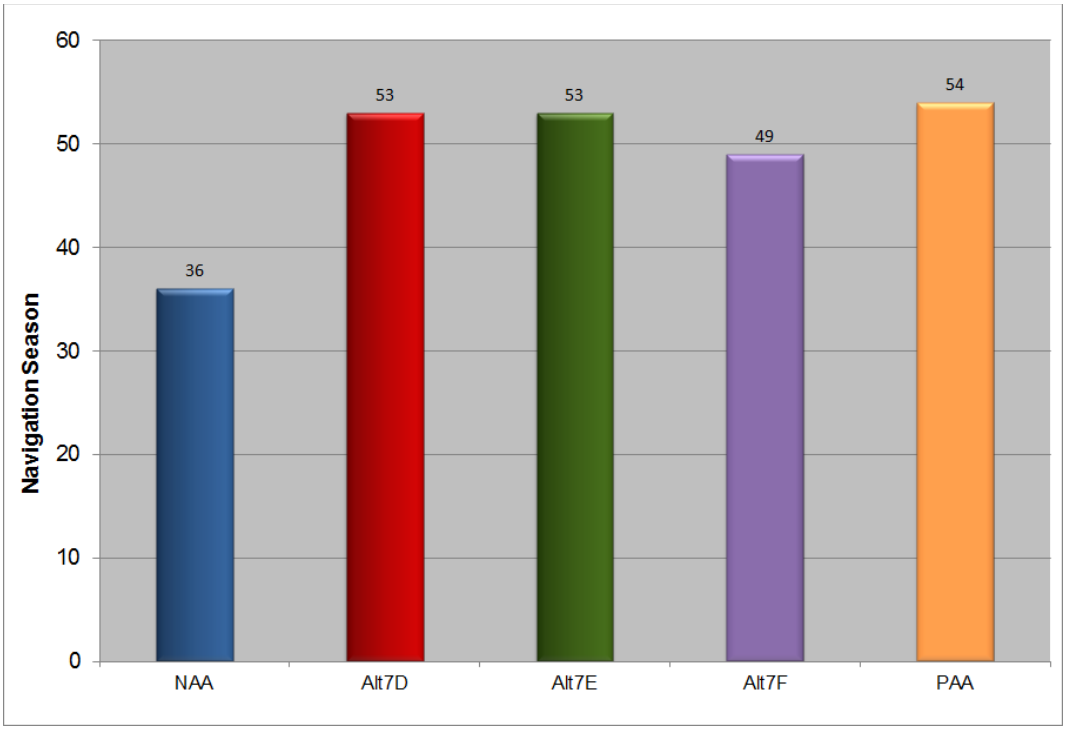


Figure 6.1-64. Number of Navigation Seasons Providing 7-ft-deep Channel (90 percent availability) in ACF Basin Projects over the Simulated Period of Record (1939–2011) for the NAA, and Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.1.4.1 No Action Alternative

USACE has not specifically implemented routine water management measures to sustain reliable navigation conditions in the Apalachicola River since 2001. Before 2001, maintenance of year-round navigation channel reliability in the Apalachicola River was provided by a combination of training works, snagging and maintenance dredging in the Apalachicola River, and releases from Jim Woodruff Lock and Dam, particularly in the low-water season in late summer and fall. Under the NAA, no change in current USACE practices would occur specifically for navigation purposes. Based on experience and consultation with navigation interests, a 7-ft channel would meet the minimum requirements of most navigation users. Even under historical operations, flow conditions in the ACF Basin did not enable the USACE to provide the authorized 9-ft by 100-ft navigation channel on a year-round basis during all years. Without maintenance dredging in the Apalachicola River, it is unreasonable to expect that navigation releases alone could sustain the authorized 9-ft deep channel, although at times during the spring high-water season, flows could support 9-ft navigation depths for intermittent periods.

Water management operations in the ACF Basin under the NAA would consist of short-term releases to provide minimum required channel depths to address specific short-term navigation needs. Special navigation releases would be considered on a case-by-case basis, as requested by navigation interests and as determined by USACE to be consistent with other ACF Basin requirements.

USACE evaluated the NAA over the modeled period of record to determine, for comparison purposes, the degree to which the navigation channel would incidentally be available to users between January and May each year. For the NAA, flows sufficient to support a minimum 7-ft channel would be expected to be available at least 21 percent of the days in January through May (Figure 6.1-59). The differences in

channel availability are likely to be primarily the result of operations under the NAA with no operational features specifically aimed at meeting a navigation flow target.

Figure 6.1-61 indicates the number of navigation seasons (January–May) that a 7-ft channel would be available in the Apalachicola River. For the NAA, 7-ft channel depths would likely be fully (100 percent) available in 15 of 73 years. In addition, model results for the NAA were reviewed to determine the extent to which navigable depths would be available using a 90-percent reliability standard (i.e., channel depths available 90 percent of the time during the navigation season). This is an important benchmark for the navigation industry to judge channel reliability. Using this 90-percent reliability standard, navigable depths of 7-ft under the NAA would be available from January through May in 36 of 73 years (about 50 percent) (Figure 6.1-63).

6.1.1.4.2 Alternative 1B

As with the NAA, Alt1B does not include specific measures to provide for navigation target flows. Nonetheless, model results for Alt1B were compared to the criteria for the 5-month navigation season to assess the extent to which Alt1B would incidentally meet those criteria.

With respect to 7-ft navigation channel depths, Alt1B would produce the same results as the NAA (Figure 6.1-59, Figure 6.1-61, and Figure 6.1-63).

6.1.1.4.3 Alternative 1C

Implementing Alt1C would likely have the same effects on navigation availability as the NAA (Figure 6.1-59, Figure 6.1-61, and Figure 6.1-63).

6.1.1.4.4 Alternative 7A

Alt7A includes water management features to support a 5-month navigation season (January–May). For Alt7A, flows sufficient to support a minimum 7-ft channel would be expected to be available at least 42 percent of the days in January through May (Figure 6.1-59). This value represents a 100-percent improvement in the availability of a viable 7-ft navigation channel compared to the NAA.

Figure 6.1-61 indicates that the number of navigation seasons that a 7-ft channel would be fully available would increase from 15 years under the NAA to 31 years for Alt7A (out of 73 years). This would represent a 107-percent improvement compared to the NAA. Using a 90-percent reliability benchmark for navigation channel depths for each 5-month navigation season (January–May) over the 73-year modeled period of record, the ACF Basin project operations for Alt7A would meet the 90-percent standard in 54 of 73 years compared 36 of 73 years for the NAA, an improvement of 50 percent (Figure 6.1-63).

6.1.1.4.5 Alternative 7C

Compared to the NAA, implementing Alt7C would likely have the same effects on navigation availability as described for Alt7A in section 6.1.1.4.4 (see Figure 6.1-60, Figure 6.1-62, and Figure 6.1-64).

6.1.1.4.6 Alternative 7D

Compared to the NAA, implementing Alt7D would likely have the same effects on navigation availability as described for Alt7A in section 6.1.1.4.4 (see Figure 6.1-60, Figure 6.1-62, and Figure 6.1-64).

6.1.1.4.7 Alternative 7E

Compared to the NAA, implementing Alt7E would likely have the same effects on navigation availability as described for Alt7A in section 6.1.1.4.4 (see Figure 6.1-60, Figure 6.1-62, and Figure 6.1-64).

6.1.1.4.8 Alternative 7F

For Alt7F, flows sufficient to support a minimum 7-ft channel would be expected to be available at least 38 percent of the days in January through May (Figure 6.1-60), slightly lower than Alt7A (42 percent). Figure 6.1-62 indicates that Alt7F would slightly decrease the number of navigation seasons in which 7-ft channel depths would be fully available (28 of 73 years) compared to Alt7A (31 of 73 years).

Using a 90-percent reliability benchmark for navigation channel depths for each 5-month navigation season (January–May) over the 73-year modeled period of record, the ACF Basin project operations for Alt7F would meet the 90-percent standard in 49 of 73 seasons, five less than for Alt7A (Figure 6.1-64).

Overall, Alt7F would be slightly less effective for navigation than Alt7A, Alt7C, Alt7D, and Alt7E, as compared to the NAA.

6.1.1.4.9 Alternative 7H (PAA)

The PAA includes water management features to support a 5-month navigation season (January–May). Flows sufficient to support a minimum 7-ft channel would be expected to be available at least 42 percent of the days in January through May (Figure 6.1-60,). This value represents a 100-percent improvement in the availability of a viable 7-ft navigation channel compared to the NAA.

Figure 6.1-62 indicates that the number of navigation seasons that a 7-ft channel would be fully available would increase from 15 years under the NAA to 31 years for the PAA (out of 73 years). This would represent a 107-percent improvement compared to the NAA. Using a 90-percent reliability benchmark for navigation channel depths for each 5-month navigation season (January–May) over the 73-year modeled period of record, ACF Basin project operations for the PAA would meet the 90-percent standard in 54 of 73 years compared 36 of 73 years for the NAA, an improvement of 50 percent (Figure 6.1-64).

6.1.1.5 Water Supply Intake Structures

This section discusses the potential impacts of alternatives to revise the Master Manual on existing M&I water intake structures in the reservoirs and mainstem rivers and their ability to continue to make water supply withdrawals under a range of hydrologic conditions. The impact descriptions summarized in Table 6.1-13 provide a qualitative assessment of those potential impacts. The assessment is based upon HEC-ResSim outputs, other studies as cited herein, and the historical record. The following subsections provide additional details on these potential effects.

Numerous M&I water supply withdrawals occur from the USACE and other private reservoirs and from the mainstem rivers in the ACF Basin. Those withdrawals are summarized in section 2.1.1.2.5.1.4. This section addresses potential effects on water withdrawals and intake structures from the NAA, Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA.

Table 6.1-13.
Summary of Change in Water Supply Intake Conditions of the Alternatives from the No Action Alternative over the Modeled Period of Record (1939–2011)

Water intake structures	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	Adverse	No change
Buford Dam to West Point Dam	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Elsewhere in the ACF Basin	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.1.1.5.1 Water Supply Intake Structures in Lake Lanier

Major M&I water intake structures in Lake Lanier include Gwinnett County, Gainesville, Cumming/Forsyth County, and Buford, Georgia. About 128 mgd (monthly average) were withdrawn in 2007 through these structures.

6.1.1.5.1.1 No Action Alternative

The minimum lake elevation under the NAA, based on the HEC-ResSim simulation over the 73-year hydrologic period of record, would be 1,054.5 ft. The historic low-pool level for Lake Lanier was elevation 1,050.8 ft in December 2007. At that time, all of the intake structures in the lake were able to function successfully. Thus, no effect on water intake structures would be expected under the NAA.

6.1.1.5.1.2 Alternative 1B

The minimum lake elevation under Alt1B would be 1,055.7 ft, based on the HEC-ResSim simulation over the period of record. Similar to the NAA, no effect on water intake structures in Lake Lanier and their ability to function successfully would be expected.

6.1.1.5.1.3 Alternative 1C

The minimum lake elevation under Alt1C would be 1,054.7 ft, based on the HEC-ResSim simulation. Similar to the NAA, no effect on water intake structures in Lake Lanier and their ability to function successfully would be expected.

6.1.1.5.1.4 Alternative 7A

The minimum lake elevation under Alt7A would be 1,053.1 ft, based on the HEC-ResSim simulation. Similar to the NAA, no effect on water intake structures in Lake Lanier and their ability to function successfully would be expected.

6.1.1.5.1.5 Alternative 7C

The minimum lake elevation under Alt7C would be 1,052.9 ft, based on the HEC-ResSim simulation. Similar to the NAA, no effect on water intake structures in Lake Lanier and their ability to function successfully would be expected.

6.1.1.5.1.6 Alternative 7D

The minimum lake elevation under Alt7D would be 1,050.3 ft, based on the HEC-ResSim simulation. However, the elevation would be expected to be 1,054.2 ft or higher 99 percent of the time over the period of record. Even though pool elevations under Alt7D could briefly decline slightly below the historic minimum elevation at Lake Lanier by up to 0.5 ft under the most severe drought conditions, no adverse effect on water intake structures and operations in Lake Lanier would be expected.

6.1.1.5.1.7 Alternative 7E

The minimum lake conditions for Alt7E would be the same as those described for Alt7D in section 6.1.1.5.1.6. Similar to the NAA, no effect on water intake structures in Lake Lanier and their ability to function successfully would be expected.

6.1.1.5.1.8 Alternative 7F

The minimum lake elevation under Alt7F would be 1,046.3 ft, based on the HEC-ResSim simulation, about 4.5 ft below the historic minimum at Lake Lanier. However, the elevation would be expected to be 1,050.9 ft or higher 99 percent of the time over the period of record. Under the most severe drought conditions, implementation of Alt7F could potentially result in some temporary disruptions and adverse impacts to water intakes structures and operations. These potential effects would occur less than one percent of the time compared to no expected effects under the NAA.

6.1.1.5.1.9 Alternative 7H (PAA)

The minimum lake conditions for the PAA would be 1,050.2 ft, based on the HEC-ResSim simulation. However, the elevation would be expected to be 1,054.1 ft or higher 99 percent of the time over the period of record. Even though pool elevations under the PAA could briefly decline slightly below the historic minimum elevation at Lake Lanier by up to 0.6 ft under the most severe drought conditions, no adverse effect on water intake structures and operations in Lake Lanier would be expected (same effect as the NAA).

6.1.1.5.2 Water Supply Intake Structures between Buford Dam and West Point Dam, Georgia

Operations at Buford Dam under the water management alternatives/water supply options for the ACF Basin were reviewed for potential effects on major M&I water supply intakes on the Chattahoochee River between Buford Dam and Whitesburg, Georgia (at Chattahoochee RM 259.8 above the headwaters of West Point Lake). Alternatives that include seasonal minimum flows at Peachtree Creek less than 750 cfs could result in decreases to the downstream water surface profile in this reach of the Chattahoochee River and potentially conflict with the operational requirements for these intake structures. River stages at those intakes under various hydrologic conditions could be insufficient to support proper operation of the intakes. The rates of withdrawal from these structures (current and future) are discussed separately in section 5.2.

Four major municipal/industrial and two thermoelectric power plant water intakes of particular interest are between Buford Dam and Whitesburg, Georgia. Those facilities are (from upstream to downstream):

- Atlanta—Fulton County Water Intake (RM 329.3)
- DeKalb County Water Intake near Norcross (RM 325.1)
- Cobb County—Marietta Water Intake below Morgan Falls Dam (RM 310.4)
- City of Atlanta Intake at Peachtree Creek (RM 300.4)

- GPC Plant McDonough Intake at Peachtree Creek (RM 299.2)
- GPC Plant Yates Intake near Whitesburg (RM 257.8)

In addition, the trout hatchery operated by Georgia Department of Natural Resources has water intake a short distance (about 1.9 miles) below Buford Dam.

Further downstream of Whitesburg, the city of LaGrange, Georgia, withdraws its water supply from West Point Lake. Before West Point Dam was constructed, the city obtained its water supply from the Chattahoochee River. The city has a water withdrawal permit from GAEPD for up to 16.0 mgd (monthly average) and withdraws about 10 mgd to meet the water supply needs of the community.

6.1.1.5.2.1 No Action Alternative

In February 2008, in the midst of the severe 2007-2008 drought period, GAEPD requested that USACE consider temporarily reducing releases at Buford Dam sufficient to support a continuous minimum flow at Peachtree Creek of 550 cfs rather than the normal 750 cfs requirement (GAEPD 2008c). The GAEPD proposed the change at the time as a temporary means to conserve depleted conservation storage in Lake Lanier. As an integral part of that request, the GAEPD performed modeling to document the potential effects of lowering the minimum flow at Peachtree Creek to 650, 600, and 550 cfs on the water surface profile in this reach of the Chattahoochee River and, consequently, on water supply intake structures and operations between Buford Dam and West Point Lake. The modeling performed by the GAEPD confirmed that, even at the 550 cfs minimum flow level, all of the water intakes between Buford Dam and the headwaters of West Point Lake would remain viable and functional for their intended purposes. USACE subsequently curtailed releases to support a minimum flow of 650 cfs at Peachtree Creek in early 2008 on a temporary basis with no observed adverse effects on these water intake structures. Under the NAA, the minimum flow requirement at Peachtree Creek would remain at 750 cfs. Accordingly, no impacts on water intake structures in the Chattahoochee River between Buford Dam and West Point Lake would occur.

In West Point Lake, the lowest pool elevation that would be expected based upon the HEC-ResSim simulation over the 73-year hydrologic period of record would be 621 ft. The historic low pool level for West Point Lake is elevation 619.7 ft in November 1985. At that time and during other low water events, the LaGrange, Georgia, water intake structure has been able to function successfully. The intake structure houses a series of intakes at the following elevations: 628, 623, 618, and 600 ft. Thus, no effect on this water intake structure would be expected under the NAA.

6.1.1.5.2.2 Alternatives 1B, 1C, 7A, 7C, 7D, 7E, 7F, and 7H

For Alt1B and Alt1C, the minimum flow requirement at Peachtree Creek would remain at 750 cfs at all times. For Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and Alt7H (PAA), the minimum flow requirement at Peachtree Creek would remain at 750 cfs from May through October and change to 650 cfs from November through April. Based upon the information presented in section 6.1.1.5.2.1, no impacts on water intake structures in the Chattahoochee River between Buford Dam and West Point Lake would be expected.

The minimum elevation for West Point Lake under Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and Alt7H (PAA) would be about elevation 621 ft based upon the HEC-ResSim simulation over the period of record compared to a historic low pool elevation of 619.7 ft (November 1985). Similar to the NAA, no effect on the LaGrange water intake structure or its operation in West Point Lake would be expected.

6.1.1.5.3 Other Water Withdrawal Structures in the ACF Basin

There are a number of other M&I water supply withdrawal structures in the Chattahoochee River downstream of West Point Dam, in the Flint River (including the reservoirs on these rivers), and in the Apalachicola River downstream of Jim Woodruff Lock and Dam. Water withdrawals throughout the basin are identified in section 2.1.1.2.5. None of the water intakes structures in the Flint River would be affected by the ACF Basin water management alternatives/water supply options under consideration in this EIS.

The city of Columbus withdraws water directly from Lake Oliver, one of the run-of-river GPC hydroelectric projects on the Chattahoochee River near Columbus. The city's intake is below the Lake Oliver permanent pool elevation of 337 ft.

Stakeholders have expressed concerns about potential impacts from ACF Basin water management activities on operations at two specific water supply intake structures in Walter F. George Lake and Lake Seminole. They are the intake structures for the MeadWestvaco Mahrt Mill located along Walter F. George Lake between Phenix City and Eufaula, Alabama, and the Southern Nuclear Operating Company's Farley Nuclear Plant near Columbia, Alabama. Section 6.1.1.2 has additional information related to potential effects on these facilities related to minimum flow considerations.

6.1.1.5.3.1 No Action Alternative

The NAA would not affect the viability or operation of any water intake structures located in the GPC reservoirs on the Chattahoochee River between West Point Dam and Columbus, Georgia.

Based upon the HEC-ResSim simulation over the period of record, the lowest pool elevation for the NAA expected at Walter F. George Lake would be about elevation 184.6 ft compared to a historic low pool elevation of 183.2 ft (April 1965). The HEC-ResSim simulation indicates that the pool elevation would exceed 186.2 ft about 99 percent of the time. The MeadWestvaco plant's water intake in the lake is at elevation 178.8 ft. Per previous input from MeadWestvaco, the pumping capacity at the structure reduces to 75 percent when the water surface elevation declines to 184.75 ft. MeadWestvaco has installed emergency pumps at the intake to operate temporarily at or below pool elevation 178.8 ft to maintain pumping capacity. The NAA would have a negligible effect on the viability and operation of the MeadWestvaco water intake structure.

For the NAA, Lake Seminole would be expected to generally operate within a range of elevation 76 ft to 77 ft, with a record low level of 74.2 ft (November 1978). Based upon their November 2008 scoping letter for the Master Manual update (and subsequently reaffirmed), the Southern Nuclear Operating Company has indicated that a pool elevation of 74.5 ft and a flow of 2,000 cfs are the minimum conditions necessary for long-term operation of Plant Farley. For short periods (defined by Southern Nuclear as a few days), the plant can operate slightly below these levels without significant restrictions. Minimum streamflow conditions are specifically addressed in section 6.1.1.2.4. The historic minimum pool level for Lake Seminole is elevation 74.2 (November 1978). The amount of time that pool levels would be expected to decline below elevation 74.5 ft over the modeled period of record would be negligible.

The only major surface water withdrawal structure in the Apalachicola River provided water for Gulf Power Company's Scholz Electric Generating Plant prior to plant closure. Gulf Power Company ceased water withdrawals and closed Plant Scholz in April 2015 (Jackson County Floridan 2015).

6.1.1.5.3.2 Alternatives 1B, 1C, 7A, 7C, 7D, 7E, 7F, and 7H

The effects of Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA (Alt7H) on water intake structures and their operation in the Chattahoochee River downstream of West Point Lake and in the

Apalachicola River would be the same as for the NAA. No adverse effects on those structures would be expected for any of these alternatives.

6.1.2 Water Quality Environmental Consequences

The sections that follow detail the results of HEC-5Q modeling under the NAA and various water supply options and address the associated environmental consequences for each alternative. The water quality model was created to serve as a defensible screening tool to make relative comparisons of the impacts among various alternatives. The central focus of this effort was to facilitate evaluation of the differences in water quality between alternatives over the algal growing season (spring, summer, and fall). As of January 2010, USACE's Technical Excellence Network guidance listed HEC-5Q as "allowed for use."

The HEC-5Q results presented in this section are for the modeled period from 2001 through 2011. That modeled period represents point and nonpoint contributions from 2001 through 2008, with monthly average values assumed for the remainder of the modeled period. Default values or relationships between parameters were used for periods with insufficient data (Appendix K). Loads from both point and nonpoint sources were varied in modeling the scenarios based on assumptions defined in section 5.2 for changes in withdrawals and wastewater return rates. Therefore, the results presented in these sections illustrate how water quality would be affected by reallocation of storage in Lake Lanier. Details of the modeling assumptions for withdrawal and return rates are provided in Appendix K.

The purpose of simulating conditions during the period of 2001–2011 was not to capture historical changes in water quality, but to capture the range of potential hydrologic conditions that influence water quality. It is also important to understand that critical conditions for water quality parameters vary under different flow and water temperature conditions. For example, water temperatures increase in warm-weather months and in low streamflow conditions. In wet-weather conditions, nutrient concentrations can increase. For that reason, water quality conditions are defined for representative wet, dry, and normal weather conditions. State and federal agencies also define warm-weather months, or the *growing season*, in different ways for regulatory purposes. The figures to follow illustrate annual conditions as well as growing seasons defined by May through October for water temperature and oxygen and April through October for nutrients. The modeled period includes wet, dry, and normal rainfall conditions to display the water quality response to varying hydrologic conditions. The wet, dry, and normal rainfall years are 2005, 2007, and 2004, respectively, based on a precipitation analysis.

The following sections present the difference (or *delta*) in various modeled parameters between the NAA and various alternatives. The longitudinal profiles presented illustrate the percentage of time a concentration of pollutant occurs as a *percent occurrence* at stations in the Apalachicola and Chattahoochee rivers. The locations of the stations are presented in Appendix K in the Water Quality Modeling Report and are presented in terms of rivermiles (RM) above the mouth of the Apalachicola River. Occurrence profiles by river mile illustrate how water quality varies along the reach and how dams, other structures, or discharges from point and nonpoint sources might affect water quality. This approach illustrates the amount of time a concentration is higher or lower than a particular value. In those plots, the 5th, 50th (or median), and 95th percent occurrences calculated from daily average modeled results are illustrated. Results were output every 6 hours from HEC-5Q. The daily average results were computed from the 6-hour output. Percentiles in the figures to follow illustrate the range of concentrations that would be likely to occur. The median values reflect the points at which 50 percent of the calculated values are higher and 50 percent are lower. The 95th and 5th percentile occurrences bracket the range of high and low calculated values that rarely occur. For example, if a dissolved oxygen plot shows a 5th percentile occurrence level at 6 mg/L, 5 percent of the observations were lower than that concentration. An occurrence level of 95 percent at 12 mg/L shows that 95 percent of modeled concentrations fell below 12 mg/L. Conversely, the same occurrence level indicates that 5 percent of the model values were higher

than 12 mg/L. This approach to presenting modeled results should facilitate understanding of the system's response without allowing the data from extreme events to skew the results. Note that the percent *occurrence* is the opposite of the percent *exceedance*.

Each alternative was compared against the NAA to determine the effects that could be expected with various alternatives. The sections to follow define the changes from the NAA for various pollutants that could be affected by changes in the operation of USACE reservoirs and wastewater returns. As in past years, temporary water management actions could be considered and, when appropriate and as reservoir conditions would allow, conducted to alleviate critical problems, including water quality concerns. Those temporary deviations in operations are not captured in the figures to follow. The operations of alternatives carried forward are defined in sections 4 and 5. Section 2.1.1.2.4.7 describes how special temporary operations may be implemented during extreme drought conditions based on coordination with project users and interested stakeholders.

6.1.2.1 Water Temperature

Reservoir operations generally have the greatest effect on water temperature and dissolved oxygen in dam tailraces, as well as some effect on algal growth in reservoir forebays. Those effects are clearly demonstrated downstream from Buford Dam, where cold water released from the deep water in Lake Lanier has created conditions to support a trout fishery in the Chattahoochee River.

Figure 6.1-65 through Figure 6.1-80 present the processed HEC-5Q modeled output for water temperature over the modeled period of record for the NAA and to illustrate variations between the results for proposed revisions to the Master Manual as defined in Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA (Alt7H) from the NAA. The modeled results were compared longitudinally down the Chattahoochee River of the ACF Basin in select locations. Longitudinal plots, or system profiles, were examined to understand the most critical locations for water quality related to various parameters. Following an evaluation of the range of longitudinal modeled results, specific locations were selected where the range of modeled output was the greatest. In consideration of the number of alternatives and the ease of viewing the results for each alternative, the results for some of the plots are presented in two figures with half of the alternatives presented on each figure. Using the results from the figures and modeled output as appropriate, the relative effects associated with each alternative are discussed in subsequent sections.

Each alternative was compared to the NAA and determined to have the following impacts:

- No additional impact if the change in water temperature was less than 0.5 °C
- A slightly adverse impact if the water temperature increased by 0.5 to 1.0 °C
- An adverse impact if the water temperature increased by 1.0 to less than 3.2 °C
- A substantial adverse impact if the water temperature increased by more than 3.2 °C, a level recommended by the state of Georgia
- A slightly beneficial impact if the water temperature decreased by 0.5 to 1.0 °C
- A beneficial impact if the water temperature decreased by 1.0 to less than 3.2 °C
- A substantial beneficial impact if the water temperature decreased by more than 3.2 °C

Table 6.1-14 shows the quantified summary of the *deltas* of alternatives from the NAA based on the criteria stated above. The results obtained in the alternatives are discussed in detail in the following sections.

Table 6.1-14.
Summary of Median Change in Water Temperature of the Alternatives from the No Action Alternative during the Modeled Period (2001–2011)

Water temperature	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Buford Dam to Atlanta	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Atlanta to West Point Lake	Baseline	No change	No change	No change	No change	Slightly adverse	No change	No change	No change
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

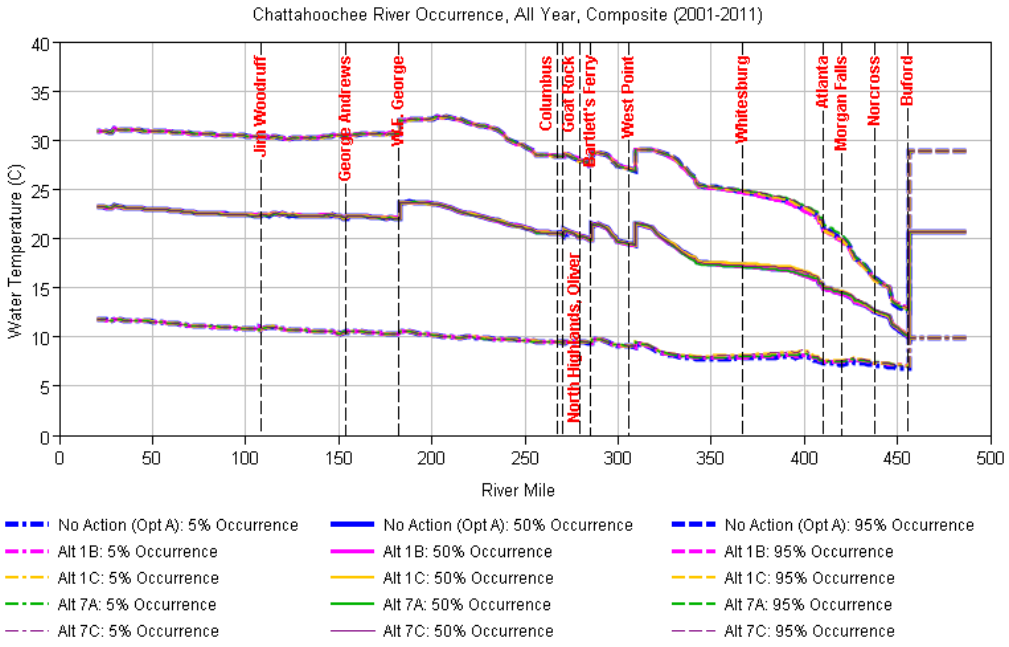


Figure 6.1-65. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin for the Period of 2001–2011 for NAA and Alternatives 1B, 1C, 7A, and 7C

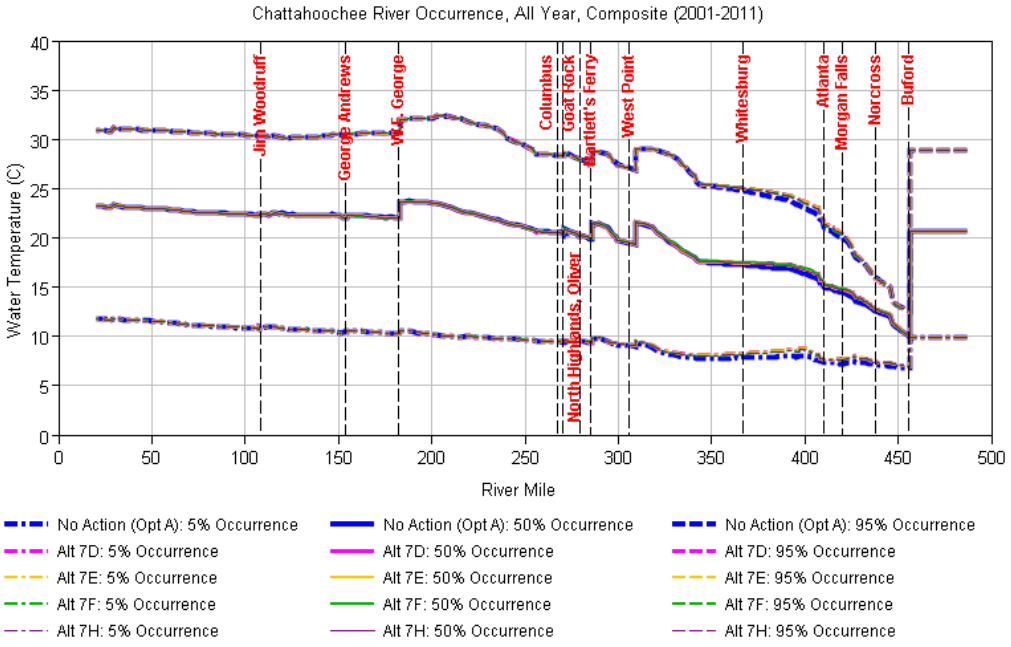


Figure 6.1-66. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

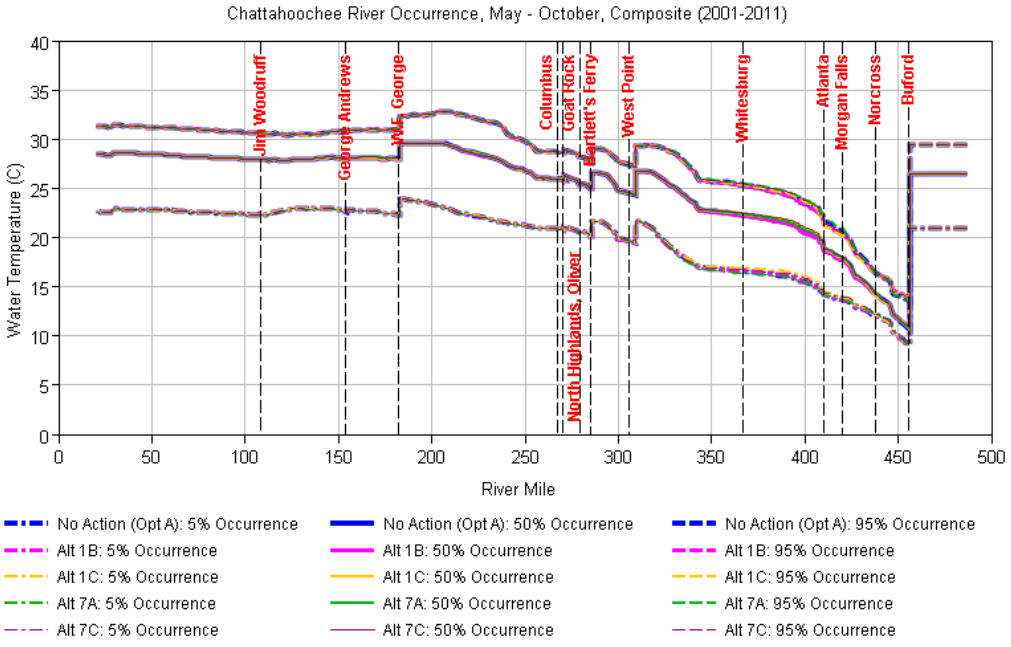


Figure 6.1-67. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin during the Growing Season (May–October) for the Period of 2001–2011 for the NAA and Alternatives 1B, 1C, 7A, and 7C

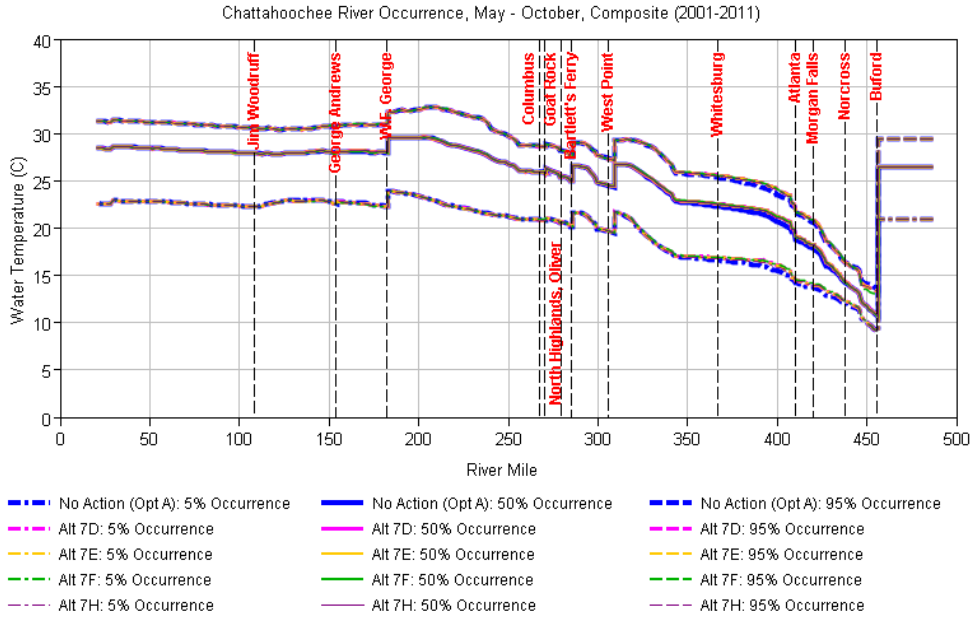


Figure 6.1-68. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin during the Growing Season (May–October) for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

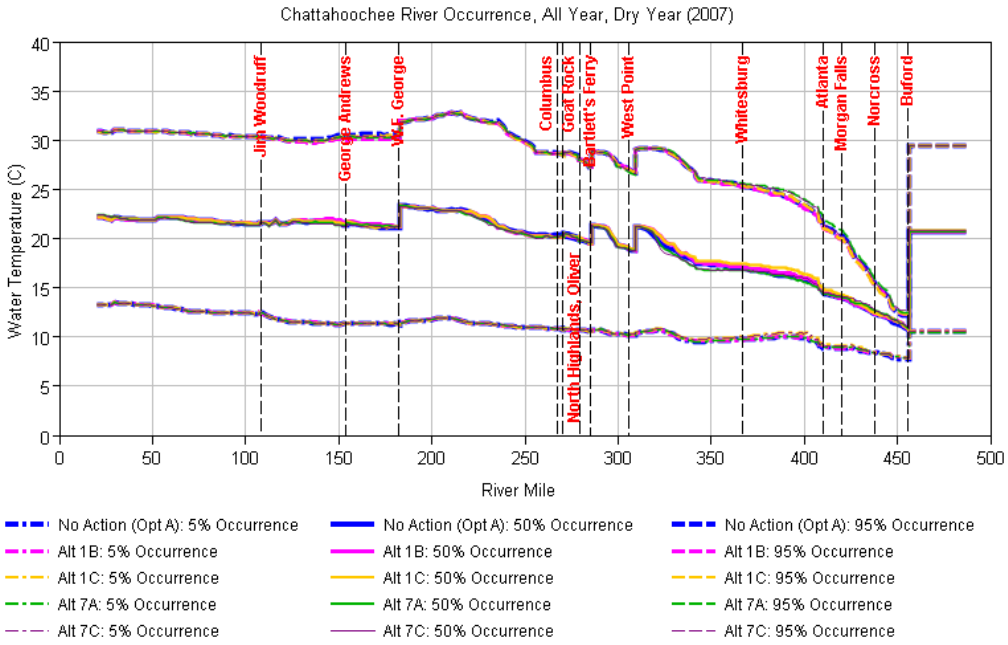


Figure 6.1-69. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin for a Dry Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

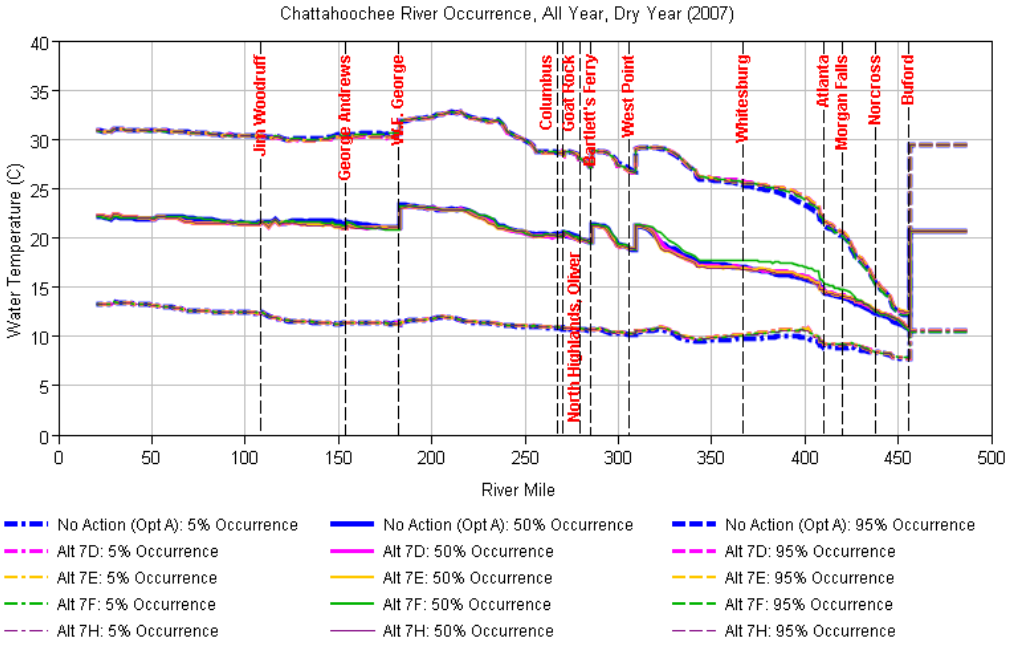


Figure 6.1-70. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin for a Dry Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

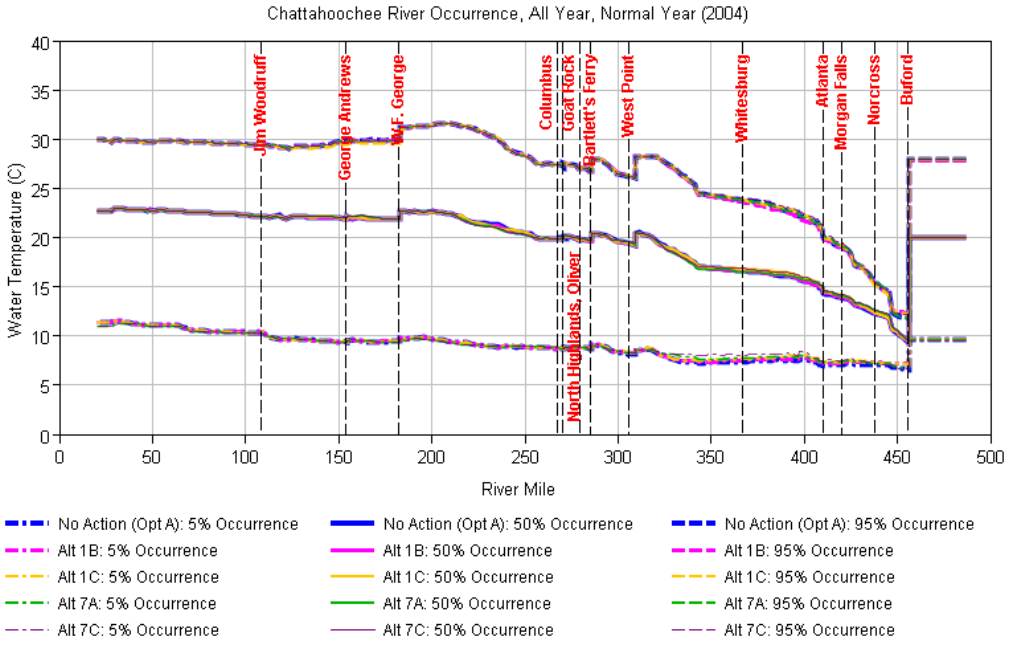


Figure 6.1-71. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin for a Normal Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

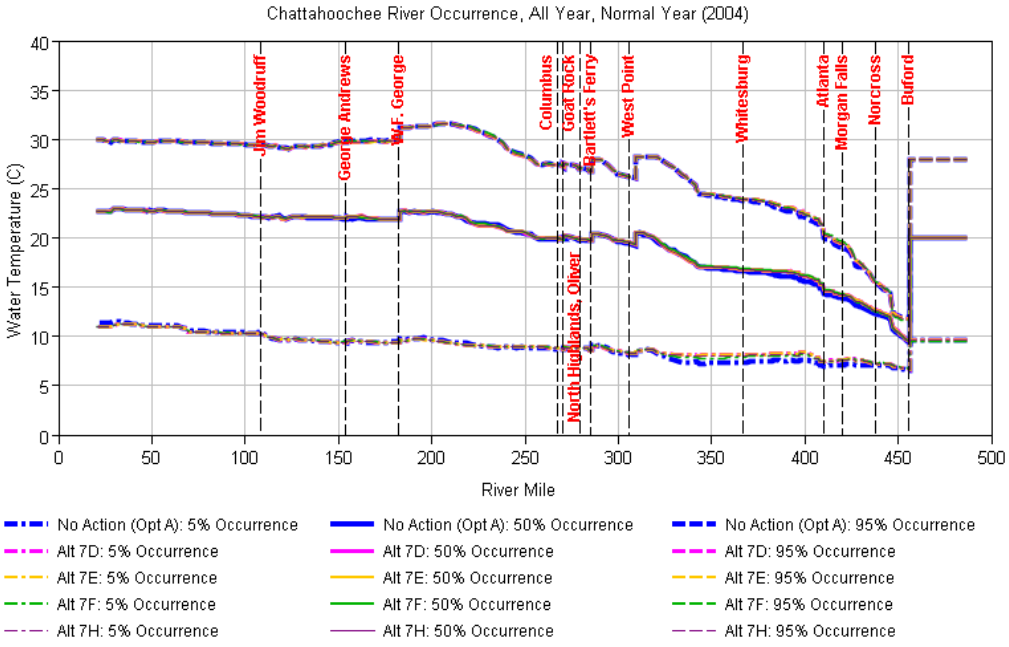


Figure 6.1-72. Longitudinal Profile Occurrence of Modeled Water Temperatures in the ACF Basin for a Normal Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

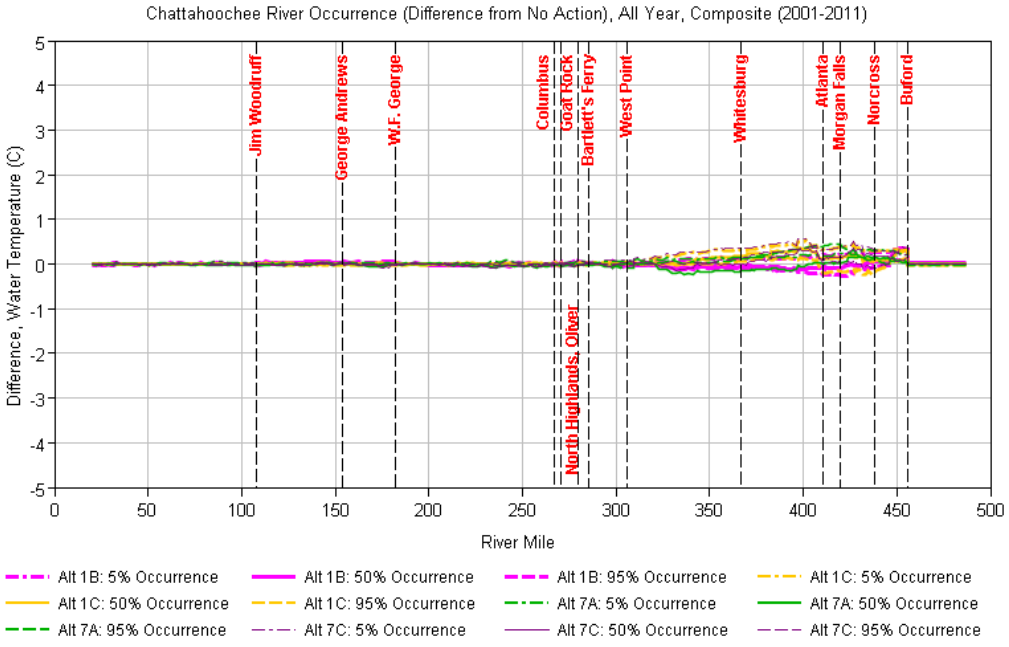


Figure 6.1-73. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 1B, 1C, 7A, and 7C

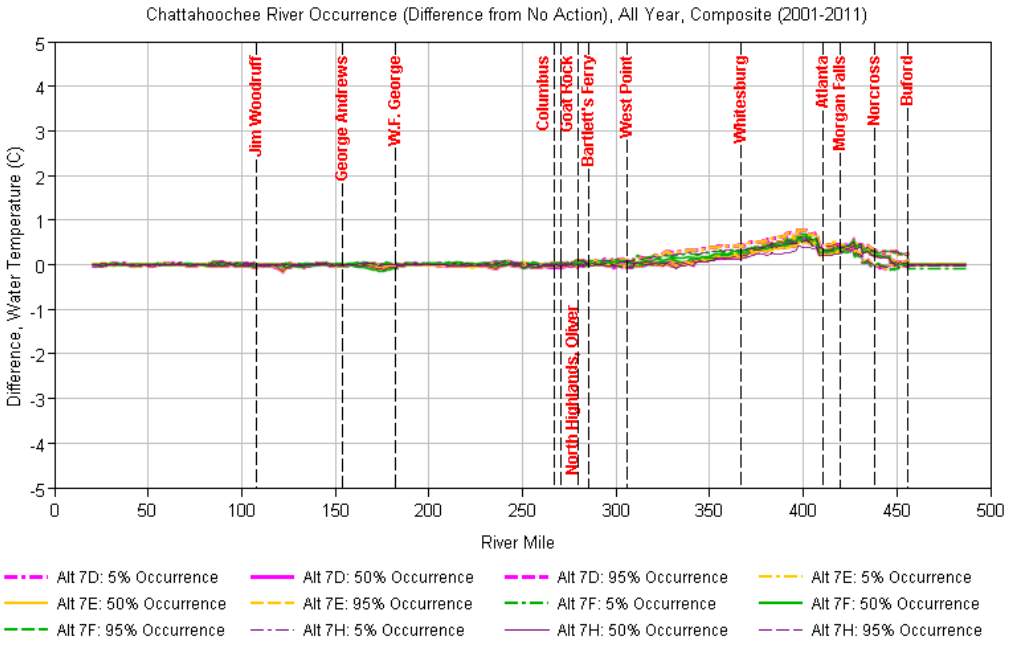


Figure 6.1-74. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 7D, 7E, 7F, and 7H (PAA)

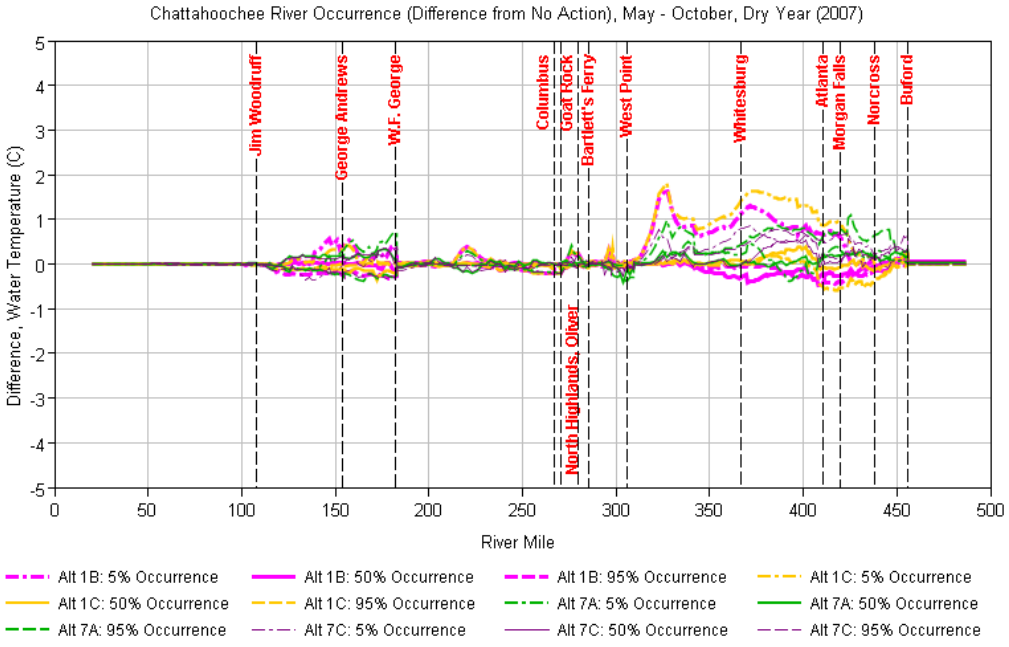


Figure 6.1-75. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin during the Growing Season (May–October) of a Dry Year for the Alternatives 1B, 1C, 7A, and 7C

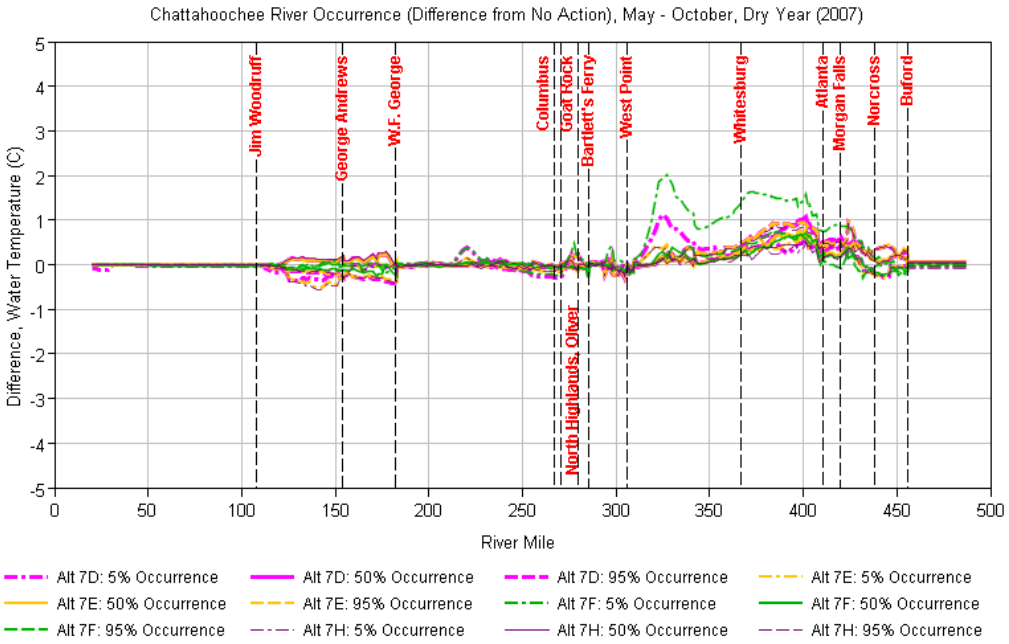


Figure 6.1-76. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin during the Growing Season (May–October) of a Dry Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

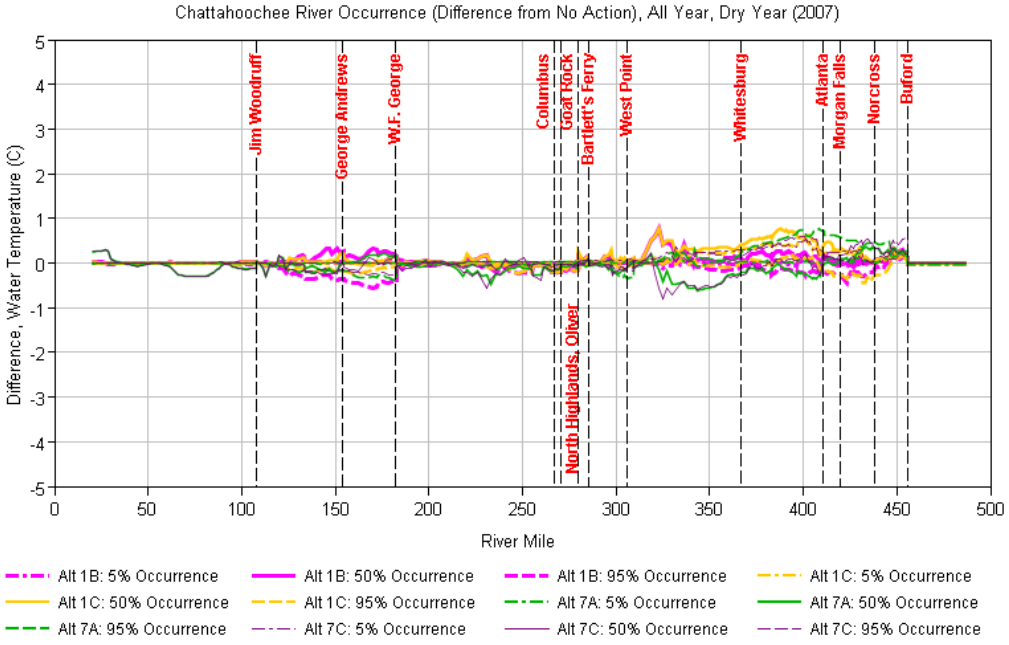


Figure 6.1-77. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin for a Dry Year for Alternatives 1B, 1C, 7A, and 7C

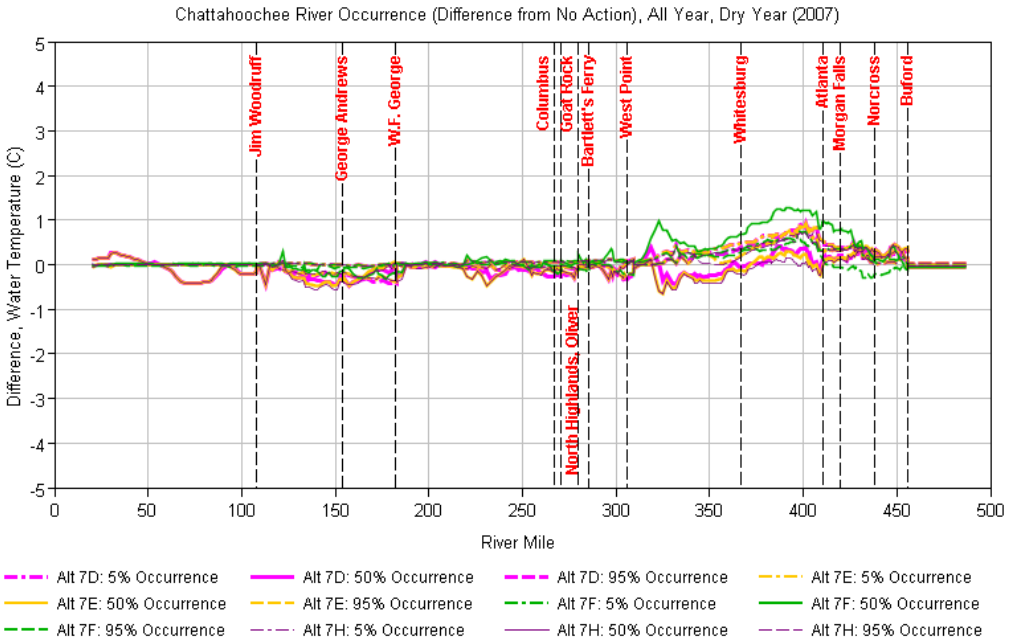


Figure 6.1-78. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin for a Dry Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

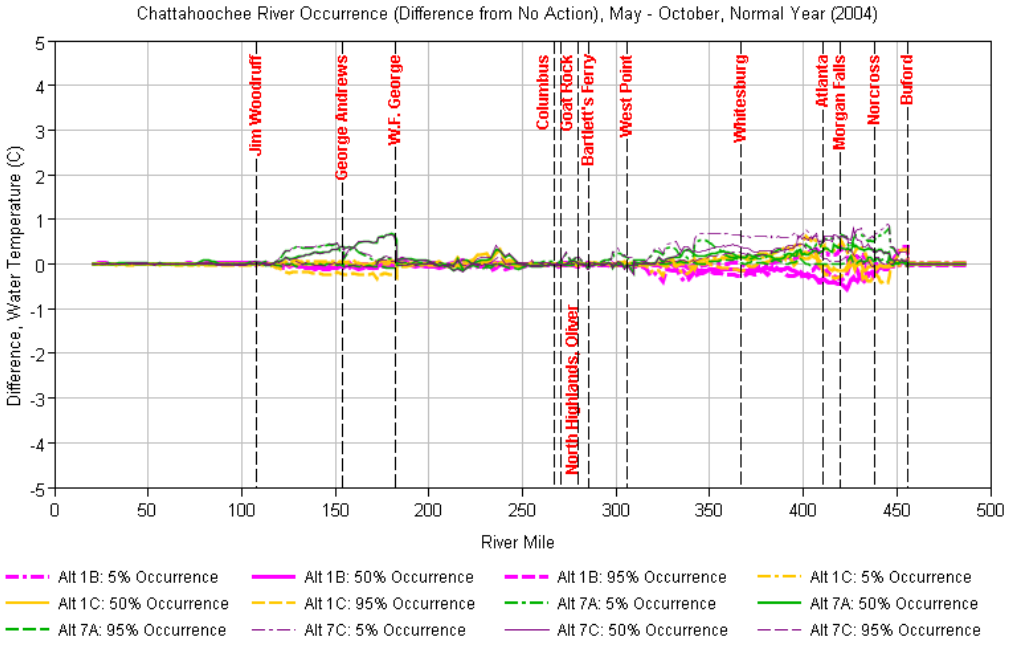


Figure 6.1-79. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin during the Growing Season (May–October) of a Normal Year for Alternatives 1B, 1C, 7A, and 7C

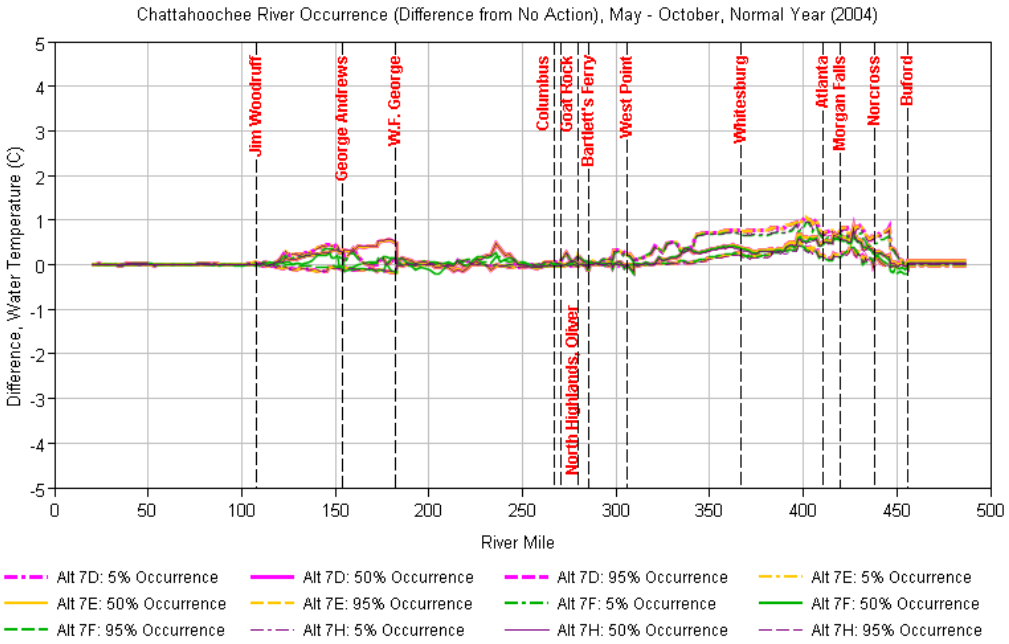


Figure 6.1-80. Longitudinal Profile of Difference in Modeled Water Temperatures from the NAA in the ACF Basin during the Growing Season (May–October) of a Normal Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.2.1.1 No Action Alternative

Based on the NAA, water temperatures rise as the river moves downstream from Lake Lanier to Apalachicola River. Cooler water is released from the reservoirs due to the water being released from the lower cooler temperature portions of Lake Lanier, West Point Lake, and Walter F. George Lake. Water temperature also fluctuates daily depending on atmospheric conditions. Figure 6.1-65 through Figure 6.1-71 present the daily median temperature along with the daily 5th and 95th percent occurrences over the modeled period, for a dry year, and for a normal year. The median water temperature is the most representative since it would be expected to occur half the time. Therefore, this section focuses on the changes in the median water temperature for the NAA at the different locations in the ACF Basin.

The Georgia state standard for water temperature is not to exceed 90 °F (32 °C). At no time is the temperature of the receiving waters to be increased by more than 5 °F (2.8 °C) above intake temperature. In streams designated as primary trout or smallmouth bass waters by the Wildlife Resources Division, there shall be no elevation of natural stream temperatures. In streams designated as secondary trout waters, there shall be no elevation exceeding 2 °F (1.1 °C) of natural stream temperatures (GAEPD 2012a).

Lake Lanier modeled results indicate that over the modeled period, the median daily water temperature would be expected to change by 10°C from the surface water in the lake to surface waters downstream of Buford Dam in the Chattahoochee River. This result is due to the water being released from Lake Lanier through Buford Dam. Water is released from the lower portion of the reservoir water column, where temperatures are much cooler than the surface layer, especially in the summer period. Figure 6.1-65 illustrates water temperature between Lake Lanier and downstream of Buford Dam in the ACF Basin. The greatest change in surface water temperatures occurs between Lake Lanier and the tailrace of Buford Dam

during the growing season. The median daily water temperatures at the tailrace of Buford Dam are expected to decrease by almost 15 °C (Figure 6.1-68).

The Chattahoochee River reach downstream of Buford Dam includes a trout fishery. The reach is designated a secondary trout stream from Buford Dam downstream near the I-285 West Bridge, about 6 mi downstream of Morgan Falls Dam (RM 426). At the tailrace of Buford Dam, the daily water temperatures for the modeled period at the 5th percent occurrence level would be about 7.5 °C (45 °F) and 13 °C (55 °F) at 95th percent occurrence level. These water temperatures are ideal conditions to support the trout fishery, as mentioned in section 2.1.2.2.1.

Minimal fluctuations in median water temperature would be expected under the NAA in the area designated as a secondary trout stream for the representative dry year (Figure 6.1-69). The dry year modeled output illustrates that the water temperature would be expected to change by 0.5 °C to 0.7 °C in this area designated as a secondary trout stream on rare occurrences. Those rare occurrences, where water temperatures are greater than 21 °C, happen during extreme low flow conditions when hydroelectric power is not being generated during weekdays. However, in dry years, water temperatures during some periods would also be expected to decrease by more than 2 °F because of an increase in the total flow of cold water, providing more ideal conditions for the coldwater trout fishery.

Median water temperatures from Atlanta to West Point Lake would experience a slow but steady increase of 4 °C, as illustrated in Figure 6.1-65. The steady increase in this reach can be attributed to both warmer downstream atmospheric conditions and wastewater being returned to the river.

The sudden drop of median temperature from 22 °C to 19 °C (i.e., 72 °F to 66 °F) (Figure 6.1-65) at the tailrace of the West Point Dam would be expected because of water being released from the bottom layer of the water column. The modeled water temperatures at the 5th percent and 95th percent occurrence levels in the West Point Dam tailrace would be well within the range of water quality standards.

From West Point Dam to Walter F. George Lake, the trend of the median water temperatures and temperatures at 5th percent and 95th percent occurrence levels would be similar to the trend expected in the tailrace of West Point Dam. The response is similar because of discharges from the Bartletts Ferry Dam on Lake Harding.

The median temperature in the tailrace of Walter F. George Lock and Dam would increase by 2 °C from the preceding reach of West Point Dam and Lake to Walter F. George Lake. This increase could be attributed to slower moving waters caused by the George W. Andrews Lock and Dam. The temperature at the 95th percent occurrence level would be at 32 °C (90 °F).

Changes in water temperature along the Chattahoochee River downstream of Walter F. George Lock and Dam to Lake Seminole for a normal year are illustrated in Figure 6.1-71. Water temperatures in a normal year along this reach would be expected to decrease by about 2 °C because of warmer atmospheric conditions and certain water management actions. For example, during periods of low flow, water at Lake Lanier would be expected to be conserved, and hydroelectric power generation from Walter F. George Dam would be expected to continue. Little change downstream of Jim Woodruff Lock and Dam would be expected from the NAA because the releases would be made to support fish and wildlife conservation. It can be observed from Figure 6.1-71 that, during a normal year, adverse conditions for fishing or the lake's designated uses at the downstream of Walter F. George Lock and Dam would not be expected.

As illustrated in Figure 6.1-65 through Figure 6.1-72, the median water temperature, temperatures at the 5th percent and 95th percent occurrence levels would be constant throughout Lake Seminole. There would be no change in this reach.

Similar to the water temperatures in Lake Seminole, the water temperatures downstream of the lake in the Apalachicola River continue to be constant at the median water temperatures and at the 5th percent and 95th percent occurrence levels.

6.1.2.1.2 Alternative 1B

Alt1B causes no change to the water temperature profile from the NAA for Lake Lanier.

Differences in water temperature from Buford Dam to Atlanta are relatively low compared with the remaining sections in the ACF Basin, with a change in water temperature of less than 0.5 °C. Changes in water temperature between the Alt1B and the NAA are best illustrated in the longitudinal profiles of the Chattahoochee River during the growing season (May–October) in a dry year (Figure 6.1-75). Figures that appear to have one line, or overlaying lines, indicate that there is no change between the conditions. The changes in temperature downstream of Buford Dam under Alt1B would be expected to be negligible compared to the NAA.

Georgia has designated the Chattahoochee River from Buford Dam downstream to the I-285 West Bridge, about 6 mi downstream of Morgan Falls Dam (RM 426), as a secondary trout stream. The state standard for a secondary trout stream is that the temperature may not increase by more than 2 °F from the NAA. Based on the range of water temperature changes that would be expected in a dry year for the growing season from May through October, overall effects would be expected to be negligible.

Changes in water temperature from Atlanta to West Point Lake at the 5th percent occurrence level for Alt1B from the NAA are illustrated in Figure 6.1-75. Changes in this reach could be due to a variety of factors including but not limited to water intakes and wastewater discharges for the city of Atlanta and the surrounding cities. The increase in modeled water temperature for Alt1B at the 5th percent occurrence level is close to the 2 °F change allowed by Georgia's water quality standards. However, the overall effects would be expected to be negligible because actual water temperatures at the 5th percent occurrence level for Alt1B would be in the range of 10–15 °C, about 15 °C less than violating the water temperature standard.

Little to no change would be expected from West Point Lake to Lake Seminole, as illustrated in Figure 6.1-73 through Figure 6.1-80.

Little change from Lake Seminole to Apalachicola River would be expected from Alt1B (Figure 6.1-73 through Figure 6.1-94) because the releases would be very similar to those under the NAA with respect to the effects of system operations on fish and wildlife conservation. On average, flows under Alt1B in the Apalachicola and Chattahoochee rivers would be expected to be slightly higher for the period from May through October (Figure 6.1-91).

6.1.2.1.3 Alternative 1C

As illustrated in Figure 6.1-73, Figure 6.1-75, and Figure 6.1-91, from Lake Lanier to Atlanta, the median water temperatures over the modeled period for Alt1C result in relatively similar trends and magnitudes as Alt1B. For the different hydrologic conditions, the changes in median water temperature for Alt1C are in range with Alt1B, with little difference expected at the 5th and 95th percent occurrence levels. Overall, the effects would be expected to be negligible when compared to the NAA.

From Atlanta to West Point Dam and Lake, the temperature at the 5th percent occurrence level over the modeled period and during the growing season would be slightly higher than the NAA, with the difference reaching its highest of 0.5 °C at RM 400 (Figure 6.1-73). For the normal and wet years, the response from Alt1C would be similar to Alt1B. As illustrated in Figure 6.1-75, temperature for the

growing season in a dry year at the 5th percent occurrence level would be higher than the difference expected in Alt1B with respect to the NAA. The 5th percent occurrence water temperature from Alt1C would be higher than Alt1B by 0.5 °C from the section from Atlanta to Whitesburg. However, these changes would have no adverse impact because the actual median daily water temperature in a dry year from Atlanta to Whitesburg would be in the range of 15–17 °C (Figure 6.1-73).

Little to no change would be expected from West Point Dam and Lake to Apalachicola River, as illustrated in Figure 6.1-73 through Figure 6.1-80. This result could be attributed to releases similar to those under the NAA with respect to the system operations. Flows under Alt1C in the section from George W. Andrews Lock and Dam to Jim Woodruff Lock and Dam would be expected to be slightly higher than the NAA during the growing season of a dry year (Figure 6.1-91).

6.1.2.1.4 Alternative 7A

Observing the *deltas* in the median water temperature over the modeled period of 2001–2011, there are minimal changes in water temperature under Alt7A compared to the NAA (Figure 6.1-73) from Lake Lanier to Atlanta. The change in median temperatures would fall between the changes expected under Alt1B and Alt1C compared to the NAA.

From Atlanta to West Point Dam and Lake, the changes in median temperature at the 5th and 95th percent occurrence levels would be between the changes under Alt1B and Alt1C for the modeled period. However, the differences in water temperatures at the 5th percent occurrence level during the normal year would be higher than Alt1B and Alt1C and reach its highest (0.5 °C) at RM 330, in the section from Whitesburg to West Point Dam and Lake. In a dry year, median temperature would decrease from Whitesburg to West Point Dam and Lake. The median temperature would get cooler by as much as 0.8 °C (RM 320–RM350) when compared to the NAA, creating beneficial conditions in this section of the ACF Basin. This change in water temperatures could be attributed to implementing the water management alternative, Alt7. The trend of the median temperatures during the growing season of a dry year would be similar to Alt1B (Figure 6.1-75); however, the magnitude would be lesser by at least 0.25 °C.

Changes in water temperature along the Chattahoochee River for the segment downstream of Walter F. George Lock and Dam to Lake Seminole for a normal year are illustrated in Figure 6.1-79. Normal year water temperatures along this reach would be expected to increase by about 0.8 °C. This increase in water temperature from the NAA could be attributed to implementing the water management Alt7.

Minimal changes would be expected in the section downstream of Lake Seminole to the Apalachicola River.

6.1.2.1.5 Alternative 7C

From Lake Lanier to West Point Dam and Lake, the changes in water temperature under Alt7C compared to the NAA are similar to the changes expected in Alt7A, except during the growing season of a normal year. The water temperature at the 5th percent occurrence level would be higher (than the differences expected in Alt7A) by 0.8 °C than under the NAA from Buford Dam downstream to Atlanta at RM 340. These changes in water temperature would have negligible effect on the system because they would be expected to occur at water temperatures within range of temperatures that support the coldwater fishery (Figure 6.1-79).

From West Point Dam and Lake to the Apalachicola River of the ACF Basin, the median temperatures at the 5th and 95th percent occurrence level respond similarly to Alt7A when compared to the NAA.

6.1.2.1.6 Alternative 7D

For Lake Lanier, no changes to the water temperature profile in Alt7D would be expected when compared to the NAA.

From Buford Dam to Atlanta, median water temperatures of less than 0.5 °C delta would be expected; these are relatively lower than the preceding reaches of the ACF Basin. Changes in water temperature between the Alt7D and the NAA are best illustrated in the longitudinal profiles of the Chattahoochee River for the modeled period (Figure 6.1-74).

From Atlanta to West Point Lake, changes in median water temperature are the greatest at 0.6 °C at RM 400 (Figure 6.1-74). Figure 6.1-76 and Figure 6.1-78 illustrate the differences in water temperature for a dry year. These differences could be due to a variety of factors that would result in slightly adverse conditions in a dry year. As illustrated in Figure 6.1-78 for the modeled period, the median water temperature would be less than the NAA by 0.2–0.5 °C from RM 360 to RM 320. Beneficial conditions for the coldwater fisheries would be expected because the decrease in water temperature for Alt7D would be in the range of 0.5–1 °C.

Little to no change would be expected from West Point Lake to Apalachicola River, as illustrated in Figure 6.1-74 through Figure 6.1-80.

6.1.2.1.7 Alternative 7E

Based on the water temperature profiles illustrated in Figure 6.1-74 through Figure 6.1-80, the changes in median water temperature at the 5th and 95th percent occurrence under Alt7E compared to the NAA are similar to the changes expected in Alt7D from Lake Lanier to Atlanta.

The trends and magnitudes of the water temperatures from Atlanta to West Point Lake perform similarly to the trends and magnitudes expected for Alt7D, except for the water temperature at the 5th percent occurrence level during the growing season in a dry year (Figure 6.1-76). The increase in the *delta* would be about 50 percent less than the *delta* expected in Alt7D. Overall, the effects would be expected to be negligible.

Little to no change would be expected from West Point Lake to Apalachicola River. The results would be similar to Alt7D.

6.1.2.1.8 Alternative 7F

The changes from Lake Lanier to Atlanta would be similar to the changes expected under Alt7D.

From Atlanta to West Point Dam and Lake, significant changes would be expected compared to the NAA. The changes would be relatively significant in the dry year (Figure 6.1-76). There would be an increase in median water temperature compared to the NAA during the growing season of a dry year with the maximum increase reaching 1.2 °C downstream of Atlanta and increasing close to 2.3 °C near Atlanta. These changes would be expected to create an adverse environment for biological resources in the section from Norcross, Georgia, to West Point Lake.

The water temperatures would be close to the NAA downstream of West Point Lake, suggesting the water supply option F to be causing the adverse changes in water temperature. Overall, the effects downstream of West Point Lake would be expected to be negligible.

6.1.2.1.9 Alternative 7H (PAA)

The trends in the change of water temperature from the NAA that would be expected along the longitudinal profile in Chattahoochee River for the PAA are illustrated in Figure 6.1-74 through Figure 6.1-80. The magnitudes for the PAA would yield negligible differences compared to the NAA. The *deltas* expected under the PAA during the growing season of a dry year would be the closest to NAA. Overall, the effects would be expected to be negligible.

For Lake Lanier, no changes to the water temperature profile under the PAA would be expected when compared to the NAA.

From Buford Dam to Atlanta, *delta* median water temperatures less than 0.5 °C would be expected. Changes in water temperature between the PAA and the NAA are best illustrated in the longitudinal profiles of the Chattahoochee River for the modeled period (Figure 6.1-74).

From Atlanta to West Point Lake, changes in median water temperature are also less than 0.5 °C (Figure 6.1-74). Figure 6.1-76 and Figure 6.1-78 illustrate the differences in water temperature for a dry year. The differences from May–October in a dry year could be due to a variety of factors that would result in slightly adverse conditions (Figure 6.1-76). As illustrated in Figure 6.1-78 for the modeled period over a full year in a representative dry year, the median water temperature would be less than for the NAA by 0.1–0.7 °C from RM 360 to RM 320.

Little to no change would be expected from West Point Lake to Apalachicola River, as illustrated in Figure 6.1-74 through Figure 6.1-80.

6.1.2.2 Dissolved Oxygen

Figure 6.1-81 through Figure 6.1-94 present the processed HEC-5Q modeled output for dissolved oxygen (DO) and annual flows over the modeled period for the NAA. Like the water temperature profiles, they illustrate variations between proposed revisions to the Master Manual as defined in Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA (Alt7H) from the NAA.

Each alternative was compared to the NAA and determined to have the following impacts:

- No additional impact if the change in DO was less than 0.1 mg/L
- A slightly adverse impact if DO decreased by 0.1 to 0.5 mg/L
- An adverse impact if DO decreased by more than 0.5 mg/L
- A substantial adverse impact if DO decreased to a level below the state water quality standards
- A slightly beneficial impact if DO increased 0.1 to 0.5 mg/L
- A beneficial impact if DO increased more than 0.5 mg/L
- A substantial beneficial impact if DO would meet the state water quality standards

Table 6.1-15 shows the quantified summary of the *deltas* of alternatives from NAA based on the criteria stated above. The results obtained in the alternatives are discussed in detail in the following sections.

Table 6.1-15.
Summary of Median Change in Dissolved Oxygen of the Alternatives from the No Action Alternative during the Modeled Period (2001–2011)

Dissolved oxygen	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	No change
Buford Dam to Atlanta	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	No change	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

Understanding the differences in flows (Figure 6.1-91 and Figure 6.1-94) between the NAA and the different alternatives, along with the varying loads from both point and nonpoint sources based on assumptions defined in section 5.2 for changes in withdrawals and wastewater return rates, helps to understand changes in DO. Longitudinal profiles of the change in DO between the NAA and the different alternatives on the Chattahoochee River from Lake Lanier downstream to the Apalachicola River are illustrated in figures below. The following longitudinal plots present 5th, 50th, and 95th percent occurrence levels over the modeled period calculated from daily average DO. The median or 50th percent occurrence levels are the most representative to use in evaluating the alternative changes and are used for most of the following discussion.

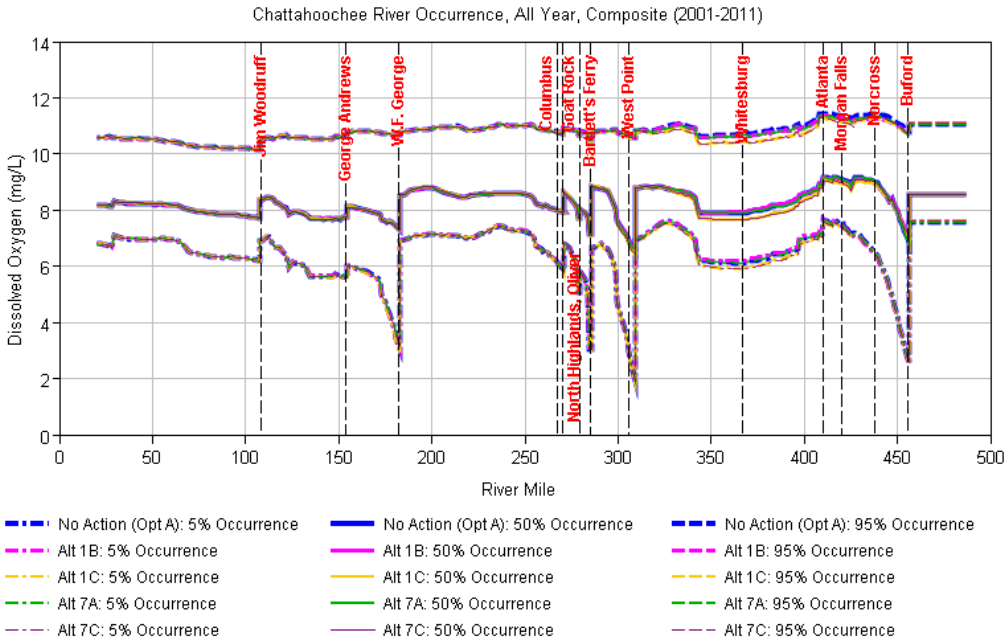


Figure 6.1-81. Longitudinal Profile Occurrence of Modeled Dissolved Oxygen in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 1B, 1C, 7A, and 7C

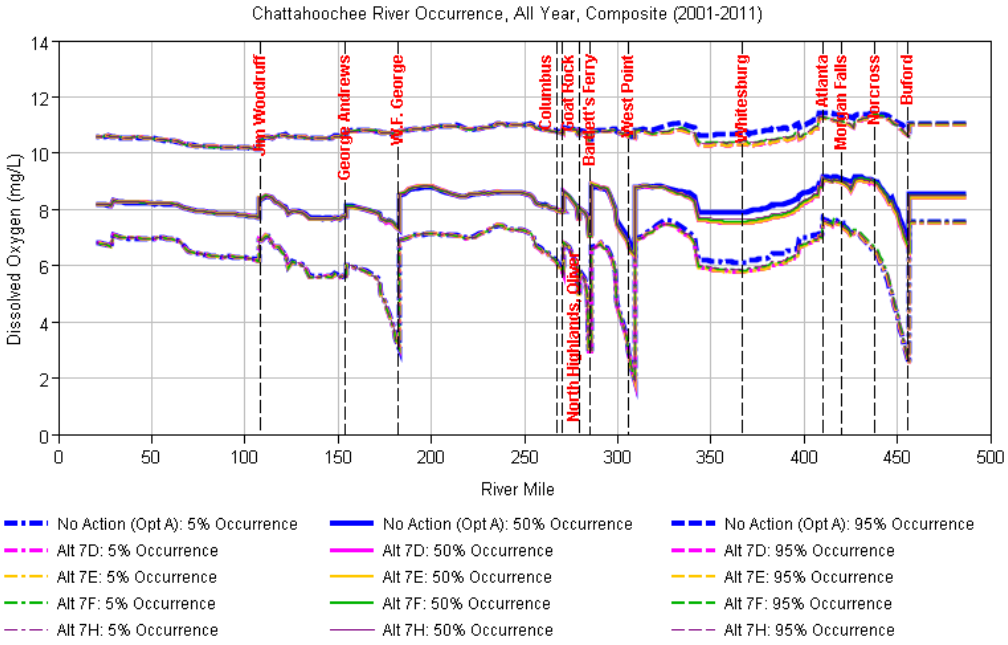


Figure 6.1-82. Longitudinal Profile Occurrence of Modeled Dissolved Oxygen in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

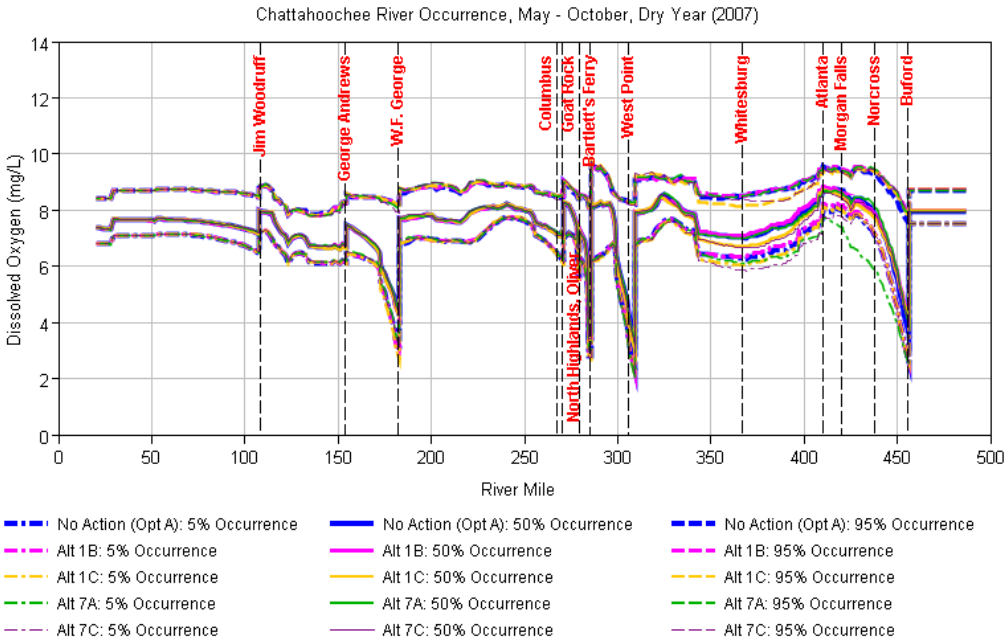


Figure 6.1-83. Longitudinal Profile Occurrence of Modeled Dissolved Oxygen in the ACF Basin during the Growing Season (May–October) of a Dry Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

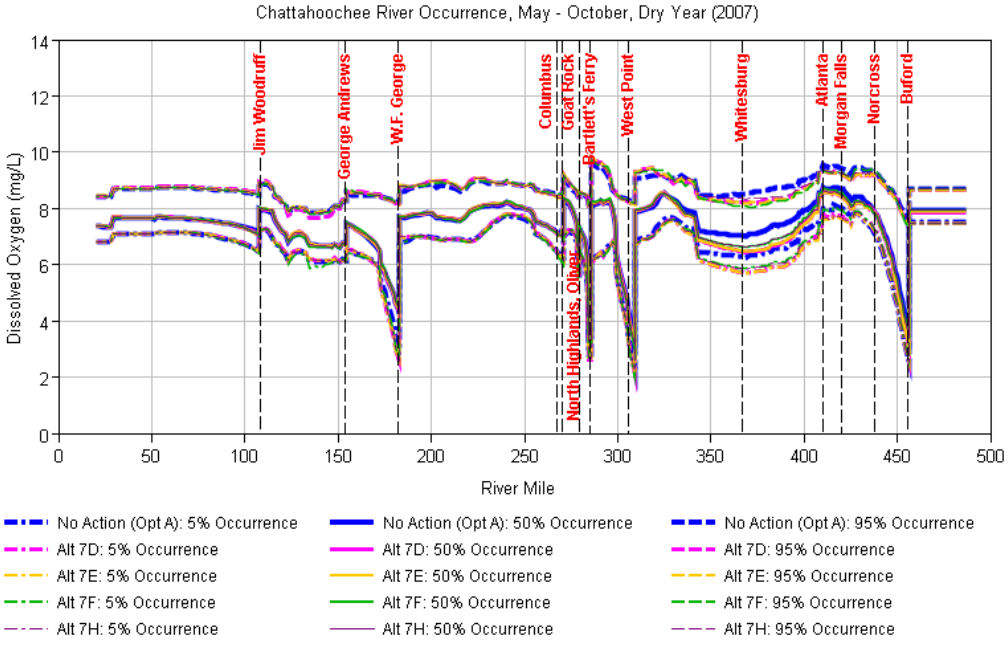


Figure 6.1-84. Longitudinal Profile Occurrence of Modeled Dissolved Oxygen in the ACF Basin during the Growing Season (May–October) of a Dry Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

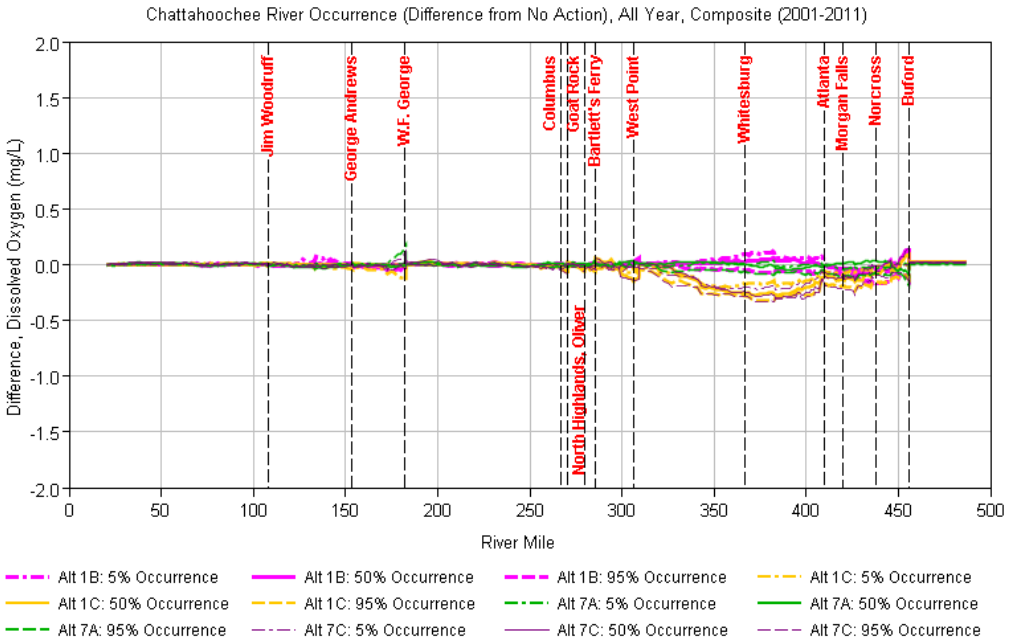


Figure 6.1-85. Longitudinal Profile of Difference in Modeled Dissolved Oxygen from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 1B, 1C, 7A, and 7C

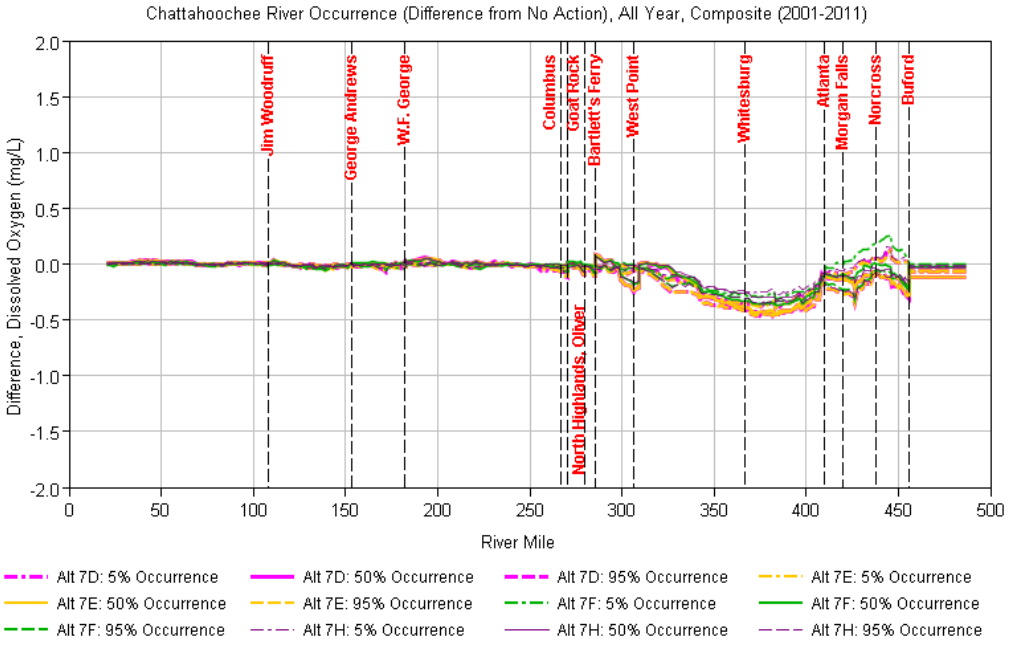


Figure 6.1-86. Longitudinal Profile of Difference in Modeled Dissolved Oxygen from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 7D, 7E, 7F, and 7H (PAA)

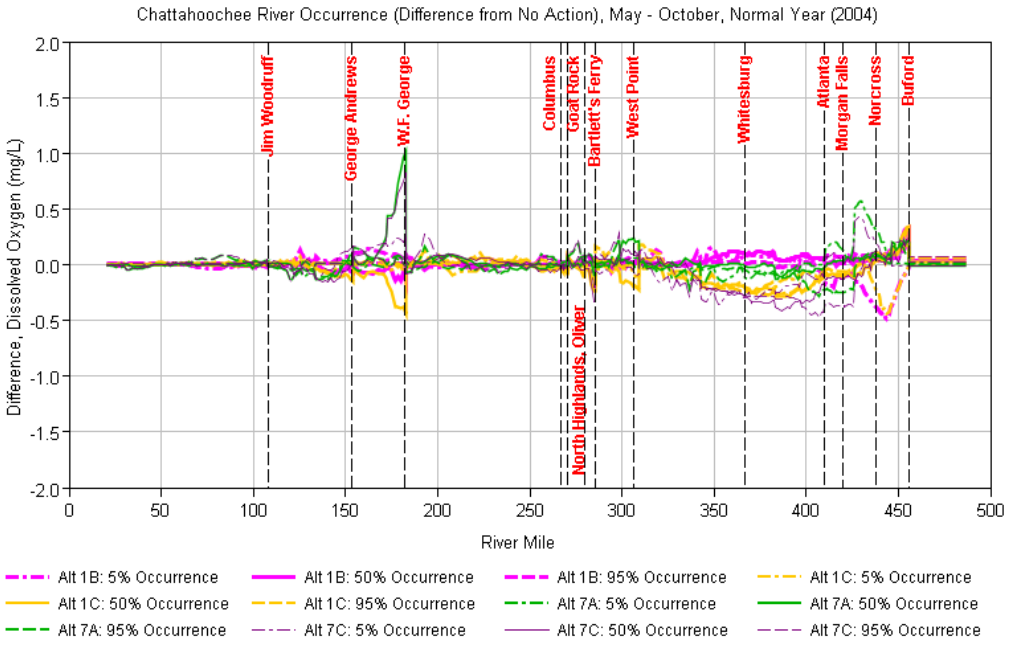


Figure 6.1-87. Longitudinal Profile of Difference in Modeled Dissolved Oxygen from the NAA in the ACF Basin during Growing Season of a Normal Year for Alternatives 1B, 1C, 7A, and 7C

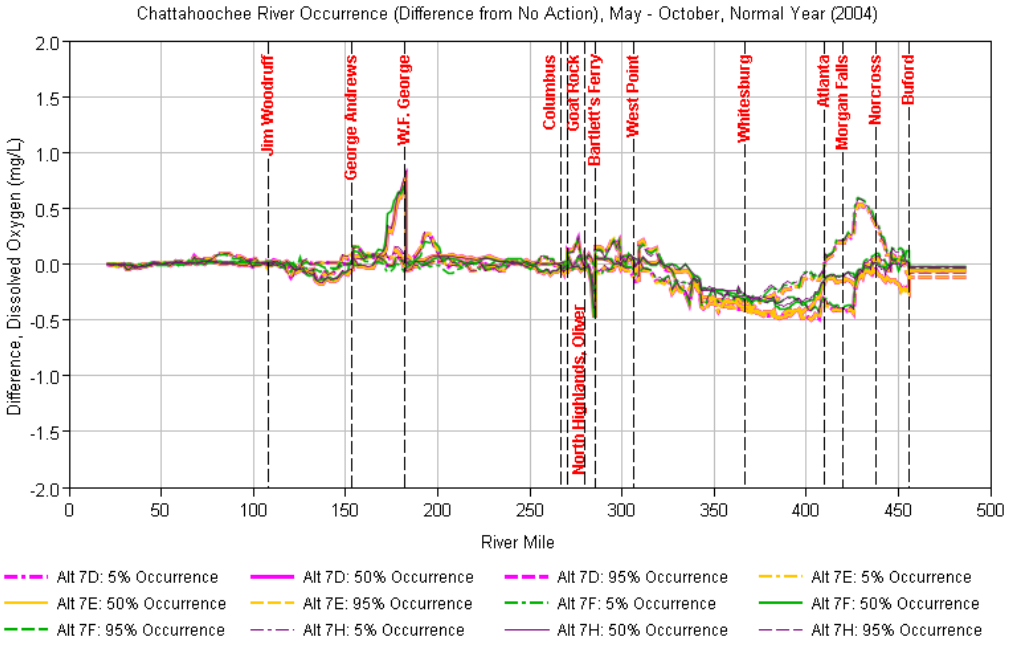


Figure 6.1-88. Longitudinal Profile of Difference in Modeled Dissolved Oxygen from the NAA in the ACF Basin during Growing Season of a Normal Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

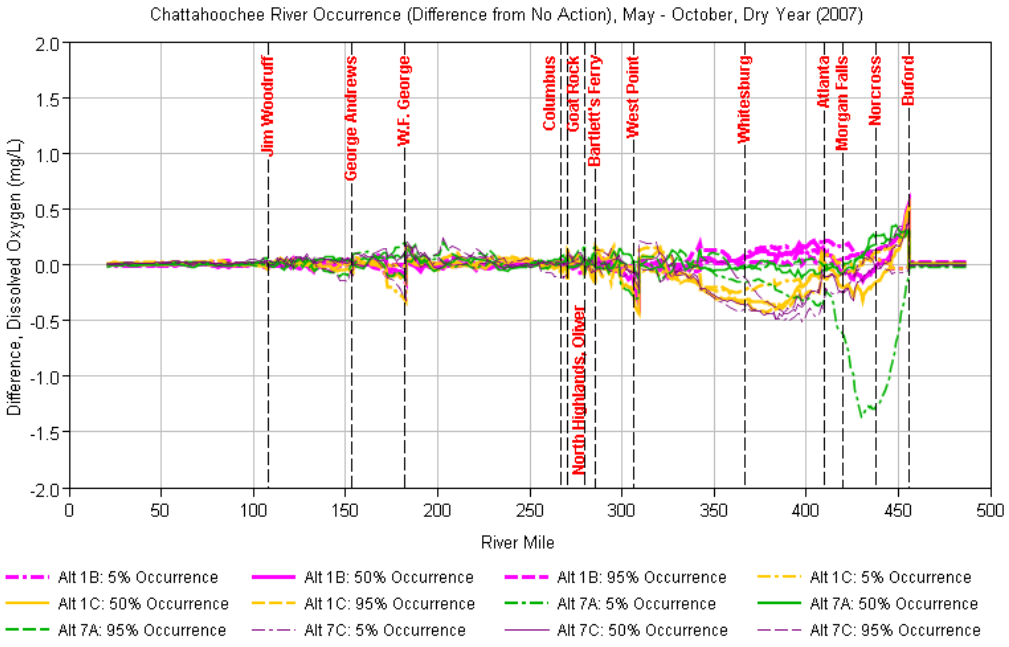


Figure 6.1-89. Longitudinal Profile of Difference in Modeled Dissolved Oxygen from the NAA in the ACF Basin during Growing Season of a Dry Year for Alternatives 1B, 1C, 7A, and 7C

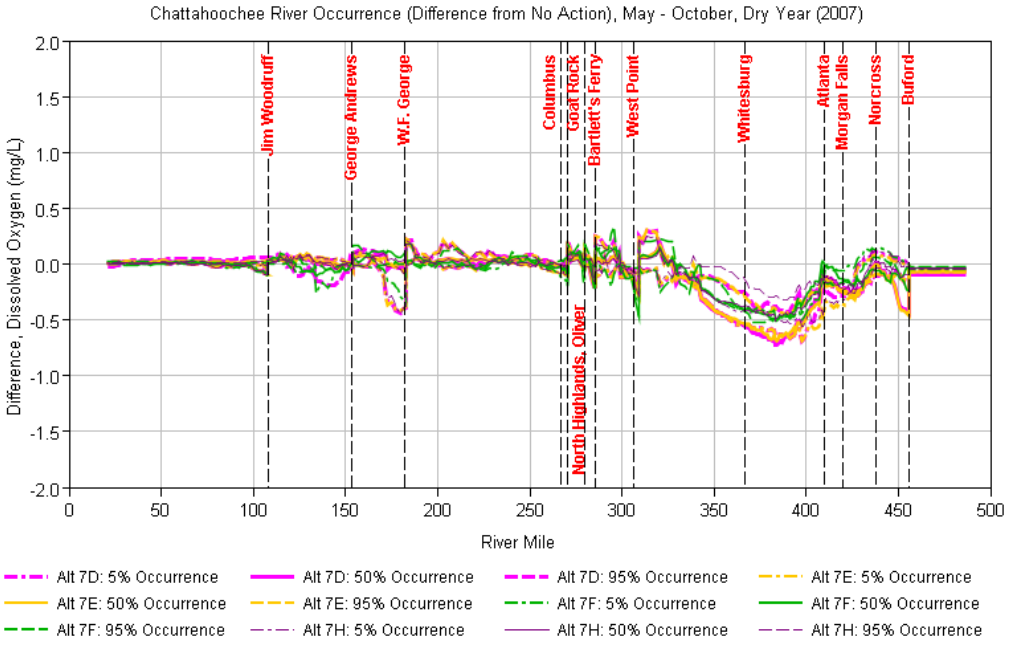


Figure 6.1-90. Longitudinal Profile of Difference in Modeled Dissolved Oxygen from the NAA in the ACF Basin during Growing Season of a Dry Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

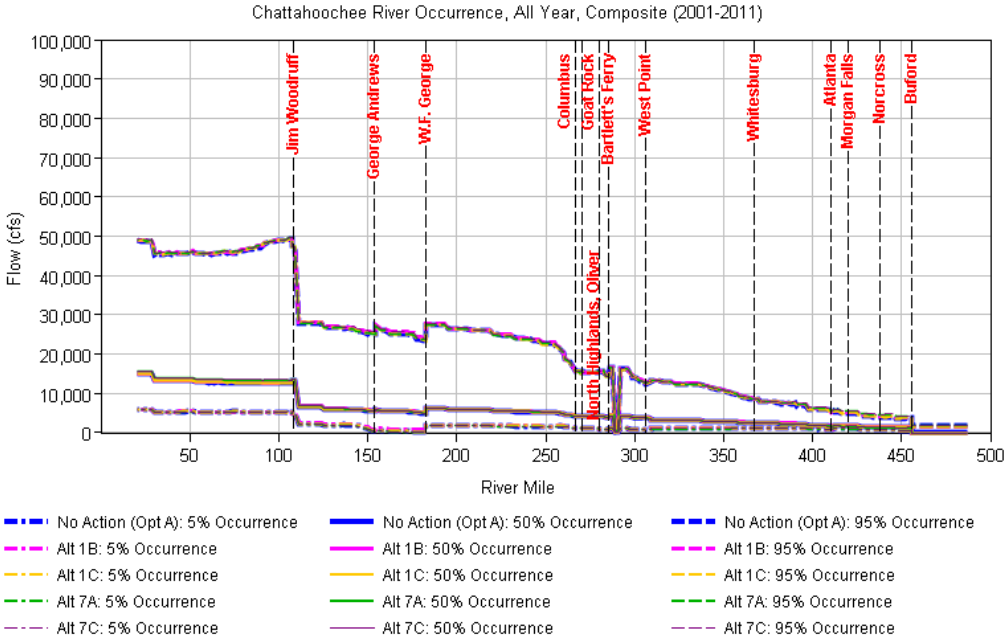


Figure 6.1-91. Longitudinal Profile Occurrence of Annual Flow in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 1B, 1C, 7A, and 7C

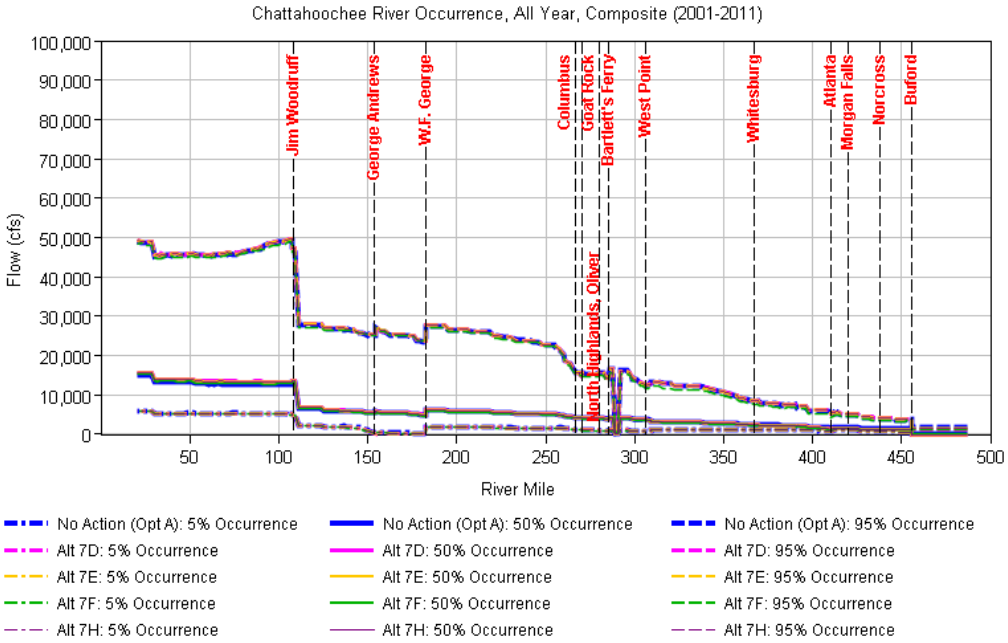


Figure 6.1-92. Longitudinal Profile Occurrence of Annual Flow in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

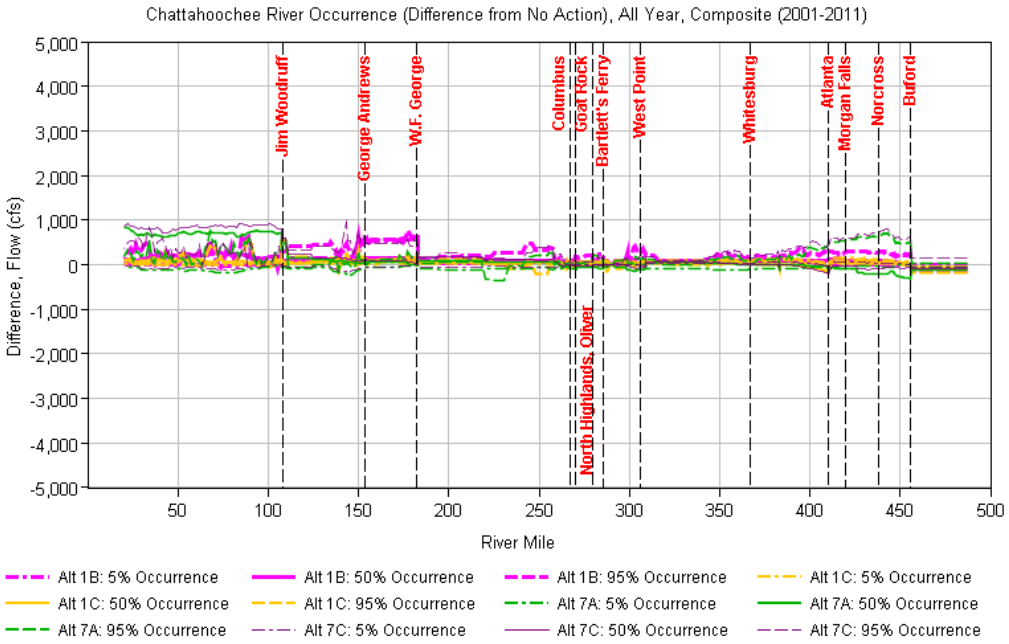


Figure 6.1-93. Longitudinal Profile of Difference in Annual Flow from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 1B, 1C, 7A, and 7C

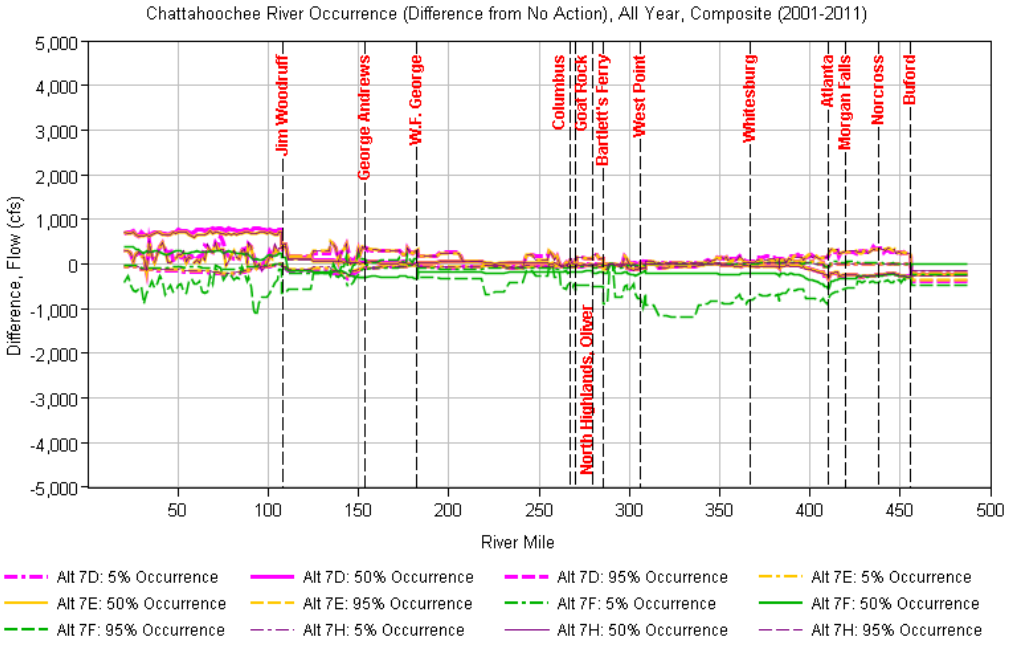


Figure 6.1-94. Longitudinal Profile of Difference in Annual Flow from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.2.2.1 No Action Alternative

Lower DO concentrations would be expected to occur below the major reservoirs under the NAA due to the low-oxygenated water being discharged from reservoirs. These low oxygen levels increase rapidly back to normal levels due to fast velocities and high reaeration downstream of dams. The DO concentrations found in the deeper portions of the reservoir may stay low because of stratification. As the water warms through the summer, the amount of DO in the water column would decrease to levels below 3 mg/L in the deeper areas. Water released from the dams is from the deeper waters, where DO is depleted over time. Downstream from the immediate dam release, the large volume of water would result in greater velocities and reaeration, increasing oxygenation. The increased oxygen levels will support fisheries downstream of dams.

Over the modeled period of 2001–2011, a variety of hydrologic conditions occur that impact the DO. DO also fluctuates daily depending on the water temperature fluctuations and atmospheric conditions. Figure 6.1-81 and Figure 6.1-83 present the daily median DO along with the daily 5th and 95th percent occurrences over the modeled period. The following discussion focuses on the changes in the median DO for the NAA at the different locations in the ACF Basin.

Georgia state water quality standards are used as a benchmark to evaluate the alternatives' impacts. For streams designated as primary trout or smallmouth bass waters by the Wildlife Resources Division, the DO water quality standards are a daily average of 6 mg/L and no less than 5 mg/L. For streams designated for warmwater species of fish, the water quality standard is a daily average of 5 mg/L and no less than 4 mg/L.

Lake Lanier modeled results indicate that over the modeled period, the median DO would be expected to change from 8.5 mg/L in the surface water in the lake to 6.8 mg/L in the surface waters downstream of Buford Dam in the Chattahoochee River. This is due to the water being released from the lower portion of the reservoir, where temperatures are much cooler and DO much lower than at the lake's surface, especially during the summer period. Figure 6.1-81 illustrates DO between Lake Lanier and downstream of Buford Dam in the ACF Basin.

The portion of the Chattahoochee River from Buford Dam to Atlanta experiences the lowest DO concentrations just downstream of the dam. DO differences would be more pronounced in a dry year (Figure 6.1-83) because of the lower flows being released from Lake Lanier and lower watershed inflows (Figure 6.1-91). Modeled simulations of 2007 illustrate that when flows are low for extended periods, the median concentration of DO under the NAA in the secondary trout fishery reach between Buford Dam and Atlanta will be above the water quality standard of 6 mg/L. Under the NAA, lower weekend flows would be expected to occur at Norcross because hydroelectric power would not be generated from Buford Dam; instead, only minimal flow would be released from Buford Dam and regulated by Morgan Falls Dam to produce a minimum required flow of 750 cfs at Peachtree Creek near Atlanta. Lower in-stream flow would be expected to yield lower DO levels on weekends in the late summer. Since the predicted HEC-5Q DO meets the state's water quality standard, the condition would not be expected to be problematic.

Georgia EPD evaluates the allowable discharged load for point sources based on the in-stream flow that occurs for seven consecutive days and has a 10-year recurrence interval period (7Q10). Any change in the in-stream low flow condition from the NAA in a way that would decrease concentrations of DO would be expected to be a significant effect.

The reach from Atlanta to West Point Lake experiences a complex change in DO around and below Metro Atlanta. The occurrences of lower DO below Atlanta can be attributed to the wastewater treatment discharges, along with the decreased low flows in the Chattahoochee River, resulting in a longer time of

travel and lower reaeration. The median DO concentrations under low flow conditions would consistently fall from 9.2 mg/L at RM 410 to less than 7.0 mg/L at RM 340 (Figure 6.1-81). This decrease would be expected from the influence of dischargers in this portion of the river. It should be noted that Georgia EPD has established waste load allocations for Metro Atlanta wastewater dischargers based on meeting the downstream DO standard of 5 mg/L and any additional decrease in the oxygen levels below Atlanta may require a change to these waste load allocations. DO in the reach downstream of RM 340 would be expected to increase by 0.5 mg/L and maintain that concentration to West Point Lake.

The median DO immediately downstream of West Point Dam would be expected to drop from the preceding reach because of low oxygenated waters released from the bottom layers of West Point Lake. These low DO releases quickly reaerate to DO levels above 5 mg/L. At the 50th percent occurrence level, the minimum DO would be above 4 mg/L and, at the 95th percent occurrence levels, the minimum DO would be above 8 mg/L.

From West Point Lake to Walter F. George Lake, downstream of Bartletts Ferry Dam, Georgia, experiences a significant drop in the DO levels at the 5th percent occurrence level. Such low concentrations would be attributed only to low flows and releases from the lower water levels (Figure 6.1-91). Downstream of Columbus, median DO would be in the range of 8 to 8.5 mg/L and the 5th percent occurrence would be expected to be above 6.5 mg/L for the NAA (Figure 6.1-81).

At the tailrace of Walter F. George Lock and Dam, DO would be similar to slightly higher than the conditions at the tailrace of West Point Dam. Increased DO concentrations downstream of Walter F. George Lock and Dam would be expected from increased velocities and higher reaeration.

Changes in DO for the reach downstream of Walter F. George Lock and Dam to Lake Seminole during the growing season of a dry year are illustrated in Figure 6.1-83. Downstream of Walter F. George Lock and Dam, the median DO concentrations in a dry year would increase from 4.5 mg/L to over 6.0 mg/L and downstream of Lake Seminole, the concentration would increase from 6.0 mg/L to 8.0 mg/L.

As illustrated in Figure 6.1-81 and Figure 6.1-83, the median DO would be constant throughout Lake Seminole.

Little change downstream of Jim Woodruff Lock and Dam would be expected under the NAA because the releases would be made considering the effects of system operations on fish and wildlife conservation. Downstream of Lake Seminole, DO in the Apalachicola River would be constant at the median, 5th percent, and 95th percent occurrence levels, with median DO of 7.8 mg/L.

6.1.2.2.2 Alternative 1B

No changes to DO in Lake Lanier would be expected in Alt1B.

Differences in DO from Buford Dam to Atlanta would be relatively small between Alt1B and NAA. The average change in DO of less than 0.05 mg/L for the modeled period would be expected and best illustrated in the longitudinal profiles during the growing season (May–October) in normal and dry years (Figure 6.1-87 and Figure 6.1-89). DO at the 5th percent occurrence during a normal year or the median DO during a dry year decreases by more than 0.1 mg/L at Norcross, illustrating a slightly adverse condition; however, DO levels would still be above the standard of 6 mg/L.

DO concentrations would be expected to increase under the Alt1B from Atlanta to West Point Lake during the critical low flow summer conditions of 2007, indicating slightly beneficial conditions (Figure 6.1-85).

Little to no change would be expected in DO from West Point Lake to Apalachicola River, as illustrated in Figure 6.1-85, Figure 6.1-87, and Figure 6.1-89.

6.1.2.2.3 Alternative 1C

As illustrated in Figure 6.1-85, the changes modeled in DO concentrations from Lake Lanier to Atlanta for Alt1C are similar in trend and range to the changes observed for Alt1B. However, from Norcross to Atlanta, the *delta* DO would be in the range of 0.1 to 0.15 mg/L. Decreased DO between 0.1 and 0.5 mg/L compared to the NAA would be considered slightly adverse because of the 10 percent difference in allowable concentrations.

From Atlanta to West Point Lake, the median DO at the 5th and 95th percent occurrence over the modeled period during dry, wet, and normal years would be lower than the DO concentrations modeled in Alt1B. There would be a persistent decrease in median DO compared to the NAA from downstream of Atlanta to West Point Lake, with the maximum *delta* occurring in the reach from Atlanta to Whitesburg. The decrease in median DO concentrations would be expected to result in slightly adverse conditions for biological resources in this section of the basin (Figure 6.1-85, Figure 6.1-87, and Figure 6.1-89).

Little to no change would be expected from West Point Dam to the Apalachicola River compared to the NAA with some decreases in median DO concentrations downstream of reservoirs (Figure 6.1-85, Figure 6.1-87, and Figure 6.1-89).

6.1.2.2.4 Alternative 7A

From Lake Lanier to Atlanta, the median DO for Alt7A would be close to or slightly higher than the NAA except in a few rare occurrences. The 5th percent occurrence DO concentrations during the growing season of a normal year would be expected to increase by as much as 0.5 mg/L in the reach from Norcross to Morgan Falls Dam (Figure 6.1-87). As illustrated in Figure 6.1-89, the 5th percent occurrence change in DO would drop by 1.4 mg/L. However, since 5th percent occurrence concentrations are rare, this change in DO would be expected to have negligible effect on the water quality since the DO levels would stay above 6 mg/L.

Little to no change would be expected from Atlanta to West Point Lake and from West Point Dam to Walter F. George Lock and Dam.

Downstream of Walter F. George Lock and Dam, in the growing season of a normal year, the median DO concentrations would be expected to increase by 1 mg/L compared to the NAA and eventually decrease in the reach upstream of George W. Andrews Lock and Dam (Figure 6.1-87). The changes in DO could be attributed to implementing water management alternative 7.

Little to no change would be expected from Lake Seminole to the Apalachicola River.

6.1.2.2.5 Alternative 7C

The DO responses for Alt7C would be similar to the *deltas* expected in Alt1C along the entire Chattahoochee River reach (Figure 6.1-87), resulting in slightly adverse conditions for the reaches, Norcross to Atlanta, and Atlanta to West Point Lake.

6.1.2.2.6 Alternative 7D

From Lake Lanier to Atlanta, a 0.3 mg/L decrease in DO would be expected for Alt7D compared to the NAA. Except for the growing season in a normal year, this section of the ACF Basin would experience a lower DO than the NAA, creating slightly adverse conditions.

In the reach from Atlanta to West Point Lake, the maximum DO decrease of 0.45 mg/L would be expected around RM 370, as illustrated in Figure 6.1-86. Similar trends would be expected in normal and dry years with the maximum decrease in a dry year reaching 0.51 mg/L (Figure 6.1-88 and Figure 6.1-90). Overall, slightly adverse DO conditions would be expected in this reach of the basin.

Downstream of West Point Dam, during the growing season of a dry year, DO levels would increase, creating a slightly beneficial condition in the tailrace of West Point Dam (Figure 6.1-90).

In the reach from West Point Dam to Walter F. George Lake, as illustrated in Figure 6.1-86, there would be little to no change in DO compared to the NAA. However, at Bartletts Ferry Dam, during the growing season of normal and dry years, DO levels would decrease, creating slightly adverse conditions.

There would be little to no change in DO from Walter F. George Lock and Dam to the Apalachicola River. However, during the growing season of a normal year, a slightly beneficial increase (by as much as 0.5 mg/L) in DO downstream of Walter F. George Lock and Dam would be expected due to changes of release flows at the dam (Figure 6.1-88).

6.1.2.2.7 Alternative 7E

The DO responses for Alt7E would be similar to the *delta* expected in Alt7D.

6.1.2.2.8 Alternative 7F

In the section from Lake Lanier to Buford Dam, as illustrated in Figure 6.1-86, the median DO *delta* for Alt7F would be 0.12 mg/L less than the NAA. Conditions would be expected to improve in the succeeding section from Buford Dam to Atlanta, with the change in median DO increasing by 0.45 mg/L in a normal year, creating a slightly beneficial condition.

In the section from Atlanta to West Point Lake, the change in DO would consistently decrease by as much as 0.3 mg/L. This would be expected in normal and dry years, creating slightly adverse conditions along this reach.

From West Point Lake to downstream, most sections of the ACF Basin would experience little to no change in the DO levels.

6.1.2.2.9 Alternative 7H (PAA)

In the section of the ACF Basin from Lake Lanier to Buford Dam, as illustrated in Figure 6.1-86, the median DO *delta* for the PAA would be 0.09 mg/L less than the NAA. Conditions would be expected to decrease from Buford Dam to Atlanta with the change in median DO over the modeled period decreasing by 0.1 mg/L, creating a slightly adverse condition. Slightly adverse conditions from decreased DO, *deltas* ranging from 0.09 mg/L to 0.32 mg/L, would continue downstream to West Point Lake.

From West Point Lake downstream, most sections of the basin would experience little to no change in the DO levels (Figure 6.1-86 through Figure 6.1-90).

6.1.2.3 Phosphorus

Alabama, Florida, and Georgia have established criteria for reservoirs and lakes in the ACF Basin for total phosphorus (TP) loads (section 2.1.2.3). The nutrient criteria for TP in major headwaters contributing to the lakes in Georgia and Alabama are based on annual loads in pounds. As tabulated in Table 2.1-29 in section 2.1.2.3, as per the water quality standards set by Alabama and Georgia, the TP annual loading for West Point Lake headwaters at Chattahoochee River at U.S. Highway 27 should not exceed 1.4 million lbs and for Walter F. George Lake headwaters, the annual TP loading at Chattahoochee River at U.S. Highway 39 should not exceed 2 million lbs. The calculated TP loads for the NAA and the remaining alternatives are presented in Table 6.1-16. The loads were calculated using the HEC-5Q model outputs of TP concentrations (mg/L) and modeled flows (cfs), and proper conversion factors were applied to derive annual loads in lbs. The numbers in the table are annual TP loads in lbs.

Florida has nutrient criteria established for freshwater streams. As per Florida's standards, the final numeric nutrient criteria for freshwater streams in Florida Panhandle West for TP is 0.06 mg/L and 0.01 mg/L for clear lakes with a range of 0.01-0.03 mg/L. The water quality standards for TP for lakes in Alabama and Georgia are provided in Table 2.1-29 and for Florida in Table 2.1-30 of section 2.1.2.3.

Table 6.1-16.
Total Phosphorus Loads at Headwaters of West Point Lake and Walter F. George Lake for 11-year Modeled Period (2001–2011)

		Annual total phosphorus loads in lbs								
Year	Location	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
2001	West Point Lake headwaters	712,042	729,853	832,050	730,127	829,468	846,084	846,723	786,410	819,239
	Walter F. George Lake headwaters	1,373,380	1,402,252	1,506,946	1,402,702	1,506,271	1,526,429	1,525,015	1,468,009	1,496,488
2002	West Point Lake headwaters	670,891	702,132	776,833	703,268	793,716	826,024	826,450	775,809	796,697
	Walter F. George Lake headwaters	1,079,952	1,112,227	1,184,946	1,113,189	1,202,678	1,230,169	1,231,679	1,180,249	1,202,749
2003	West Point Lake headwaters	1,270,703	1,309,912	1,396,143	1,306,027	1,413,926*	1,449,893*	1,449,236*	1,352,748	1,408,768*
	Walter F. George Lake headwaters	1,954,469	1,993,905	2,086,044*	1,988,970	2,101,499*	2,140,170*	2,140,033*	2,044,897*	2,098,159*
2004	West Point Lake headwaters	883,364	905,238	990,088	890,469	989,293	1,023,943	1,024,053	955,520	987,643
	Walter F. George Lake headwaters	1,451,393	1,473,003	1,565,769	1,459,882	1,564,434	1,601,415	1,601,451	1,529,833	1,562,383
2005	West Point Lake headwaters	1,116,965	1,142,321	1,224,942	1,130,145	1,226,904	1,271,900	1,271,952	1,218,666	1,232,542
	Walter F. George Lake headwaters	2,010,591*	2,034,651*	2,128,284*	2,026,424*	2,130,808*	2,188,730*	2,188,927*	2,138,291*	2,144,219*
2006	West Point Lake headwaters	705,698	712,634	798,419	703,214	791,495	825,839	826,116	775,752	794,918
	Walter F. George Lake headwaters	1,198,458	1,205,366	1,289,879	1,195,423	1,282,730	1,317,800	1,318,025	1,269,881	1,286,756

		Annual total phosphorus loads in lbs								
Year	**Location**	**NAA**	**Alt1B**	**Alt1C**	**Alt7A**	**Alt7C**	**Alt7D**	**Alt7E**	**Alt7F**	**PAA**
2007	West Point Lake headwaters	469,004	485,581	552,060	485,456	568,670	585,670	591,220	517,418	564,871
	Walter F. George Lake headwaters	922,982	940,756	1,005,209	947,301	1,030,354	1,045,388	1,051,605	974,640	1,025,569
2008	West Point Lake headwaters	441,386	462,814	526,447	431,574	509,374	541,677	541,031	541,368	518,935
	Walter F. George Lake headwaters	1,159,097	1,178,081	1,263,457	1,154,693	1,245,961	1,289,824	1,288,353	1,255,254	1,258,390
2009	West Point Lake headwaters	1,245,841	1,288,431	1,363,185	1,270,839	1,365,128	1,391,727	1,386,803	1,298,329	1,352,346
	Walter F. George Lake headwaters	2,399,330*	2,442,559*	2,552,606*	2,434,530*	2,559,675*	2,608,440*	2,605,140*	2,511,776*	2,560,087*
2010	West Point Lake headwaters	851,467	866,463	942,646	850,458	934,860	968,223	968,557	923,678	936,327
	Walter F. George Lake headwaters	1,555,310	1,570,288	1,649,183	1,556,247	1,641,427	1,676,518	1,677,036	1,644,997	1,643,827
2011	West Point Lake headwaters	628,419	640,478	718,731	645,005	729,506	767,476	767,746	719,937	735,635
	Walter F. George Lake headwaters	1,048,589	1,061,845	1,136,121	1,067,285	1,148,430	1,183,242	1,183,661	1,137,943	1,153,484

Note:
* denotes an exceedance of the water quality standard.

In addition to comparing loadings to the lakes' standards, each alternative was compared to the NAA and determined to have the following impacts:

- No additional impact if the change in TP was less than 0.01 mg/L
- A slightly adverse impact if TP increased by 0.01 to 0.02 mg/L
- An adverse impact if TP increased by more than 0.02 mg/L
- A substantial adverse impact if the change in TP contributes to the state water quality standard exceedance
- A slightly beneficial impact if TP decreased by 0.01 to 0.02 mg/L
- A beneficial impact if TP decreased by more than 0.02 mg/L
- A substantial beneficial impact if the change in TP avoided any state water quality standard exceedance

Table 6.1-17 shows the quantified summary of the *deltas* of alternatives from the NAA based on the criteria stated above. The results obtained in the alternatives are discussed in detail in the following sections.

Table 6.1-17.
Summary of Median Change in Total Phosphorus of the Alternatives from the No Action Alternative during the Modeled Period (2001–2011)

Total phosphorus	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Buford Dam to Atlanta	Baseline	Slightly beneficial	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Slightly adverse	No change	Substant-ially adverse	Substant-ially adverse	Substant-ially adverse	Adverse	Substant-ially adverse
West Point Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
West Point Dam to Walter F. George Lake	Baseline	Slightly adverse	Substan-tially adverse	Slightly adverse	Substant-ially adverse	Substant-ially adverse	Substant-ially adverse	Substant-ially adverse	Substant-ially adverse
Walter F. George Lake	Baseline	No change	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

Longitudinal profiles were used as an initial indication of changes that would be expected between the NAA and the different alternatives. Figure 6.1-95 through Figure 6.1-102 illustrate the response of orthophosphate (PO_4) and TP to changes between the NAA and the alternatives in ways similar to other parameters. Figure 6.1-103 through Figure 6.1-106 illustrate the response of TP to changes between the NAA and the alternatives in ways similar to other parameters.

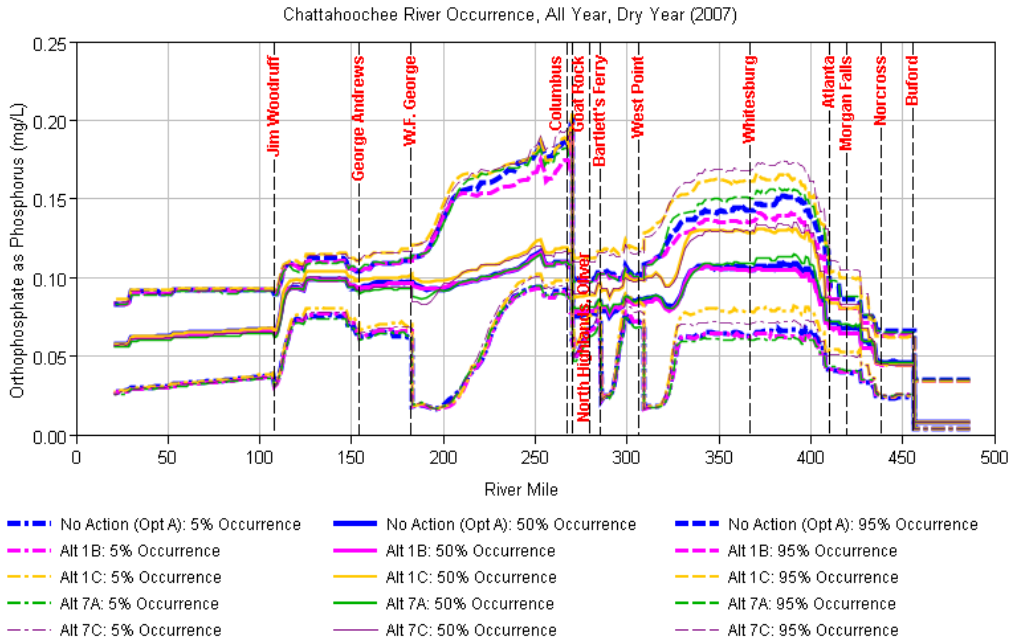


Figure 6.1-95. Longitudinal Profile Occurrence of Modeled Orthophosphate in the ACF Basin for a Dry Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

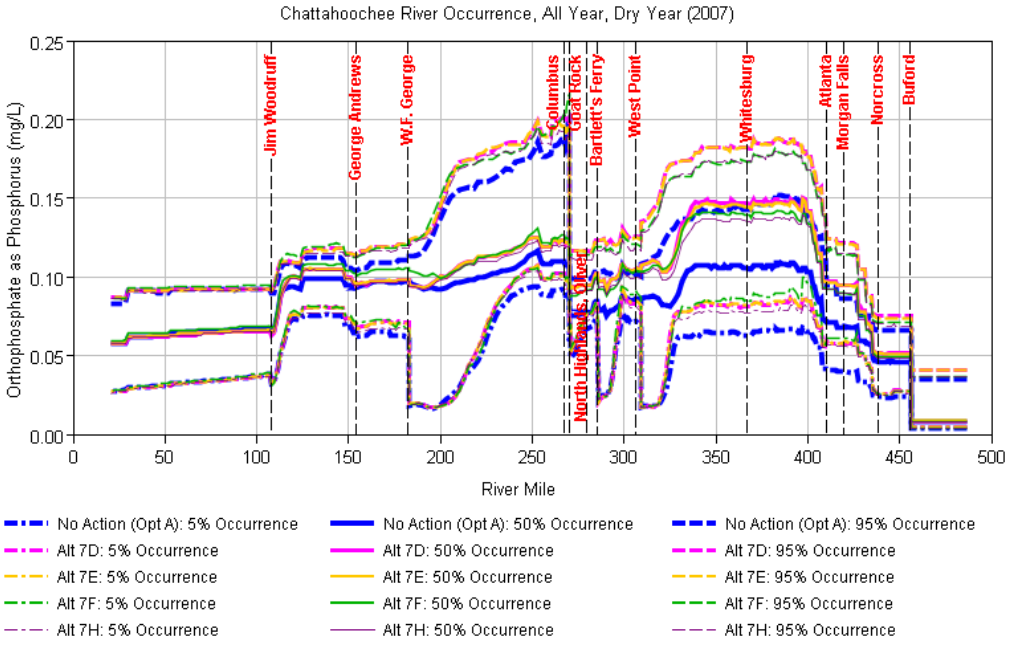


Figure 6.1-96. Longitudinal Profile Occurrence of Modeled Orthophosphate in the ACF Basin for a Dry Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

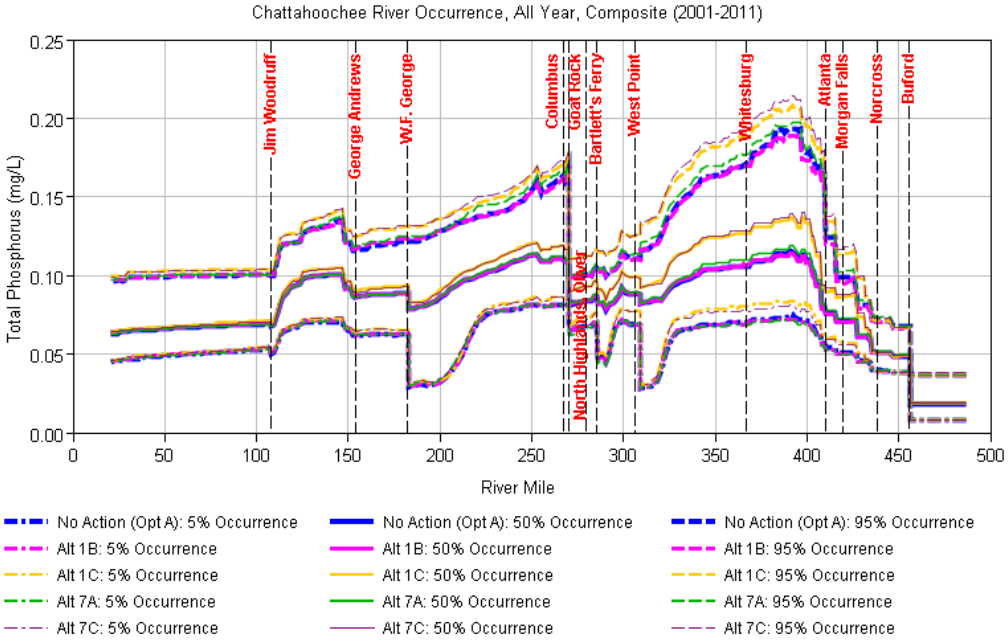


Figure 6.1-97. Longitudinal Profile Occurrence of Modeled Total Phosphorus in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 1B, 1C, 7A, and 7C

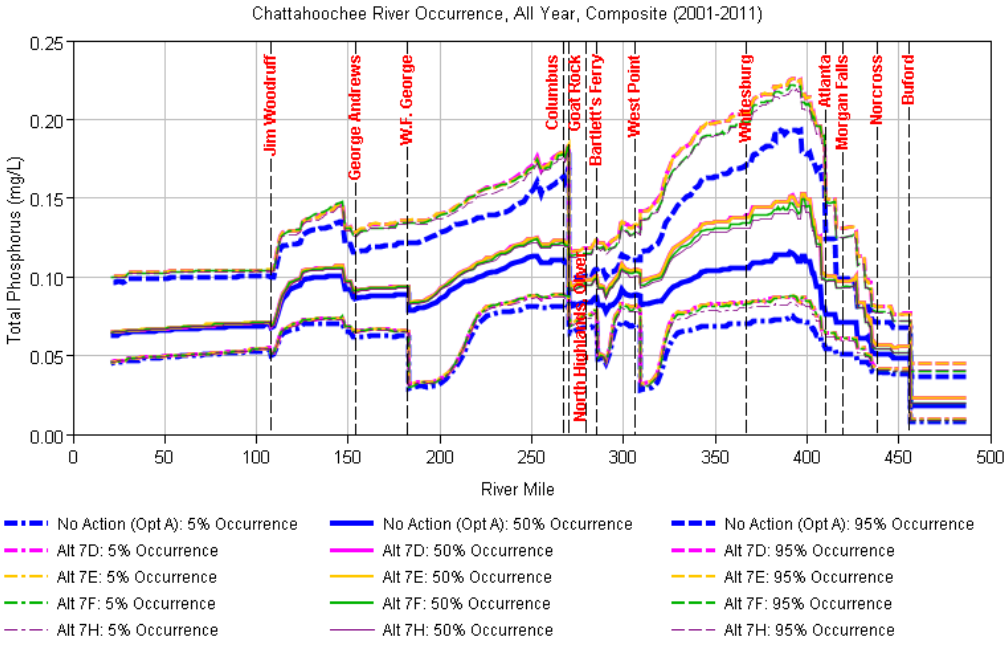


Figure 6.1-98. Longitudinal Profile Occurrence of Modeled Total Phosphorus in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

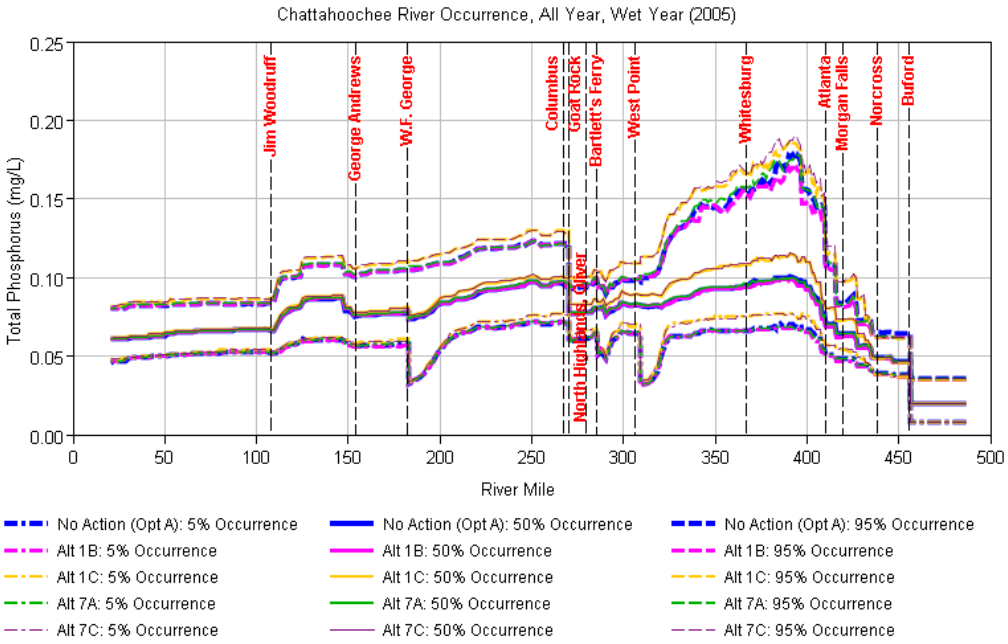


Figure 6.1-99. Longitudinal Profile Occurrence of Modeled Total Phosphorus in the ACF Basin for a Wet Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

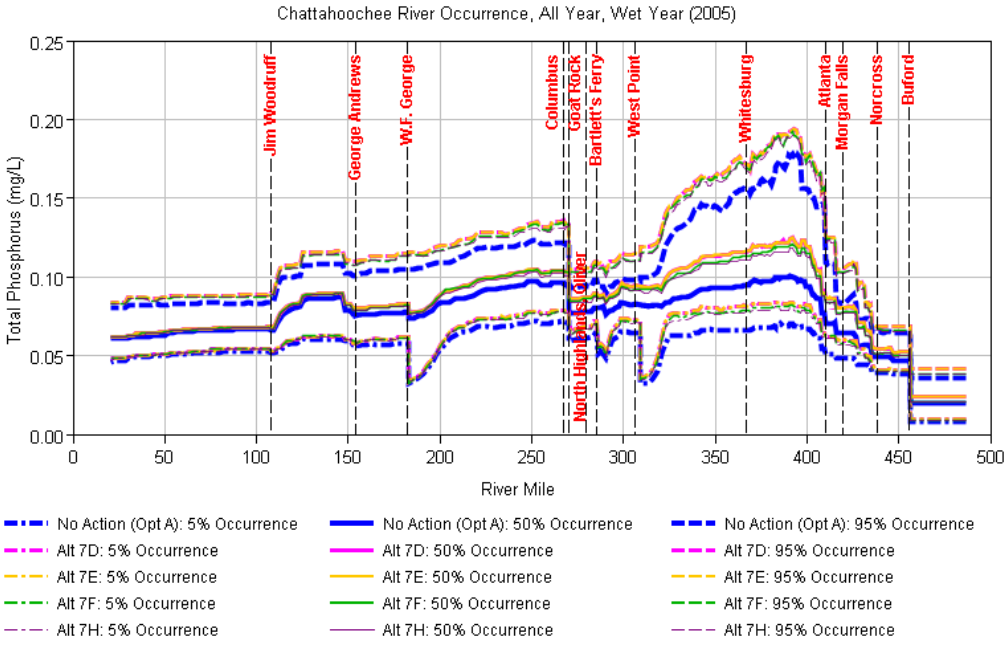


Figure 6.1-100. Longitudinal Profile Occurrence of Modeled Total Phosphorus in the ACF Basin for a Wet Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

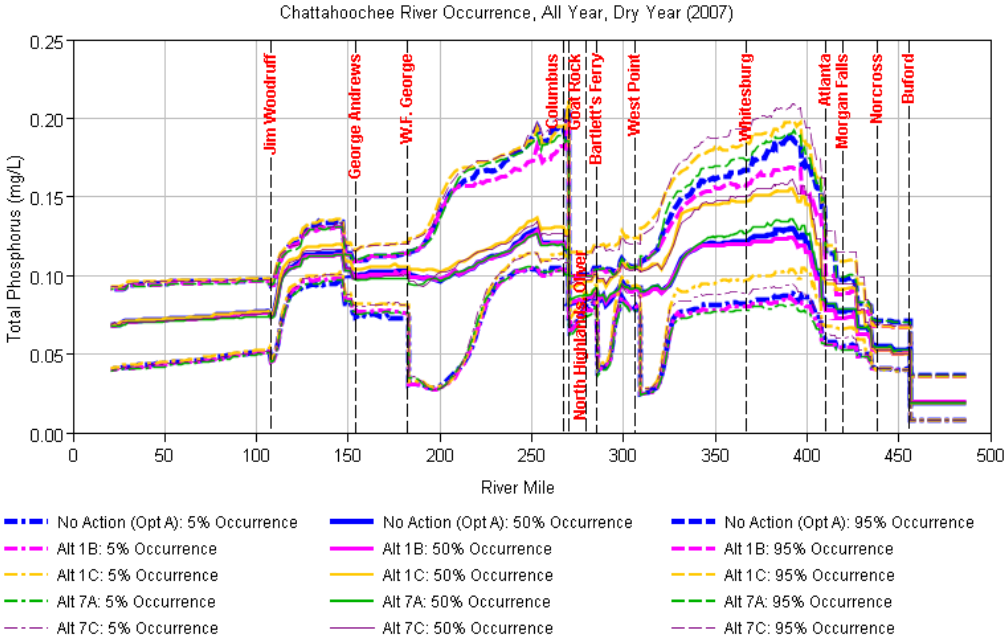


Figure 6.1-101. Longitudinal Profile Occurrence of Modeled Total Phosphorus in the ACF Basin for a Dry Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

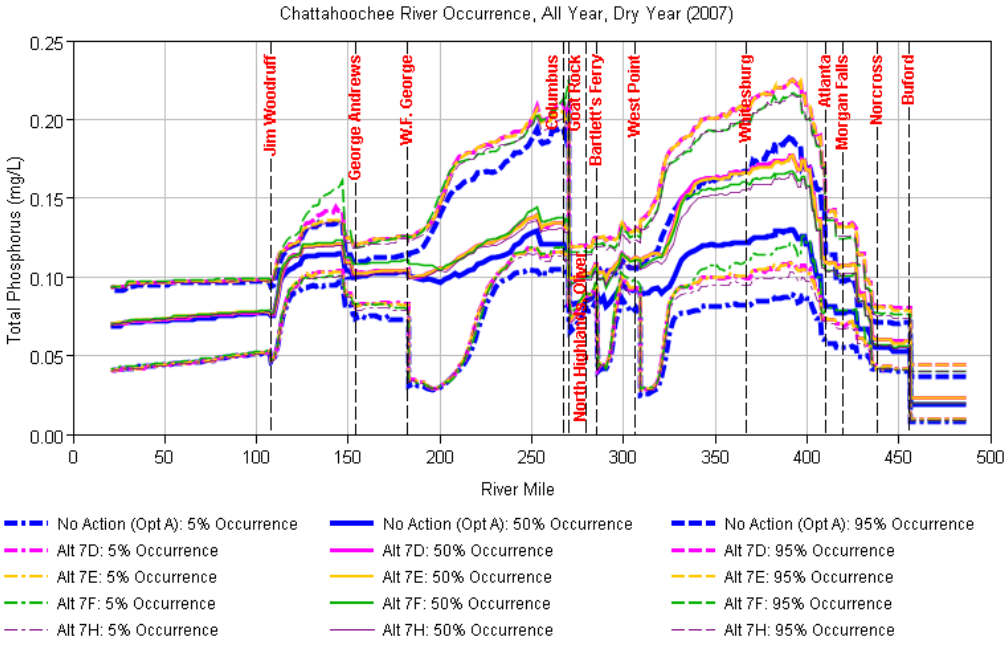


Figure 6.1-102. Longitudinal Profile Occurrence of Modeled Total Phosphorus in the ACF Basin for a Dry Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

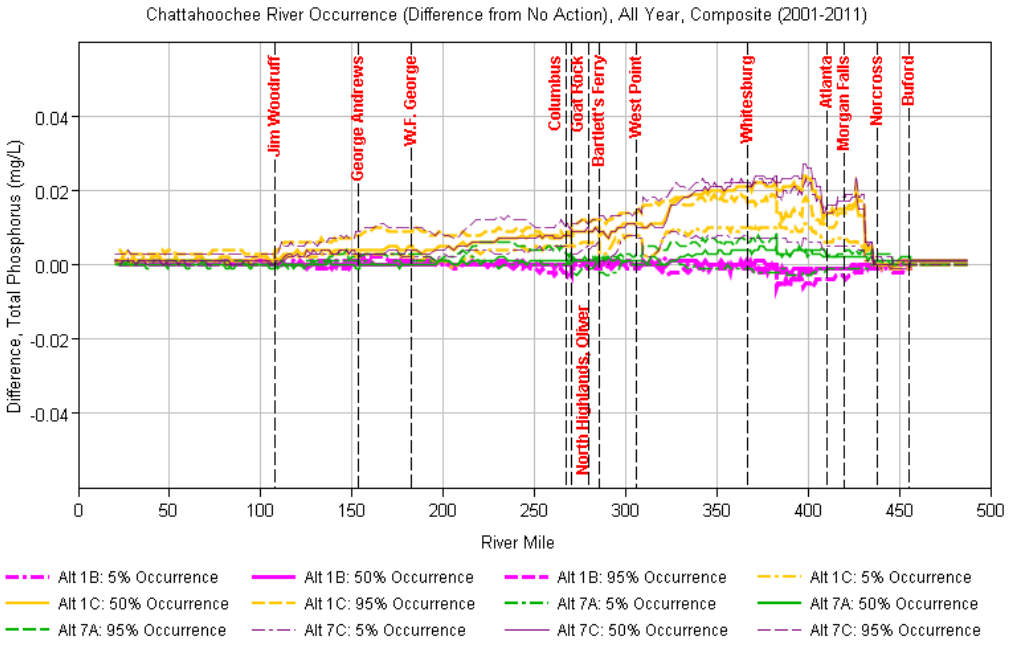


Figure 6.1-103. Longitudinal Profile of Difference in Modeled Total Phosphorus from the NAA in the ACF Basin for Alternatives 1B, 1C, 7A, and 7C

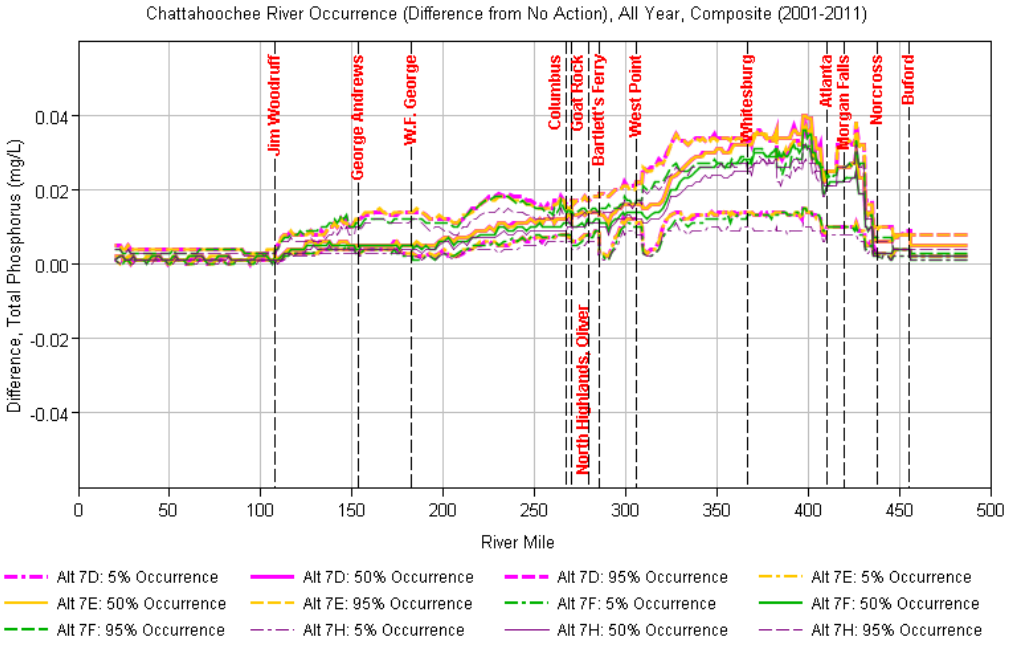


Figure 6.1-104. Longitudinal Profile of Difference in Modeled Total Phosphorus from the NAA in the ACF Basin for Alternatives 7D, 7E, 7F, and 7H (PAA)

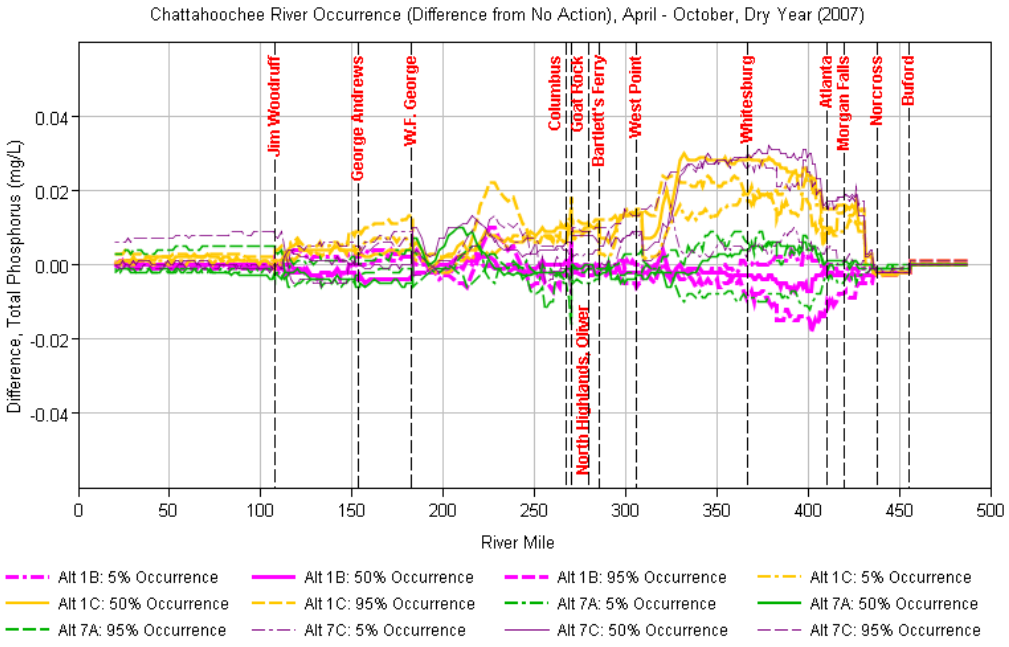


Figure 6.1-105. Longitudinal Profile of Difference in Modeled Total Phosphorus from the NAA in the ACF Basin during Growing Season of a Dry Year for Alternatives 1B, 1C, 7A, and 7C

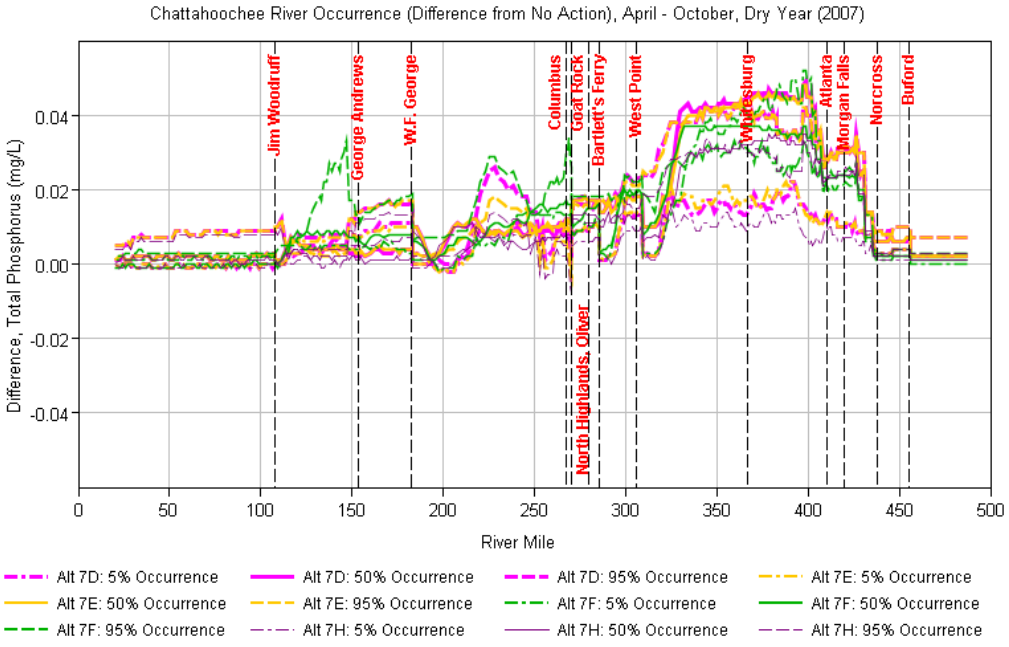


Figure 6.1-106. Longitudinal Profile of Difference in Modeled Total Phosphorus from the NAA in the ACF Basin during Growing Season of a Dry Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.2.3.1 No Action Alternative

The major effect of phosphorus on water quality is its influence on the growth of chlorophyll *a;* higher levels of phosphorus can mean higher levels of chlorophyll *a* and degraded water quality.

Lake Lanier's modeled results indicate that over the modeled period, the median TP concentrations and the 5th and 95th percent occurrences would be expected to be at 0.033 mg/L, 0.023 mg/L, and 0.053 mg/L, respectively (Figure 6.1-97).

From the tailrace of Buford Dam to Atlanta, the daily median TP concentration increases from 0.048 mg/L to 0.076 mg/L. The rare event of a 95th percent occurrence of TP concentrations would be in the range of 0.068 mg/L to 0.124 mg/L. A similar trend and magnitudes can be expected for median TP levels for a wet year (Figure 6.1-99).

As presented in Figure 6.1-97, the 0.08-0.12 mg/L increase in median TP from Atlanta to West Point Lake could be attributed to the wastewater treatment dischargers, with the 95th percent occurrence ranging from 0.151 to 0.193 mg/L. As tabulated in Table 6.1-16 from modeled results, the TP loads in the year 2003 are close to the water quality standard of 1.4 million lbs. The most critical changes in TP would be expected in low flow years, represented by conditions in 2007. In dry-weather conditions, the median TP concentrations indicate an increase of up to 0.08 mg/L in the reach downstream of Atlanta to Whitesburg (Figure 6.1-101). In dry-weather conditions along this reach of the Chattahoochee River, concentrations of TP reach 0.048 mg/L.

A decrease in TP concentrations in the maximum of the median concentrations would be expected in the reach from Atlanta to West Point Lake. The maximum of the median TP concentrations would decrease from 0.116 to 0.096 mg/L (a 0.02 mg/L decrease from Atlanta to West Point Lake).

The range of modeled results for median TP in the reach from West Point Dam to Walter F. George Lake is 0.04–0.08 mg/L. According to Table 6.1-16, at Walter F. George Lake at Chattahoochee River and U.S. Highway 39, the TP loads are expected to exceed the 2 million lbs state standard in the years 2005 and 2009.

The median TP concentrations at the Walter F. George Lock and Dam would be expected at 0.08 mg/L. The TP at the 95th percent occurrence level would be 0.411 mg/L (Figure 6.1-97).

Changes in median TP concentrations along the Chattahoochee River for the reach downstream of Walter F. George Lock and Dam to Lake Seminole for the entire modeled period would be expected to be around 0.089 mg/L (Figure 6.1-97).

At Lake Seminole, the modeled TP concentration at the median and 5th percent occurrence level would be greater than the water quality standard set by the state of Florida for its lakes of 0.084 mg/L.

The modeled median TP concentration in the Apalachicola River would be expected to be 0.067 mg/L, greater than the water quality standard set by 0.017 mg/L.

Both TP and PO_4 were modeled. As mentioned earlier, TP impacts the chlorophyll *a* levels in a water body and with phosphorus usually existing as PO_4 in nature, a closer look at PO_4 in the basin better illustrates the influences of the various sources on its levels. A comparison of PO_4 during dry periods indicates that the reservoirs are sinks for PO_4 (Figure 6.1-95). Reservoir operations resulting in changes in flow along the Chattahoochee River would be expected to affect the impact that point source discharges have in the system, especially under low flow conditions.

6.1.2.3.2 Alternative 1B

Based on Figure 6.1-103 and Table 6.1-16, little to no change would be expected in the median TP concentrations under the NAA from Lake Lanier to Apalachicola River. The water quality would continue to be better than the standards at Lake Seminole and the Apalachicola River. However, during the growing season of a dry year, the longitudinal change in TP concentrations from Buford Dam to West Point Lake at the 95th percent occurrence level would decrease 0.01 mg/L. The slightly beneficial conditions would be expected in this reach of the ACF Basin because the decrease in median TP concentration is between 0.01–0.02 mg/L.

The NAA modeled annual TP loads exceed water quality standards set by Georgia in the Walter F. George Lake headwaters in 2005 and 2009 (Table 6.1-16). Therefore, although modeled annual TP loads for Alt1B continue to exceed water quality standards from West Point Dam to Walter F. George Lake, those exceedances would not be considered substantially adverse. Instead, the median increase from NAA in 2005 and 2009 was assumed slightly adverse for Alt1B.

6.1.2.3.3 Alternative 1C

In Lake Lanier, little to no change would be expected under Alt1C in the median concentrations and concentrations at the 5th and 95th percent occurrence levels.

In the reach from Buford Dam to Atlanta, an increase of 0.01 mg/L in the median TP concentrations from the NAA would be expected. The increase in concentration would create slightly adverse conditions in the reach, possibly contributing to increased chlorophyll *a* growth.

The reach from Atlanta to West Point Lake would be expected to have the greatest increase under Alt1C of any of the reaches in the basin. During the modeled period, the median TP concentrations and the concentration at the 95th percent occurrence level would increase by 0.02 mg/L. Based on the decision criteria set for TP, this range of increase in concentrations would result in slightly adverse conditions (Figure 6.1-103). In addition, there would be a 0.03 mg/L increase in the median TP concentrations during the growing season of a dry year under Alt1C (Figure 6.1-105). This would be expected to create adverse conditions in the reach from April through October in a dry year. The water quality standard set by the state of Georgia at West Point Lake tributaries would be met according to modeled simulations. Increased median TP concentrations could be attributed to the water supply option C.

From West Point Lake to Walter F. George Lake, based on the median TP concentrations during the modeled period and the growing season of a dry year, there would be a 0.01–0.02 mg/L increase in the TP concentrations (Figure 6.1-103 and Figure 6.1-105). However, as per Table 6.1-16, the modeled annual loads for TP would be higher than the water quality standard allowed for TP for Walter F. George Lake headwaters in 2003, 2005, and 2009. Modeled TP would be higher than the water quality standard in an additional year compared to the NAA, creating substantially adverse conditions in the reach from West Point Dam to Walter F. George Lake.

In the Walter F. George Lake of the basin, there would be slightly adverse conditions caused by median TP concentrations increasing by 0.01 mg/L.

Little to no change under Alt1C would be expected in the reach from Walter F. George Lock and Dam to the Apalachicola River. Modeled TP concentrations would continue to be higher than water quality standards allowed at Lake Seminole and the Apalachicola River.

6.1.2.3.4 Alternative 7A

Under Alt7A, there would be little to no change from the NAA in the ACF Basin. Alt7A modeled TP loads would continue to be greater than water quality standards allowed at the Walter F. George Lake headwaters, Lake Seminole, and the Apalachicola River. The NAA modeled annual TP loads exceed water quality standards set by Georgia in the Walter F. George Lake headwaters in 2005 and 2009 (Table 6.1-16). Therefore, although modeled annual TP loads for Alt7A continue to exceed water quality standards from West Point Dam to Walter F. George Lake, those exceedances would not be considered substantially adverse. Instead, a median increase from NAA in 2005 and 2009 was assumed slightly adverse for Alt1A.

Minimal changes observed in Alt7A indicate that there would be a negligible effect on TP by implementing water management Alt7. The change from the NAA in Table 6.1-16 quantifies the change in load that would be expected from changes in water management operations. The differences between Alt7A and alternatives 7C, 7D, 7E, 7F, and the PAA in Table 6.1-16 represent the changes in water quality that would be expected from changes to return flows from various water supply options.

6.1.2.3.5 Alternative 7C

The changes in TP concentrations expected under Alt7C from the NAA would be similar to the changes expected in Alt1C from NAA in the reach from Lake Lanier to Atlanta and from Walter F. George Lake to the Apalachicola River.

In the reach from Atlanta to West Point Lake, the changes in TP concentrations during the modeled period and the growing season of a dry year from the NAA would be similar to the changes observed in Alt1C compared to the NAA (Figure 6.1-103 and Figure 6.1-105); 2003 being the exception. In the modeled simulation of 2003, the annual TP load would be greater than the water quality standard set by Georgia at West Point Lake headwaters (Table 6.1-16). This exceedance of water quality standards, when the NAA met standards, would be expected to be substantially adverse for the reach from Atlanta to the headwaters of West Point Lake. West Point Lake conditions would be similar to those under Alt1C.

The TP loads into the headwaters of Walter F. George Lake would also be higher than the water quality standard in the modeled simulation of 2003 when the NAA met water quality standards. This simulated change in meeting water quality standards would be assumed to create substantially adverse conditions from West Point Dam to the headwaters of Walter F. George Lake.

6.1.2.3.6 Alternative 7D

In the reach from Buford Dam to Atlanta, the median TP concentrations for Alt7D would be greater than the NAA by 0.01 mg/L, creating slightly adverse conditions.

From Atlanta to West Point Lake, Figure 6.1-103 illustrates that the change in median TP concentration and at the 95th percent occurrence level would be 0.03 mg/L greater than the NAA. Such high concentrations would be expected due to the changes in water withdrawn and returned downstream of Atlanta. According to Table 6.1-16, modeled TP would be greater than water quality standards allowed at the West Point Lake headwaters when standards would be met under the NAA, causing substantially adverse conditions in this reach.

From West Point Lake to Lake Seminole, there would be an increased change of 0.01 mg/L from the NAA, creating slightly adverse conditions. In the reach from West Point Dam to the headwaters of Walter F. George Lake, the modeled annual TP loads (Table 6.1-16) would be greater than the water quality standards in 2003 when the NAA would be expected to meet standards. This exceedance of water quality

standards, when the NAA met standards, would be expected to be substantially adverse for the reach from West Point Dam to the headwaters of Walter F. George Lake.

In the reach from Lake Seminole to Apalachicola River, there would be little to no change expected from the NAA. Modeled TP concentrations would continue to be greater than water quality standards in this reach.

6.1.2.3.7 Alternative 7E

The changes in TP concentrations expected in Alt7E from the NAA would be similar to the changes expected in Alt7D in the ACF Basin. Modeled TP loads would be higher than the water quality standards allow at West Point Lake headwaters, Walter F. George Lake headwaters, Lake Seminole, and the Apalachicola River.

6.1.2.3.8 Alternative 7F

Based on Figure 6.1-104 and Figure 6.1-106, the trend changes expected in Alt7F would be similar to the trend expected in Alt7D with the magnitude of changes lower than under Alt7D compared to the NAA in the 5th and 95th percent occurrence levels. Modeled TP loads would be lower than the water quality standard allowed at West Point Lake headwaters. However, adverse conditions would be expected in this reach (from Atlanta to West Point Lake) because the change in median TP concentrations would be greater than 0.02 mg/L. Similar to the NAA, modeled TP loads would continue to be higher than water quality standards allowed at Walter F. George Lake headwaters, Lake Seminole, and the Apalachicola River; except in 2003. In the model simulation for 2003, the annual TP load (Table 6.1-16) would be greater than the water quality standard allowed at the headwaters of Walter F. George Lake when the NAA would be expected to meet standards. This exceedance of water quality standards, when the NAA met standards, would be expected to be substantially adverse for the reach from West Point Dam to Walter F. George Lake.

6.1.2.3.9 Alternative 7H (PAA)

In the reach from Buford Dam to Atlanta, the median TP concentrations for the PAA would be greater than the NAA by 0.01 mg/L, creating slightly adverse conditions.

From Atlanta to West Point Lake, Figure 6.1-104 illustrates that the change in median TP concentration and at the 95th percent occurrence level would be 0.03 mg/L greater than under the NAA. Such high concentrations would be expected due to the changes in water withdrawn and returned downstream of Atlanta. Some dischargers could be required by their NPDES permits to change the way they operate during low flow conditions. GAEPD intends to ensure that water quality standards are met at all flows based on revisions in their 2013 triennial review (GAEPD 2014).

According to Table 6.1-16, TP loads would be greater than water quality standards allowed at the West Point Lake headwaters in the model simulation of 2003 for the PAA. However, in 2003, the modeled NAA would meet water quality standards. Therefore, substantially adverse conditions could occur in this reach due to not meeting water quality standards under the PAA when they would have been met under the NAA. During all other years of the modeled period, TP loads under the PAA would be less than the water quality standard.

From West Point Dam to Walter F. George Lake, there would be an increased change of 0.01 mg/L from the NAA. However, the annual TP loads (Table 6.1-16) would be greater than the water quality standard allowed at the Walter F. George Lake headwaters in the model simulation of 2003 when the NAA would have been expected to meet standards. This exceedance of water quality standards, when the NAA met

standards, would be expected to be substantially adverse for the reach from West Point Dam to the headwaters of Walter F. George Lake.

In Walter F. George Lake and downstream to the Apalachicola River, there would be little to no change in concentrations expected from the NAA.

6.1.2.4 Nitrogen

Total nitrogen (TN) is an important parameter to look at because it affects the growth of chlorophyll *a;* the effects of chlorophyll *a* are discussed in the next section. Longitudinal profiles were used as an initial indication of changes that would be expected between the NAA and the different alternatives. Figure 6.1-107 through Figure 6.1-116 illustrate the response of TN to changes between the NAA and the alternatives in ways similar to other parameters. Reviewing the longitudinal profiles helped to identify changes in TN concentrations that may be attributed to assumptions about wastewater treatment dischargers' loads or the contributing watershed sources versus changes due to water management actions.

Each alternative was compared to the NAA and determined to have the following impacts:

- No additional impact if the change in TN was less than 0.1 mg/L
- A slightly adverse impact if TN increased by 0.1 to 0.5 mg/L
- An adverse impact if TN increased by more than 0.5 mg/L
- A substantial adverse impact if the change in TN contributes to the state water quality standard exceedance
- A slightly beneficial impact if TN decreased by 0.1 to 0.5 mg/L
- A beneficial impact if TN decreased by more than 0.5 mg/L
- A substantial beneficial impact if the change in TN avoided any state water quality standard exceedance

Table 6.1-18 shows the quantified summary of the *deltas* of alternatives from the NAA based on the criteria stated above. The results obtained in the alternatives are discussed in detail in the following sections.

Table 6.1-18.
Summary of Median Change in Total Nitrogen of the Alternatives from the No Action Alternative during the Modeled Period (2001–2011)

Total nitrogen	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	Slightly beneficial	Slightly beneficial	No change	Slightly beneficial	Adverse	Adverse	Slightly adverse	Slightly adverse
Buford Dam to Atlanta	Baseline	Slightly beneficial	No change	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Adverse	No change	Adverse	Adverse	Adverse	Adverse	Adverse
West Point Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Adverse	Adverse	Slightly adverse	Slightly adverse
West Point Dam to Walter F. George Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

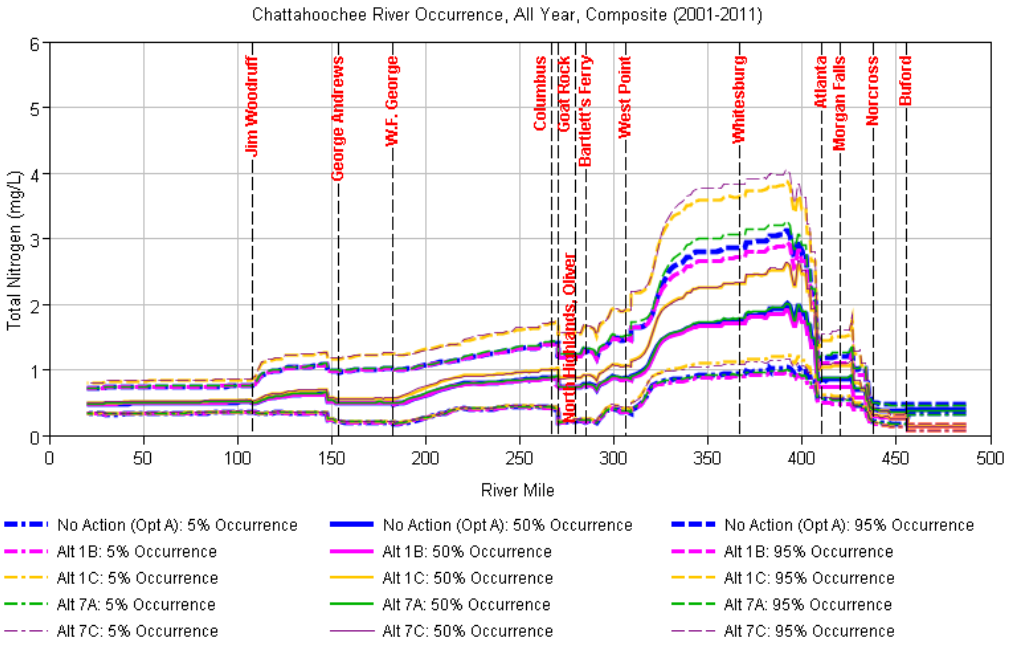


Figure 6.1-107. Longitudinal Profile Occurrence of Modeled Total Nitrogen in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 1B, 1C, 7A, and 7C

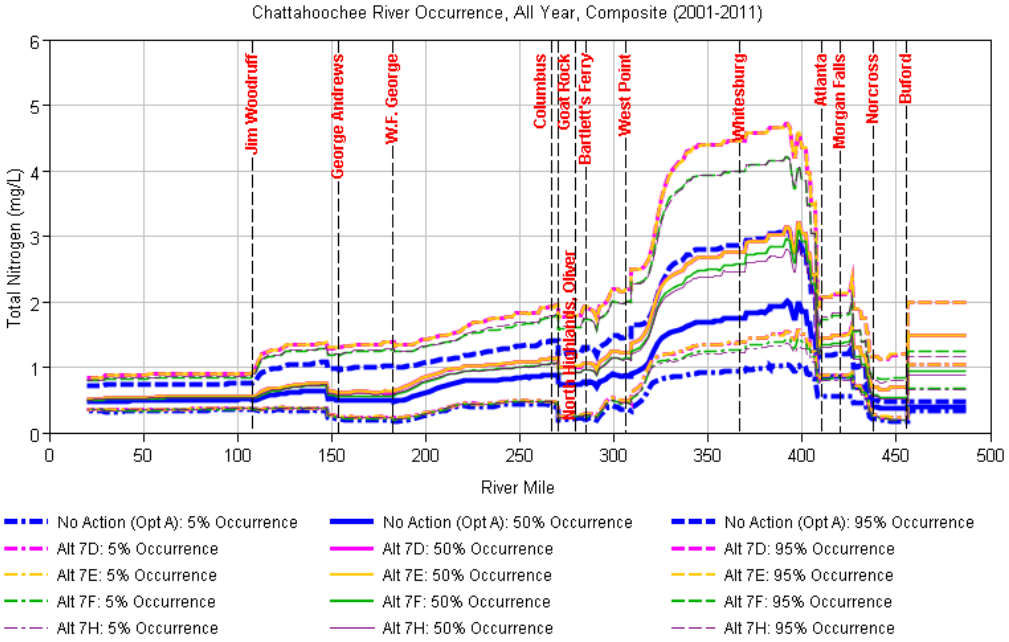


Figure 6.1-108. Longitudinal Profile Occurrence of Modeled Total Nitrogen in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

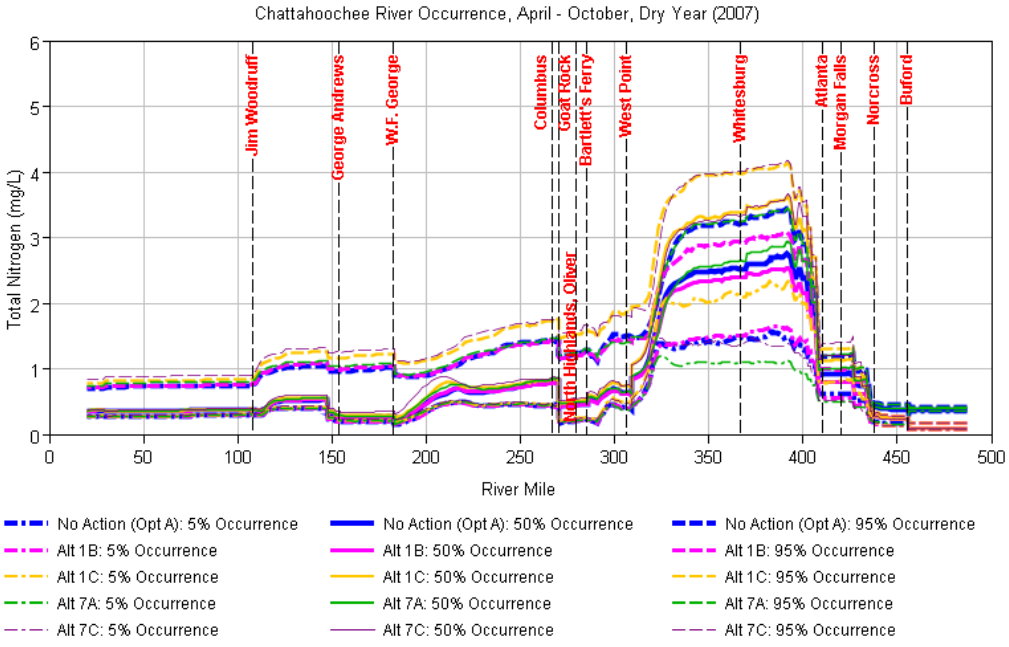


Figure 6.1-109. Longitudinal Profile Occurrence of Modeled Total Nitrogen in the ACF Basin during the Growing Season (April–October) of a Dry Year for NAA and Alternatives 1B, 1C, 7A, and 7C

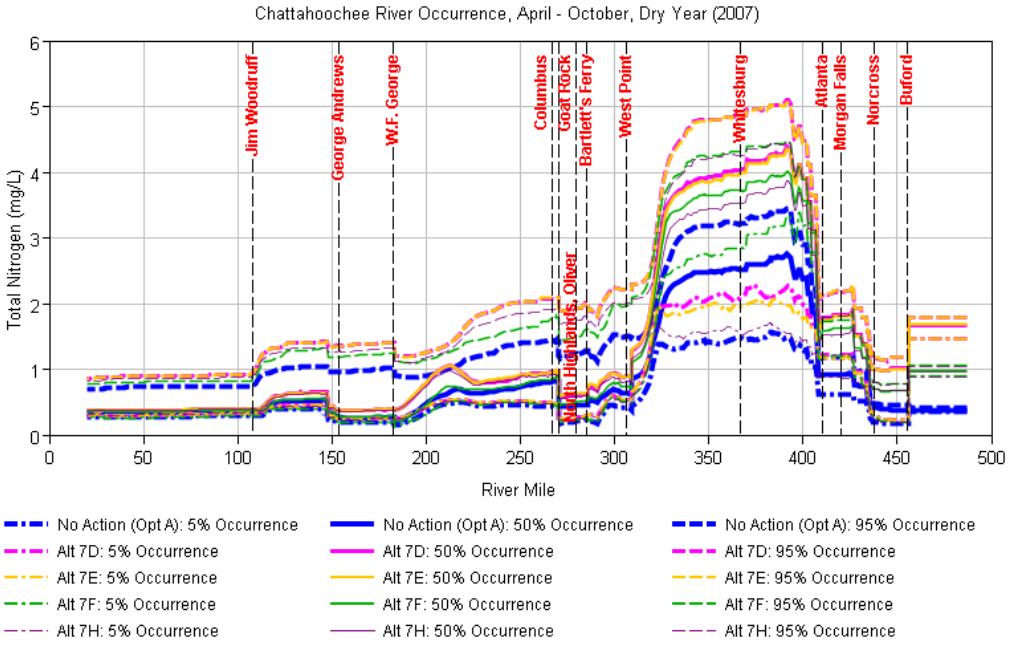


Figure 6.1-110. Longitudinal Profile Occurrence of Modeled Total Nitrogen in the ACF Basin during the Growing Season (April–October) of a Dry Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

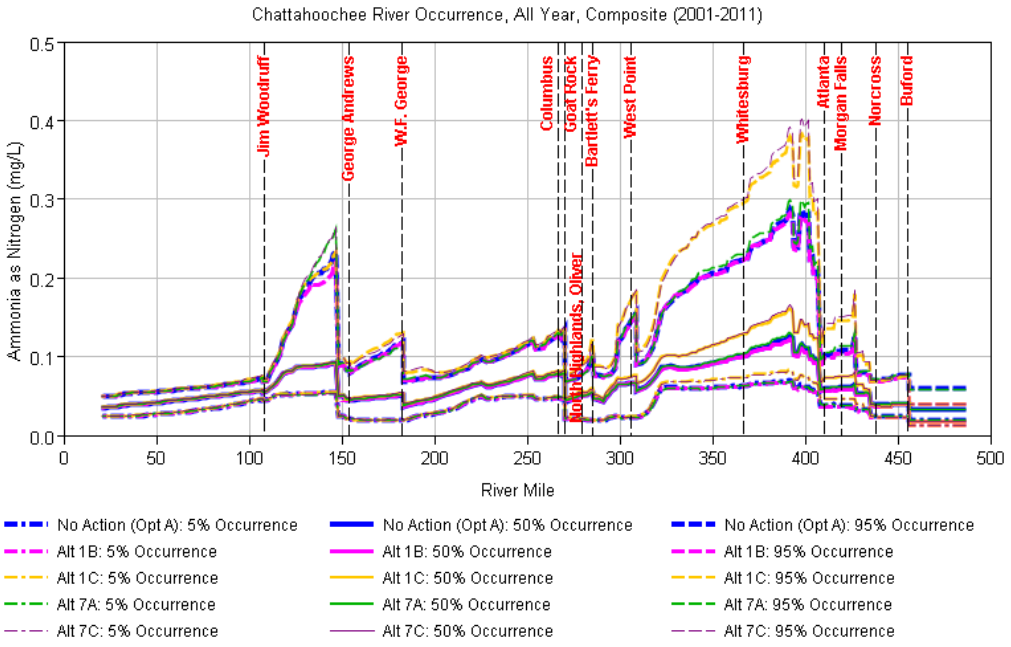


Figure 6.1-111. Longitudinal Profile Occurrence of Modeled Ammonia in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 1B, 1C, 7A, and 7C

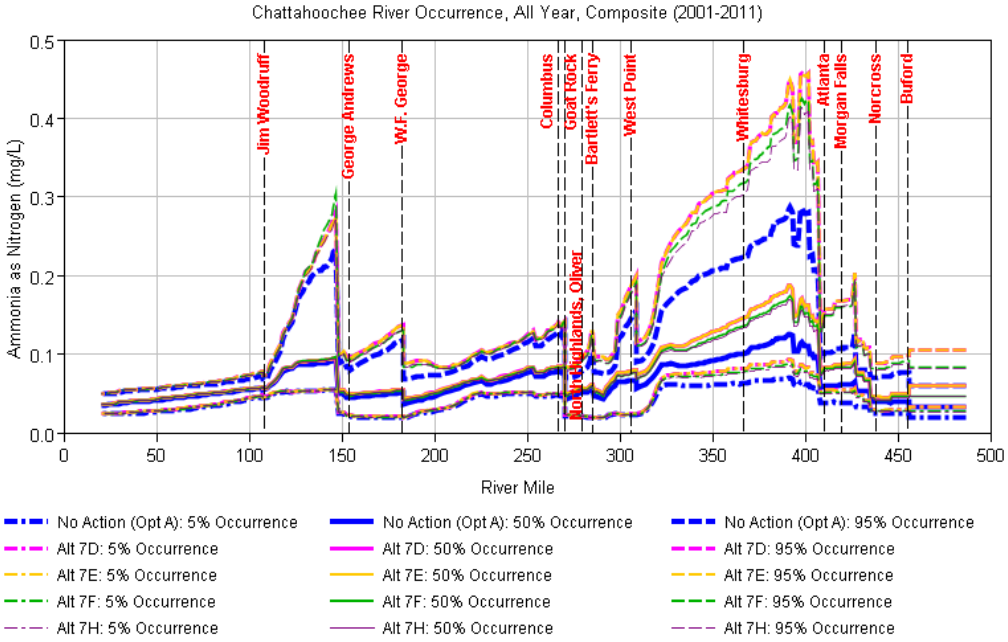


Figure 6.1-112. Longitudinal Profile Occurrence of Modeled Ammonia in the ACF Basin for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

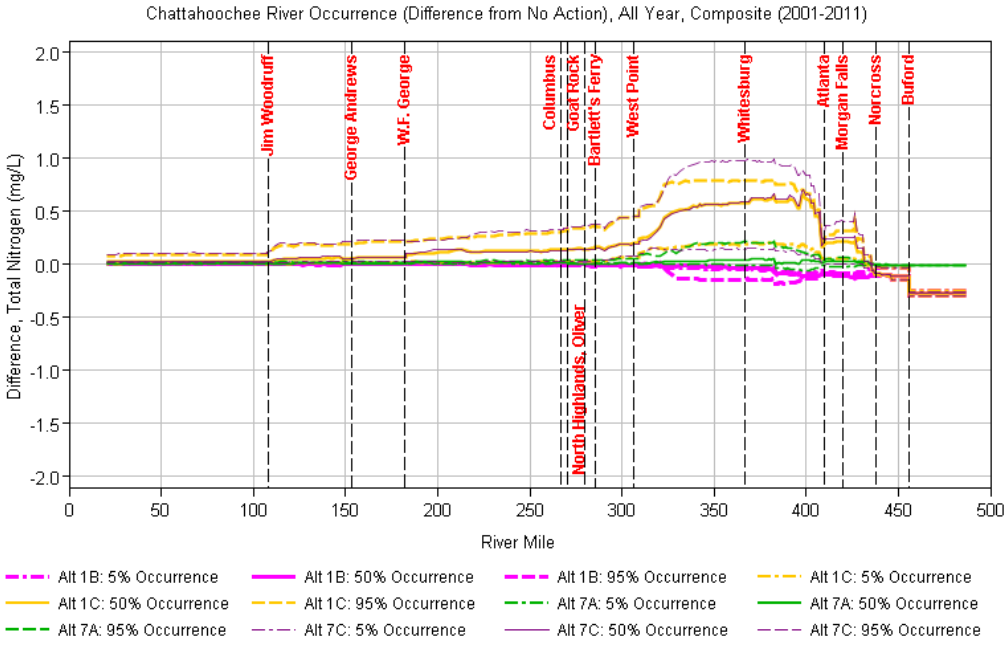


Figure 6.1-113. Longitudinal Profile of Difference in Modeled Total Nitrogen from the NAA in the ACF Basin for Alternatives 1B, 1C, 7A, and 7C

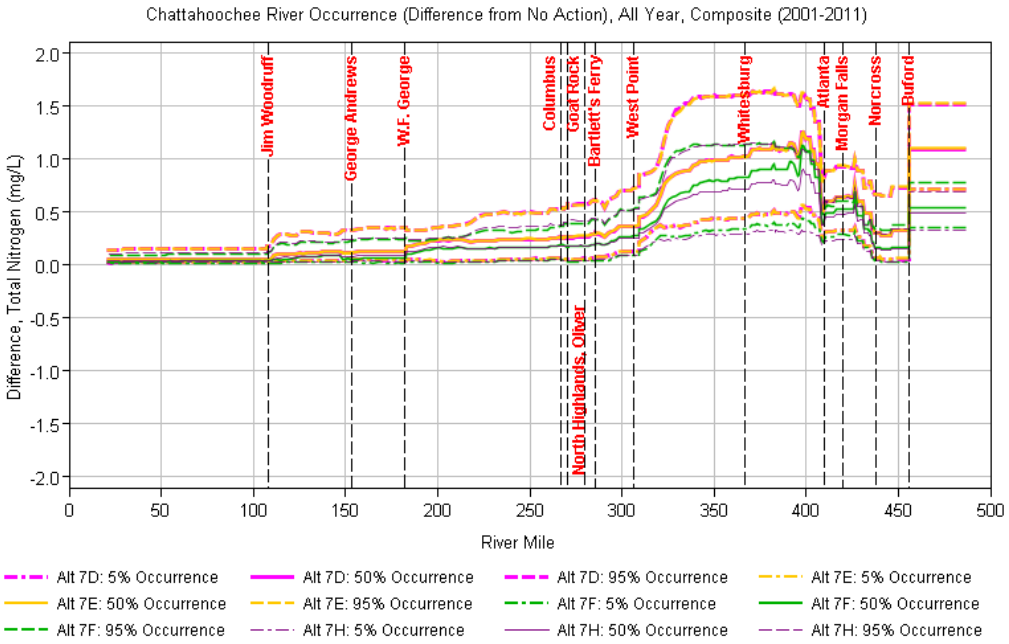


Figure 6.1-114. Longitudinal Profile of Difference in Modeled Total Nitrogen from the NAA in the ACF Basin for Alternatives 7D, 7E, 7F, and 7H (PAA)

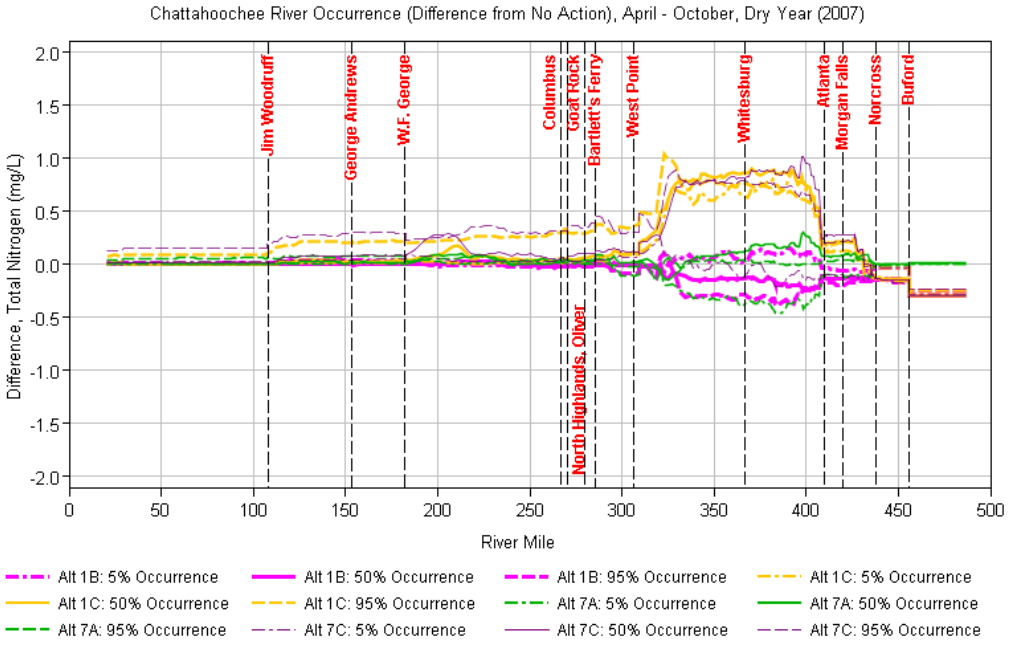


Figure 6.1-115. Longitudinal Profile of Difference in Modeled Total Nitrogen from the NAA in the ACF Basin during the Growing Season of a Dry Year for Alternatives 1B, 1C, 7A, and 7C

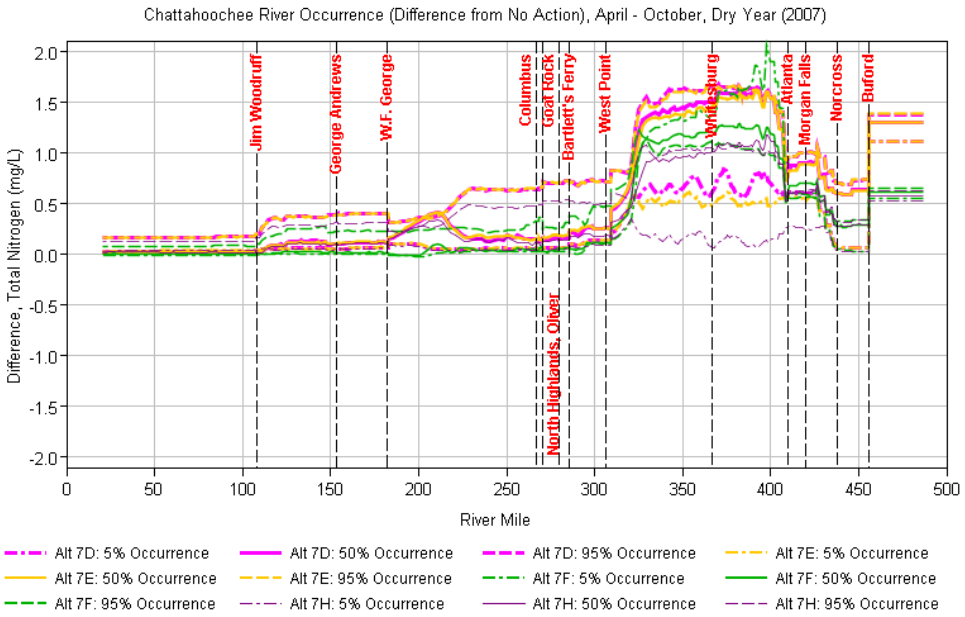


Figure 6.1-116. Longitudinal Profile of Difference in Modeled Total Nitrogen from the NAA in the ACF Basin during the Growing Season of a Dry Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.2.4.1 No Action Alternative

Lake Lanier, West Point Lake, and Walter F. George Lake have site-specific water quality standards for TN. TN concentrations at Lake Lanier and West Point Lake are not to be less than 4 mg/L, and at Walter F. George Lake, they cannot exceed 3 mg/L (GAEPD 2012a). Georgia has no in-stream standards for nitrogen. In November 2010, Florida finalized in-stream TN standards for freshwater streams. The standard in the freshwater reach of the Apalachicola River is 0.67 mg/L and, for clear lakes, it is 0.51 mg/L, with a range of 0.51–0.93 mg/L (FLDEP 2013b).

TN under the NAA indicates the levels increase around Atlanta and then decrease as the river moves downstream from Atlanta to the Apalachicola River (Figure 6.1-107). The TN increases are due to the nutrient load wastewater treatment discharges that occur along the river. Figure 6.1-107 and Figure 6.1-110 present the daily median TN along with the daily 5th and 95th percent occurrences over the modeled period. The discussion mainly focuses on the changes in the median TN, which is the most representative of overall conditions.

For Lake Lanier, the modeled results indicate that, over the modeled period and during normal, wet, or dry hydrologic conditions, the modeled median TN concentrations and the 5th and 95th percent occurrences would not be expected to exceed the water quality standard of 4 mg/L (Figure 6.1-107 and Figure 6.1-110).

From the tailrace of Buford Dam to Atlanta, the daily median TN concentration increases from 0.4 mg/L to 0.9 mg/L. The rare 95th percent occurrence of TN concentrations would be in the range of 0.5 mg/L to 1.2 mg/L. A similar trend and magnitudes can be expected for median TN levels for normal, wet, and dry years.

From Atlanta to West Point Lake, as illustrated in Figure 6.1-107, there is a 0.5–0.7 mg/L increase in median TN, which could be attributed to wastewater treatment discharges. The most critical changes in TN would be expected in low flow years, represented by conditions in 2007. In dry-weather conditions, the modeled median TN concentrations indicate an increase of up to 0.8 mg/L downstream of Atlanta, although there would be no violation of the water quality standard in the river reach. In dry-weather conditions along this reach of the Chattahoochee River, concentrations of TN are near 3.5 mg/L. With nitrate being the significant contributor to such high TN concentrations, algal growth may occur.

West Point Lake's modeled TN levels would not exceed the water quality standard of no TN concentration greater than 4 mg/L for all modeled conditions, including at the 95th percent occurrence for the entire modeled period.

From West Point Dam to Walter F. George Lake, the TN continues to decrease, except around Columbus, where TN again increases, most likely caused by the wastewater nutrient discharges.

Figure 6.1-107 illustrates the range of modeled results for TN in the area from West Point Dam to Walter F. George Lake. The TN water quality standard of less than 3 mg/L would be expected to be met.

For Walter F. George Lock and Dam to the Lake Seminole reach, modeled TN concentrations continue to decrease, meeting water quality standards (Figure 6.1-107 and Figure 6.1-109).

Below Lake Seminole, the modeled median TN concentration fluctuates from 0.5–0.6 mg/L, violating the water quality standard set for the lake by the state of Florida of 0.51 mg/L (FLDEP 2013b) and resulting in substantially adverse conditions.

However, further downstream in the Apalachicola River, the TN levels are below Florida's water quality standard. The modeled median TN concentration would be less than the standard by 0.2 mg/L (FLDEP 2013b).

A closer look at ammonia in the basin (Figure 6.1-111) better illustrates the influence of point and nonpoint sources. The sharp increases in the ammonia concentrations are mostly due to wastewater treatment discharges and some of the minor increases are due to increased watershed ammonia loadings. Reservoir operations resulting in changes in flow along the Chattahoochee River would be expected to affect the impact that point source discharges have in the system, especially under low flow conditions.

6.1.2.4.2 Alternative 1B

For Lake Lanier, the median TN *delta* would be expected to decrease by 0.2 mg/L, as illustrated in Figure 6.1-113, and would be expected to have a slightly beneficial effect in the lake. These slightly beneficial conditions would be most prevalent during the growing season of a dry year, as shown in Figure 6.1-115.

The median TN *delta* for the reach from Buford Dam to Atlanta decreases by 0.12 mg/L, yielding slightly beneficial conditions. This could be attributed to the water supply option B.

The changes in TN from Atlanta to West Point Lake for Alt1B from the NAA are illustrated in Figure 6.1-113. The TN median change for Alt1B is negligible; however, the decrease in TN at the 95th percent occurrence level is close to a 0.15 mg/L. The reach would be classified as *no change*, or negligible change from the NAA.

Little to no change would be expected from West Point Lake to downstream of the ACF Basin, as illustrated in Figure 6.1-113 through Figure 6.1-115.

6.1.2.4.3 Alternative 1C

Similar to the response in Alt1B, decreased TN would be beneficial to conditions in Lake Lanier (Figure 6.1-113).

In the reach from Buford Dam to Atlanta during the modeled period, little to no change would be expected from Buford Dam to Norcross. As illustrated in Figure 6.1-113, there would be a consistent increase in the median TN *delta* through Atlanta, creating slightly adverse conditions. The same phenomenon would be expected during a dry year (Figure 6.1-115).

The reach from Atlanta to West Point Lake would be the most adversely affected in the entire ACF Basin. The maximum median TN *delta* would be 0.6 mg/L in the reach from Atlanta to Whitesburg, resulting in an adverse impact. A water quality standard exceedance would be expected at the West Point Lake at the 95th percent occurrence (Figure 6.1-115) of modeled results. These conditions could be due to the operations to provide the 2040 need for the withdrawal of 408 mgd by Atlanta from the Chattahoochee River.

As illustrated in Figure 6.1-113 and Figure 6.1-115, the median *delta* concentrations of TN at West Point Lake, West Point Dam to Walter F. George Lake, and Walter F. George Lock and Dam would continue to decrease but still be above the NAA levels. TN conditions would improve from adverse to slightly adverse.

Little to no change would be expected at Lake Seminole and downstream in the ACF Basin, as illustrated in figures shown above.

6.1.2.4.4 Alternative 7A

Little to no change would be expected under Alt7A when compared to the NAA (indicating no major changes between water management alternatives Alt1 and Alt7). However, there would be slightly adverse conditions in the reach from Atlanta to West Point Lake during the growing season of a dry year.

6.1.2.4.5 Alternative 7C

The response of TN in Alt7C would be very similar to the response in Alt1C, with higher median TN *deltas* in some instances during the representative dry year (Figure 6.1-115). Compared to the NAA, Alt7C would result in the same slightly adverse conditions from West Point Lake to Walter F. George Lake and adverse conditions from Atlanta to West Point Lake.

6.1.2.4.6 Alternative 7D

As illustrated in Figure 6.1-114, the entire Chattahoochee River reach appears to be under adverse or slightly adverse conditions, with TN changes between 0.1 and 0.5 mg/L greater than the NAA.

In Lake Lanier, the median TN concentration would increase by about 0.71 mg/L compared to the NAA (Figure 6.1-114). The conditions would be adverse during the growing season of a dry year (Figure 6.1-116). These conditions could be attributed to 297 mgd being withdrawn from Lake Lanier.

From Buford Dam to Atlanta, the median TN concentrations would increase by 0.5 mg/L as compared to the NAA. The conditions would still be slightly adverse, including in the growing season of a dry year. The less adverse conditions could be attributed to withdrawing less water from the river since 297 mgd would be withdrawn from Lake Lanier.

The TN levels in the reach from Atlanta to West Point Lake would increase from the already high NAA TN concentrations, as the water supply option of D provides for the 2040 need of 408 mgd to Atlanta. The median TN concentration would increase by 1 mg/L compared to NAA. This reach would experience adverse conditions not only during the modeled period but also during all hydrologic (i.e., wet, dry, and normal) conditions. The modeled TN concentration in the reach would be expected to be greater than water quality standards at West Point Lake in the 95th percent occurrence, but because the concentrations are rare occurrences, would not be classified as substantially adverse.

The adverse conditions would continue to West Point Lake. Downstream of West Point Dam, the effects of dilution would be seen. At this reach, the median TN concentration would be changed by roughly 0.6 mg/L from the NAA as compared to 1 mg/L in the preceding reach.

From West Point Dam to Lake Seminole, the increase in TN is not as great—that is, a 0.1–0.5 mg/L increase from the NAA, resulting in slightly adverse conditions.

Little to no change would be expected in the downstream section of the ACF Basin at the Apalachicola River.

6.1.2.4.7 Alternative 7E

The response of TN modeled in Alt7E would be very similar to the response in Alt7D, with adverse and slightly adverse conditions for most of the river. The occurrence of higher median TN *deltas* in some instances during the representative dry year (Figure 6.1-116) is because of the similarity between water supply options D and E, except for the withdrawal from Lake Lanier, which would decrease by 40 mgd in Alt7E.

6.1.2.4.8 Alternative 7F

In Lake Lanier, the median TN increases by 0.35 mg/L compared to the NAA, resulting in a slightly adverse condition. This condition could be due to the 30.6 percent of return of wastewater to Lake Lanier. Similar to Lake Lanier, the reach from Buford Dam to Atlanta would experience slightly adverse conditions from increased TN. The water withdrawals would be similar to water supply option D.

From Atlanta to West Point Lake, the median TN concentration would increase by 0.84 mg/L from the NAA for the modeled period and by 1.2 mg/L during the growing season of a dry year, resulting in an adverse condition.

West Point Dam to Walter F. George Lock and Dam median TN *deltas* would increase by 0.1–0.5 mg/L, resulting in slightly adverse conditions. Little to no change in TN would be expected in the rest of the Chattahoochee and Apalachicola rivers.

6.1.2.4.9 Alternative 7H (PAA)

In Lake Lanier, the median TN increases by 0.32 mg/L compared to the NAA, resulting in a slightly adverse condition. Similar to Lake Lanier, the reach from Buford Dam to Atlanta would experience slightly adverse conditions from increased TN. This condition could be due to the return rate of wastewater.

From Atlanta to West Point Lake, the median TN concentration would increase by 0.72 mg/L from the NAA for the modeled period and by 1.2 mg/L during the growing season of a dry year, resulting in an adverse condition.

West Point Dam to Walter F. George Lock and Dam median TN *deltas* would increase by less than 0.2 mg/L, resulting in slightly adverse conditions. Little to no change in TN would be expected in the rest of the Chattahoochee and Apalachicola rivers.

6.1.2.5 Chlorophyll *a*

Chlorophyll *a* is used as an indicator of lake or reservoir health. Too much chlorophyll *a* caused by excess nutrients can cause the lake or reservoir to become unhealthy for humans and fish. Management of reservoirs does not generally contribute to nutrient loads in water bodies. However, the regulation of inflows to and outflows from reservoirs, along with the change in water withdrawals and wastewater discharges, do influence phytoplankton growth.

Figure 6.1-117 through Figure 6.1-126 and Figure 6.1-122 present the processed HEC-5Q modeled output for chlorophyll *a* over the modeled period for the NAA. Like the water temperature profiles, they also illustrate variations between proposed revisions to the Master Manual as defined in Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA (Alt7H) from the NAA.

Each alternative was compared to the NAA and determined to have the following impacts:

- No additional impact if the change in chlorophyll *a* was less than 0.5 µg/L
- A slightly adverse impact if chlorophyll *a* increased by 0.5 to 2.0 µg/L
- An adverse impact if chlorophyll *a* increased by more than 2.0 µg/L
- A substantial adverse impact if the change in chlorophyll *a* contributes to the state water quality standard exceedance set for lakes
- A slightly beneficial impact if chlorophyll *a* decreased by 0.5 to 2.0 µg/L
- A beneficial impact if chlorophyll *a* decreased by more than 2.0 µg/L
- A substantial beneficial impact if the change in chlorophyll *a* avoided any state water quality standard exceedance set for lakes

Table 6.1-19 shows the quantified summary of the *deltas* of alternatives from the NAA based on the criteria stated above. The results obtained in the alternatives are discussed in detail in the following sections.

Table 6.1-19.
Summary of Median Change in Chlorophyll *a* of the Alternatives from the No Action Alternative during the Modeled Period of 2001-2011

Chlorophyll *a*	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	No change	No change	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Buford Dam to Atlanta	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Atlanta to West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Dam to Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

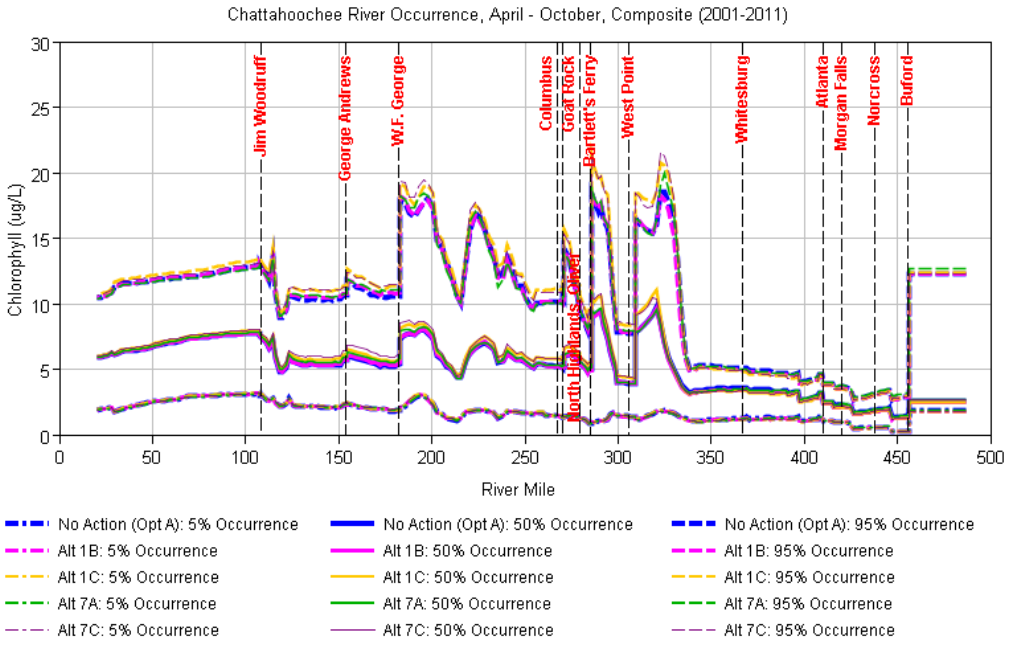


Figure 6.1-117. Longitudinal Profile Occurrence of Daily Chlorophyll *a* in the ACF Basin during the Growing Season (April-October) for the Period of 2001-2011 for the NAA and Alternatives 1B, 1C, 7A, and 7C

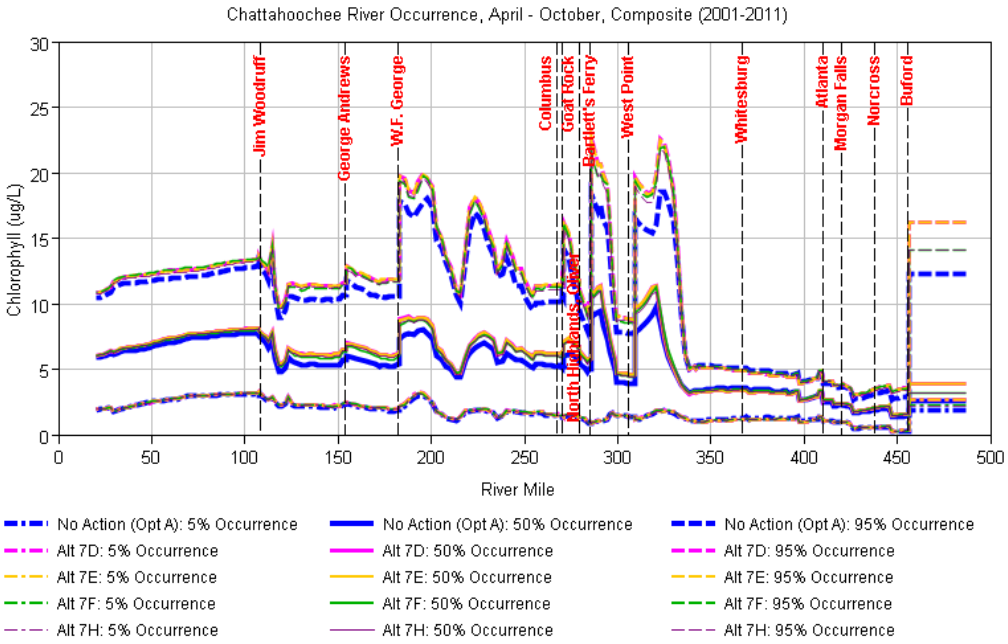


Figure 6.1-118. Longitudinal Profile Occurrence of Modeled Chlorophyll *a* in the ACF Basin during the Growing Season (April–October) for the Period of 2001–2011 for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

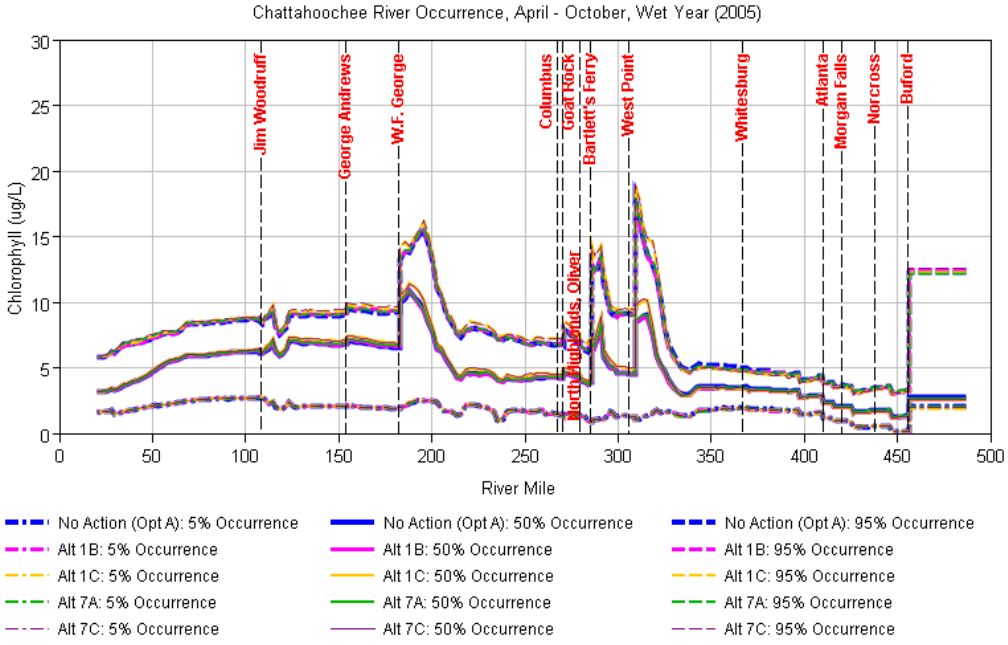


Figure 6.1-119. Longitudinal Profile Occurrence of Modeled Chlorophyll *a* in the ACF Basin during the Growing Season (April–October) of a Wet Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

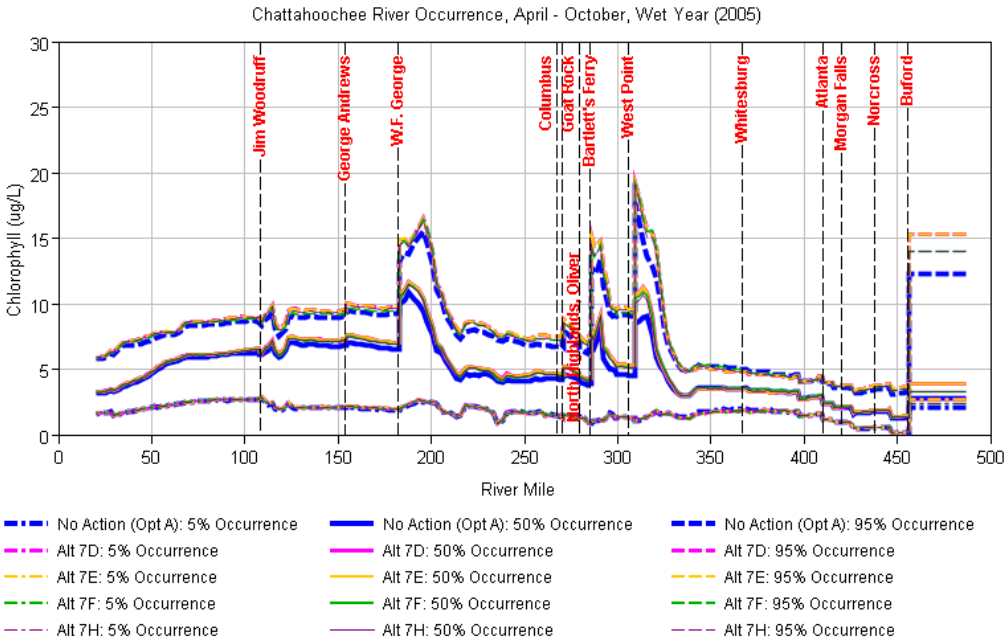


Figure 6.1-120. Longitudinal Profile Occurrence of Modeled Chlorophyll *a* in the ACF Basin during the Growing Season (April–October) of a Wet Year for the NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

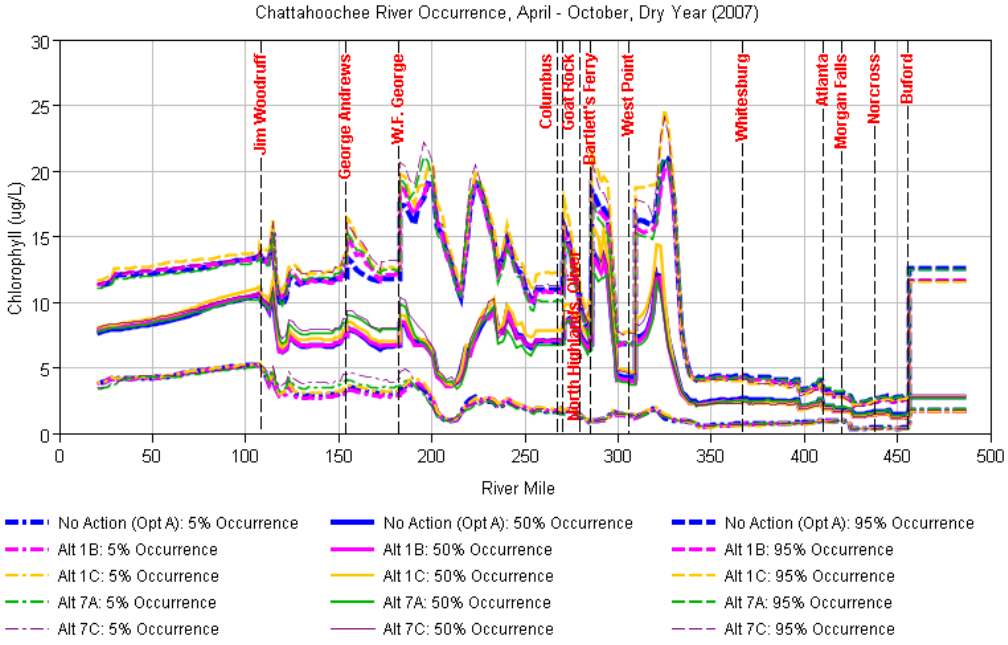


Figure 6.1-121. Longitudinal Profile Occurrence of Modeled Chlorophyll *a* in the ACF Basin during the Growing Season (April–October) of a Dry Year for the NAA and Alternatives 1B, 1C, 7A, and 7C

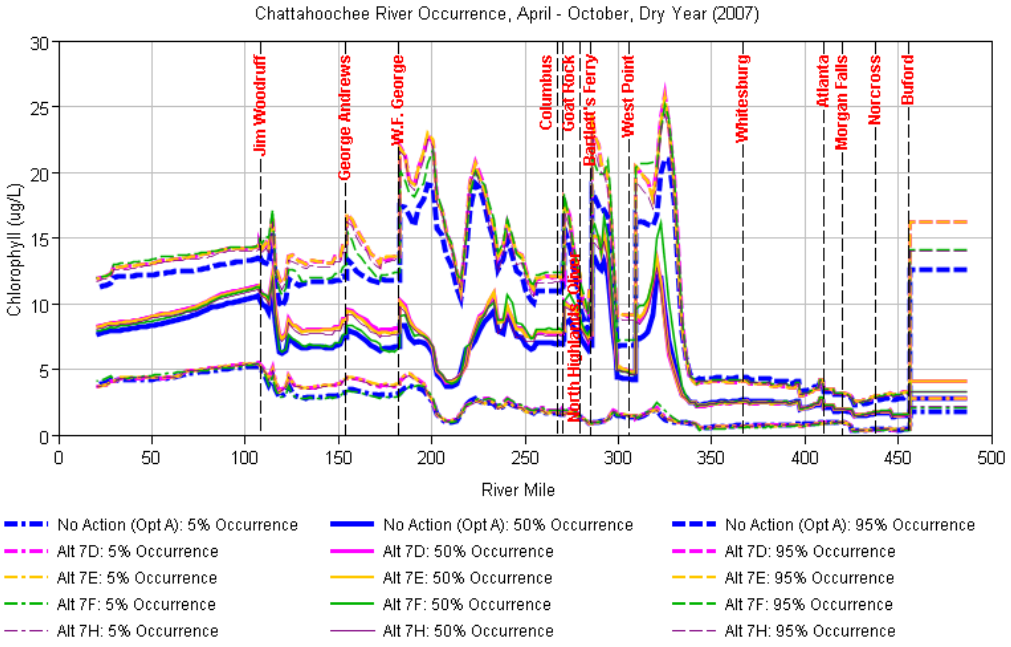


Figure 6.1-122. Longitudinal Profile Occurrence of Modeled Chlorophyll *a* in the ACF Basin during the Growing Season (April–October) of a Dry Year for NAA and Alternatives 7D, 7E, 7F, and 7H (PAA)

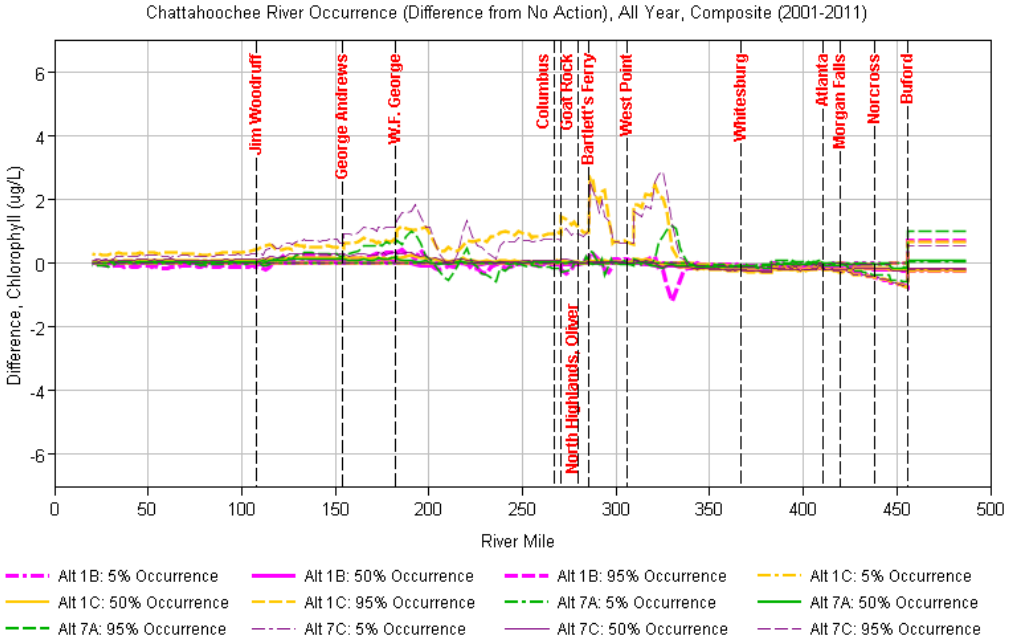


Figure 6.1-123. Longitudinal Profile of Difference in Modeled Chlorophyll *a* from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 1B, 1C, 7A, and 7C

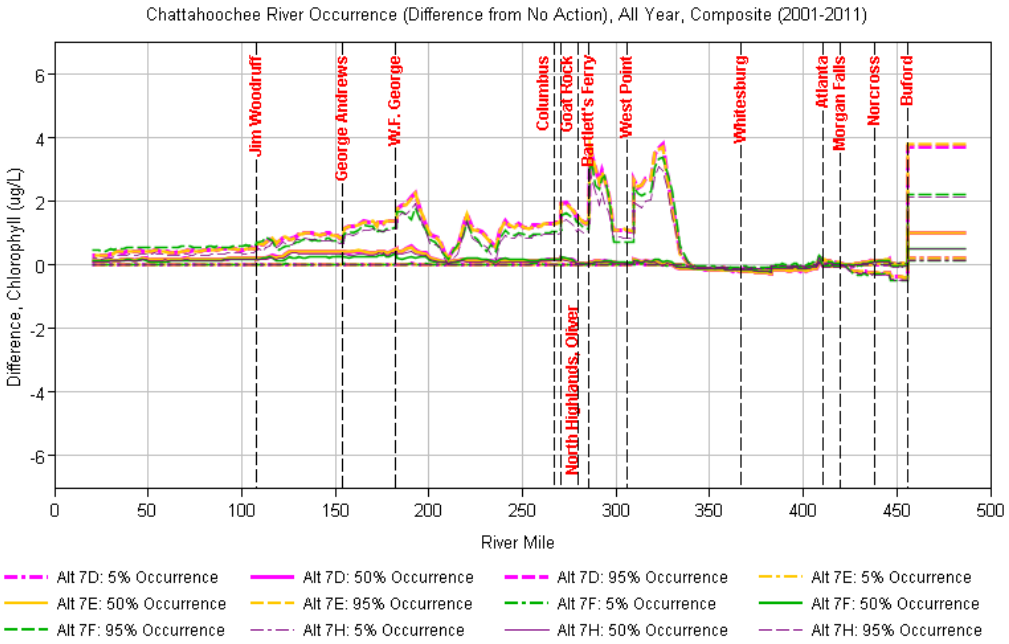


Figure 6.1-124. Longitudinal Profile of Difference in Modeled Chlorophyll *a* from the NAA in the ACF Basin for the Period of 2001–2011 for Alternatives 7D, 7E, 7F, and 7H (PAA)

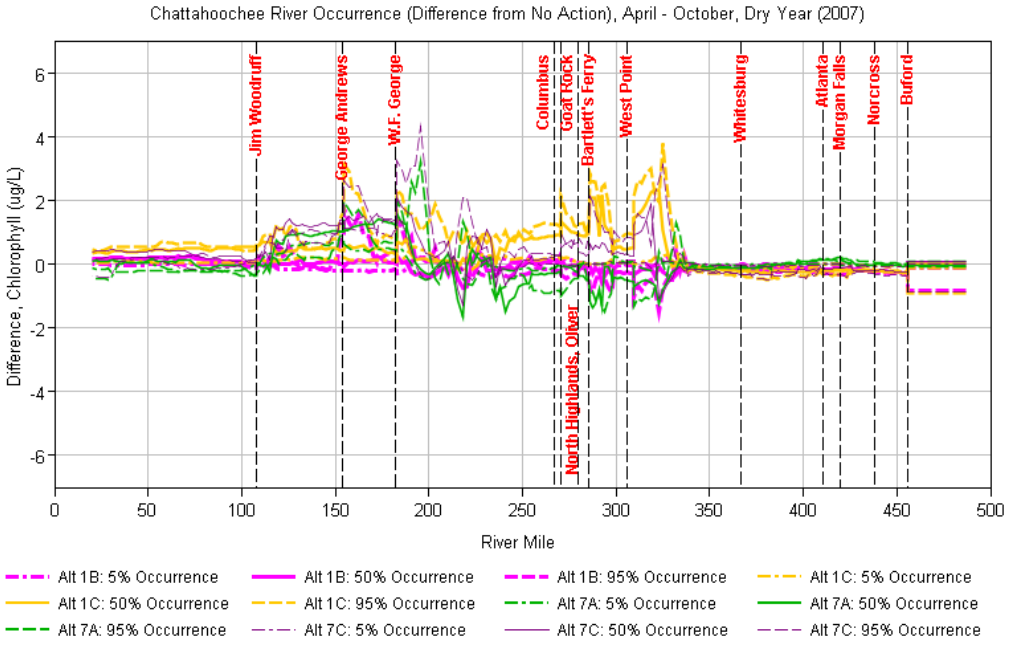


Figure 6.1-125. Longitudinal Profile of Difference in Modeled Chlorophyll *a* from the NAA in the ACF Basin during the Growing Season (April–October) of a Dry Year for Alternatives 1B, 1C, 7A, and 7C

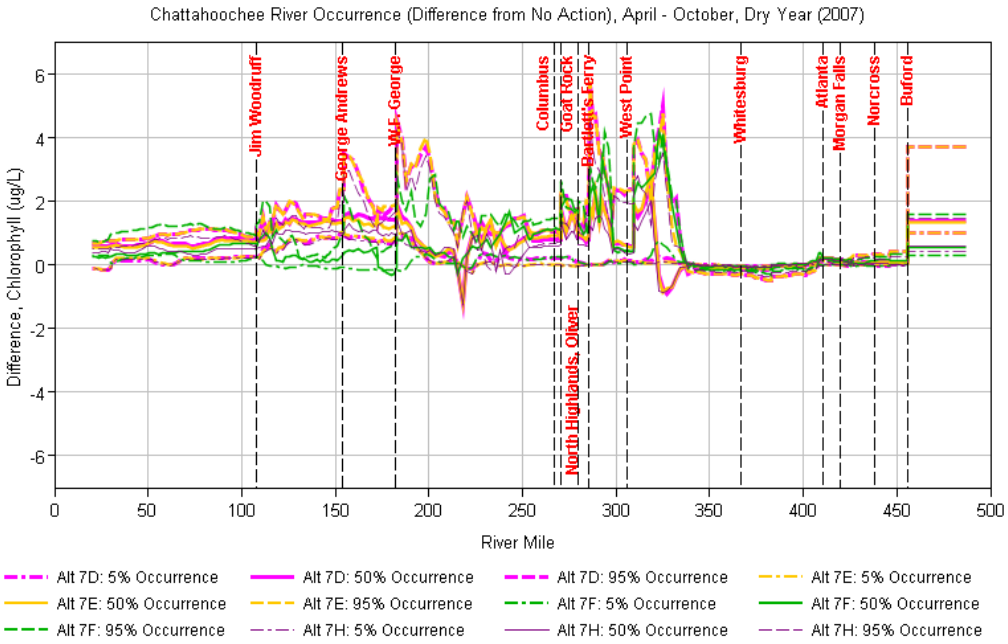


Figure 6.1-126. Longitudinal Profile of Difference in Modeled Chlorophyll *a* from the NAA in the ACF Basin during the Growing Season (April–October) of a Dry Year for Alternatives 7D, 7E, 7F, and 7H (PAA)

6.1.2.5.1 No Action Alternative

The state of Georgia has set water quality standards for chlorophyll *a* that apply during the growing season (April–October) and are site-specific for Lake Lanier, West Point Lake, and Walter F. George Lake. The growing season average of chlorophyll *a* at Lake Lanier, upstream of Buford Dam forebay, upstream from the Flowery Branch confluence, and at Browns Bridge Road should not exceed 5 µg/L. At Boiling Bridge on the Chestatee River and at the Chattahoochee River, the growing season average of chlorophyll *a* should not exceed 10 µg/L. According to Georgia water quality standards, the growing season average of chlorophyll *a* for West Point Lake should not exceed 27 µg/L at the LaGrange water intake (Table 2.1-29). For Walter F. George Lake, mid-river at U.S. Highway 82, the growing season average should not exceed 18 µg/L and 15 µg/L at mid-river below the dam forebay (Table 2.1-29). For clear lakes in Florida, the EPA has set the numeric criteria of 0.006 mg/L (6 µg/L). No standard has been set for freshwater streams in the state of Florida (Table 2.1-30). The 2012 list of impaired waters identified Lake Lanier and Apalachicola Bay as being impaired for chlorophyll *a* (Table 2.1-33). Other water bodies in the ACF Basin are meeting water quality standards for chlorophyll *a*.

Figure 6.1-117 through Figure 6.1-118 present the longitudinal profile occurrence of phytoplankton as chlorophyll *a* in micrograms per cubic meter or per liter of water (µg/L) for April through October for the modeled period of 2001–2011. This period is generally considered the growing season by water quality regulators in Georgia and Alabama. The growing season is a period of plant productivity followed by warm temperatures and little rainfall. The figures illustrate the modeled water quality for the modeled period (Figure 6.1-117), as well as wet (Figure 6.1-119) and dry (Figure 6.1-121) years. The greatest changes in chlorophyll *a* growth occur in dry years (Figure 6.1-121). Chlorophyll *a* varies more in dry years because water is more stagnant as a result of decreased inflows. During years of more rainfall,

pollutants are often flushed through the system by higher streamflows (Figure 6.1-120). The process of flushing can also be referred to as *dilution*.

Modeled results indicate that the growing season chlorophyll *a* would be expected to be maintained around 2.5 µg/L in Lake Lanier (Figure 6.1-117). At this concentration, the water quality standard at the lake would be met during the modeled period of 2001–2011 (Table 6.1-20).

In the Chattahoochee River reach from Buford Dam to Atlanta, the median growing season concentration during the modeled period, wet, and dry year, would be expected to be less than 2.5 µg/L. In addition, the concentrations at the 95th percent occurrence level would be expected to be less than 5 µg/L, indicating low phytoplankton growth.

In the reach from Atlanta to West Point Lake, the median growing season concentration of chlorophyll *a* from Atlanta to Whitesburg would be maintained at less than or equal to 5 µg/L. However, further downstream of Whitesburg at RM 340, a rapid increase in median chlorophyll *a* concentrations could be expected during the growing season and, by RM 330, close to 10 µg/L (Figure 6.1-117). This could be attributed to the increased load of nutrients from the cities surrounding Atlanta. At the mid-reservoir location in West Point Lake, the modeled growing season chlorophyll *a* would be expected to exceed the water quality standard. The 95th percent occurrence level at this location would be between 7–17 µg/L. Although the mid-reservoir location might not be located exactly at the LaGrange water intake—where the standard (less than 27 µg/L) is set—concentrations modeled over the year are within the water quality standard, including at the 95th percent occurrence level during the modeled period. In 2007, the response of chlorophyll *a* at the mid-reservoir location was much worse than in the 2001 drought. The mid-reservoir chlorophyll *a* at West Point Lake (illustrated in Table 6.1-20) would be the expected result of sustained minimum flow releases from Buford Dam during drought operations.

Maximum chlorophyll *a* concentrations at the West Point Lake would be greatly affected by the nutrient loads. Although the median chlorophyll *a* concentrations would be maintained at 2.6 µg/L, the 95th percent occurrence level would reach 17 µg/L during the growing season.

In the reach from West Point Dam to Walter F. George Lake, the elevated growing season median concentrations upstream of Bartletts Ferry Dam would not be expected to affect other recourses or current uses of the ACF Basin.

Similar to West Point Lake, rare occurrences of increased chlorophyll *a* would be expected in dry years in mid-reservoir stations at Walter F. George Lake (Table 6.1-20). Stakeholders in the basin are most concerned about chlorophyll *a* in Walter F. George Lake, where concentrations could be near 20 µg/L in dry years at the 95th percent occurrence level. These areas are likely locations for plant and algal growth because water moving through reservoirs generally slows down, allowing time for nutrient uptake. Occurrences in the 5th and 95th percent of the modeled output would be considered rare. In Walter F. George Lake, the growing season average standard for chlorophyll *a* is 18 µg/L at U.S. Highway 82. Median growing season concentrations in the NAA were simulated below the state standard in a mid-reservoir location (Table 6.1-20).

At Lake Seminole, the geometric mean would never exceed 6 µg/L (Table 6.1-20). The growing season median chlorophyll *a* would be in the range of 5–7 µg/L, a considerable decrease in concentration from the preceding reaches.

At the Apalachicola River, the median growing season concentrations would consistently decrease from downstream of Lake Seminole and would be maintained around 6 µg/L at RM50.

Table 6.1-20.
Growing Season (April–October) Average and Annual Geometric Mean of Chlorophyll *a* at the Lakes in the ACF Basin

Year	Modeled (µg/L)									Change from NAA (µg/L)							
	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier[a]																	
2000	2.6	4.9	5.2	4.9	6.4	6.4	5.7	5.7	5.7	2.3	2.4	2.6	2.4	3.8	3.8	3.1	3.1
2001	3.2	3.9	4.0	3.8	4.1	4.8	4.7	4.2	4.2	0.7	0.8	0.6	0.9	1.6	1.5	1.0	0.9
2002	3.8	4.0	4.0	4.2	4.1	5.8	5.8	4.9	4.8	0.1	0.2	0.4	0.3	2.0	2.0	1.1	1.0
2003	3.7	3.9	3.8	3.8	4.0	5.1	5.1	4.3	4.3	0.1	0.1	0.1	0.2	1.3	1.3	0.6	0.6
2004	4.6	4.3	4.3	4.5	4.4	6.1	6.1	5.1	5.2	-0.3	-0.3	0.0	-0.2	1.5	1.5	0.6	0.6
2005	4.2	4.1	4.1	4.2	4.1	5.6	5.6	4.8	4.8	-0.2	-0.2	0.0	-0.1	1.3	1.3	0.5	0.5
2006	4.1	3.9	3.9	4.0	3.9	5.6	5.6	4.7	4.7	-0.3	-0.3	-0.1	-0.3	1.5	1.5	0.6	0.6
2007	4.2	4.1	4.0	4.2	4.1	5.9	5.8	4.8	4.9	-0.2	-0.2	0.0	-0.1	1.6	1.6	0.6	0.7
2008	4.0	3.9	3.9	4.0	3.9	5.7	5.7	4.8	4.7	-0.1	-0.1	0.0	-0.1	1.7	1.7	0.8	0.7
2009	4.2	3.9	4.0	4.2	4.0	5.7	5.7	4.9	4.7	-0.2	-0.2	0.0	-0.2	1.5	1.5	0.7	0.5
2010	4.1	3.9	3.9	4.0	3.8	5.4	5.4	4.5	4.6	-0.2	-0.2	-0.1	-0.2	1.4	1.4	0.5	0.5
2011	4.2	4.0	4.0	4.3	4.1	5.8	5.8	4.8	4.9	-0.3	-0.3	0.0	-0.2	1.5	1.5	0.6	0.6
West Point Mid-Lake[a]																	
2000	7.9	8.5	9.7	8.6	11.8	12.5	12.6	11.9	12.1	0.5	1.7	0.7	3.9	4.6	4.6	4.0	4.1
2001	8.1	7.9	8.5	8.0	8.1	8.3	8.5	9.1	8.4	-0.2	0.4	-0.1	0.0	0.2	0.5	1.0	0.4
2002	11.1	10.3	11.8	11.3	11.7	12.1	12.1	11.9	11.9	-0.9	0.6	0.1	0.5	0.9	0.9	0.7	0.7
2003	4.4	4.3	4.4	4.4	4.4	4.6	4.6	4.7	4.5	-0.2	0.0	0.0	0.0	0.1	0.1	0.3	0.1
2004	5.8	5.5	5.9	6.1	6.5	6.5	6.5	6.6	6.4	-0.3	0.2	0.3	0.7	0.8	0.8	0.9	0.7
2005	4.1	3.9	4.1	4.1	4.1	4.3	4.3	4.4	4.3	-0.2	0.0	0.0	0.0	0.2	0.2	0.3	0.1
2006	7.2	6.8	7.5	7.2	7.3	7.6	7.6	8.0	7.5	-0.4	0.3	0.1	0.1	0.4	0.4	0.8	0.3
2007	9.4	8.8	9.8	9.5	9.8	10.2	10.0	11.7	9.8	-0.6	0.4	0.2	0.4	0.8	0.7	2.4	0.4
2008	10.7	10.6	11.1	10.8	11.0	11.4	11.4	11.1	11.2	-0.2	0.3	0.0	0.3	0.6	0.6	0.4	0.4
2009	7.8	7.7	8.5	8.1	8.7	9.3	9.3	9.1	9.2	-0.1	0.7	0.2	0.9	1.5	1.5	1.3	1.3
2010	6.2	6.0	6.5	6.1	6.5	6.8	6.8	6.9	6.7	-0.1	0.4	0.0	0.3	0.6	0.6	0.7	0.5
2011	8.1	7.8	8.5	9.4	9.6	10.0	9.9	9.9	9.8	-0.3	0.4	1.3	1.5	1.9	1.8	1.8	1.7
Walter F. George Mid-Lake[a]																	
2000	9.3	9.1	9.8	8.8	9.9	10.0	10.0	10.0	9.9	-0.1	0.5	-0.5	0.6	0.8	0.8	0.7	0.6
2001	7.7	7.8	8.0	7.7	8.1	8.4	8.3	8.2	8.1	0.1	0.4	0.1	0.4	0.7	0.6	0.5	0.5
2002	8.1	8.4	8.6	8.5	8.8	9.0	9.0	8.9	8.8	0.2	0.5	0.4	0.7	0.8	0.8	0.8	0.7
2003	4.9	4.9	5.1	4.9	5.1	5.2	5.2	5.2	5.1	0.0	0.2	0.0	0.2	0.3	0.3	0.4	0.3
2004	7.0	7.0	7.7	7.1	7.6	7.9	7.9	7.7	7.7	0.0	0.6	0.1	0.6	0.8	0.8	0.7	0.6
2005	4.9	4.9	5.2	5.0	5.2	5.3	5.3	5.2	5.2	0.0	0.2	0.0	0.2	0.4	0.4	0.3	0.3
2006	8.3	8.1	8.7	8.7	9.1	9.3	9.3	9.2	9.2	-0.1	0.4	0.5	0.8	1.1	1.1	1.0	0.9
2007	9.0	8.9	9.4	9.0	9.6	9.6	9.6	9.5	9.5	-0.1	0.4	0.0	0.6	0.7	0.7	0.5	0.5
2008	9.3	9.4	9.7	9.7	10.0	10.2	10.2	10.1	10.1	0.0	0.3	0.4	0.7	0.9	0.9	0.7	0.7
2009	6.9	6.9	7.4	6.9	7.3	7.5	7.6	7.4	7.4	0.0	0.5	0.0	0.4	0.6	0.7	0.5	0.5
2010	5.9	5.9	6.2	5.9	6.1	6.4	6.4	6.3	6.3	0.0	0.3	0.0	0.3	0.6	0.6	0.5	0.4
2011	8.1	8.0	8.4	8.0	8.5	8.8	8.7	8.7	8.5	-0.2	0.3	-0.1	0.4	0.7	0.6	0.6	0.4

Year	Modeled (µg/L)									Change from NAA (µg/L)							
	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Seminole Mid-Lake[b]																	
2000	3.3	3.4	3.5	3.4	3.4	3.5	3.5	3.4	3.4	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.1
2001	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
2002	3.0	3.2	3.2	3.1	3.2	3.3	3.3	3.3	3.2	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.2
2003	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1
2004	3.1	3.1	3.2	3.1	3.2	3.2	3.2	3.2	3.2	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.1
2005	3.1	3.1	3.2	3.1	3.2	3.2	3.2	3.2	3.2	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1
2006	3.0	3.0	3.1	3.2	3.3	3.3	3.3	3.3	3.3	0.0	0.1	0.2	0.3	0.4	0.3	0.3	0.3
2007	3.3	3.2	3.4	3.4	3.7	3.7	3.7	3.3	3.6	0.0	0.1	0.2	0.4	0.4	0.4	0.0	0.4
2008	3.3	3.3	3.4	3.4	3.6	3.6	3.6	3.6	3.6	0.0	0.1	0.1	0.2	0.3	0.3	0.3	0.3
2009	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1
2010	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.7	2.7	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
2011	2.9	2.8	3.0	3.0	3.1	3.2	3.2	3.2	3.1	0.0	0.1	0.1	0.2	0.4	0.4	0.3	0.3

Notes:
[a.] Based on growing season average.
[b.] Based on geometric mean for the modeled period.

6.1.2.5.2 Alternative 1B

Negative changes in chlorophyll *a* indicate that the Alt1B decreases the amount of chlorophyll *a,* decreasing the phytoplankton growth. Chlorophyll *a* standards are based on the average of growing season concentrations being less than a designated concentration; therefore, decreased chlorophyll *a* would indicate an improvement in water quality conditions.

As illustrated in Table 6.1-20, little to no changes would be expected for Lake Lanier during the modeled period of 2001–2011. As reported in Table 6.1-20, the modeled growing season average comes close to the state's water quality standard for the year 2000. However, from 2001 on, the change from the NAA in the growing season averages would be close to zero or less than the NAA, indicating that chlorophyll *a* would not be expected to be less than the standard.

Little to no changes would be expected from Buford Dam to Atlanta.

From Atlanta to West Point Lake, little to no change would be expected in the median chlorophyll *a* concentrations from Atlanta to RM 340. This could be attributed to the same water management alternative as being used for NAA. However, a slight decrease of 0.5 µg/L would be expected in the 95th percent occurrence level. Although the concentrations at the 95th percent occurrence levels are rare, a decrease in chlorophyll *a* concentrations is always a positive sign for water quality. The modeled concentration of chlorophyll *a* for West Point Lake at the LaGrange water intake would be expected to meet water quality standards (Table 6.1-20).

Except for changes in the 5th and 95th percent occurrence levels, little to no change from NAA would be expected for Alt1B from West Point Lake to the Apalachicola River, as illustrated in Figure 6.1-123 and Figure 6.1-125. As reported in Table 6.1-20, chlorophyll *a* water quality standards would be expected to meet for Walter F. George Lake and Lake Seminole.

6.1.2.5.3 Alternative 1C

As illustrated in Figure 6.1-123 and Figure 6.1-125, there would be little to no change from Lake Lanier to Atlanta in the modeled median concentrations of chlorophyll *a* as compared to NAA. The water quality standard for the growing season average would be met at Lake Lanier (Table 6.1-20).

From Atlanta to West Point Lake, little to no change would be expected in the median chlorophyll *a* concentrations for the modeled period as compared to NAA. However, at RM 340, the median growing season average during a dry year would increase by at least 2 µg/L. Those conditions could be attributed to the increased water drawn from the river to meet the future needs of Atlanta and its surrounding cities. As illustrated in Figure 6.1-125, the concentration at the 95th percent occurrence level would increase by 4 µg/L. According to Table 6.1-20, the modeled growing season average would be expected to meet the water quality standard for West Point Lake for the period of 2001–2011.

Little to no change would be expected in the median chlorophyll *a* concentrations (Figure 6.1-123) from West Point Lake to the Apalachicola River. However, the concentrations at the 95th percent occurrence levels would continue to gradually decrease from 2 µg/L at Bartletts Ferry Dam to 0.1 µg/L in the Apalachicola River. A similar response would be expected during the growing season of a dry year. The modeled median growing season concentration would decrease from 2 µg/L upstream of Bartletts Ferry Dam to 0.2 µg/L in the Apalachicola River. The water quality standards would be met for Walter F. George Lake and Lake Seminole.

6.1.2.5.4 Alternative 7A

Little to no change would be expected in the modeled median concentrations for 2001–2011 from Lake Lanier to West Point Lake as compared to the NAA (Figure 6.1-123). The water quality standards would be expected to be met for Lake Lanier and West Point Lake.

From West Point Dam to Walter F. George Lake, Figure 6.1-125 illustrates that the growing season median concentration in a dry year would be expected to decrease by 1–1.8 µg/L. The decrease in concentrations could be attributed to the continuous releases from West Point Dam to maintain minimum flows of 675 cfs. The modeled median concentrations for the period of 2001–2011 would be expected to have little to no change as compared to the NAA. The water quality standards would be expected to be met at Walter F. George Lake (Table 6.1-20).

Little to no change would be expected from Walter F. George Lake to the Apalachicola River as compared to the NAA. The water quality standards would be expected to be met at Lake Seminole.

6.1.2.5.5 Alternative 7C

Little to no change would be expected from Lake Lanier to Atlanta in the modeled median concentrations of chlorophyll *a* (Figure 6.1-123). The water quality standard would be expected to be met at Lake Lanier (Table 6.1-20).

From Atlanta to West Point Lake, the concentration at the 95th percent occurrence level would be expected to increase to at least 3 µg/L from the NAA in the reservoir at RM 330 (Figure 6.1-123). During the growing season of a dry year, Figure 6.1-125, the median concentration would be expected to increase to 2 µg/L at the same location. This could be attributed to the water supply option C because similar responses could be seen in Alt1C. The water quality standards would be expected to be met at West Point Lake.

From West Point Dam to the Walter F. George Lake, little to no change would be expected in the median concentrations of chlorophyll *a* from NAA for the period of 2001–2011. The modeled median growing season average in a dry year would change by ±1 µg/L upstream of Walter F. George Lake, with a higher change expected by 2 µg/L at RM 180 (Figure 6.1-125). The water quality standard would be expected to be met at Walter F. George Lake.

From Walter F. George Lake to Lake Seminole, the modeled median growing season concentration in a dry year would be expected to be higher than the NAA by at least 1 µg/L (Figure 6.1-125). The water quality standard would be expected to be met at Lake Seminole.

Little to no change from the NAA would be expected downstream of Jim Woodruff Lock and Dam.

6.1.2.5.6 Alternative 7D

The median chlorophyll *a* concentration for the period of 2001–2011 would increase by 0.5 µg/L at Lake Lanier as compared to the NAA (Figure 6.1-124). The median growing season concentration for a dry year would be expected to increase by at least 1.8 µg/L as compared to the NAA (Figure 6.1-126). This would create slightly adverse conditions in this reach of the ACF Basin. In addition, Table 6.1-20 suggests that the modeled growing season average for Alt7D would be less than the water quality standard of 5 µg/L set upstream of the Buford Dam forebay. Concentrations would be expected to be less than the standard in more than 1 year in a 5-year period.

Little to no change would be expected from Buford Dam to Atlanta as compared to the NAA.

From Atlanta to West Point Lake, the median concentrations for the period of 2001–2011 would be expected to be close to the NAA except for the concentrations at the 95th percent occurrence level (Figure 6.1-124). At RM 330, the modeled change in median growing season concentration increases from -1 µg/L to 2 µg/L from NAA (Figure 6.1-126). However, the water quality standards would be expected to be met at West Point Lake.

From West Point Lake to Walter F. George Lake, the modeled median growing season concentration would be expected to be consistently lower than in the reach from Atlanta to West Point Lake. The water quality standard would be expected to be met at Walter F. George Lake.

From Walter F. George Lake to Lake Seminole, the median growing season concentration for a dry year would be expected to be 1 µg/L higher than the NAA. The median concentration for the modeled period would be expected to have little to no change compared to the NAA.

Little to no change would also be expected downstream of Lake Seminole.

6.1.2.5.7 Alternative 7E

The response for Alt7E would be similar to the response expected in Alt7D as compared to the NAA. Concentrations of modeled chlorophyll *a* would be less than water quality standards in Lake Lanier.

6.1.2.5.8 Alternative 7F

Little to no change would be expected in the median concentrations of chlorophyll *a* for the modeled period except for the concentrations at the 95th percent occurrence level. Concentrations at the 95th percent occurrence level would be higher than NAA by 4 µg/L upstream of West Point Dam, gradually decrease to 2 µg/L upstream of Walter F. George Lock and Dam, and decrease down to 0.2 µg/L in the

Apalachicola River (Figure 6.1-124). Concentrations of modeled chlorophyll *a* would be less than water quality standards in Lake Lanier.

The median growing season chlorophyll *a* concentration during a dry year would be expected to be higher by 4 µg/L compared to the NAA at RM 330. The median concentration would be expected to be 3 µg/L higher than the NAA upstream of Bartletts Ferry Dam and would continue to decrease, downstream of the ACF Basin in the Apalachicola River (Figure 6.1-126).

6.1.2.5.9 Alternative 7H (PAA)

Little to no change from the NAA would be expected from Lake Lanier to Atlanta. Modeled chlorophyll *a* concentrations would be less than the water quality standard in Lake Lanier.

The conditions from Atlanta to RM 340 would be expected to be the same as the NAA during the modeled period. During the growing season of a dry year, the median change in chlorophyll *a* concentrations would be expected to be lower by 0.047 µg/L from the NAA.

From West Point Lake to Lake Seminole, the median change in growing season concentrations during the dry year would be expected to be higher by 1 µg/L from the NAA. Over the modeled period, however, differences from the NAA would be less than 0.5 µg/L.

Little to no changes would be expected in the reach downstream of Lake Seminole.

6.2 Geology and Soils

Effects on geology and soils that can be influenced by USACE water management activities are limited to sedimentation and erosion of the river and lakebeds and shorelines. USACE has no control over the management of soils and underlying geology on land outside USACE jurisdiction; thus, sources of sediment related to agricultural practices, land development, and activities along tributaries are considered a background condition within which the management measures must function.

Thus, prime and unique farmland resources within the ACF Basin would not be affected under the NAA or any of the other alternatives.

Sedimentation and erosion activity in river networks modified by locks and dams and hydropower facilities, such as the ACF Basin projects, can be divided into two general types: 1) river bed shoaling and bank erosion, and 2) lakebed sedimentation and shoreline erosion. In general, riverine sedimentation and bank erosion processes are active only during floods. Studies of rivers throughout the world indicate that high flows, with recurrence intervals of about 1.5 years, are dominant in shaping the channel (Dunne and Leopold 1978). Flows of such magnitude are termed the *channel forming discharge*. Generally, the typical channel-forming discharges can be thought of as the annual peak flood. Additionally, sediments eroded from landscapes during intense rainfalls and eroded from stream and river banks during high flow events are transported in the greatest quantities and distances during floods. The sediment is deposited as shoals where the rivers and tributaries enter the lakes.

Important channel-forming processes related to the ACF Basin projects include tailwater degradation downstream of projects (sections 2.2.2.4.2 and 2.2.2.4.3), and bank erosion within the river portions above the project pools and downstream of Jim Woodruff Lock and Dam. Similarly, lake sedimentation is dominated by flood events, when the erosive forces throughout the watershed are most severe and the most sediment is delivered to the rivers and lakes.

In the ACF Basin, the average annual floods at all locations of interest are far in excess of the typical annual low flows. Because the management measures pertain, in particular, to low flow conditions experienced during droughts, their potential effect on sedimentation and erosion, when compared to the NAA, would be considered negligible and unpredictable. Therefore, the management measures for drought conditions, described in section 4.1.2.2, are not discussed with regard to lake sedimentation and channel-forming processes for any of the alternatives.

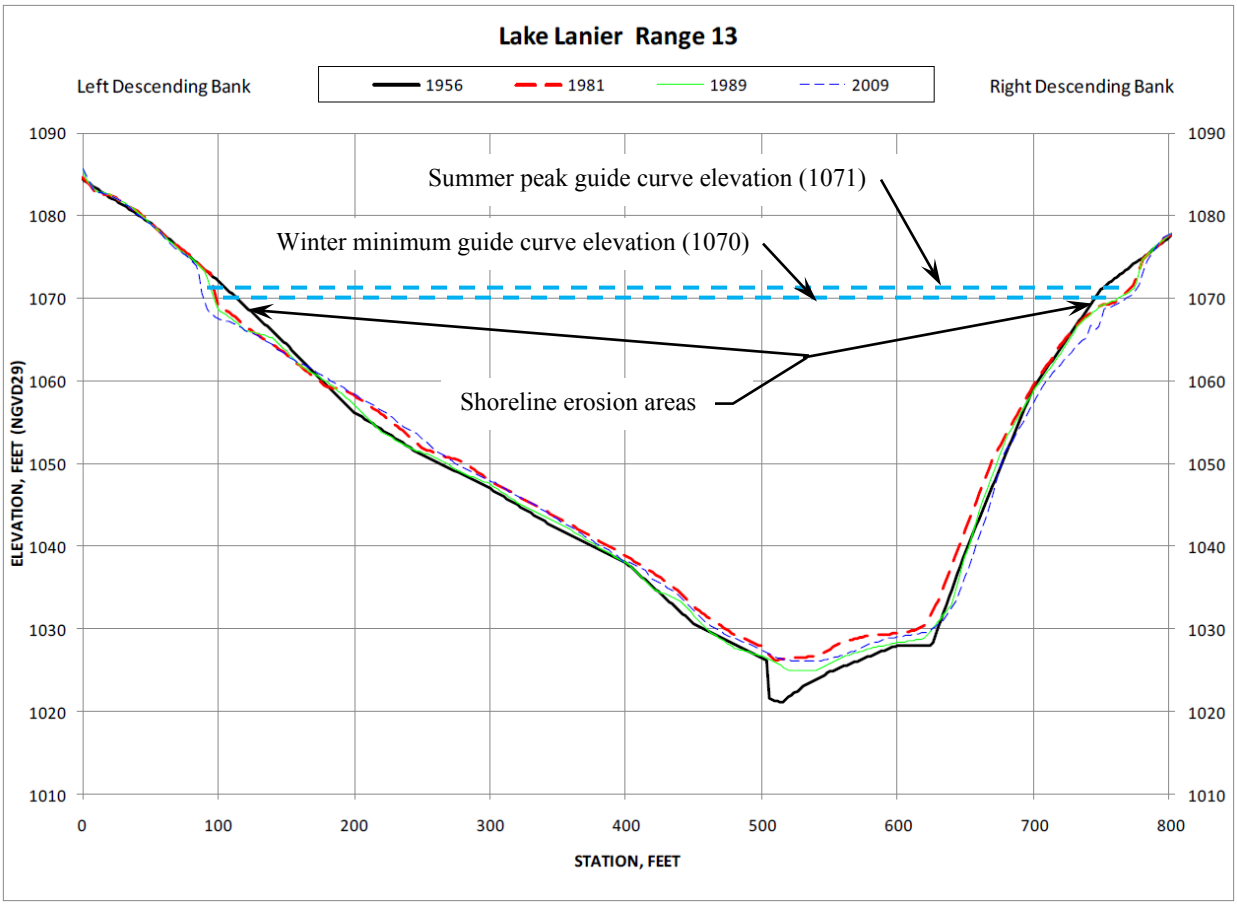
Lake shoreline erosion activity is not limited to times of high flows and can occur at all water levels and flow conditions. The shoreline erosion rate is a balance between the erosive forces versus the stabilizing forces: that is, waves that are driven by wind and boat traffic versus density of shoreline vegetation and durability of shoreline soils. Thus, management measures within control of USACE that influence shoreline erosion include lake elevation and duration at any given elevation. Those management measures are discussed in relation to their respective alternatives. Table 6.2-1 presents a summary of the effects of various alternatives on geology and soils.

Table 6.2-1.
Summary of Geology and Soils

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
George W. Andrews Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE Reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.2.1 Lake Lanier

No change would be expected for any of the alternatives. Under the NAA, the lake shorelines would continue to erode at the present rate and lake sedimentation would continue at the present rate. In general, the shoreline erosion trends on Lake Lanier indicate that the highest rates occurred during the first 25 years since impoundment and have since slowed (Figure 6.2-1). The change in rate is due to the winnowing of fine soil particles by wave action over the first several years after impoundment. Erosion-resistant gravel, cobble, and bedrock shorelines are left behind (Tetra Tech 2011b).



Source: Tetra Tech 2011.

Figure 6.2-1. Sedimentation Range Cross-Section from Lake Lanier (Typical for the Four Large ACF Reservoirs)

The range of annual lake level fluctuation is sufficient to have, over the past several decades, already exposed and eroded these shorelines down to more erosion-resistant materials. Therefore, the wave erosion from raising and lowering of long-term median water surface elevations would still be expected to be negligible compared with the highest rates that occur during the first 25 years since impoundment.

6.2.2 West Point Lake

The effects would be expected to be the same as the NAA for all the alternatives. Under the NAA, the lake shorelines would continue to erode at the present rate and lake sedimentation would continue at the present rate. In general, the shoreline erosion trends on West Point Lake indicate that the highest rates occurred during the first 20 years since impoundment and have since slowed. The process is described in section 6.2.1 and is represented in Figure 6.2-1. Sedimentation range cross-section figures specific to West Point Lake are provided in Tetra Tech 2011c.

6.2.3 Walter F. George Lake

The effects would be expected to be the same as the NAA for all the alternatives. The differences between the mean daily water surface elevations is negligible between all alternatives, thus the erosion and sedimentation rates would be expected to continue as in the past.

Under the NAA, the lake shorelines would continue to erode at the present rate and lake sedimentation would continue at the present rate. In general, the shoreline erosion trends on Walter F. George Lake indicate that the highest rates occurred during the first 20 years since impoundment and have since slowed. The process is described in section 6.2.1 and is represented in Figure 6.2-1. Sedimentation range cross-section figures specific to Walter F. George Lake are provided in Tetra Tech 2011.

6.2.4 George W. Andrews Lake

Effects for all alternatives would be expected to be the same as for the NAA. George W. Andrews Lake is a run-of-the-river project where flood flows are the dominant force in shoreline erosion and sediment deposition processes. All the alternatives have a negligible influence on changes to water levels and flow velocities, thus any changes to the existing erosion and sedimentation processes are negligible.

Under the NAA, the shorelines would continue to erode at the present rate and lake sedimentation would continue at the present rate. In general, the shoreline erosion trends on George W. Andrews Lake indicate that the highest rates occurred during the first 20 years since impoundment and have since slowed. The process is described in section 6.2.1 and is represented in Figure 6.2-1. Sedimentation range cross section figures specific to George W. Andrews Lake are provided in Tetra Tech 2011e.

6.2.5 Lake Seminole (Jim Woodruff Lock and Dam)

No change in erosion and sedimentation patterns in Lake Seminole would be expected from any of the alternatives. The NAA would see the continuation of the current water control operations that entail minor variations in lake levels. The shorelines tend to have low slopes and are protected from wave erosion by dense aquatic and bank vegetation. Lake level conditions under all alternatives would essentially be the same as those for the NAA. Thus, any changes in shoreline erosion and lakebed sedimentation would be expected to be negligible.

Downstream of Jim Woodruff Lock and Dam, erosion and sedimentation patterns in the Apalachicola River for all of the alternatives would likely not differ from patterns that would continue under the NAA. As discussed in detail in section 6.1.1.2.5, no appreciable differences in discharges from Jim Woodruff Lock and Dam and flow conditions in the Apalachicola River would occur over the modeled period of record for the PAA or any of the other alternatives when compared to conditions under the NAA.

6.3 Land Use

Adverse effects on land use are a result of land use change that would be incompatible with adjacent land uses. The degree to which the proposed action and alternatives conflict with established land uses in the area, disrupt or divide established land use configurations, represent a substantial change in existing land uses, or are inconsistent with adopted land use plans will determine the severity of the adverse effects.

Effects on land use are described in the subsequent subsections and summarized in Table 6.3-1. An adverse effect on land use is any land use change that would be incompatible with adjacent land uses experienced with lower water surface elevation conditions. The lower water levels can diminish or impair the shoreline for its intended land use because of exposed shoreline and lakebed. Although lower water levels would not change a land use designation (e.g., an area designated for public recreation such as a boat ramp or marina, or a fishing, swimming, or picnic area), it can make the land use less desirable or unusable. As water surface elevations decline, boat launching ramps, beaches, and shoreline fishing areas can become unusable; navigation hazards can surface; channels to marinas can become impassable; and private boat docks can become unusable.

Table 6.3-1.
Summary of Effects on Land Use

Alternative	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Buford Dam/Lake Lanier	Baseline	Slightly beneficial	Slightly beneficial	Slightly beneficial and adverse	Slightly beneficial	Baseline	Slightly adverse	Substantially adverse	Slightly adverse
West Point Dam and Lake	Baseline	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lock, Dam, and Lake	Baseline	No change	No change	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
George W. Andrews Lock, Dam, and Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Jim Woodruff Lock and Dam / Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE Reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.3.1 Lake Lanier and Downstream of Buford Dam

6.3.1.1 No Action Alternative

No change would be expected. The NAA would see the continuation of the current water control operations at each project. Effects on land use along project shorelines would be the same as in the past, with deviations in lake levels and shoreline due to seasonal and yearly variations in flow and climatic conditions (see section 6.1.1.1.1.1). No change would be expected along the river shoreline or in the CRNRA downstream of Buford Dam. Under the NAA, flow conditions in the river necessary to successfully pursue a quality water-based recreation experience in the CRNRA (e.g., wade fishing) would continue to be available essentially at all times (except for extreme high flow conditions during major flood events) (see section 6.1.1.2.2.1).

6.3.1.2 Alternative 1B

Slightly beneficial effects would be expected. For Alt1B, Lake Lanier would have a slight improvement in water surface elevation conditions (i.e., 1–2 ft higher) and would be below the ILL, RIL, and WAL fewer percent of days per year and for fewer years of the modeled hydrologic period of record compared to the NAA (see section 6.1.1.1.1.2). The improvement in water surface elevation conditions at Lake Lanier under Alt1B would largely be attributable to the revised action zones that would require more conservative project operations to conserve storage with the onset of extremely dry conditions in the basin. Keeping more water in the reservoir throughout the year would avoid entering in to the IIL (or below), allowing the project shoreline to be used for its intended public recreation, limited development, or protected shoreline land uses year round.

Slightly beneficial effects would be expected downstream of Buford Dam along the river shoreline in the CRNRA. Compared to the NAA, flow conditions for water-based recreation pursuits within the CRNRA would be increased slightly during weekdays (see section 6.1.1.2.2.2). Operations under Alt1B would exceed the 1,000 cfs desired as a baseline level of flow to support most water-based recreational uses of the CRNRA on 79 percent of the days.

6.3.1.3 Alternative 1C

Effects on land use along the project shoreline would be expected to be the same as the NAA. They would be similar to what they have been in the past, as Alt1C would likely have similar effects on water surface elevations in Lake Lanier as the NAA. The differences in the percent of days that water surface elevations would likely decline below designated impact levels for public use and recreational activities would be negligible compared to the NAA, and the differences between Alt1C and NAA in the number of years that lake levels would decline below IIL, RIL, and WAL would be minor (section 6.1.1.1.1.3).

Slightly beneficial effects would be expected on land use downstream of Buford Dam along the river shoreline in the CRNRA, as Alt1C would likely result in slightly improved flow conditions between Buford Dam and West Point Lake compared to the NAA. Operations under Alt1C would exceed the 1,000 cfs desired as a baseline level of flow to support most water-based recreational uses of the CRNRA on about 84 percent of the days (section 6.1.1.2.2.3).

6.3.1.4 Alternative 7A

Slightly beneficial effects would be expected along the project shoreline. Median daily water surface elevations in Lake Lanier for Alt7A would follow a similar pattern to the NAA, except that they would be slightly higher in the fall and winter months. The percentage of days that water surface elevations would likely decline below designated impact levels for public use and recreational activities would be slightly lower for Alt7A than for the NAA, allowing the project shoreline to be used for its intended public recreation, limited development, or protected shoreline land uses. The difference between Alt7A and the NAA with respect to the number of years that lake levels would drop below IIL, RIL, and WAL is considered minor, with one exception: The number of years that lake levels would likely drop below WAL would decrease from 17 (NAA) to 11 (Alt7A), based on the full 12-month period, and from six (NAA) to four (Alt7A) for the peak recreation season (section 6.1.1.1.1.4).

Slightly adverse effects would be expected under Alt7A along the river shoreline in the CRNRA downstream of Buford Dam, as slight decreases in modeled flow values under Alt7A compared to the NAA would represent a minor decline in flow conditions in the CRNRA relative to NPS-recommended goals for CRNRA recreation flows. Under Alt7A, daily flows would exceed 1,000 cfs on about 73 percent of the days (compared to 77 percent for NAA) (section 6.1.1.2.2.4).

6.3.1.5 Alternative 7C

Slightly beneficial effects would be expected along the project shoreline. For Alt7C, the pool elevations in Lake Lanier would be in Zone 1 for 62 percent of the time compared to 56 percent for the NAA. The percent of time in Zones 2 and 4 would decrease and would slightly increase for Zone 3, compared to the NAA. The most noteworthy reduction in percent of time would be for Zone 4, from 15 percent of the time for the NAA to 10 percent of the time for Alt7C (section 6.1.1.1.1.5). The improvement in water surface elevation conditions at Lake Lanier under Alt7C would allow for the project shoreline to be used for its intended public recreation, limited development, or protected shoreline land uses.

Slightly beneficial effects would be expected on land use downstream of Buford Dam along the river shoreline in the CRNRA, as Alt7C would likely result in slightly improved flow conditions between Buford Dam and West Point Lake compared to the NAA (section 6.1.1.2.2.5).

6.3.1.6 Alternative 7D

Slightly adverse effects on project shoreline land use would be expected. Under Alt7D, median daily water surface elevations in July through early September would likely range up to 0.5 ft lower than the NAA. Pool levels would likely drop below IIL and RIL slightly more often than under the NAA and would likely result in pool levels in Zones 1 and 2 for a slightly lower percent of time than the NAA and a slightly greater percent of time in Zone 3 than under the NAA (section 6.1.1.1.1.6).

Slightly adverse effects would be expected on land use along the river shoreline downstream of Buford Dam. Under this alternative, median and low monthly flows at Buford (RM 348.1) and downstream at Atlanta-Peachtree Creek (RM 300.5) over the 73-year modeled period of record (1939–2011) would slightly decrease over the NAA by about 100 cfs. Using a daily average flow of 1,000 cfs as a baseline level of flow to support most water-based recreational uses of the CRNRA, operations under this alternative would exceed that level 68 percent of the days in the period of record, about 8 percent less than the NAA (see section 6.1.1.2.2.6).

6.3.1.7 Alternative 7E

Slightly adverse effects on project shoreline land use would be expected. Under Alt7E, median daily water surface elevations in July through early September would likely range up to 0.5 ft lower than under the NAA. Pool levels would likely drop below IIL and RIL slightly more often than the NAA and would likely result in pool levels in Zones 1 and 2 for a slightly lower percent of time than the NAA and a slightly greater percent of time in Zone 3 than the NAA (section 6.1.1.1.1.7).

Slightly adverse effects would be expected on land use along the river shoreline downstream of Buford Dam. Under Alt7E, median and low monthly flows at Buford and downstream at Atlanta-Peachtree Creek over the 73-year modeled period of record would slightly decrease over the NAA by about 100 cfs. Using a daily average flow of 1,000 cfs as a baseline level of flow to support most water-based recreational uses of the CRNRA, operations under this alternative would exceed that level 68 percent of the days in the period of record, about 8 percent less than under the NAA (see section 6.1.1.2.2.7).

6.3.1.8 Alternative 7F

Substantial adverse effects would be expected on land use along the project shoreline. For Alt7F (see section 6.1.1.1.1.8), Lake Lanier would have lower water surface elevation conditions (median daily water surface elevations from about 1.0 ft to 1.4 ft lower than under the NAA) and would be below the ILL, RIL, and WAL a greater percent of days per year and for more years of the modeled hydrologic period of record compared to the NAA. The lower water levels under Alt7F would diminish or impair the shoreline for its intended land use of public recreation, limited development, or protected shoreline because of exposed shoreline and lakebed. IIL, RIL, and WAL impacts can be generally characterized by adverse effects to boat ramps, private marina and dock owners, and public swimming areas. Although the lower lake levels would not change the land use designation, it would make the land use less desirable or unusable. The scenic appeal of protected shoreline land use would be impacted by exposed shoreline and lakebed. Shoreline land use designated for public recreation (e.g., public boat docks, marinas, and swimming areas) as well as limited development areas with boat docks would be adversely affected in a similar manner, with the exposed shoreline and lakebed reducing the usability of the areas. As the lake levels would drop to IIL, RIL, or WAL levels (see Figure 6.1-6), boat launching ramps and beaches would become unusable, navigation hazards would surface, channels to marinas would be impassable or wet slips would need to be relocated, and private boat docks would become unusable.

Adverse effects would be expected on land use along the river shoreline downstream of Buford Dam. For Alt7F, minor adverse changes in flow conditions between Buford Dam and West Point Lake would be expected in comparison to the NAA. Median daily flows for Alt7F immediately downstream of Buford Dam would closely match those for the Alt7D except that they would tend to be even lower than under Alt7D from mid-February through mid-April. Appreciable decreases in modeled flow values at Peachtree Creek under Alt7F compared to the NAA would represent a minor detrimental effect on flow conditions in the CRNRA compared to NPS-recommended goals for CRNRA recreation flows (see section 6.1.1.2.2.8).

6.3.1.9 Alternative 7H (PAA)

Slightly adverse effects on project shoreline land use would be expected. Under Alt7H, median daily water surface elevations in July through early September would likely be lower than under the NAA. Pool levels would likely drop below IIL and RIL slightly more often than the NAA and would likely result in pool levels in Zones 1 and 2 for a slightly lower percent of time than the NAA and a slightly greater percent of time in Zone 3 than the NAA (section 6.1.1.1.1.9). As the lake levels would drop to IIL or RIL levels, boat launching ramps and beaches would become unusable, navigation hazards would surface, channels to marinas would be impassable or wet slips would need to be relocated, and private boat docks would become unusable.

Slightly adverse effects would be expected on land use along the river shoreline downstream of Buford Dam. Under Alt7H, median and low monthly flows at Buford and downstream at Atlanta-Peachtree Creek over the 73-year modeled period of record would slightly decrease compared to the NAA. Using a daily average flow of 1,000 cfs as a baseline level of flow to support most water-based recreational uses of the CRNRA, operations under this alternative would exceed that level less than under the NAA (see section 6.1.1.2.2.9). Exposed shoreline and low flow conditions would reduce or eliminate the usability of the shoreline or river for public recreation uses such as fishing, picnicking, or boating.

6.3.2 West Point Lake and Downstream of West Point Dam

6.3.2.1 No Action Alternative

No change would be expected. The NAA would see the continuation of the current water control operations at West Point Dam and Lake. Effects on land use along the project shoreline and the river shoreline downstream of West Point Dam would be the same as they have been in the past, with deviations in lake levels and shoreline due to seasonal and yearly variations in flow and climatic conditions (see sections 6.1.1.1.2.1 and 6.1.1.2.3.1).

6.3.2.2 Alternative 1B

No change would be expected. Alt1B would essentially have the same effects on water surface elevations in West Point Lake as the NAA. The model outputs for the Alt1B are nearly identical to those under the NAA. Effects on land use along the project shoreline and the river shoreline downstream of West Point Dam would be the same as they have been in the past, with deviations in lake levels and shoreline due to seasonal and yearly variations in flow and climatic conditions (see sections 6.1.1.1.2.2 and 6.1.1.2.3.2).

6.3.2.3 Alternative 1C

No change would be expected. Alt1C would essentially have the same effects on water surface elevations in West Point Lake as the NAA. The model outputs for Alt1C are nearly identical to those under the NAA. Effects on land use along the project shoreline and the river shoreline downstream of West Point

Dam would be the same as they have been in the past, with deviations in lake levels and shoreline due to seasonal and yearly variations in flow and climatic conditions (see sections 6.1.1.1.2.3 and 6.1.1.2.3.3).

6.3.2.4 Alternative 7A

Slightly adverse effects would be expected on land use along the project shoreline. Table 6.1-4 indicates that the number of years the West Point Lake summer (May-September) pool would drop below the IIL and RIL over the modeled period of record (1938-2011) would exceed the NAA by 4 years for IIL and 2 years for RIL (section 6.1.1.1.2.4). Lower lake levels would make the land use less desirable or unusable. As the lake level would drop below IIL and RIL levels, shoreline land use designated for public recreation (e.g., public or private boat docks, marinas, and swimming areas) would be adversely affected by exposed shoreline and lakebed, reducing the usability of these areas.

No change would be expected on land use along the river shoreline downstream of West Point Dam. Effects downstream of West Point Dam would be about the same as under the NAA (see section 6.1.1.2.3.4).

6.3.2.5 Alternative 7C

Slightly adverse effects would be expected on land use along the project shoreline. Median daily water surface elevations in West Point Lake would follow a pattern similar to the NAA; however, the number of years that lake levels would likely drop below IIL over the modeled period of record during the peak recreation season would exceed the NAA by 6 years under Alt7C (section 6.1.1.1.2.5).

No change would be expected on land use along the river shoreline downstream of West Point Dam, as the effects would be about the same as those under the NAA. For Alt7C, daily flows below West Point Dam at the minimum level of 675 cfs would occur on 10 percent of the days over the period of record, the same percentage as for the NAA. Daily flows at Columbus would be expected to equal or exceed the daily average target flow of 1,350 cfs on 94 percent of the days over the modeled period of record (compared to 95 percent for the NAA) (see section 6.1.1.2.3.5).

6.3.2.6 Alternative 7D

Slightly adverse effects would be expected on land use along the project shoreline. Table 6.1-4 indicates that the number of years the West Point Lake summer (May-September) pool would drop below the IIL over the modeled period of record (1938-2011) for Alt7D would exceed the NAA by 6 years. Lower lake levels would make the land use less desirable or unusable. As the lake level would drop below the IIL, some boat launching ramps would be unusable, most beaches would be unusable or minimally usable, and navigation hazards would begin to surface due to exposed shoreline and lakebed (section 6.1.1.1.2.6).

No change would be expected on land use along the river shoreline downstream of West Point Dam, as the effects would be about the same as those under the NAA. For Alt7D, median daily flows downstream of West Point Dam would be nearly the same as those for the NAA (section 6.1.1.2.3.6).

6.3.2.7 Alternative 7E

Slightly adverse effects would be expected on land use along the project shoreline. Table 6.1-4 indicates that the number of years the West Point Lake summer pool would drop below the IIL over the modeled period of record for Alt7E would exceed the NAA by about 6 years (section 6.1.1.1.2.7). Lower lake levels would make shoreline land use less desirable or unusable.

No change would be expected on land use along the river shoreline downstream of West Point Dam, as effects downstream of West Point Dam would be about the same as under the NAA. For Alt7E, median daily flows downstream of West Point Dam would be nearly the same as those for the NAA (section 6.1.1.2.3.7).

6.3.2.8 Alternative 7F

Slightly adverse effects would be expected on land use along the project shoreline, as median daily water surface elevations in West Point Lake would be slightly lower than the lake levels in the NAA from February through October. The difference between Alt7F and the NAA with respect to the number of years that the lake levels would drop below the IIL during the recreation season would be additional 9 years compared to the NAA (see Table 6.1-4 and section 6.1.1.1.2.8).

Slightly adverse effects would be expected on land use along the river shoreline downstream of West Point Dam. For Alt7F, the median daily flows downstream of West Point Lake would be consistently equal to or lower than flows under the NAA throughout the year. In the spring months and from November to early December, flow values could range from zero to 1,000 cfs lower than the NAA (see section 6.1.1.2.3.8).

6.3.2.9 Alternative 7H (PAA)

Slightly adverse effects would be expected on land use along the project shoreline. Table 6.1-4 indicates that under Alth7H, the number of years the West Point Lake summer pool (during peak recreation period) would drop below the IIL over the modeled period of record (1938-2011) would be an additional 6 years over the NAA (section 6.1.1.1.2.9). Lower lake levels would make the land use around the lake less desirable or unusable. As the lake level would drop below the IIL, some boat launching ramps would be unusable, most beaches would be unusable or minimally usable, and navigation hazards would begin to surface due to exposed shoreline and lakebed.

No change would be expected on land use along the river shoreline downstream of West Point Dam, as effects would be about the same as under the NAA (see section 6.1.1.2.3.9).

6.3.3 Walter F. George Lake and Downstream of Walter F. George Lock and Dam

6.3.3.1 No Action Alternative

No change would be expected. The NAA would see the continuation of the current water control operations at Walter F. George Lock and Dam. Effects on land use along the project shoreline and the river shoreline downstream of the dam would be the same as they have been in the past, with deviations in lake levels and shoreline due to seasonal and yearly variations in flow and climatic conditions (see sections 6.1.1.1.3.1 and 6.1.1.2.4.1).

6.3.3.2 Alternative 1B

No change would be expected on land use along the project shoreline. Under Alt1B, the median daily water surface elevations in Walter F. George Lake over the modeled period of record would be essentially the same as under the NAA. Alt1B would essentially have the same effects on the percent of days that the water surface elevations would likely decline below the designated impact levels and affect the usability of the shoreline as the NAA (see section 6.1.1.1.3.2).

No change would be expected on land use along the river shoreline downstream of Walter F. George Dam. Median daily flow differences between Alt1B and the NAA would be negligible. Based on model

results over the modeled period of record, daily average flows of 2,000 cfs or greater would occur about 97 percent of the time for Alt1B compared to 96 percent for the NAA (see section 6.1.1.2.4.2).

6.3.3.3 Alternative 1C

No change would be expected on land use along the project shoreline. Under Alt1C, the median daily water surface elevations in Walter F. George Lake over the modeled period of record would be essentially the same as under the NAA. Alt1C would essentially have the same effects on the percent of days that the water surface elevations would likely decline below the designated impact levels and affect the usability of the shoreline as the NAA (see section 6.1.1.1.3.3).

No change would be expected on land use along the river shoreline downstream of Walter F. George Dam. The effects of Alt1C on flow conditions (at both median and 90 percent exceeded flow levels) would nearly be identical to the effects of the NAA (see section 6.1.1.2.4.3).

6.3.3.4 Alternative 7A

Adverse effects would be expected on land use along the project shoreline. The difference between Alt7A and NAA with respect to the number of years that the lake levels would drop below IIL, RIL, and WAL would be considered minor (Table 6.1-5) with one exception. The number of years that lake levels would likely drop below IIL would increase from 5 (NAA) to 19 (Alt7A), based on the full 12-month period, and from 3 (NAA) to 6 (Alt7A) for the peak recreation season (see section 6.1.1.1.3.4). Adverse effects from dropping below the impact levels would make shoreline land use less desirable or unusable. As the lake levels would drop below the IIL, some boat launching ramps would be unusable, most beaches would be unusable or minimally usable, and navigation hazards would surface due to exposed shoreline and lakebed.

Adverse effects on land use along the river shoreline downstream of Walter F. George Lock and Dam would be expected. For Alt7A, model results for median daily flows would be a close match to NAA flows throughout the year with the following exceptions. Alt7A flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher), and Alt7A flows for June and July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (section 6.1.1.2.4.4).

6.3.3.5 Alternative 7C

Adverse effects on land use along the project shoreline would be expected for Alt7C. The difference between Alt7C and NAA with respect to the number of years that the lake levels would drop below IIL, RIL, and WAL would be considered minor (Table 6.1-5) with one exception. The number of years that lake levels would likely drop below IIL would increase from 5 (NAA) to 18 (Alt7C), based on the full 12-month period, and from 3 (NAA) to 7 (Alt7C) for the peak recreation season (see section 6.1.1.1.3.5). Adverse effects from dropping below the IIL would make some boat launching ramps unusable, most beaches would be unusable or minimally usable, and navigation hazards would surface due to exposed shoreline and lakebed.

Adverse effects on land use along the river shoreline downstream of Walter F. George Lock and Dam would be expected. Alt7C model results for median daily flows would be very similar to NAA flows, with the exceptions that Alt7C flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher). Alt7C flows for June and July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (section 6.1.1.2.4.5).

6.3.3.6 Alternative 7D

Adverse effects on land use along the project shoreline would be expected for Alt7D. The difference between Alt7D and the NAA with respect to the number of years that the lake levels would drop below IIL, RIL, and WAL would be considered minor (Table 6.1-5) with one exception. The number of years that lake levels would likely drop below IIL would increase from 5 (NAA) to 20 (Alt7D), based on the full 12-month period, and from 3 (NAA) to 6 (Alt7D) for the peak recreation season (see section 6.1.1.1.3.6). Adverse effects from dropping below the IIL would make some boat launching ramps unusable, most beaches would be unusable or minimally usable, and navigation hazards would surface due to exposed shoreline and lakebed.

Adverse effects on land use along the river shoreline downstream of Walter F. George Lock and Dam would be expected. Alt7D model results for median daily flows would be very similar to NAA flows, with the exceptions that Alt7D flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher). Alt7D flows for June and July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (section 6.1.1.2.4.6).

6.3.3.7 Alternative 7E

Adverse effects on land use along the project shoreline would be expected for Alt7E. The difference between Alt7E and NAA with respect to the number of years that the lake levels would drop below IIL, RIL, and WAL would be considered minor (Table 6.1-5) with one exception. The number of years that lake levels would likely drop below IIL would increase from 5 (NAA) to 20 (Alt7E), based on the full 12-month period, and from 3 (NAA) to 6 (Alt7E) for the peak recreation season (see section 6.1.1.1.3.7). Adverse effects from dropping below the IIL would make some boat launching ramps unusable, most beaches would be unusable or minimally usable, and navigation hazards would surface due to exposed shoreline and lakebed.

Adverse effects on land use along the river shoreline downstream of Walter F. George Lock and Dam would be expected. Alt7E model results for median daily flows would be very similar to NAA flows, with the exceptions that Alt7E flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher). Alt7E flows for June and July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (section 6.1.1.2.4.7).

6.3.3.8 Alternative 7F

Adverse effects on land use along the project shoreline would be expected for Alt7F. The difference between Alt7F and NAA with respect to the number of years that the lake levels would drop below IIL, RIL, and WAL would be considered minor (Table 6.1-5) with one exception. The number of years that lake levels would likely drop below IIL would increase from 5 (NAA) to 17 (Alt7F), based on the full 12-month period, and from 3 (NAA) to 4 (Alt7F) for the peak recreation season (see section 6.1.1.1.3.8). Adverse effects from dropping below the IIL would make some boat launching ramps unusable, most beaches would be unusable or minimally usable, and navigation hazards would surface due to exposed shoreline and lakebed.

Adverse effects on land use along the river shoreline downstream of Walter F. George Lock and Dam would be expected. Alt7F model results for median daily flows would be very similar to NAA flows, with the exceptions that Alt7F flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher). Alt7F flows for June and

July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (section 6.1.1.2.4.8).

6.3.3.9 Alternative 7H (PAA)

Adverse effects on land use along the project shoreline would be expected for Alt7H. The difference between Alt7H and NAA with respect to the number of years that the lake levels would drop below IIL, RIL, and WAL would be considered minor (Table 6.1-5) with one exception. The number of years that lake levels would likely drop below IIL would increase from 5 (NAA) to 20 (Alt7H), based on the full 12-month period, and from 3 (NAA) to 6 (Alt7H) for the peak recreation season (see section 6.1.1.1.3.9). Adverse effects from dropping below the IIL would make some boat launching ramps unusable, most beaches would be unusable or minimally usable, and navigation hazards would surface due to exposed shoreline and lakebed.

Adverse effects on land use along the river shoreline downstream of Walter F. George Lock and Dam would be expected. Alt7H model results for median daily flows would be very similar to NAA flows, with the exceptions that Alt7H flows for January and for mid-April through May would be higher than NAA flows (ranging from marginally higher to as much as about 1,500 cfs higher). Alt7H flows for June and July would be lower than NAA flows (ranging from marginally lower to as much as about 1,500 cfs lower) (section 6.1.1.2.4.9). Exposed or flooded shoreline due to low or high flow conditions would reduce or eliminate the usability of the shoreline for public recreation uses such as fishing, picnicking, or boat launches.

6.3.4 George W. Andrews Lake and Downstream of George W. Andrews Lock and Dam

No change would be expected. Effects on all the alternatives would be the same as the NAA. The NAA would see the continuation of the current water control operations at George W. Andrews Lock and Dam, which is a run-of-river project operating at 102 ft (with minor variations) and no conservation storage (see section 6.1.1.1.4). Implementing the NAA or any of the alternatives would not have an effect on lake level or flow conditions at George W. Andrews Lake. No change would be expected to land use along the project shoreline or downstream along the river shoreline.

6.3.5 Lake Seminole (Jim Woodruff Lock and Dam)

No change in land use would be expected on Lake Seminole. Effects on all the alternatives would be the same as the NAA. The NAA would see the continuation of the current water control operations at Jim Woodruff Lock and Dam and Lake Seminole, which is a run-of-river project normally operating at about 77 ft (with minor variations) and no conservation storage (see section 6.1.1.1.5). Implementing the NAA or any of the alternatives would not have an effect on lake level or flow conditions at Lake Seminole. No change would be expected to land use along the project shoreline.

Downstream of Jim Woodruff Lock and Dam along the banks of the Apalachicola River, current land use would not be affected by the PAA or other alternatives. Section 6.1.1.2.5 provides detailed information to demonstrate that flow conditions in the Apalachicola River would not change appreciably for these alternatives compared to the NAA. Thus, no change in land use patterns would be expected.

6.3.6 Non-USACE Reservoirs

No change would be expected. Effects on all the alternatives would be the same as the NAA. The NAA would see the continuation of the current water control operations at non-USACE reservoirs (see section 6.1.1.1.6). Implementing the NAA or any of the alternatives would not have an effect on lake level

conditions at the non-USACE reservoirs. No change would be expected to land use along the project shorelines or downstream along the river shoreline.

6.4 Biological Resources

The following sections describe the environmental consequences of the No Action Alternative and Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA on biological resources in the ACF Basin, including vegetation, wildlife, fish and aquatic resources, protected species, and fish and wildlife management facilities.

Throughout the entire Master Manual update process, USACE has coordinated its activities closely with the U.S. Fish and Wildlife Service (USFWS). USACE has engaged the USFWS since 2006 to seek input on the potential effects of proposed operational modifications to ACF projects on fish and wildlife resources in the basin, including federally listed threatened and endangered species. Endangered species consultation for conservation of protected species in the Apalachicola River below Jim Woodruff Lock and Dam, in accordance with section 7 of the Endangered Species Act (ESA) as described in section 2.1.1.2.4.4, was initiated in March 2006 and has continued since. Additionally, USACE has obtained USFWS input during three rounds of EIS scoping for the Master Manual update between 2008 and early 2013. Multiple rounds of scoping were triggered by court decisions, all of which influenced or altered the scope of the proposed Master Manual update. The USFWS provided a Planning Aid Letter (PAL) in April 2010 and an updated PAL in March 2011. Subsequently, USFWS submitted a draft Fish and Wildlife Coordination Report (FWCAR) to USACE, Mobile District in June 2011. Due to a change in scope of the Master WCM update resulting from the June 2011 opinion of the U.S. Court of Appeals for the 11th Circuit (see section 3.5.2.8.2), USFWS provided a second draft FWCAR to USACE on July 31, 2015. These documents and USACE responses are included in Appendix J of this EIS. Following public review of the draft EIS for the Master Manual update, the USFWS will prepare and submit a final FWCAR to USACE.

The July 2015 USFWS report recommended evaluations and analyses to address the following considerations: flow conditions; water quality; fish passage; climate change; reservoir and riverine fisheries management; Apalachicola Bay resources; the inclusion of a decision support model and adaptive management; federally-petitioned species under the Endangered Species Act (ESA); impacts to the Chattahoochee River National Recreation Area; and ecosystem services. Specifically, USFWS included recommendations to address concerns about water quality conditions in project tailraces and to modify flow regimes downstream of the reservoir projects to improve habitat conditions for fish and wildlife. USFWS recommendations for hydrologic modeling included addressing the impacts of increasing consumptive demands and evaluating alternative models to reflect flow extremes and climate change. A number of the recommended conservation measures are beyond the scope of the ACF WCM update process and are addressed in the USACE response to the draft FWCAR in Appendix J.

USACE is updating the Master WCM and individual project WCMs for the ACF Basin. The WCM update process is to determine how the federal projects in the ACF Basin should be operated to meet all authorized purposes and to implement these operations through the means of the updated water control plans and manuals. Fish and wildlife conservation is an authorized purpose of the federal ACF system. As good stewards of the environment and wanting to assure that the fish and wildlife interests were adequately considered, the USACE sought comment and analysis of the PAA by the USFWS and state agencies prior to release of the draft EIS to the public. Although the PAA does not include any construction or structural modifications to the ACF projects, nor is a report or a recommendation to Congress part of this effort, the USACE utilized the general framework of the FWCA to solicit input from USFWS and state agencies and to organize the information provided.

Consultation activities with the USFWS in accordance with section 7 of the ESA regarding potential effects on listed species in the ACF Basin that may be affected by the Master WCM update are discussed in section 6.4.3, and all pertinent documentation is provided in Appendix J.

6.4.1 Vegetation and Wildlife Resources

As discussed in section 2.5, vegetation resources include the terrestrial vegetation communities in the ACF Basin, as well as freshwater and estuarine wetland communities, and terrestrial wildlife resources in the ACF Basin, with an emphasis on those species known, or likely, to occur in riparian or terrestrial areas. Under normal climatic and water quantity conditions, water management operations in the ACF Basin have little to no discernible effect on terrestrial vegetative communities and wildlife. Under drought conditions, it is the intensity and duration of the drought that affects terrestrial vegetative communities and wildlife. Under drought conditions, water management operations in the ACF Basin have no discernible effect on terrestrial vegetative communities and wildlife. Under flood conditions, however, water management operations in the ACF Basin have the potential to affect terrestrial vegetative communities and wildlife beneficially or adversely.

A summary of effects on vegetation and wildlife resources is provided in Table 6.4-1.

Table 6.4-1.
Summary of Vegetation and Wildlife Resources

Vegetation and wildlife resources	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Chattahoochee River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Flint River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.4.1.1 No Action Alternative

6.4.1.1.1 Chattahoochee River

Implementing the NAA would have no effect on terrestrial vegetation or wildlife along the Chattahoochee River. As stated above, under normal climatic and drought conditions, water management operations in the ACF Basin have little to no change on terrestrial vegetative communities and wildlife. Flood risk management operations under the NAA would continue as they have since 1989. The Lake Lanier and West Point Dam and Lake projects would store flood water, and it would be released from the reservoirs so that flows would not exceed the bankfull discharges. Terrestrial vegetation and wildlife along the Chattahoochee River, therefore, would not be altered by implementing the NAA.

6.4.1.1.2 Flint River

Implementing the NAA would have no effect on terrestrial vegetation or wildlife along the Flint River. No aspect of the NAA has any effect on flow conditions along the river.

6.4.1.1.3 Apalachicola River

Implementing the NAA would have no effect on terrestrial vegetation or wildlife along the Apalachicola River and Bay. Flows from the Jim Woodruff Lock and Dam and the amount and extent of floodplain inundation along the Apalachicola River and in the Apalachicola Bay would not change under the NAA. The current drought plan specifies a minimum release of 5,000 cfs from the Jim Woodruff Lock and Dam unless the composite conservation storage falls below the Drought Zone, in which case the minimum release from the Jim Woodruff Lock and Dam is 4,500 cfs. This plan would continue to be implemented under the NAA.

6.4.1.2 Alternative 1B

Effects on terrestrial vegetative communities and wildlife under Alt1B would be similar to those under the NAA.

6.4.1.2.1 Chattahoochee River

Implementing Alt1B would have the same effects on terrestrial vegetative communities and wildlife along the Chattahoochee River as the NAA.

6.4.1.2.2 Flint River

Implementing Alt1B would have no effect on terrestrial vegetation or wildlife along the Flint River.

6.4.1.2.3 Apalachicola River

Alt1B would not alter flow conditions appreciably in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section 6.1.1.2.5). Thus, implementing Alt1B would have the same effects on terrestrial vegetative communities and wildlife along the Apalachicola River as the NAA.

6.4.1.3 Alternative 1C

The effects of implementing Alt1C on terrestrial vegetation and wildlife would be consistent with those under the NAA.

6.4.1.3.1 Chattahoochee River

Implementing Alt1C would have the same effects on terrestrial vegetative communities and wildlife along the Chattahoochee River as the NAA.

6.4.1.3.2 Flint River

Implementing Alt1C would have no effect on terrestrial vegetation or wildlife along the Flint River.

6.4.1.3.3 Apalachicola River

Alt1C would not alter flow conditions appreciably in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section 6.1.1.2.5). Thus, implementing Alt1C would have the same effects on terrestrial vegetative communities and wildlife along the Apalachicola River as the NAA.

6.4.1.4 Alternative 7A

6.4.1.4.1 Chattahoochee River

Implementing Alt7A would have the same effects on terrestrial vegetative communities and wildlife along the Chattahoochee River as the NAA.

6.4.1.4.2 Flint River

Implementing Alt7A would have no effect on terrestrial vegetation or wildlife along the Flint River.

6.4.1.4.3 Apalachicola River

Alt7A would not appreciably alter flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section 6.1.1.2.5). Thus, implementing Alt7A would be expected to have the same effects on terrestrial vegetative communities and wildlife along the Apalachicola River as the NAA.

6.4.1.5 Alternative 7C

6.4.1.5.1 Chattahoochee River

Implementing Alt7C would have the same effects on terrestrial vegetative communities and wildlife along the Chattahoochee River as the NAA.

6.4.1.5.2 Flint River

Implementing Alt7C would have no effect on terrestrial vegetation or wildlife along the Flint River.

6.4.1.5.3 Apalachicola River

Alt7C would not appreciably alter flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section 6.1.1.2.5). Thus, implementing Alt7C would have effects on terrestrial vegetative communities and wildlife along the Apalachicola River similar to those of the NAA.

6.4.1.6 Alternative 7D

6.4.1.6.1 Chattahoochee River

Implementing Alt7D would have the same effects on terrestrial vegetative communities and wildlife along the Chattahoochee River as the NAA.

6.4.1.6.2 Flint River

Implementing Alt7D would have no effect on terrestrial vegetation or wildlife along the Flint River.

6.4.1.6.3 Apalachicola River

Alt7D would not appreciably alter flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section

6.1.1.2.5). Thus, implementing Alt7D would have effects on terrestrial vegetative communities and wildlife along the Apalachicola River similar to those of the NAA.

6.4.1.7 Alternative 7E

6.4.1.7.1 Chattahoochee River

Implementing Alt7E would have the same effects on terrestrial vegetative communities and wildlife along the Chattahoochee River as the NAA.

6.4.1.7.2 Flint River

Implementing Alt7E would have no effects on terrestrial vegetation or wildlife along the Flint River.

6.4.1.7.3 Apalachicola River

Alt7E would not appreciably alter flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section 6.1.1.2.5). Thus, implementing Alt7E would have effects on terrestrial vegetative communities and wildlife along the Apalachicola River similar to those of the NAA.

6.4.1.8 Alternative 7F

6.4.1.8.1 Chattahoochee River

Implementing Alt7F would have the same effects on terrestrial vegetative communities and wildlife along the Chattahoochee River as the NAA.

6.4.1.8.2 Flint River

Implementing Alt7F would have no effect on terrestrial vegetation or wildlife along the Flint River.

6.4.1.8.3 Apalachicola River

Alt7F would not appreciably alter flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section 6.1.1.2.5). Thus, implementing Alt7F would have effects on terrestrial vegetative communities and wildlife along the Apalachicola River similar to those of the NAA.

6.4.1.9 Alternative 7H (PAA)

6.4.1.9.1 Chattahoochee River

Implementing the PAA would have no effect on terrestrial vegetation or wildlife along the Chattahoochee River. Under normal climatic and drought conditions, water management operations in the ACF Basin have little to no influence on terrestrial vegetative communities and wildlife. Flood risk management operations under the PAA would continue as they have since 1989. The Lake Lanier and West Point Dam and Lake projects would store flood water, and it would be released from the reservoirs so that flows would not exceed the bankfull discharges. Terrestrial vegetation and wildlife along the Chattahoochee River, therefore, would not be affected by implementing the PAA.

6.4.1.9.2 Flint River

Implementing the PAA would have no effect on terrestrial vegetation or wildlife along the Flint River.

6.4.1.9.3 Apalachicola River

The PAA would not appreciably alter flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam and continuing to the Apalachicola Bay compared to the NAA (see section 6.1.1.2.5). Under the PAA, vegetation and wildlife along the Apalachicola River would be expected to experience slightly adverse conditions when flow in the river drops below 5,000 cfs during extreme drought conditions. These conditions would occur infrequently and would generally be of relatively short duration (a few weeks or less). The vegetation and wildlife along the Apalachicola River would be able to endure the conditions with no measureable changes to vegetative community composition or wildlife populations.

6.4.2 Fish and Aquatic Resources

6.4.2.1 Rivers

Fish and aquatic resources in the ACF Basin between Buford Dam and Apalachicola Bay could be affected somewhat differently under the alternatives, depending on the extent of changes in streamflow and water quality conditions compared to the NAA.

The nine alternatives, each of which incorporates a different water supply option, includes one of two water management alternatives (Alt1 and Alt7) from Table 4.2-1. Both of these include fish and wildlife conservation measures, including current fish spawn standard operating procedures and fish passage lockages at Jim Woodruff Lock and Dam. The alternatives evaluated also call for similar federally listed threatened and endangered species operations, including the current ramping rate with suspension of the ramping rate during prolonged low flows, and current seasonal flow targets. One difference is that alternatives 7A, 7B, 7C, 7D, 7E, 7F, and the PAA call for the ramping rate to be suspended in drought conditions.

The ranges used to define water quality effects were determined based on conditions that would protect fish and aquatic resources. Therefore, these definitions can be used to assess the effects of various management alternatives on these communities. Water quality parameters that relate to fish and aquatic resources include water temperature, dissolved oxygen (DO), total phosphorus (TP), total nitrogen (TN), and chlorophyll *a*. Excessively low DO concentrations can cause fish kills because fish require a minimum concentration of dissolved oxygen for survival. Water temperature is often considered in conjunction with DO because there is generally an inverse correlation between the two parameters. Warm water holds less DO than cold water, so high water temperatures can be associated with low DO levels. Nutrients such as TN and TP can disrupt aquatic ecosystems when concentrations become elevated. High nutrient levels can cause increased algae growth, which can then result in high turbidity, oxygen depletion, and other associated effects. Chlorophyll *a* concentration is an indicator of algal biomass. Thus, a high concentration of chlorophyll *a* is additional evidence of a degraded stream condition that is not favorable for fish and aquatic resources. Decision criteria for establishing thresholds for these water quality parameters are presented in sections 6.1.2.1 (water temperature), 6.1.2.2 (DO), 6.1.2.3 (TP), 6.1.2.4 (TN), and 6.1.2.5 (chlorophyll *a*).

The Chattahoochee River is essentially disconnected from its floodplain, so floodplain connectivity would not be influenced by the different alternatives. In addition, changes in streamflow on the Chattahoochee River between Buford Dam and Lake Seminole are minor under the various alternatives and are not expected to have direct effects on fish and aquatic resources. Streamflow conditions for the Chattahoochee River are described in detail in section 6.1.1.2 for each alternative relative to the NAA.

Figure 6.1-19 through Figure 6.1-30 present model outputs for Buford Dam and the Chattahoochee River at Peachtree Creek and Atlanta over the modeled period of hydrologic record. The figures present results for magnitude of flow conditions at Buford Dam and at Atlanta, and percent of days exceeded for flows at the Chattahoochee River (Peachtree Creek, Atlanta). Figure 6.1-31 through Figure 6.1-44 present model outputs for the Chattahoochee River at Whitesburg and for West Point Dam, including the magnitude of flow conditions at West Point Dam and at Columbus. Figure 6.1-47 and Figure 6.1-50 present the magnitude of flow conditions at George W. Andrews Lock and Dam. These figures show that there is little difference between alternatives.

The Apalachicola River has a wide and relatively flat floodplain, and the river is highly connected to vast overbank areas with backwater sloughs and interconnecting channel. The Apalachicola River floodplain is highly sensitive to appreciable changes in flow conditions downstream of Woodruff Lock and Dam, floodplain connectivity, and fall rates in the river.

For the NAA, flows in the Apalachicola River would be governed by the current RIOP, as described in section 5.2.1.1.4. Adjustments would be made in operations under alternatives 7A, 7B, 7C, 7D, 7E, 7F, and the PAA to protect threatened and endangered species, as outlined in section 5.2.

The criteria used to define water quantity effects on fish and aquatic resources in the Apalachicola River downstream of Jim Woodruff Lock and Dam include discharge rates and area of floodplain habitat. These criteria are appropriate for assessing overall effects on the wide variety of aquatic organisms, including aquatic vegetation, riverine and estuarine fish, amphibians, reptiles, mollusks, and other invertebrates that inhabit the Apalachicola River and the adjacent floodplain.

A summary of effects on aquatic resources is provided in Table 6.4-2. For this summary, effects on aquatic resources in segments of the Chattahoochee River due to changes in water quality from the NAA are based on median changes in water quality parameters, as indicated in Table 6.1-14 (water temperature), Table 6.1-15 (DO), Table 6.1-17 (TP), Table 6.1-18 (TN), and Table 6.1-19 (chlorophyll *a*). Effects at the 5th percent and 95th percent occurrence and during the growing season of a dry year are discussed in the following sections, where applicable, but represent rare conditions and were not used to determine the overall effect. Effects of water quantity changes on fish and aquatic resources in the Apalachicola River are detailed in section 6.4.2.1.4. The most extreme effect of all criteria that were evaluated for a stream segment was used to determine the overall effect. For example, if the effect of an alternative is slightly adverse for DO and no change for other water quality parameters, the effect on fish and aquatic resources was determined to be slightly adverse (due to changes in DO).

Table 6.4-2.
Summary of Effects on Riverine Fish and Aquatic Resources

Riverine fish and aquatic resources	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Buford Dam to Atlanta	Baseline	Slightly Beneficial	Slightly adverse	No change	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Atlanta to West Point Lake	Baseline	No change	Adverse	No change	Substantially adverse	Substantially adverse	Substantially adverse	Adverse	Substantially adverse
West Point Dam to Walter F. George Lake	Baseline	No change	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Walter F. George Lock and Dam to Lake Seminole	Baseline	No change	No change	No change	No change	No change	Slightly adverse	No change	No change
Apalachicola River	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.4.2.1.1 Chattahoochee River Downstream of Buford Dam

6.4.2.1.1.1 No Action Alternative

Stream flow and water quality conditions in the Chattahoochee River downstream of Buford Dam would not change under the NAA. Section 6.1.1.2.2 describes flows along this reach of the Chattahoochee River. Operations to support fish spawning in rivers, consistent with other project purposes, would continue as currently practiced. Aquatic communities in the Chattahoochee River below Buford Dam are heavily influenced by water control operations at the dam, particularly because of the effect on water temperature and dissolved oxygen. Therefore, water quality conditions for the NAA are used as the baseline against which the other alternatives are compared.

The cool water released from the reservoir supports a trout fishery below the dam, which would not otherwise be possible in this part of Georgia. Water temperature increases going downstream of the dam. During the growing season, the median daily water temperature is over 15 °C warmer at the downstream end of the reach than it is just below Buford Dam.

The portion of the Chattahoochee River from Buford Dam to Atlanta experiences the lowest DO concentrations just downstream of the dam. Modeled DO differences are more pronounced during the growing season of a dry year, causing DO concentrations to drop below the water quality standard of 6 mg/L. The area affected by low DO during dry conditions is limited to a small reach just below the dam, from which fish can move downstream into conditions that are more favorable.

Nutrient levels are high from Atlanta to West Point Lake. The highest concentrations occur in low flow years. In dry-weather conditions along this reach of the Chattahoochee River, concentrations of TN are near 3.5 mg/L. Downstream of Whitesburg, very high median chlorophyll *a* concentrations occur during the growing season, close to 10 µg/L. High nutrient and chlorophyll *a* concentrations are indicators of degraded stream conditions, and generally do not support a high-quality aquatic community.

6.4.2.1.1.2 Alternative 1B

Implementing Alt1B would be expected to have a slightly beneficial effect on fish and aquatic resources. These effects would result from negligible changes in temperature, an average change in DO of less than 0.05 mg/L from Buford Dam to Atlanta, little to no change in TP concentrations, a minor decrease in the TN concentration between Buford Dam and Atlanta, and little to no change in chlorophyll *a* concentrations. Decreased DO during a dry year by more than 0.1 mg/L would be expected at Norcross, but DO concentrations would be expected to increase from Atlanta to West Point Lake during the critical low flow summer conditions.

6.4.2.1.1.3 Alternative 1C

Implementing Alt1C would be expected to have a slightly adverse effect on fish and aquatic resources. These effects would result from negligible changes in temperature, a decrease in DO downstream of Buford Dam to West Point Lake, a slight increase in TP concentrations, an increase in TN concentrations from Norcross through Atlanta, and little to no change in chlorophyll *a* concentrations. The maximum decrease in DO would be expected in the reach from Atlanta to Whitesburg, and the median growing season average chlorophyll *a* concentration at RM 340 during a dry year would increase by at least 2 µg/L, creating an adverse effect on fish and aquatic resources during a critical period.

6.4.2.1.1.4 Alternative 7A

Implementing Alt7A would be expected to have both slightly beneficial and slightly adverse effects on fish and aquatic resources. The median temperature would not change below Buford Dam, though it could decrease by as much as 0.8 °C during a dry year from Whitesburg to West Point Lake, creating a beneficial effect. A minor increase in TN in dry years from Atlanta to West Point Lake would have a slightly adverse effect. Little to no change in DO, TP, and chlorophyll *a* would be expected under Alt7A.

6.4.2.1.1.5 Alternative 7C

Implementing Alt7C would be expected to have slightly adverse effects on fish and aquatic resources. The alternative would be expected to result in a negligible effect on water temperature, a decrease in DO downstream of Buford Dam to West Point Lake and a maximum decrease in DO expected in the reach from Atlanta to Whitesburg, a slight increase in the TP concentration, an increase in the TN concentration from Norcross through Atlanta, and a slight increase in the chlorophyll *a* concentration. Overall, Alt7C would have no effect on aquatic resources from Buford Dam to Atlanta but a substantially adverse effect from Atlanta to West Point Lake due to an increase in nutrients and a decrease in DO. As in past years of drought, working closely with states and affected stakeholders, USACE releases may assist with public health and safety throughout the ACF Basin.

6.4.2.1.1.6 Alternative 7D

Implementing Alt7D would be expected to have slightly adverse effects on fish and aquatic resources. Water temperature would be expected to increase slightly from Buford Dam to Atlanta and decrease slightly from what it is under the NAA from Atlanta to West Point Lake, creating beneficial and adverse effects for fish and aquatic resources along different reaches of the Chattahoochee River. DO would be expected to decrease slightly. TP would increase slightly from Buford Dam to Atlanta and increase substantially from Atlanta to West Point Lake, primarily due to changes in water withdrawn and returned downstream of Atlanta. Modeled TP would be greater than water quality standards allow at the West Point Lake headwaters, causing substantially adverse conditions in this reach. There would be a slight increase in the TN concentration and little to no change in the chlorophyll *a* concentration.

Overall, the effect on fish and aquatic resources due to changes in water quality from the NAA would be slightly adverse from Buford Dam to Atlanta, and substantially adverse from Atlanta to West Point Lake due to an increase in nutrients and a decrease in DO.

6.4.2.1.1.7 Alternative 7E

Implementing Alt7E would be expected to have slightly adverse effects on fish and aquatic resources. Water quality effects under this alternative would be expected to be very similar to those expected under Alt7D, except that water temperature would not be expected to change appreciably from what it is under the NAA.

Overall, Alt7E would be expected to have a slightly adverse effect on aquatic resources due to changes in water quality from the NAA from Buford Dam to Atlanta, and a substantially adverse effect from Atlanta to West Point Lake due to an increase in nutrients and a decrease in DO.

6.4.2.1.1.8 Alternative 7F

Implementing Alt7F would be expected to have an adverse effect on fish and aquatic resources. Water temperature would be expected to increase from Atlanta to West Point Lake, with an increase of 2.3 °C near Atlanta. DO would be expected to increase slightly from Buford Dam to Atlanta but to decrease

slightly from Atlanta to West Point Lake. TP would increase slightly from Buford Dam to Atlanta and increase more from Atlanta to West Point Lake, although the modeled TP concentration would be less than water quality standards allow at the West Point Lake headwaters. TN would increase slightly, and there would be little to no change in the concentration of chlorophyll *a*.

Overall, Alt7F would have a slightly adverse effect on aquatic resources due to changes in water quality from the NAA from Buford Dam to Atlanta due to an increase in nutrients, and an adverse effect from Atlanta to West Point Lake due to an increase in nutrients and a decrease in DO.

6.4.2.1.1.9 Alternative 7H (PAA)

Implementing the PAA would be expected to have an adverse effect on fish and aquatic resources in the Chattahoochee River downstream of Buford Dam. Water temperature would be expected to increase slightly from Buford Dam to Atlanta and decrease slightly from Atlanta to West Point Lake. DO would be expected to decrease slightly. TP would increase slightly from Buford Dam to Atlanta and increase more from Atlanta to West Point Lake, although the modeled TP concentration would be less than water quality standards allow at the West Point Lake headwaters. TN would increase slightly and there would be little to no change in the concentration of chlorophyll *a*. Overall, the PAA would be expected to have a slightly adverse effect on aquatic resources from Buford Dam to Atlanta, and a substantially adverse effect from Atlanta to West Point Lake due to an increase in nutrients and a decrease in DO.

6.4.2.1.2 Chattahoochee River Downstream of West Point Dam

6.4.2.1.2.1 No Action Alternative

Implementing the NAA would have no effect on fish and aquatic resources in the Chattahoochee River downstream of the West Point Dam. Water quality conditions under the NAA are used as the baseline against which the other alternatives are compared.

Median water temperature drops suddenly from 22 °C to 19 °C at the tailrace of the West Point Dam due to water being released from the bottom layer of the water column. Temperature increases going downstream of the dam. Median DO concentrations are above 6.5 mg/L. The median TP concentration in the reach from West Point Dam to Walter F. George Lake is 0.04–0.08 mg/L. TN decreases downstream of the West Point Dam, except near Columbus, where it increases, most likely due to nutrient-rich wastewater discharges. Chlorophyll *a* concentrations are elevated downstream of the West Point Dam during the growing season.

6.4.2.1.2.2 Alternative 1B

Implementing Alt1B would be expected to have a negligible effect on water quality parameters. Little to no change would be expected in water temperature, DO, median TP and TN concentrations, and chlorophyll *a*.

6.4.2.1.2.3 Alternative 1C

Implementing Alt1C would be expected to have a slightly adverse effect on fish and aquatic resources due to a 0.01–0.02 mg/L increase in the TP concentration and a slight increase in the TN concentration. Little to no change in water temperature, DO, and chlorophyll *a* downstream of West Point Lake would be expected under Alt1C.

6.4.2.1.2.4 Alternative 7A

Implementing Alt7A would be expected to have no effect on fish and aquatic resources downstream of the West Point Dam. Under Alt7A, there would be little to no change in water temperature, DO, TP, TN, and chlorophyll *a*. In a dry year, the growing season median concentration of chlorophyll *a* would be expected to decrease by 1–1.8 µg/L, resulting in a slightly beneficial effect on fish and aquatic resources.

6.4.2.1.2.5 Alternative 7C

Implementing Alt7C would be expected to have a slightly adverse effect on fish and aquatic resources downstream of the West Point Dam. The change in TP and TN concentrations under Alt7C would be similar to the change expected under Alt1C, resulting in slightly adverse effects on fish and aquatic resources during dry years. Little to no change in water temperature, DO, and chlorophyll *a* would be expected for this river segment under Alt7C.

6.4.2.1.2.6 Alternative 7D

Implementing Alt7D would be expected to have a slightly adverse effect on fish and aquatic resources downstream of the West Point Dam. There would be little to no change in water temperature and DO. During the growing season of dry year, DO levels would increase slightly in the tailrace of West Point Dam, creating a slightly beneficial condition, and decrease slightly at Bartletts Ferry Dam, creating a slightly adverse condition. An increased change in TP of 0.01 mg/L would be expected. Downstream of West Point Dam, an increase in TN of 0.1–0.5 mg/L would create a slightly adverse condition. Similar to the NAA, the modeled TP would be greater than the water quality standard allows at the Walter F. George Lake headwaters. Downstream of West Point Dam, Alt7D would have a slightly adverse effect on fish and aquatic resources. The median growing season chlorophyll *a* concentration would not be expected to change.

6.4.2.1.2.7 Alternative 7E

Implementing Alt7E would be expected to have a slightly adverse effect on fish and aquatic resources downstream of West Point Dam, with effects similar to those under Alt7D. There would be a slight increase in DO below West Point Dam and a slight decrease in DO at Bartletts Ferry Dam. The modeled TP concentration would increase slightly and would be higher than the water quality standards at Walter F. George Lake headwaters. The TN concentration would be expected to increase slightly, and there would be little to no change in water temperature and chlorophyll *a*.

6.4.2.1.2.8 Alternative 7F

Implementing Alt7F would be expected to have a slightly adverse effect fish and aquatic resources. The effects under Alt7F would be similar to those under Alt7D and Alt7E.

6.4.2.1.2.9 Alternative 7H (PAA)

Implementing the PAA would be expected to have a slightly adverse effect on fish and aquatic resources. There would be no change expected in water temperature, the median DO concentration would be slightly higher than the other alternatives, the TP and TN concentrations would be slightly elevated, and the median change in growing season concentrations of chlorophyll *a* during the dry year would be expected to be higher by 1 µg/L. The overall effect of the PAA on aquatic resources would be slightly adverse downstream of West Point Dam due to an increase in nutrients.

6.4.2.1.3 Chattahoochee River Downstream of Walter F. George Dam

6.4.2.1.3.1 No Action Alternative

Implementing the NAA would result in no change in the effects on fish and aquatic resources. Slower-moving waters caused by the George W. Andrews Lock and Dam increase the median temperatures in the tailrace of Walter F. George Lock and Dam by 2 °C from the preceding reach of West Point Dam to Walter F. George Lake.

DO below the Walter F. George Lock and Dam is similar to or slightly higher than it is below West Point Dam. During the growing season of a dry year, median DO concentrations downstream of Walter F. George Lock and Dam increase quickly from 4.5 mg/L to above 6.0 mg/L and then continue to rise from 6.0–8.0 mg/L to Lake Seminole.

The median TP concentration downstream of Walter F. George Lock and Dam to Lake Seminole is around 0.089 mg/L. TN decreases from Walter F. George Lock and Dam to Lake Seminole.

6.4.2.1.3.2 Alternative 1B

Implementing Alt1B would not be expected to have an effect on water quality below Walter F. George Dam. Water quality conditions would be expected to be similar to those under the NAA.

6.4.2.1.3.3 Alternative 1C

Implementing Alt1C would not be expected to have an effect on water quality below Walter F. George Dam. Water quality conditions would be expected to be similar to those under the NAA.

6.4.2.1.3.4 Alternative 7A

Implementing Alt7A would be expected to have a slightly adverse effect on fish and aquatic resources downstream of Walter F. George Lock and Dam. Water temperatures during the growing season of a normal year would be expected to increase by about 0.8 °C, creating a slightly adverse effect. The median DO concentration would be expected to increase by 1 mg/L, which would have a negligible effect on fish and aquatic resources. There would be little to no change in TP, TN, and chlorophyll *a* under Alt7A.

6.4.2.1.3.5 Alternative 7C

Implementing Alt7C would be expected to have a slightly adverse effect on fish and aquatic resources downstream of Walter F. George Lock and Dam. Water temperatures during the growing season of a normal year would be expected to increase by about 0.8 °C for Alt7C, creating a slightly adverse effect. Changes in DO, TP, and TN would be negligible under Alt7C.

The median growing season concentration of chlorophyll *a* in a dry year would be expected to be higher than the NAA by at least 1 µg/L, causing a slightly adverse effect.

6.4.2.1.3.6 Alternative 7D

Implementing Alt7D would be expected to have a slightly adverse effect on fish and aquatic resources downstream of Walter F. George Lock and Dam. There would be little to no change in water temperature or DO. TP and TN would increase slightly, which would be expected to have an adverse effect on fish and aquatic resources. The median growing season concentration of chlorophyll *a* for a dry year would be expected to be 1 µg/L higher than the NAA, resulting in slightly adverse effects.

6.4.2.1.3.7 Alternative 7E

Implementing Alt7E would be expected to have effects similar to those of Alt7D, with slightly adverse effects on fish and aquatic resources downstream of Walter F. George Lock and Dam.

6.4.2.1.3.8 Alternative 7F

Implementing Alt7F would be expected to have a slightly adverse effect on fish and aquatic resources downstream of Walter F. George Lock and Dam due to a slight increase in the TP concentration. Other water quality conditions would remain similar to those under the NAA.

6.4.2.1.3.9 Alternative 7H (PAA)

Implementing the PAA would be expected to have negligible effects on fish and aquatic resources downstream of Walter F. George Lock and Dam. There would be a slight increase in TP and the median growing season chlorophyll *a* concentration during a dry year would be expected to be about 1 µg/L higher, creating slightly adverse conditions for aquatic life. There would be little to no change in water temperature, DO, and TN.

6.4.2.1.4 Apalachicola River

In the Apalachicola River, fish and aquatic resources, including aquatic vegetation, riverine and estuarine fish, amphibians, reptiles, mollusks, and other invertebrates, could be affected by changes in discharge rates and area of floodplain habitat on the Apalachicola River. The river level (dependent on the discharge from the Jim Woodruff Dam) largely dictates available floodplain habitat.

Discharge rates on the Apalachicola River are similar across alternatives. Flow conditions downstream of Jim Woodruff Lock and Dam for the proposed alternatives would not be appreciably different from flow conditions under the NAA. As described in detail in section 6.1.1.2.5 and summarized in Table 6.1-2, flow conditions under each alternative were essentially characterized as "no change" from the NAA.

Floodplain habitat connectivity on the Apalachicola River is also similar across alternatives. The maximum 30-day growing season floodplain habitat connectivity for each alternative was calculated as the maximum amount of floodplain spawning habitat available for at least 30 consecutive days during the months of April through October. This criterion was based on the life history requirements of many riverine fishes, including species specific to the Apalachicola River. This criterion is also an appropriate standard for assessing habitat for the wide range of other aquatic organisms that inhabit the Apalachicola River and its floodplain. Table 6.4-3 shows the area of floodplain habitat for each alternative. All alternatives are less than 2 percent different from the NAA.

Table 6.4-3.
Floodplain Habitat Connectivity on the Apalachicola River

	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Annual Maximum 30-day Growing Season Floodplain Connectivity (acres)	17896	18024	18016	18133	18227	18022	18022	17659	18029

Discharge rates and area of floodplain habitat are the principal factors that could influence aquatic organisms and communities in the Apalachicola River and for each of these evaluation criteria, the differences are slight between each of the alternatives and the NAA. Given wastewater return rates are unchanged along this reach and flows in the Apalchicola River are similar across alternatives, water

quality in the Apalachicola River would also be relatively unchanged as illustrated in Figures 6.1-65 through 6.1-126. Therefore, each of the alternatives evaluated would be expected to have negligible effects on fish and aquatic resources in the Apalachicola River.

6.4.2.2 Reservoirs

This section describes the effects on reservoir fisheries and other aquatic resources associated with changes in USACE operations and various water supply options on Lake Lanier, West Point Lake, Walter F. George Lake, George W. Andrews Lock and Dam, and Lake Seminole.

Operational flow changes would affect habitat for reservoir fisheries and other aquatic resources mainly through changes in water levels, reservoir flushing rates (retention times), and associated changes in water quality parameters (e.g., nutrient loading and dissolved oxygen concentrations). Seasonal water-level fluctuations can substantially change the area of shallow-water habitats and inundated shoreline vegetation in reservoirs and, in turn, influence the reproductive success of resident fish populations.

Substantial daily or weekly fluctuations in reservoir levels associated with hydroelectric power generation peaking operations could adversely affect reservoir fisheries by dewatering spawning and nursery habitats for littoral species, exposing nests and eggs deposited in shallow-water habitats, and reducing the availability of shoreline cover and its associated invertebrate food supply. Performance measures developed by the USFWS were used in this evaluation, specifically to assess reservoir fisheries habitat with the assumption that a greater departure of reservoir levels from optimum (e.g., littoral spawning, rearing) results in a greater effect on habitats, including loss. The Reservoir Fisheries Performance Measure (RFPM) was recommended by the USFWS because it specifically characterizes the spatial extent of the reservoir most likely to support successful fish survival and reproduction as a direct function of containing suitable habitat features.

The effect of the alternatives on reservoir fisheries was determined using the area (in acres) of productive zone inundated for more than 30 days during the spawning season, as calculated using the RFPM. The inundated productive zone was defined for each reservoir and is presented in subsequent sections. Table 6.4-4 summarizes the overall effect of alternatives on reservoir fish and aquatic resources.

Table 6.4-4.
Summary of Reservoir Fish and Aquatic Resources

Reservoir fish and aquatic resources	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Lake Lanier	Baseline	No change	No change	No change	No change	No change	No change	Slightly beneficial	No change
West Point Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Walter F. George Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
George W. Andrews Lake	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Lake Seminole	Baseline	No change	No change	No change	No change	No change	No change	No change	No change
Non-USACE reservoirs	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.4.2.2.1 Lake Lanier

This section describes the effects of operations under the alternatives considered and refers to Figure 6.1-1 through Figure 6.1-6 for daily water surface elevations over the period of record for Lake Lanier. No effects on reservoir fisheries and other aquatic resources would be expected if the RFPM output acreage is within approximately 150 acres (plus or minus) of the median NAA model output. If the modeled productive zone inundated for more than 30 days during the spawning season is between 7,050 and 7,350 acres, no effects on reservoir fisheries and other aquatic resources would be expected. In general, increased acreage from 7,400 to 7,600 acres would be slightly beneficial, decreased acreage from 6,800 to 7,000 acres would be slightly adverse, decreased acreage from 6,500 to 6,800 acres would be adverse, and acreage less than 6,400 acres would be substantially adverse. In general, increased acreage is beneficial while decreased acreage is adverse. The advantage of acreage increases diminishes as inundation reaches extreme expanses.

6.4.2.2.1.1 No Action Alternative

No effects on reservoir fisheries and other aquatic resources would result from implementing the NAA. Median daily water surface elevations, shown in Figure 6.1-1, would be expected, representing a continuation of current conditions at Lake Lanier. RFPM model results predict a median productive zone of approximately 7,200 acres inundated for more than 30 days, with a range from approximately 2,500 to 12,000 acres. These values serve as the baseline for comparing the potential effects of the other alternatives.

6.4.2.2.1.2 Alternative 1B

Implementing Alt1B would be expected to have no effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,124 acres, with a range of from approximately 3,600 to 12,000 acres.

6.4.2.2.1.3 Alternative 1C

Implementing Alt1C would be expected to have no effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,252 acres, with a range of from approximately 2,500 to 12,000 acres.

6.4.2.2.1.4 Alternative 7A

Implementing Alt7A would be expected to have no effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,211 acres, with a range of from approximately 2,400 to 11,800 acres.

6.4.2.2.1.5 Alternative 7C

Implementing Alt7C would be expected to have no effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,311 acres, with a range of from approximately 1,100 to 11,600 acres.

6.4.2.2.1.6 Alternative 7D

Implementing Alt7D would be expected to have no effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,243 acres, with a range of from approximately 1,300 to 12,600 acres.

6.4.2.2.1.7 Alternative 7E

Implementing Alt7E would be expected to have no effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,243 acres, with a range of from approximately 900 to 12,600 acres.

6.4.2.2.1.8 Alternative 7F

Implementing Alt7F would be expected to have slightly beneficial effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,426 acres, with a range of from approximately 800 to 14,400 acres.

6.4.2.2.1.9 Alternative 7H (PAA)

Implementing the PAA would be expected to have no effects on reservoir fisheries and other aquatic resources on Lake Lanier. The median inundated productive zone for more than 30 days would be expected to be 7,243 acres, with a range of from approximately 927 to 12,600 acres.

6.4.2.2.2 West Point Lake

West Point Lake has a surface area of 25,864 acres. Water surface elevations for West Point Lake under the modeled conditions and different alternatives are discussed in section 6.1.1.1.2. This section describes the effects of operations under the alternatives considered and refers to Figure 6.1-7 through Figure 6.1-12 for daily water surface elevations over the period of record for West Point Lake. Decision criteria for environmental effects are based on the RFPM for West Point Lake. No effects on reservoir fisheries and other aquatic resources would be expected if the RFPM output acreage is within approximately 50 acres (plus or minus) of the median model output for the NAA, 3,687 acres, or between 3,640 and 3,740 acres. In general, increased acreage from 3,740 to 3,850 acres would be slightly beneficial, decreased acreage from 3,550 to 3,640 acres would be slightly adverse, decreased acreage from 3,300 to 3,550 acres would be adverse, and acreage less than 3,300 acres would be substantially adverse.

6.4.2.2.2.1 No Action Alternative

Implementing the NAA would be expected to have no effect on reservoir fisheries and other aquatic resources. The RFPM results predict a median inundated productive zone of 3,687 acres for more than 30 days at West Point Lake, with a range from 1,598 to 7,496 acres. This serves as the baseline for comparing potential effects of other alternatives.

6.4.2.2.2.2 Alternative 1B

Implementing Alt1B would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,667 acres, with a range from approximately 1,600 to 7,300 acres.

6.4.2.2.2.3 Alternative 1C

Implementing Alt1C would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,698 acres, with a range from approximately 1,570 to 7,440 acres.

6.4.2.2.2.4 Alternative 7A

Implementing Alt7A would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,660 acres, with a range from approximately 2,156 to 8,100 acres.

6.4.2.2.2.5 Alternative 7C

Implementing Alt7C would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,692 acres, with a range from approximately 1,950 to 8,062 acres.

6.4.2.2.2.6 Alternative 7D

Implementing Alt7D would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,698 acres, with a range from approximately 1,811 to 8,281 acres.

6.4.2.2.2.7 Alternative 7E

Implementing Alt7E would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,698 acres, with a range from approximately 1,840 to 8,185 acres.

6.4.2.2.2.8 Alternative 7F

Implementing Alt7F would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,705 acres, with a range from approximately 2,343 to 7,023 acres.

6.4.2.2.2.9 Alternative 7H (PAA)

Implementing the PAA would be expected to have no effects on reservoir fisheries and other aquatic resources on West Point Lake. The median inundated productive zone for more than 30 days would be expected to be 3,698 acres, with a range from approximately 1,840 to 8,191 acres.

6.4.2.2.3 Walter F. George Lake

Walter F. George Lake (Lake Eufaula) has a surface area of approximately 45,180 acres. Figure 6.1-13 through Figure 6.1-18 present daily water surface elevations relative to Walter F. George Lake operations over the modeled period of record for the alternatives considered. Decision criteria for environmental effects were based on the RFPM for Walter F. George Lake. No effects on reservoir fisheries and other aquatic resources on Walter F. George Lake would be expected if the RFPM output acreage is within approximately 150 acres (plus or minus) of 11,545 acres, the median model output for the NAA. No effects on reservoir fisheries and other aquatic resources on Walter F. George Lake would be expected if the productive zone inundated for more than 30 days during the spawning season is between 11,400 and 11,700 acres. In general, increased acreage from 11,700 to 11,850 acres would be slightly beneficial, decreased acreage from 11,250 to 11,400 acres would be slightly adverse, decreased acreage from 11,100 to 11,250 acres would be adverse, and an inundated productive zone less than 11,000 acres would be substantially adverse.

6.4.2.2.3.1 No Action Alternative

Implementing the NAA would have no effects on reservoir fisheries and other aquatic resources on Walter F. George Lake. The RFPM results predict a median inundated productive zone of 11,545 acres for more than 30 days at Walter F. George Lake. The expected inundated area ranges from a minimum of 10,438 acres to a maximum of 14,944 acres. This serves as the baseline for comparing potential effects of the other alternatives.

6.4.2.2.3.2 Alternative 1B

Implementing Alt1B would be expected to have no effects on reservoir fisheries and other aquatic resources on Walter F. George Lake. Alt1B would be expected to result in lake levels identical to those under the NAA.

6.4.2.2.3.3 Alternative 1C

No change from the NAA would be expected under Alt1C. The RFPM results in a median productive zone of 11,537 acres inundated for more than 30 days with an approximate range of 11,200 to 11,633 acres.

6.4.2.2.3.4 Alternative 7A

No change from the NAA would be expected under Alt7A. The RFPM results in a median productive zone of 11,574 acres inundated for more than 30 days.

6.4.2.2.3.5 Alternative 7C

No change from the NAA would be expected under Alt7C. The RFPM results in a median productive zone of 11,545 acres inundated for more than 30 days with an approximate range of 11,148 to 11,906 acres.

6.4.2.2.3.6 Alternative 7D

No change from the NAA would be expected under Alt7D. The RFPM results in a median productive zone of 11,545 acres inundated for more than 30 days with an approximate range of 11,193 to 11,673 acres.

6.4.2.2.3.7 Alternative 7E

No change from the NAA would be expected under Alt7E. The RFPM results in a median productive zone of 11,559 acres inundated for more than 30 days with an approximate range of 9,365 to 5,643 acres.

6.4.2.2.3.8 Alternative 7F

No change from the NAA would be expected under Alt7F. The RFPM results in a median productive zone of 11,574 acres inundated for more than 30 days with an approximate range of 11,199 and 11,808 acres.

6.4.2.2.3.9 Alternative 7H (PAA)

No change from the NAA would be expected under the PAA. The RFPM results in a median productive zone of 11,559 acres inundated for more than 30 days with an approximate range of 9,380 to 5,643 acres.

6.4.2.2.4 George W. Andrews Lake

George W. Andrews Lake is a run-of-river project with little variation in water surface elevation between the NAA and various alternatives, as described in section 6.1.1.1.4. Therefore, RFPM was not applied to George W. Andrews Lake. No change would be expected in productive zone inundation on George W. Andrews Lake under any of the alternatives.

6.4.2.2.5 Lake Seminole

Lake Seminole is also a run-of-river project with little variation in water surface elevation between the NAA and various alternatives, as described in section 6.1.1.1.5. Therefore, the RFPM was also not applied to Lake Seminole. No changes in lake levels would be expected under any of the alternatives on Lake Seminole.

6.4.2.2.6 Other Reservoirs and Impoundments

As described in section 6.1.1.1.6, no changes would occur to the structures and/or operations of non-USACE reservoirs under any of the alternatives considered. Consequently, no change would be expected in the spatial extent of the productive zones for reservoir fisheries habitat in non-USACE reservoirs.

6.4.2.3 Apalachicola Bay and Estuary

Functionally, estuaries exist at the junction of fresh and salt waters, and their function is integrally linked to freshwater inputs. Principal consequences for the management of freshwater flow to estuaries are related to both the magnitude and timing of flows (Mann and Lazier 1991). Freshwater flows are integral not only to maintaining the delivery of material and energy critical to estuarine productivity but also to providing habitat conditions conducive to maintaining the diversity and abundance of the estuarine community. As mentioned in section 2.5.3.3, three regions in the Apalachicola Bay estuary are of interest with respect to salinity requirements for juvenile Gulf sturgeon and oyster habitat and several species have a fishery management plan consistent with their essential fish habitat (EFH) designation. Changes in salinity and other water quality parameters in Apalachicola Bay and Estuary are negligible, given little to no change in streamflows from the NAA in the Apalachicola River at Chattahoochee, Florida (as discussed in detail in section 6.1.1.2.5 and presented in Figure 6.1-55, Figure 6.1-56, Table 6.1-9, and Table 6.4-5).

The NAA and the PAA both operate for federally listed threatened and endangered species downstream from Jim Woodruff Lock and Dam. Both the NAA and PAA include current ramping rates, suspension of ramping rates in drought, and current minimum flow provisions at the Chattahoochee, Florida USGS gage on the Apalachicola River. Differences in the operation of Jim Woodruff Lock and Dam for downstream federally listed threatened and endangered species only occurs if the basin inflow is less then 7,000 cfs for 30 days. As described in section 4.1.2.8.8.3, the ramping rate would be suspended in cases of prolonged low flow under the PAA. Because neither the flows nor the quality of the water entering Apalachicola Bay from the river would change appreciably under any of the proposed alternatives, no EFH for commercial fisheries in Apalachicola Bay, designated under the Magnuson-Stevens Fishery Conservation and Management Act, would be adversely affected by implementing any of the alternatives.

Table 6.4-5.
Summary of the Effects to Estuarine Fish and Aquatic Resources

	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Estuarine fish and aquatic resources	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.4.3 Protected Species

Reservoir operations can influence two types of direct or indirect actions that might affect the habitats of federal- and state-protected species listed in Table 2.5-5:

- Alteration of flow regimes in reservoirs and downstream of dams
- Water quality degradation

USACE is responsible for determining project-specific effects on protected species, because the effects depend largely on where and how the actions occur. USACE is further responsible for pursuing consultation with the USFWS in accordance with section 7 of the ESA regarding any expected effects on those species.

Following agency coordination and public comment on the draft EIS, USACE will prepare a Biological Assessment (BA) for the PAA and will formally initiate consultation with the USFWS pursuant to the consultation procedures of section 7 of the ESA. The BA will be prepared in accordance with the criteria for analysis as defined in the ESA *Section 7 Consultation Handbook*. The final EIS will incorporate the documentation of the section 7 consultation process in Appendix J, including specific measures necessary to conserve listed species and any associated critical habitat in the basin affected by the Master WCM update/WSSA.

6.4.3.1 Alteration of Flow Regimes in Reservoirs and Downstream of Dams

Little information is available on the linkages between flow regime characteristics and the life histories of protected species occurring in the ACF Basin. Previous efforts at riverine ecosystem restoration have demonstrated that it is not possible to simultaneously optimize conditions for all species (Sparks 1992, 1995; Toth 1995). However, overall biological diversity and ecosystem function benefit from interannual variations in species success (Tilman et al. 1994). Consistent with authorized project purposes, the ecology and biodiversity of the basin, including its protected species, can be sustained when natural patterns of variability of flow regimes in the basin can be maintained or restored. USACE has been working with the USFWS through ESA section 7 consultation and the provisions of the Fish and Wildlife Coordination Act to establish flow regimes throughout the basin that meet the project purposes of federal reservoirs for peaking operations and ensure adequate flows downstream of dams, particularly during the spawning season. As discussed in section 4.1.3.5.3, operations to allow small pulses were found to inherently and adversely affect hydroelectric power, flood risk management, and navigation through the use of potentially significant amounts of storage, and these water management measures were eliminated from detailed evaluation. Current operations in the basin for fish spawning, fish passage, and provisions of minimum flows at the USGS gage in the Apalachicola River at Chattahoochee, Florida have been protective of listed species and were included in this WCM update as described in section 4.9.

6.4.3.2 Water Quality Degradation

Riverine communities generally require clean water with sufficiently high DO concentrations and appropriate temperatures. Although controls on point source discharges under the Water Pollution Act of 1972, as amended, has improved water quality in the ACF Basin since the 1970s, problems related largely to nonpoint source sedimentation and other contaminants continue in many river reaches. For example, urban runoff is the major source of water quality degradation for the Chattahoochee River in the reach between Atlanta and Whitesburg, Georgia (Stamer et al. 1979). Biological conditions in the ACF Basin are most severely degraded in the urbanized reaches of the basin (Frick et al. 1998). Water quality degradation is a frequently cited concern for the riverine-dependent species included in the Comprehensive Study's Protected Species Report (Ziewitz et al. 1997). It is quite likely that water quality

is a limiting factor for several of the species, including the six federally listed mussels. Any actions that could alter water quality must address effects on the protected species.

6.4.3.3 Impacts of Modeled Alternatives

Federal- and state-protected species occurring in or near water systems of the ACF Basin are presented in Table 2.5-5. Based on habitat preference and federal status, a subset of those species has been identified as having a high potential to be affected by the proposed changes in flow regime (USFWS 2010). The following sections present the results of the HEC-ResSim modeling used to evaluate the potential effect of various alternatives on federally listed Gulf sturgeon and mussels in the Apalachicola River.

An evaluation of Chattahoochee River shoal bass based on recommendations from the USFWS (USFWS 2013) is also included in the discussion. Although the shoal bass is not currently listed by USFWS, NOAA has identified it as a Species of Concern and it is a state-listed species in Georgia (threatened) and Alabama (protected). USFWS recommended the performance metrics used for shoal bass in section 6.4.3.3.3.

6.4.3.3.1 Gulf Sturgeon

No impact from the NAA would be expected on Gulf sturgeon under any of the alternatives (Table 6.4-6). Gulf sturgeon spawning habitat was quantified at three locations known to support the species. The maximum amount of habitat available during inundation at 8.5- to 17.8-ft depths from March through May, as well as during which conditions range from 8.5 to 17.8 ft over a 30-day period to support the timing of three life stages (i.e., spawning, egg incubation, and early larval development) of Gulf sturgeon were evaluated. Collectively, these stages have been estimated to occur over approximately 30 days in the ACF Basin (USFWS 2008a; Pine et al. 2006). The effects of the alternatives were based on the change in median annual Gulf sturgeon spawning habitat from that available under the NAA, which is 18.17 acres. The median spawning habitat under all the alternatives (i.e., Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA) would be expected to be equal to the NAA at 18.17 acres. Table 6.4-6 summarizes these effects.

Table 6.4-6.
Summary of the Effects to Gulf Sturgeon

	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Gulf sturgeon	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.4.3.3.2 Mussels

Mussel species—including the federally protected fat threeridge, Chipola slabshell, and purple bankclimber—all have federally designated critical habitat in the ACF Basin. Several metrics were used to evaluate the effects of the alternatives on mussel species in the Apalachicola River from exposure during low flow conditions (Table 6.4-7). River water levels (dependent on the discharge of Jim Woodruff Dam) largely dictate available habitat for Apalachicola River mussels, and fluctuations in those levels have the potential to strand mussels. Water management operations affecting river water level fall rates in the Apalachicola River are described in section 4.1.2.8.

The following subsections define the effects of alternatives on mussels based on five specific metrics defined by the USFWS (2013):

1. Interannual frequency of flow rates less than 5,000 to 10,000 cfs
2. Median number of days flows per year are less than the thresholds of 5,000 and 10,000 cfs
3. Median number of consecutive days per year flows are less than 5,000 to 10,000 cfs

4. Median fall rate when flows are less than 10,000 cfs
5. Maximum fall rate when flows are less than 10,000 cfs

As described in section 4.1.2.8, USACE considered fall rates in the Apalachicola River and the ramping of releases from Jim Woodruff Dam in the development of the alternatives considered for evaluation.

Table 6.4-7 summarizes the effects of various alternatives on mussels in the Apalachicola River.

Table 6.4-7.
Summary of the Effects to Mussels

Mussels	NAA	Alt1B	Alt1C	Alt7A	Alt7C	Alt7D	Alt7E	Alt7F	PAA
Interannual frequency (percent of years) of flow rates <5,000 cfs/<10,000 cfs	Baseline	No change	No change	Adverse	No change	Adverse	Adverse	Adverse	Adverse
Median number of days/year with flows <10,000 cfs	Baseline	Slightly beneficial	No change	Slightly beneficial	No change	Slightly adverse	No change	No change	No change
Median number of consecutive days/year with flows <10,000 cfs	Baseline	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Beneficial	Slightly adverse
Median fall rates when discharge <10,000 cfs	Baseline	No change	No change	No change	No change	No change	No change	Beneficial	No change
Maximum fall rates when discharge <10,000 cfs	Baseline	No change	Slightly beneficial	Slightly beneficial	Slightly beneficial	No change	No change	No change	No change

6.4.3.3.2.1 No Action Alternative

Under the NAA, fall rates along the Apalachicola River below Jim Woodruff Lock and Dam would remain relatively steady. Interannual frequency of flow rates greater than 5,000 cfs would occur in 93 percent of years. The median number of consecutive days on which flows would be less than 10,000 cfs is 27. The median number of days per year when the flow would be less than 10,000 cfs is 63. Flows would not be less than 5,000 cfs for either median number of days per year or median consecutive days per year. This serves as the baseline for comparing the potential effects of the other alternatives.

6.4.3.3.2.2 Alternative 1B

Implementing Alt1B would be expected to have negligible effects on mussels. Of the listed USFWS metrics, a slightly beneficial effect would be expected from a minor decrease in the median number of days per year with flows less than 10,000 cfs and a slightly adverse effect would be expected from a minor increase in the median number of consecutive days per year with flow rates less than 10,000 cfs.

6.4.3.3.2.3 Alternative 1C

Implementing Alt1C would be expected to have negligible effects on mussels. Of the listed USFWS metrics, a slightly beneficial effect would be expected from a decreased maximum fall rate, and a slightly adverse effect would be expected from an increase in median number of consecutive days per year with flow rates less than 10,000 cfs.

6.4.3.3.2.4 Alternative 7A

Implementing Alt7A would be expected to have an adverse effect on mussels. An adverse effect would be expected from an increase of 1 percent of years with flow rates less than 5,000 cfs (which equates to a 200 percent change). Additionally, a slightly beneficial effect would be expected from a decrease in the median number of days per year with flows less than 10,000 cfs, and a slightly adverse effect would be expected from an increase in median number of consecutive days per year with flow rates less than 10,000 cfs.

6.4.3.3.2.5 Alternative 7C

Implementing Alt7C would be expected to have a negligible impact on mussels, similar to that under the NAA.

6.4.3.3.2.6 Alternative 7D

Implementing Alt7D would be expected to have an adverse effect on mussels from an interannual frequency flow rate less than 5,000 cfs in 3 percent of years, which equates to a change of 200 percent (as under Alt7A). Additionally, a slightly adverse effect would be expected from an increase in the number of days per year and the number of consecutive days per year that flow rates would be less than 10,000 cfs.

6.4.3.3.2.7 Alternative 7E

Implementing Alt7E would be expected to have adverse effects similar to those under Alt7D. An adverse effect would be expected from an increase in the percent of years with an interannual frequency flow rate less than 5,000 cfs, and a slightly adverse effect would be expected from an increase in the number of consecutive days per year on which flow rates would be less than 10,000 cfs.

6.4.3.3.2.8 Alternative 7F

Implementing Alt7F would be expected to have adverse and beneficial effects. Beneficial effects would be expected from fewer consecutive days per year of flows less than 10,000 cfs and from a decrease in the median fall rate when flows are less than 10,000 cfs. Adverse effects would be expected from an increase in the percent of years with interannual frequency of flow rates less than 5,000 cfs.

6.4.3.3.2.9 Alternative 7H (PAA)

Implementing the PAA would be expected to have an adverse effect on mussels from an increase in the percent of years with an interannual frequency of flow rates less than 5,000 cfs. A slightly adverse effect would be expected from an increase in the number of consecutive days per year when flow rates would be less than 10,000 cfs.

6.4.3.3.3 Shoal Bass

Shoal bass (*Micropterus cataratae*) is a fairly recently described species (Williams and Burgess 1999) in the centrarchid (sunfish) family and is endemic to the ACF Basin. Shoal bass frequently occur in shoals (commonly co-occurring with other species) over rocky sediments in water exceeding 0.66 ft per second. Recruitment of age-3 bass is of particular interest since this cohort has survived prevalent river conditions and has the potential to be stocked to support the recreational fishery. Recruitment success is largely dependent on surface water and spring temperature and is highly correlated with discharge. Therefore, results from both the HEC-5Q and HEC-ResSim modeling efforts were used to evaluate the effects of various alternatives using the Chattahoochee River Shoal Bass Recruitment Performance Measure

(CRSBPM) defined by USFWS (USFWS 2013). The results of the evaluation for each alternative are presented in Table 6.4-8.

Table 6.4-8.
Summary of the Effects of Chattahoochee River Shoal Bass Recruitment Performance Measures Applied at Atlanta, Georgia

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Shoal bass recruitment	Baseline	No change	Slightly beneficial	Slightly beneficial	Slightly beneficial	Beneficial	Beneficial	Beneficial	Beneficial

6.4.3.3.3.1 No Action Alternative

No effects on shoal bass recruitment would occur under the NAA, which represents the baseline for comparison of the effect of various alternatives.

6.4.3.3.3.2 Alternative 1B

No change in shoal bass recruitment would be expected under Alt1B.

6.4.3.3.3.3 Alternative 1C

A slightly beneficial effect would be expected on shoal bass recruitment under Alt1C from a slightly higher population of age-3 fish.

6.4.3.3.3.4 Alternative 7A

A slightly beneficial effect would be expected on shoal bass recruitment under Alt7A. The population of age-3 fish under Alt7A would be slightly higher than under Alt1C.

6.4.3.3.3.5 Alternative 7C

Effects under Alt7C would be similar to those under Alt7A, with slightly beneficial effects for shoal bass recruitment.

6.4.3.3.3.6 Alternative 7D

A beneficial effect on shoal bass recruitment would be expected under Alt7D. Recruitment would be slightly higher under Alt7D than under any of the previously discussed alternatives.

6.4.3.3.3.7 Alternative 7E

A beneficial effect on shoal bass recruitment would be expected under Alt7E. Effects would be similar to those that would occur under Alt7D.

6.4.3.3.3.8 Alternative 7F

A beneficial effect on shoal bass recruitment would be expected under Alt7F. Effects would be similar to those that would occur under Alt7D.

6.4.3.3.3.9 Alternative 7H (PAA)

A beneficial effect on shoal bass recruitment would be expected under the PAA. Recruitment would be slightly higher under the PAA than under any of the previously discussed alternatives except Alt7D.

6.4.4 Fish and Wildlife Management Facilities

6.4.4.1 Eufaula National Wildlife Refuge

USACE considered a request by USFWS to cycle Walter F. George Lake between the highest levels (190 ft) in late winter/early spring to the lowest levels (185 ft) in late summer to accommodate Eufaula National Wildlife Refuge operations. The USFWS recommended a seasonal pattern of reservoir levels at Walter F. George Lake that would provide seasonal habitat for a large number of migratory bird species, control the spread of undesirable aquatic vegetation, and allow the manipulation of off-reservoir impoundments for waterfowl. The objective of those recommendations, which were included in the draft Fish and Wildlife Coordination Act (FWCA) report for the USACE's 1998 draft EIS on ACF Basin water allocation, was to manage the reservoir so that it behaves more like a river.

As proposed, the option to manage Walter F. George Lake for the Eufaula Wildlife Refuge would have significant adverse effects on the authorized project purposes and the structural stability and safety of the dam, as described in section 4.1.3.5.5. Therefore, operations to manage Walter F. George Lake to benefit the Eufaula Wildlife Refuge were eliminated from inclusion, as described in section 4.1.3.5.5.

The differences between the mean daily water surface elevations at Walter F. George Lake are negligible between all alternatives. Therefore, no change would be expected to the Eufaula National Wildlife Refuge or the biological communities within it under any of the alternatives as shown in Table 6.4-9.

Table 6.4-9.
Summary of the Effects on Eufaula National Wildlife Refuge

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Eufaula National Wildlife Refuge	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.4.4.2 Fish Hatcheries

Four major fish hatcheries are in the ACF Basin. The Buford Trout Hatchery is the only one that relies on surface flows for its operations and is the largest user of water. Changes in flow on the Chattahoochee River are negligible between alternatives, and would not be expected to affect operations at the Buford Trout Hatchery. No changes would be expected at any of the hatcheries under any of the alternatives considered.

6.5 Socioeconomics

6.5.1 Municipal and Industrial Water Supply

This section provides a summary of the effects of municipal and industrial water supply (see Table 6.5-1). Alternatives that fail to meet Metro Atlanta's 2040 water supply needs are substantially adverse and those that meet the requested amount for 2040 are substantially beneficial. Details of the effects are included in Appendix B, the *Water Supply Storage Assessment Report*.

Table 6.5-1.
Summary of the Effects on Municipal and Industrial Water Supply

Water supply withdrawals	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
From Lake Lanier	Baseline	Substantially adverse	Substantially adverse	Substantially adverse	Substantially adverse	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial
From Metro Atlanta, downstream of Buford Dam	Baseline	Substantially adverse	Substantially beneficial	Substantially adverse	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial

6.5.1.1 Water Supply Withdrawals from Lake Lanier

6.5.1.1.1 No Action Alternative

Under the NAA, 128 mgd water would be withdrawn from Lake Lanier, representing the current level of direct withdrawals. This amount, however, is less than the 297 mgd requested by the state of Georgia. In its 2013 request, Georgia indicated that 297 mgd was needed by 2040. The NAA assumes a deficit of 169 mgd from the requested amount. Other alternatives would need to be implemented to accommodate the remainder of the stated need.

6.5.1.1.2 Alternative 1B

Alt1B assumes 20 mgd would be withdrawn from Lake Lanier. This represents the level of direct withdrawals under relocation contracts from Lake Lanier. This gross withdrawal represents a 108-mgd decrease over the NAA, leaving an unmet need in 2040 of 277 mgd. These impacts are considered to be substantially adverse. Other alternatives would need to be implemented to accommodate the remainder of the stated need.

6.5.1.1.3 Alternative 1C

Alt1C assumes 20 mgd in relocation contracts would be withdrawn from Lake Lanier with an additional 40 mgd being provided by Glades Reservoir. This would leave an unmet need in 2040 of 237 mgd. These impacts are considered to be substantially adverse. Other alternatives would need to be implemented to accommodate the remainder of the stated need.

6.5.1.1.4 Alternative 7A

Alt7A assumes 128 mgd would be withdrawn from Lake Lanier. This represents the current level of direct withdrawals from Lake Lanier. As with the NAA, other alternatives would need to be implemented to accommodate the remainder of the stated need.

6.5.1.1.5 Alternative 7C

Alt7C assumes 20 mgd would be withdrawn from Lake Lanier. As with Alt1C, these impacts are considered to be substantially adverse. Other alternatives would need to be implemented to accommodate the remainder of the stated need.

6.5.1.1.6 Alternative 7D

Alt7D assumes 297 mgd would be withdrawn from Lake Lanier, including 20 mgd for relocation contracts. This represents the level of direct withdrawals requested by Georgia to meet their 2040 water supply need from Lake Lanier and would require reallocation of about 318,126 ac-ft of storage to support withdrawal of 277 mgd at a first cost of about $76.3 million (Appendix B).

6.5.1.1.7 Alternative 7E

Alt7E assumes 257 mgd would be withdrawn from Lake Lanier, including 20 mgd for relocation contracts. An additional 40 mgd would be provided by Glades Reservoir, which together with a reallocation to support a withdrawal of 237 mgd would satisfy Georgia's 2040 water supply need. This gross withdrawal of 237 mgd would require a reallocation of about 272,187 ac-ft of storage at a first cost of about $65.6 million (Appendix B).

6.5.1.1.8 Alternative 7F

Alt7F assumes 297 mgd would be withdrawn from Lake Lanier, including 20 mgd for relocation contracts. This represents the level of direct withdrawals requested by Georgia to meet their 2040 water supply need from Lake Lanier and would require reallocation of about 318,126 ac-ft of storage to support withdrawal of 277 mgd at a first cost of about $76.3 million (Appendix B).

6.5.1.1.9 Alternative 7H (PAA)

Under the PAA, 185 mgd would be withdrawn from Lake Lanier, including 20 mgd for relocation contracts. An additional 40 mgd would be provided by Glades Reservoir, which together with a reallocation to support a withdrawal of 165 mgd would satisfy a substantial portion (60 percent) of Georgia's stated 2040 water supply need. This gross withdrawal of 165 mgd would require a reallocation of about 189,497 ac-ft of storage at a first cost of about $45.4 million (Appendix B).

6.5.1.2 Metro Atlanta Water Supply Withdrawals Downstream of Buford Dam

6.5.1.2.1 No Action Alternative

Under the NAA, 277 mgd would be released from Buford Dam to support gross water withdrawals out of the Chattahoochee River below Buford Dam. This represents the current level of withdrawals from the Chattahoochee River serving Metro Atlanta. This amount would be insufficient to meet the estimated 2040 need of 408 mgd. Other sources of supply would be required to satisfy the unmet need, which would increase the costs of water supply.

6.5.1.2.2 Alternative 1B

Alt1B assumes 277 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River below Buford Dam. This represents the current level of direct withdrawals from Chattahoochee River serving Metro Atlanta. There is no change from the NAA. This amount would be insufficient to meet the estimated 2040 need of 408 mgd. Other sources of supply would be required to satisfy the unmet need, which would increase the costs of water supply.

6.5.1.2.3 Alternative 1C

Alt1C assumes 408 mgd would be released from Buford Dam to support gross water withdrawals out of the Chattahoochee River below Buford Dam. This represents the requested 2040 water supply need of

direct withdrawals from Chattahoochee River serving Metro Atlanta; therefore, there would be a substantially beneficial socioeconomic effect.

6.5.1.2.4 Alternative 7A

Alt7A assumes 277 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River below Buford Dam. This represents the current level of direct withdrawals from Chattahoochee River serving Metro Atlanta. There is no change from the NAA. This amount would be insufficient to meet the estimated 2040 need of 408 mgd. Other sources of supply would be required to satisfy the unmet need, which would increase the costs of water supply.

6.5.1.2.5 Alternative 7C

Alt7C assumes 408 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River below Buford Dam. This represents the requested 2040 water supply need of direct withdrawals from Chattahoochee River serving Metro Atlanta; therefore, there would be a substantially beneficial socioeconomic effect.

6.5.1.2.6 Alternative 7D

Alt7D assumes 408 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River below Buford Dam. This represents the requested 2040 water supply need of direct withdrawals from Chattahoochee River serving Metro Atlanta; therefore, there would be a substantially beneficial socioeconomic effect. This represents a 131-mgd increase from the NAA.

6.5.1.2.7 Alternative 7E

Alt7E assumes 408 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River below Buford Dam. This represents the requested 2040 water supply need of direct withdrawals from Chattahoochee River serving Metro Atlanta; therefore, there would be a substantially beneficial socioeconomic effect.

6.5.1.2.8 Alternative 7F

Alt7F assumes 408 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River below Buford Dam. This represents the requested 2040 water supply need of direct withdrawals from Chattahoochee River serving Metro Atlanta; therefore, there would be a substantially beneficial socioeconomic effect.

6.5.1.2.9 Alternative 7H (PAA)

Under the PAA, 408 mgd would be released from Buford Dam to support withdrawals out of the Chattahoochee River below Buford Dam. This represents the requested 2040 water supply need of direct withdrawals from Chattahoochee River serving Metro Atlanta; therefore, there would be a substantially beneficial socioeconomic effect.

6.5.2 Navigation

Navigation is an authorized purpose on the ACF Basin system. Channel availability was modeled for both a 7-ft and 9-ft channel. This availability was measured by evaluating the modeled flow at the

Blountstown, Florida, gage. A 7-ft channel would be considered "available" with a flow greater than 16,200 cfs. A 9-ft channel would be considered "available" with a flow greater than 20,050 cfs.

Table 6.5-2.
Summary of the Effects on Navigation

Navigation	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
7-ft	Baseline	No change	No change	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial	Substantially beneficial
9-ft	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.5.2.1 No Action Alternative

Under the NAA, a 9-ft channel would be available 2.7 percent of the time during the period of record between January and May. A 7-ft channel would be available 20.5 percent of the time during the period of record from January to May.

6.5.2.2 Alternative 1B

Under Alt1B, a 9-ft channel would be available 5.5 percent of the time during the period of record between January and May. A 7-ft channel would be available 20.5 percent of the time during the period of record from January to May.

6.5.2.3 Alternative 1C

Alt1C would have essentially the same effects as described for NAA in section 6.5.2.1 with respect to navigation availability.

6.5.2.4 Alternative 7A

Under Alt7A, a 9-ft channel would be available 2.7 percent of the time during the period of record between January and May (same as the NAA). A 7-ft channel would be available 42.5 percent of the time during the period of record from January to May. This represents a 22 percent difference over the NAA. This could have a beneficial effect for commercial navigation on the system.

6.5.2.5 Alternative 7C

Under Alt7C, a 9-ft channel would be available 2.7 percent of the time during the period of record between January and May (same as the NAA). A 7-ft channel would be available 43.8 percent of the time during the period of record from January to May. This represents a 23.3 percent difference over the NAA. This could have a beneficial effect for commercial navigation on the system.

6.5.2.6 Alternative 7D

Compared to the NAA, Alt7D would have essentially the same effects as described for Alt7A in section 6.5.2.4 with respect to navigation availability.

6.5.2.7 Alternative 7E

Compared to the NAA, Alt7E would have essentially the same effects as described for Alt7A in section 6.5.2.4 with respect to navigation availability.

6.5.2.8 Alternative 7F

Under Alt7F, a 9-ft channel would be available 2.7 percent of the time during the period of record between January and May (same as the NAA). A 7-ft channel would be available 38.4 percent of the time during the period of record from January to May. This represents a 17.9 percent difference over the NAA. This could have a beneficial effect for commercial navigation on the system.

6.5.2.9 Alternative 7H (PAA)

Under the PAA, a 9-ft channel would be available 2.7 percent of the time during the period of record between January and May (same as the NAA). A 7-ft channel would be available 42.5 percent of the time during the period of record from January to May. This represents a 22 percent difference over the NAA. This could have a beneficial effect for commercial navigation on the system.

6.5.3 Hydroelectric Power Generation

The hydropower analysis was performed over the entire ACF Basin system, including both federal and private generation plants. The analysis is discussed in detail in Appendix D of the Water Supply Storage Assessment Report, Appendix B of this EIS. The energy and capacity values for each alternative are displayed in Table 6.5-3. The effect of various alternatives on hydroelectric power generation is summarized in Table 6.5-4.

Table 6.5-3.
Energy and Capacity Values for Each Alternative

	Energy value	Capacity value	Total value	Change in value compared to the NAA
NAA	$89,206,000	$83,976,000	$173,182,000	$0
Alt1B	$90,892,000	$83,552,000	$174,444,000	$1,262,000
Alt1C	$90,189,000	$84,278,000	$174,467,000	$1,285,000
Alt7A	$88,951,000	$83,787,000	$172,738,000	($444,000)
Alt7C	$90,060,000	$84,248,000	$174,308,000	$1,126,000
Alt7D	$88,475,000	$83,876,000	$172,351,000	($831,000)
Alt7E	$88,480,000	$83,833,000	$172,313,000	($869,000)
Alt7F	$86,157,000	$83,298,000	$169,455,000	($3,727,000)
PAA	$88,470,000	$83,836,000	$172,306,000	($876,000)

Table 6.5-4.
Summary of the Effects on Hydroelectric Power Generation

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Hydroelectric Power Generation	Baseline	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly beneficial	Slightly adverse	Slightly adverse	Adverse	Slightly adverse

6.5.3.1 No Action Alternative

Under the NAA, the total energy and capacity benefit is $173.1 million, which represents the current system energy value.

6.5.3.2 Alternative 1B

Under the Alt1B, the total energy and capacity benefit increase is $1.2 million when compared to the NAA, which represents less than a 1-percent increase over the NAA.

6.5.3.3 Alternative 1C

Under the Alt1C, the total energy and capacity benefit increase is $1.2 million when compared to the NAA, which represents less than a 1-percent increase over the NAA.

6.5.3.4 Alternative 7A

Under the Alt7A, the total energy and capacity benefit decrease is $444,000 when compared to the NAA, which represents less than a 1-percent decrease over the NAA.

6.5.3.5 Alternative 7C

Under the Alt1C, the total energy and capacity benefit increase is $1.1 million when compared to the NAA, which represents less than a 1-percent increase over the NAA.

6.5.3.6 Alternative 7D

Under the Alt7A, the total energy and capacity benefit decrease is $831,000 when compared to the NAA, which represents less than a 1-percent decrease over the NAA.

6.5.3.7 Alternative 7E

Under the Alt7A, the total energy and capacity benefit decrease is $869,000 when compared to the NAA, which represents less than a 1-percent decrease over the NAA.

6.5.3.8 Alternative 7F

Under the Alt7F, the total energy and capacity benefit decrease is $3.7 million when compared to the NAA, which represents a 2.1-percent decrease over the NAA.

6.5.3.9 Alternative 7H (PAA)

Under the PAA, the total energy and capacity benefit decrease is $876,000 when compared to the NAA, which represents less than a 1-percent decrease over the NAA.

6.5.4 Agricultural Water Supply

Agricultural water withdrawals occur in the lower half of the Chattahoochee River system and the Flint River. Modeling assumed that the current level of agricultural water withdrawals would be supported in the ACF Basin by using it as an input to the HEC-ResSim operations model. Therefore, no changes to agricultural water supply would be assumed from the alternatives (Table 6.5-5).

Table 6.5-5.
Summary of the Effects on Agricultural Water Supply

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Agricultural water supply	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.5.5 Oyster Industry of Apalachicola Bay

The change in flows in the Apalachicola River can be used as a metric for potential effects to the oyster populations in Apalachicola Bay. Refer to section 6.1.1.2.5 for a discussion of changes in median and low flows in the Apalachicola River. Section 6.1.1.2.5 presents information to show that flow conditions in the Apalachicola River downstream from Jim Woodruff Lock and Dam under the proposed alternatives do not differ appreciably from flows under the NAA. Consequently, differences in freshwater inflow into Apalachicola Bay among the alternatives would not be expected.

6.5.6 Flood Risk Management

A study constraint included no reduction to the current level of flood risk management. Current flood risk management is discussed in section 2.6.5. The effect of various alternatives on flood risk management is defined in Table 6.5-6.

Table 6.5-6.
Summary of the Effects on Flood Risk Management

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Flood risk management	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.5.6.1 No Action Alternative

Under the NAA, flood risk management operations would remain unchanged from those currently employed, which are achieved by storing damaging floodwater. This reduces downstream river levels below those that would have occurred without the dams in place. Of the five USACE reservoirs, only the Buford Dam (Lake Lanier) and West Point Dam and Lake projects were designed with space to store floodwaters.

6.5.6.2 Alternative 1B

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.6.3 Alternative 1C

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.6.4 Alternative 7A

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.6.5 Alternative 7C

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.6.6 Alternative 7D

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.6.7 Alternative 7E

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.6.8 Alternative 7F

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.6.9 Alternative 7H (PAA)

Since no guide curves are modified under this alternative, it would not likely have any beneficial or adverse influence on flood risk management in the ACF Basin. The level of flood risk would be the same as discussed under the NAA.

6.5.7 Recreation

National Economic Development (NED) recreation benefits were used as the basis of comparing alternatives. The methodology used for computing the benefits is described in Appendix M, together with a detailed presentation of the resulting benefits. Table 6.5-7 summarizes the economic effects of various alternatives on recreation.

Table 6.5-7.
Summary of the Effects on Recreation

Recreation	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Lake Lanier	Baseline	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly beneficial	Slightly adverse	Slightly adverse	Substantially adverse	Slightly adverse
West Point Lake	Baseline	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial
Walter F. George Lake	Baseline	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse

6.5.7.1 Lake Lanier

The average annual NED recreation benefits for the NAA and eight other alternatives are shown in Table 6.5-8. As can be seen in the table, the benefits for any alternative vary less than 2 percent. The PAA (Alt7H) would have average annual benefits of $78,501,000, only 0.28 percent less than the NAA.

Table 6.5-8.
Lake Lanier Recreation Benefit Summary

	Annualized recreation value ($)	Annualized change vs. without project	Percent change
NAA	$78,721,000	$0	0.0%
Alt1B	$79,069,000	$348,000	0.44%
Alt1C	$78,734,000	$13,000	0.02%
Alt7A	$78,694,000	($27,000)	-0.03%
Alt7C	$78,795,000	$74,000	0.09%
Alt7D	$78,501,000	($220,000)	-0.28%
Alt7E	$78,501,000	($220,000)	-0.28%
Alt7F	$77,345,000	($1,376,000)	-1.75%
PAA	$78,501,000	($220,000)	-0.28%

6.5.7.2 West Point Lake

The average annual NED recreation benefits for the NAA and eight other alternatives are shown in Table 6.5-9. As can be seen in the table, the benefits for any alternative vary significantly less than 1 percent. PAA (Alt7H) would have average annual benefits of $21,211,000, only 0.16 percent greater than the NAA.

Table 6.5-9.
West Point Lake Recreation Benefit Summary

	Annualized recreation value ($)	Annualized change vs. without project	Percent change
NAA	$21,177,000	$0	0.0%
Alt1B	$21,186,000	$9,000	0.04%
Alt1C	$21,204,000	$27,000	0.13%
Alt7A	$21,168,000	($9,000)	-0.04%
Alt7C	$21,220,000	$43,000	0.20%
Alt7D	$21,220,000	$43,000	0.20%
Alt7E	$21,220,000	$43,000	0.20%
Alt7F	$21,194,000	$17,000	0.08%
PAA	$21,211,000	$34,000	0.16%

6.5.7.3 Walter F. George Lake

The average annual NED recreation benefits for the NAA and eight other alternatives are shown in Table 6.5-10. As can be seen in the table, the benefits for any alternative vary less than 0.10 percent. The PAA (Alt7H) would have average annual benefits of $32,897,000, only 0.07 percent less than the NAA.

Table 6.5-10.
Walter F. George Lake Recreation Benefit Summary

	Annualized recreation value ($)	Annualized change vs. without project	Percent change
NAA	$32,919,000	$0	0.0%
Alt1B	$32,929,000	$10,000	0.03%
Alt1 C	$32,929,000	$10,000	0.03%
Alt7A	$32,897,000	($22,000)	-0.07%
Alt7C	$32,897,000	($22,000)	-0.07%
Alt7D	$32,897,000	($22,000)	-0.07%
Alt7E	$32,897,000	($22,000)	-0.07%
Alt7F	$32,908,000	($11,000)	-0.03%
PAA	$32,897,000	($22,000)	-0.07%

6.5.8 Environmental Justice

Executive Order (EO) 12898 requires federal agencies to consider and address the impacts of their activities on minority and low-income populations (for more details, see section 2.6.1.0). Water management activities at the reservoirs in the ACF Basin for the NAA and alternatives 1B, 1C, 7A, 7C, 7D, 7E, 7F and the PAA were reviewed with respect to environmental justice considerations. Table 6.5-11 summarizes the effect of the alternatives.

During the scoping process for this EIS, no significant environmental justice concerns relative to water management operations in ACF Basin reservoirs were identified. Access and use of the USACE reservoirs in the basin by minority and low-income populations would most likely focus on shoreline access activities like picnicking, wading/swimming, and recreational and subsistence fishing, primarily from the bank or public docks/piers, rather than on boating-related activities that would tend to be somewhat less dependent on high lake levels. Low water levels in the lakes would tend to affect those shoreline access activities slightly more than boating-related activities. Therefore, the access and usability of the lake resources for all visitors may be negatively affected by low lake levels but are likely to be marginally higher for low-income and minority visitors.

Table 6.5-11.
Summary of the Effects on Environmental Justice

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Environmental justice	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.5.8.1 No Action Alternative

Seasonal fluctuations in the water surface elevations under the NAA, even with relatively normal rainfall conditions in the basin, could create minor inconveniences for local residents, including low-income and minority populations, who use USACE reservoirs for fishing and other forms of recreation. Those uses might be more constrained during extreme drought years, but those constraints and their associated effects are not likely to be disproportionately higher for low-income and minority populations. All lake users could be affected under those conditions, which might last for months at a time but are temporary. USACE resource managers at the lakes work closely with the public under such circumstances and pursue reasonable temporary measures to maintain at least a minimum level of access to the lakes until the extreme conditions improve.

The Master Manual and the individual project WCMs outline current communication measures to promote and maintain public safety at USACE projects, both in the reservoirs and the tailrace areas below the dams, including automated warning systems associated with rapid changes in flow and stage conditions downstream of the dams when hydropower generation is initiated and/or spillway gates are opened.

6.5.8.2 Alternative 1B

Alt1B would have essentially the same effects as described for NAA in section 6.5.8.1 with respect to minority and low-income populations.

6.5.8.3 Alternative 1C

Alt1C would have essentially the same effects as described for NAA in section 6.5.8.1 with respect to minority and low-income populations.

6.5.8.4 Alternative 7A

Alt7A would have essentially the same effects as described for NAA in section 6.5.8.1 with respect to minority and low-income populations.

6.5.8.5 Alternative 7C

Alt7C would have essentially the same effects as described for NAA in section 6.5.8.1 with respect to minority and low-income populations.

6.5.8.6 Alternative 7D

Alt7D would have essentially the same effects as described for NAA in section 6.5.8.1 with respect to minority and low-income populations.

6.5.8.7 Alternative 7E

Alt7E would have essentially the same effects as described for NAA in section 6.5.8.1 with respect to minority and low-income populations.

6.5.8.8 Alternative 7F

Alt7F would have essentially the same effects as described for NAA in section 6.5.8.1 with respect to minority and low-income populations.

6.5.8.9 Alternative 7H (PAA)

Seasonal fluctuations in the water surface elevations under the PAA, even with relatively normal rainfall conditions in the basin, could create minor inconveniences for local residents, including low-income and minority populations, who use the USACE reservoirs for fishing and other forms of recreation. Those uses might be more constrained during extreme drought years, but those constraints and their associated effects are not likely to be disproportionately higher for low-income and minority populations. All lake users could be affected under those conditions, which might last for months at a time but are temporary. USACE resource managers at the lakes work closely with the public under such circumstances and pursue reasonable temporary measures to maintain at least a minimum level of access to the lakes until the extreme conditions improve.

There is no expected impacts to anglers downstream of reservoirs due to minimal change in flows in comparison to the NAA.

The Master Manual and the individual project WCMs outline current communication measures to promote and maintain public safety at USACE projects, both in the reservoirs and the tailrace areas below the dams, including automated warning systems associated with rapid changes in flow and stage conditions downstream of the dams when hydropower generation is initiated and/or spillway gates are opened.

6.5.9 Protection of Children

EO 13045 requires federal agencies to consider and address the impacts of their activities on children with respect to environmental health and safety risks (see section 2.6.12 for more details). Operation of large reservoir projects provide increased opportunities for public access and use, particularly in the form of water-based recreation. Public use of the projects inherently includes a level of health and safety risk to both adults and children. USACE pursues extensive measures at operating projects to minimize such risks by implementing water safety and other education programs, providing clear signage, marking designated uses areas, removing hazards where appropriate, restricting public access to certain areas designated for authorized personnel only, and other activities designed to promote safe use, many of which are directly focused on children who visit the projects. Table 6.5-12 summarizes the effects of alternatives.

Table 6.5-12.
Summary of the Effects on Protection of Children

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Protection of children	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.5.9.1 No Action Alternative

The environmental health and safety activities at USACE projects as described in section 6.5.9 would be expected to continue and would be adjusted over time as needs might change. Existing water management activities at the reservoirs do not impose any undue risks to children that are not effectively addressed by the current activities.

6.5.9.2 Alternative 1B

Alt1B would have the same effects relative to protection of children as described for the NAA in section 6.5.9.1. No additional risks would be imposed by the proposed updates to water management practices.

As technological advances in communication, changing demographics, and other related factors may dictate, USACE will continue to seek innovative ways to reach out to the public and share information on public safety and other project-related matters.

6.5.9.3 Alternative 1C

Alt1C would have the same effects relative to protection of children as described for the Alt1B in section 6.5.9.2. No additional risks would be imposed by the proposed updates to water management practices.

6.5.9.4 Alternative 7A

Alt7A would have the same effects relative to protection of children as described for the Alt1B in section 6.5.9.2. No additional risks would be imposed by the proposed updates to water management practices or increased water supply.

6.5.9.5 Alternative 7C

Alt7C would have the same effects relative to protection of children as described for the Alt1B in section 6.5.9.2. No additional risks would be imposed by the proposed updates to water management practices or increased water supply.

6.5.9.6 Alternative 7D

Alt7D would have the same effects relative to protection of children as described for the Alt1B in section 6.5.9.2. No additional risks would be imposed by the proposed updates to water management practices or increased water supply.

6.5.9.7 Alternative 7E

Alt7E would have the same effects relative to protection of children as described for the Alt1B in section 6.5.9.2. No additional risks would be imposed by the proposed updates to water management practices or increased water supply.

6.5.9.8 Alternative 7F

Alt7F would have the same effects relative to protection of children as described for the Alt1B in section 6.5.9.2. No additional risks would be imposed by the proposed updates to water management practices or increased water supply.

6.5.9.9 Alternative 7H (PAA)

The PAA would have the same effects relative to protection of children as described for the NAA in section 6.5.9.1. No additional risks would be imposed by the proposed updates to water management practices. As technological advances in communication, changing demographics, and other related factors may dictate, the USACE will continue to seek innovative ways to reach out to the public and share information on public safety and other project-related matters. No additional risks would be imposed by the proposed updates to water management practices or increased water supply.

6.6 Aesthetic Resources

The effects of various alternatives on aesthetic resources are summarized in Table 6.6-1 and discussed below.

Table 6.6-1.
Summary of the Effects on Aesthetic Resources

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Aesthetic resources	Baseline	No change	No change	No change	No change	No change	No change	Slightly adverse	No change

Under the NAA, both USACE and non-federal reservoirs serve as valuable aesthetic assets in the ACF Basin. Even though there would be slight differences (higher or lower) in lake elevations over time compared to the NAA, Master Manual update alternatives Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, and the PAA would not result in a change in aesthetic resources and values. The effects on lake levels under Alt7F at Lake Lanier and, to a lesser extent, West Point Lake would be more substantial at certain times, particularly under drought conditions, as more barren shoreline areas would be exposed. Thus, the effects on aesthetic resources on these lakes under Alt7F would be considered slightly adverse compared to the NAA.

Compared to the NAA, deviations in flow conditions downstream of the USACE projects in the ACF Basin under Alt1B, Alt1C, Alt7A, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA would be visually imperceptible. No changes to aesthetic resources and values in these areas would be expected.

6.7 Cultural Resources

The effects of various alternatives on cultural resources are summarized in Table 6.7-1 and detailed in the subsections that follow.

Table 6.7-1.
Summary of the Effects on Cultural Resources

	NAA	ALT1B	ALT1C	ALT7A	ALT7C	ALT7D	ALT7E	ALT7F	PAA
Cultural resources	Baseline	No change	No change	No change	No change	No change	No change	No change	No change

6.7.1 No Action Alternative

Under the NAA, the operation of USACE projects in the ACF Basin would be expected to remain unchanged. Therefore, effects on cultural resource sites would be expected to be the same as they have been in the past. Based on the 2009 evaluation of current conditions (Brockington 2010), most of the ACF Basin sites are expected to experience three distinct effects: erosion, deposition, and access. Quantifying those effects have been problematic, as no specific framework has been established to track site-specific information needed over time to evaluate the multivariant and dynamic systems involved with these natural and man-made fluvial processes as they relate to cultural resources. Additionally, without this historic data, it is difficult to ascertain what observed conditions are natural versus a function of a USACE undertaking. For instance, it is currently unrealistic to determine scientifically if site erosion is a function of USACE operation versus natural rain events, natural ecosystem changes over time, and/or all of the aforementioned based on the existing data.

Although there has been no quantified longitudinal study of past erosion and deposition impacts to cultural sites, Brockington's 2009 study inventoried 93 percent of the cultural sites located in the ACF Basin sample as experiencing erosion and 33 percent experiencing deposition. However revealing they might be, these percentages should be taken as multivariant trends rather than adverse effects to cultural resources that are specifically tied to USACE water management. Another perspective could include these trends correlating more with the geomorphology of the existing environment than existing water management practices under the current NAA. Regardless, it can be assumed that these trends would continue under the NAA.

Historically, conservation measures have not been undertaken along the shoreline, and it might be too late to preserve any remaining intact site contexts by implementing them now. As erosion and deposition over time may pose risks to specific sites, options to mitigate effects will be evaluated and implemented, as needed, based on the nature of the cultural resource as well as engineering and cost-effectiveness considerations. Potential options may range from protection by way of structural measures (e.g., fill, rip-rap, sheet pile) to excavation of the site(s), all in consultation with the State Historic Preservation Office and tribal interests (as appropriate). Available data from the ACF Basin reviewed by Fedoroff (2014) concluded that access rates occur at a near-constant rate regardless of current water management practices in the ACF Basin—with the exception of a few cultural resource sites as identified in the study. Additionally, a GIS framework was created to track exposure rates based on water level in order to generate the longitudinal data needed for a monitoring and adaptive management plan tailored to specific cultural resources in the ACF Basin in need of additional access protection.

6.7.2 Alternatives 1B, 1C, 7A, 7C, 7D, 7E, and 7F

As stated in the NAA evaluation, there are not enough significant differences between any of the alternatives to quantify a specific increase or decrease of impacts to cultural resources outside of the general statements outlined in the previous sections. However, it should be noted that a monitoring and adaptive management plan has been implemented for the ACF Basin study of sample cultural sites that will aid in implementing mitigation measures for any of the alternatives currently evaluated.

6.7.3 Alternative 7H (PAA)

Hydrologic models are not particularly meaningful for cultural resources assessments as impacts to cultural resources are site-type-specific and often require longitudinal data sets linked to specific archaeological research questions of site significance. Additionally, as the cultural resources for this project were initially reviewed from a programmatic level and next assessed from a sample size of n=15, the current state of knowledge on site-specific impacts on the ACF Basin is lacking and, at best, is not sufficient in the scientific literature to marry with hydrologic model projections. With these caveats in mind, several general statements can be made about impacts to cultural resources from the evaluated alternatives, including the PAA (Alt7H).

First, under the PAA, the rate of erosion at cultural resources sites would be expected to generally remain the same, based on the baseline No Action Study (Fedoroff 2014). It is unlikely that the PAA would reduce the percentage of sites (93 percent of the sites known and unknown) undergoing erosion from the NAA as the baseline inundation rates for the No Action Study largely remained constant despite changes in current USACE water management activities (Fedoroff 2014). Additionally, under the PAA, estimate of 33 percent of sites undergoing the effects of deposition would also remain relatively the same.

Second, although this alternative does not approach the issue of flow rate as it specifically affects cultural resource sites, it can be assumed to some degree that the sites within the ACF Basin that would experience high flow action scenarios would experience negative impacts on cultural resources. Areas such as riverbeds located below dam spill gates and in shoals, outside river bends, and steep riverbank

slopes with erodible soils would be impacted; however, the actual rate and extent of effects would need to be quantified based on observable data linked to the specific cultural site information. Furthermore, these areas are typical of high flow scenarios, thus the effects could also be constant relative to the NAA.

Finally, there are not enough significant differences between the NAA and the PAA in scale to evaluate specific differences in effects to cultural resources in the existing data. However, the 2014 baseline study has illustrated that, with proper monitoring and management using the existing GIS tools available to USACE, mitigations can be recommended as effects are observed over time (Fedoroff 2014). Although the percentage of sites that undergo the effects of erosion and deposition is expected to remain relatively the same across all the alternatives, some of the effects might be positive for the preservation of cultural resources site, while others will be negative. As with both, the NAA and the PAA, mitigation measures would be pursued, either protection or excavation, when the site is at risk for observable adverse impact.

6.8 Climate Change Analysis

Scientific evidence from the immediately preceding decades demonstrates that natural climate variability may be changing. These anticipated changes may reflect shifts in the average or baseline conditions, regional meteorological phenomena, and the range of variability of those phenomena. These potential changes have potential implications regarding the capacity of USACE projects and operations to accommodate different climatological baselines, greater climatological variation, and a wider range of meteorological conditions.

The ACF Master WCM project delivery team, in response to USACE guidance and public interest and input, engaged the Institute for Water Resources (IWR) to develop a numerical model to evaluate the resilience and limitations of proposed ACF Basin water management scenarios in response to potential climate change conditions. The ACF numerical model was developed to correlate with the HEC-ResSim and HEC-5Q models for the ACF system. Simulating the model-projected critical yield in HEC-ResSim and HEC-5Q would provide an indication of the effects of prospective climate change on hydrology and water quality in the ACF Basin. The objective of this effort was a quantitative analysis of potential climate change in ACF Basin hydrology and, by extension, ACF Basin management.

This climate change analysis capitalized on existing data and methodologies developed by a coalition of agencies and academic institutes as part of the Coupled Model Intercomparison Project, Phase 5 (CMIP5) (LLNL 2015). In broad terms, a general circulation model (GCM) numerically representing the physical processes (e.g., atmospheric, land surface) of the ACF Basin was employed to estimate basin climate change due to human influences. The GCM outputs were statistically scaled to a finer time and space scale, and bias corrected. The scaled and corrected GCM outputs were applied to a variable infiltration capacity (VIC) model. The Liang VIC model is a globally applied, open-source, macroscale hydrologic model that solves for water-energy balance (University of Washington 2015).

The methodologies applied for the ACF Basin climate change analysis and the approach by which the results were used in the HEC-ResSim and HEC-5Q models are described in detail in the documentation presented in Appendix N.

For the purposes of the climate change analysis in support of the ACF Basin Master WCM update process, the climate change-affected unimpaired flow (UIF) results for 2021–2050 were carried forward for comparison to results for the NAA and the PAA (Alt7H). Years 2021–2050 most closely match the anticipated project lifespan for the Master WCM update/WSSA analyses, as reflected in the project NEPA documentation. The climate change-affected UIF values were used in the ACF Basin HEC-ResSim and HEC-5Q models to compute a range of outputs for various parameters (basin inflow, reservoir pool elevations, hydropower production, streamflow) that may be expected should climate change trends continue.

Appendix N contains a number of figures depicting average and median basin inflow values, reservoir water surface elevation values, hydropower production values, and streamflow values at selected points in the basin. Results for the NAA and PAA (Alt7H) are plotted along with the range of climate change-affected values. The high-low range of potential climate change-affected outputs generally follow the same seasonal trends as the NAA values. However, the range of high and low boundaries for the modeled climate change-affected values generally indicate greater extremes. The high and low extremes are no more severe than those that have been historically experienced in the ACF Basin. Generally, the plotted PAA values tend to fall within the range of climate change-affected results, indicating that the PAA water management scenario would likely be flexible and adaptable enough to perform effectively within the range of hydrologic conditions represented.

Similarly, water quality simulations with HEC-5Q indicate that climate-affected water quality conditions would not be expected to deviate significantly from results for the NAA and PAA (Alt7H). Based on the simulations, water quality concentrations (median) between Alt7H and the Alt7H-2050-Q1 (Dry) scenario would be similar; median concentrations during wet years would generally be less. Appendix N provides further details on potential water quality effects associated with climate change, including several figures with model results for specific water quality parameters (biochemical oxygen demand, total phosphorus, ammonia, chlorophyll *a*, nitrogen, and dissolved oxygen).

6.9 Cumulative Effects

Cumulative effects in ecosystems are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" (40 CFR Parts 1500–1508). Constructing dams in riverine ecosystems abruptly, severely, and permanently alters many important physical and biological processes involving the movement of water, energy, sediments, nutrients, and biota. Fourteen major dams impound mainstem channels of the ACF Basin (Table 2.1-3), eliminating, fragmenting, and dramatically altering riverine habitat.

The WCM update/WSSA process for the USACE projects in the ACF Basin is an undertaking to update reservoir water management practices and address water supply storage reallocation issues in a manner that best meets the federally authorized projects' purposes by both applying a system-wide approach to project operations and considering current conditions and needs in the basin. Consequently, the WCM update/WSSA process, and the impact analysis presented herein, consider the cumulative effects of the continued operation of these USACE projects in the basin.

Numerous other federal (non-USACE) and non-federal activities are already occurring and will likely continue to occur in the ACF Basin in the future. These activities might affect the water resources and other important natural and human resources in the ACF Basin, and in some cases beyond the basin boundaries. Those pertinent other federal and non-federal activities that are reasonably foreseeable, and their associated cumulative effects in conjunction with USACE project operations, are summarized in the following paragraphs.

As described in section 2.1.1.1.6.10, the USACE conducted a preliminary survey in 2002 of existing reservoirs in the ACF Basin in Alabama and Georgia that are not on the mainstem rivers of the basin. The survey identified 411 reservoirs in the ACF Basin (Alabama and Georgia) that are 20 ac or larger (USACE, Mobile District 2002a). In Alabama, 25 reservoirs larger than 20 ac were identified for a total surface area of about 1,900 ac with an average reservoir size of about 77 ac. In Georgia, 386 reservoirs were identified with a total surface area of about 23,800 ac and an average reservoir size of about 62 ac (USACE, Mobile District 2002a). Those existing impoundments serve a variety of purposes, including water supply for livestock and irrigation, fish and wildlife conservation, recreation, and M&I water supply. Hundreds of other smaller ponds and impoundments are scattered across the basin. While the

preliminary survey might not have identified and included every impoundment in the ACF Basin, it was detailed enough to provide a reasonably complete summary of the more noteworthy surface water impoundments in the ACF Basin.

Table 2.1-4 summarizes non-USACE reservoir projects in the ACF Basin for which USACE has issued a section 404 permit since 1988 (a total of nine) or for which a USACE permit is pending (two). Those reservoirs generally represent local water supply projects for public supply needs in the Metro Atlanta portion in Georgia. All those projects, completed and pending, represent a total surface area of about 5,000 ac and a yield of about 175 mgd.

Georgia, Metropolitan North Georgia Water Planning District (MNGWPD), and the affected counties have undertaken a number of actions to meet projected future demands for public water supply. Those efforts, which include both instituting aggressive conservation measures and developing new sources of water, are described in detail in Appendix G. A 2008 study by the Georgia Environmental Finance Authority (GEFA), summarized in section 2.1.1.2.10.1.4 and Appendix G, identifies ongoing and potential future investments in new reservoirs to address water supply needs in Georgia (GEFA 2008). The 2008 study revealed that four existing local reservoir project (three in the Flint River Basin and one in the Chattahoochee River Basin) have the potential to expand storage volume by about two times the current level of about 6.4 billion gallons. The proposed Dog Creek Reservoir expansion in Douglas County, Georgia, was completed in 2009. At the time of the 2008 study, one proposed new reservoir (Lake McIntosh in Fayette County, Georgia) was under construction. Lake McIntosh was completed in 2012. Two reservoirs, Bear Creek Reservoir (Bear Creek, Fulton County, Georgia) and Glades Reservoir (Flat Creek, Hall County, Georgia), are now also in the permitting process.

Both the Bear Creek and Glades Reservoir were considered in the HEC-ResSim modeling effort for this EIS. Other than the additional loss and fragmentation of stream habitat as discussed below, the local water supply reservoir projects are likely to have an inconsequential overall effect on water quantity aspects of the ACF Basin. This conclusion is generally supported by the variations between alternatives with and without Glades Reservoir. The proposed projects are geographically dispersed within the ACF Basin, one upstream of Lake Lanier and one off the Chattahoochee River between Atlanta and West Point Lake. The potential effects of the proposed reservoirs on Master Manual update alternatives are expected to be minor.

Table 3 in Appendix G identifies 16 additional locations in the ACF Basin in Georgia that have been determined to be generally suitable by the state of Georgia from an engineering and site development standpoint for future water supply reservoir development. These locations were compiled from a variety of different studies and reports. Future development at any of those locations would be highly speculative (not reasonably foreseeable for purposes of this cumulative effects analysis). Similar regional or statewide studies have not been completed in Alabama or Florida. There are no known plans for water supply reservoir development in the Alabama or Florida portion of the ACF Basin.

One effect of converting flowing water habitat to still water by dam construction along ACF Basin mainstem rivers and tributaries has been the decline or loss of river-dependent species of freshwater fishes, mussels, and snails. The habitat fragmentation effects of dams in the ACF Basin have resulted in declines in habitat for anadromous fishes. The USACE, GPC, and other reservoirs in the ACF Basin have changed the frequency of floodplain inundation in some areas and altered the ecology of the river. New dams in the basin would replicate many of those effects elsewhere in the tributary streams and add to the cumulative alteration of natural flow regimes and habitat fragmentation. Depending on the location, size, and operating modes, amid other impacts that new dams being built to meet water supply demands could be adversely affecting, and possibly jeopardizing the continued existence of, some protected aquatic species.

As discussed in section 2.1.1.1.6.6, various private sector hydroelectric power interests have pursued steps to acquire licenses from FERC for non-USACE hydroelectric power development at George W. Andrews Lock and Dam, beginning in the early 1980s. It is reasonable to expect that a cost-effective project to produce non-USACE hydropower under a FERC license is likely to occur in the future for a variety of reasons, including: greater emphasis on developing clean energy sources; increases in fossil fuel costs; and less challenging environmental requirements associated with retrofitting an existing structure versus developing a new power generation source.

On June 19, 2014, FERC issued a preliminary permit to Mid-Atlantic Hydro, LLC, for purposes of studying the feasibility of non-USACE hydropower development at George W. Andrews Lock and Dam (FERC 2014). The preliminary permit is in effective for 3 years. If this effort does not result in the production of non-USACE hydropower, it is likely that other permit applications will be forthcoming. If so, the proposed hydropower development at the dam and other pertinent issues would be addressed though the FERC non-USACE hydropower licensing process.

As outlined in section 2.1.1.2.5.1.3, demands for public water supply and agricultural water supply in the ACF Basin have steadily increased since 1970 and are expected to continue to increase in the future. In 1990, agricultural water supply represented more than 10 percent of surface water withdrawals in the ACF Basin. As water efficiency and conservation measures associated with public water supply (particularly in those portions of the ACF Basin in Metro Atlanta) become more institutionalized through education, incentives, and enforceable laws/regulations, the rate of increase in water demand is likely to appreciably decline. This trend is supported by data in section 2.1.1.2.5.1.3. Industrial water use in the ACF Basin has declined dramatically in the past 40 years with more efficient uses of water for industrial and thermoelectric power generation.

For purposes of this cumulative effects analysis, it is not appropriate to speculate on what specific actions Alabama, Florida, Georgia, the MNGWPD, or local water providers might elect to pursue in the future in response to water resource-related litigation or water allocations formulas derived by these states. In general, more aggressive conservation measures could be likely to reduce or curtail the growth of current water demands, as would the implementation of any feasible water reuse projects. In the portion of the ACF Basin within Metro Atlanta, interbasin transfers are likely to continue for the foreseeable future, reflecting a minor net loss of water from the Chattahoochee River Basin to the Ocmulgee River Basin. Existing laws and regulatory mechanisms limiting interbasin transfers in Georgia would likely have to be modified to enable this option to be implemented on a larger scale. Other specific recommendations to address future shortfalls in water supply will likely be included in the regional water plans developed by the regional water councils established under the Georgia state water plan (SWP).

Human-induced inputs of various stressors into aquatic and terrestrial ecosystems can further compromise the ability of an ecological system to support a healthy biota. As growth (increased density of human habitation) continues, the impacts on terrestrial ecosystems and wetlands adjacent to water bodies in the ACF Basin are expected to become more degraded in spite of various levels of regulation and conservation efforts (e.g., stream buffers and wetland mitigation requirements). If, however, additional attention is given to protecting the integrity of floodplains and restrictions are placed on land cover conversions from residential/suburban/urban development, those areas could retain their function in fluvial processes. Those factors are expected to influence conditions in tributaries, but they are expected to have little, if any, effect on the inundation of floodplains and wetlands in the Chattahoochee River corridor, since it is largely driven by reservoir operations.

For the Master Manual update process, the ROI for land use is the USACE project land and the adjacent shoreline. The proposed changes to water management operations and water supply alternatives would affect water surface elevations in reservoirs of along the Chattahoochee River, in turn affecting project shorelines. Therefore, the focus of the land use analysis is on the project land over which the USACE has

proprietary or managerial jurisdiction and the immediately adjacent land. The alternatives analyzed in this EIS would not change land use allocations or zoning, would not change established land uses, and would not disrupt or divide established land use configurations. Therefore, no cumulative effects would be expected.

USACE typically considers requests for a variety of real estate easements/leases at its projects. Numerous real estate easement activities are ongoing in the ACF Basin. Recent examples include additional easements for new roadwork at Lake Lanier and Walter F. George Lake and utility crossings above Walter F. George Lake. Such actions are not expected to have impacts on water management decisions or project purposes nor would they be impacted by the proposed action.

The Apalachicola Bay estuary faces a variety of anthropogenic pressures, including upland development and associated pollution, groundwater pumping, recurring droughts, fishery pressures, sea level rise, wetland destruction, and flow modification from upstream reservoirs. Amid that pressure and signs of increased stress in recent years, even with variable system conditions, the Apalachicola Bay estuary has remained a productive estuarine ecosystem.

Appreciable flow alteration (in terms of quantity, quality, timing, and distribution) would be likely to have potential effects on the Apalachicola Bay estuary, including its commercial fisheries. Because flow conditions in the Apalachicola River downstream of Jim Woodruff Lock and Dam would not differ appreciably among the alternatives compared to the NAA as discussed in section 6.1.1.2.5, the proposed updates to the Master Manual would likely have negligible effect on the aquatic resources and ecological function of the Apalachicola Bay estuary. As indicated in section 2 of the EIS, the ACF Basin upstream of Jim Woodruff Lock and Dam contributes roughly 80 percent of the total flow to Apalachicola River. Review of HEC-ResSim model outputs for flow on the Apalachicola River at Chattahoochee, Florida (see section 6.1.1.2.5) and Blountstown, Florida, indicate that the PAA would have little effect on the flow regime on the river at those locations and further downstream entering Apalachicola Bay compared to the NAA. Therefore, the PAA, or any of the other alternatives, would be expected to have a negligible incremental effect on the hydrodynamic regime, aquatic resources, and ecological function of the Apalachicola Bay estuary compared to the NAA.

Any negligible changes to hydrodynamic conditions in the bay that would occur under the PAA would most likely be inconsequential compared to the cumulative effects of anticipated sea level rise on physical and ecological conditions in the estuary. Initial vulnerability assessments conducted by USACE in accordance with the Comprehensive Evaluation of Projects with Respect to Sea-Level Change (CESL) (USACE 2014a) indicate that sea level at Apalachicola, Florida, would be estimated to rise by 0.16 ft up to 0.39 ft between 2015 and 2050 and by 1.21 ft up to 4.51 ft between 2015 and 2100 (USACE 2014b).

A number of factors, including pollutant loads and in-stream flows (water quantity), influences water quality. Pollutant loads include both point and nonpoint sources of pollution. Point sources of pollution are regulated by EPA through the National Pollutant Discharge Elimination System under the Water Pollution Act of 1972, as amended. Nonpoint sources of pollution are also targeted to reduce pollutant loads under the Water Pollution Act of 1972, as amended, through TMDLs. Enforcement of reductions is varied because of limited resources. As activities in the ACF Basin change from forested to urban land cover, peak flows in the system are likely to increase and baseflows in the system are likely to decrease. Urban land cover generally decreases interception of rainfall and infiltration, increasing stormwater runoff. That would be expected to result in less assimilative capacity during periods of low flow because baseflow decreases.

A water body's ability to assimilate pollutants is dependent on the amount of water in-stream, especially during low flow periods. That is why the HEC-ResSim models have been developed to ascertain the relationship between quantity and quality in the ACF Basin. Agencies regulating water quality in rivers

and reservoirs will continue to monitor for impairment and improvement, and to enforce reductions until standards are met. That balance of what is allowable and what is discharged is an ongoing cycle of monitoring, assessment, and implementation.

Implementing the PAA and other alternatives would result in cumulative effects in the ACF Basin with respect to water quality. Changes in discharges during low-conditions by some entities holding NPDES permits would affect DO, TP, and TN from Atlanta, Georgia, to West Point Lake. For the most part, those effects would be expected to occur only during low flow periods.

It is assumed that over time, water quality standards will be met because of reductions achieved through the Water Pollution Act of 1972, as amended. Nutrient loads are also expected to decrease because of stringent new criteria for Florida finalized in November 2010. The criteria establish freshwater standards in Lake Seminole that might require upstream reductions to ensure compliance. Compliance with these new water quality standards will be determined by state water quality regulating agencies—ADEM, Florida DEP, and Georgia EPD.

Regardless of changes in reservoir operation, populations in the ACF Basin are expected to increase in the future, thus bringing more people into potential contact with known significant archaeological sites along the lakeshores and waterways. Increased human interaction is likely to increase the impact of access due to vandalism or artifact collection.

6.10 Mitigation Considerations

Mitigation includes measures to avoid, reduce, minimize, or compensate for adverse impacts that could result from a selected course of action; in this case, the update of the Master Manual. As potential water management measures were identified and alternatives were developed and analyzed for beneficial and adverse effects to be addressed in this EIS, potential mitigative actions were identified and considered in the planning process.

The iterative process employed by USACE to formulate and evaluate water management alternatives and water supply options was coupled with substantial coordination with the USFWS and others. These factors provided a strong framework for 1) considering the incremental effects of the various components of the alternatives, and 2) adjusting proposed operations to minimize adverse effects on the natural environment, as well as social, cultural, and economic impacts.

Based on information provided by the State of Georgia, the model assumptions for Alt1C, Alt7C, Alt7D, Alt7E, and the PAA all included the increase in treated wastewater discharges into the Chattahoochee River from Metro Atlanta. Implementing Alt7C, Alt7D, Alt7E, or the PAA may result in adverse effects on water quality from Atlanta to West Point Lake because of increased TP loads. Alt1C, Alt7C, Alt7D, Alt7E, Alt7F, and the PAA may also experience adverse effects in TN along this reach, from Atlanta to West Point Lake. Both Alt1C, which includes USACE current management operations, and the PAA demonstrate comparable effects to water quality. This shows that these effects would principally be the result of increases in treated wastewater returns to the river system resulting from proposed increases in water supply withdrawals to meet future needs in Metro Atlanta and, for some alternatives, higher assumed return rates for treated wastewater (as a percentage of withdrawals) than presently occurs. As much as 100 to 160 mgd of additional treated wastewater discharges to the Chattahoochee River would be expected under these alternatives. If GAEPD permits additional discharges, GAEPD may require changes to discharge permits for some facilities to assure that water quality is maintained in this reach of the river. As in past years, working closely with states and affected stakeholders, special releases from USACE projects might be made to assist with public health and safety throughout the ACF Basin. USACE will periodically notify users when such releases are made, and water users can also directly notify USACE of their needs for special releases.

Specific compensatory mitigation measures would not be required based on the analysis of the PAA and other atlernatives, which shared model assumptions about water supply and wastewater returns. No specific mitigation commitments are included in the PAA or other alternatives, but all the alternatives incorporate measures known to benefit fish and wildlife, such as current fish spawning and passage procedures as well as ramping rates and flow targets in the Apalachicola River at Chattahoochee, Florida.

Water management inherently involves adapting to unforeseen conditions. The development of water control criteria for the management of water resources is conducted throughout all phases of a water control project. Water control criteria are based on sound engineering practices using the latest approved models and techniques for all reasonably foreseeable conditions. There could be further refinements or enhancements of the water control procedures to account for changed conditions resulting from new requirements, additional data, or changed social or economic goals. However, it is necessary to define the water control plan in precise terms at a particular time to ensure implementation of the intended functional commitments in accordance with the authorizing documents (EM 1110-2-3600 Management of Water Control Systems). Because adverse effects of the water control plan might occur due to unforeseen conditions, actions would be taken within applicable authority and policies, and in coordination with other interests, to address such conditions when they occur through the implementation of temporary deviations to the water control plan (e.g., interim operation plans).

Such temporary deviations from the approved water control plan might have effects that go beyond the scope of the current evaluation. An evaluation of each potential action would be made at the time of its consideration because it is not possible to predict the entire range of possible water management responses to extraordinary circumstances. If it is determined that an action had not been previously considered by the NEPA evaluation, a supplemental EIS or an EA would be required.

6.11 Other NEPA Considerations

6.11.1 Irreversible or Irretrievable Commitments of Resources

Irreversible or irretrievable resource commitments relate to the use of nonrenewable resources and the effects that use of those resources will have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time. Irretrievable resource commitments involve the use or loss in value of an affected resource that cannot be restored because of the action (e.g., extinction of a threatened or endangered species).

The PAA and the other Master Manual update alternatives are generally not consumptive in nature. Maintaining peak hydropower production as an objective in the development of Master Manual update promotes continued use of renewable resources (water) to meet peak power demands in lieu of fossil fuels. The reallocation of conservation storage at Lake Lanier for water supply in the PAA would represent an administrative commitment of reservoir storage from one use to another even though the net loss of water to the ACF Basin system would be limited to the consumptive use associated with the additional water supply. The PAA for the Master Manual update would be expected to have generally positive effects on resources (e.g., potential reduction of damages from flooding) with the exception of the indirect adverse effects of total phosphorus and riverine fish and aquatic resources between Atlanta and West Point Lake as discussed in sections 6.1.2.3.9 and 6.4.2.1.1.9. Overall, irreversible or irretrievable commitments of resources under the PAA would be negligible.

6.11.2 Short-Term Uses of the Human Environment and Maintenance of Long-Term Productivity

The construction of large dams in the ACF Basin altered the environment in various ways. For instance, the creation of reservoirs replaced free-flowing rivers and streams and adjacent floodplains, significantly altering the habitat and the composition of aquatic species that favor living in high-velocity water or wide, slow-moving rivers versus those that thrive in a series of large impoundments. Dams with large storage capacity have the effect of reducing the occurrence and magnitude of peak flows; those periods are typically used as opportunities to refill reservoirs and reduce downstream flooding. These projects provide substantial opportunities for economic growth and development and an improved quality of life in the southeast region of the U.S. through improved flood risk management, increased hydropower production, new recreational opportunities, dependable navigation channels, more stable sources of water supply, and other benefits to the public. Operations to reduce flood risk have decreased the occurrence and severity of damaging floods but have also changed the character of floodplain vegetation and available habitats. Construction of dams has also allowed maintenance of minimum flows downstream of the dams during critically dry periods. Before dam construction and reservoir creation, water levels would have likely decreased well below acceptable levels for aquatic species and water withdrawal intakes. Since dam construction, a coldwater fishery was created downstream of Buford Dam and a bass fishery was created in West Point Lake. The proposed update of the Master Manual would not be expected to substantially alter the present relationship between short-term uses of man's environment and maintenance and enhancement of long-term productivity. The proposed Master Manual update includes operational adjustments that best balance the multiple purposes of the USACE projects in the ACF Basin, including those that would sustain and improve environmental conditions in the basin.

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9 Persons and Agencies Consulted

Tanya Blalock, Environmental Manager, Georgia Power Company, Water and Waste Programs. August 2010.

Angela Chelette, Northwest Florida Water Management District. Havana, Florida. January 2011.

Kenneth Day. U.S. Army Corps of Engineers, Mobile District, Operations Division, Natural Resource Management Section. 2010, December 1.

Jim Greenfield, Senior Water Quality Modeler retired U.S. Environmental Protection Agency Region 4, Atlanta, Georgia. June 2010 and July 2014.

Cindy House, U.S. Army Corps of Engineers, Mobile District, Regulatory Division. December 2010.

Sarah Jernigan, Lake George W. Andrews, Resource Manager. July 2010.

Ed Johnson, U.S. Army Corps of Engineers, Savannah District, Regulatory Division, Piedmont Field Office. December 2010.

Kimberly Minton, Chief Technical Support Section, Water Division, Alabama Department of Environmental Management, May 2014.

B. Mortimer, Environmental Coordinator, ACF Rivers Project. Email on 2010 December 27.

Ernest Noe, U.S. Army Corps of Engineers, Lake Sidney Lanier, Chief Ranger. 2010 December 7 and 2014 July 3.

Joseph Paine, U.S. Army Corps of Engineers, Mobile District, Planning Division, Plan Formulation Branch. 2012, September 6.

David Scott, U.S. Army Corps of Engineers, West Point Lake, Park Ranger. 2014 July 8.

William Smallwood, U.S. Army Corps of Engineers, Operations Division, Walter F. George Project Office, Project Manager. 2010, December 16.

Jody Timmons, U.S. Army Corps of Engineers, Lake Seminole. 2010 December 1 and 2014 July 9.

Ben Williams, U.S. Army Corps of Engineers, West Point Lake, Park Ranger. 2010, December 1.

Brian Zettle, Biologist, Inland Environment Team Chief, U.S. Army Corps of Engineers Mobile District. 2014, August and November. Personal communication.

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10 Distribution List

The EIS was distributed both in hard copy by the US Postal Service and electronically through the project website. Notification of availability was distributed through the *Federal Register* and an email sent to those on the project mailing list. Hard copies were also made available at libraries throughout the ACF Basin and sent to stakeholders who had requested hard copies. The project mailing list includes Federal, State, and local agencies, Native American tribes, elected officials, other organizations, and individuals.

10.1 Federal Agencies

ADVISORY COUNCIL AND HISTORIC PRESERVATION
ARMY GENERAL COUNSEL
CONGRESSIONAL RESEARCH SERVICE
FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL HWY ADMINISTRATION
FEDERAL MARITIME COMMISSION
FERC
FOREST SERVICE SOUTHERN REGION
HORSESHOE BEND NATIONAL MILITARY PARK
KENNESAW MOUNTAIN NATIONAL BATTLEFIELD PARK
MARITIME ADMINISTRATION
NASA
NATIONAL MARINE FISHERIES SERVICE, NOAA
NATIONAL OCEAN SERVICE, NOAA
NATIONAL PARK SERVICE
NATIONAL WEATHER SERVICE
NATIONAL WILDLIFE FEDERATION
NOAA
OAK RIDGE NATIONAL LABRATORY
SOIL CONSERVATION SERVICE
US AIR FORCE
US ARMY
US ARMY CORPS OF ENGINEERS
US COAST GUARD GROUP
US CONSOLIDATED FARM SERVICE AGENCY
US DEPARTMENT OF AGRICULTURE
US DEPARTMENT OF COMMERCE
US DEPARTMENT OF HEALTH & HUMAN SERVICES
US DEPARTMENT OF JUSTICE
US DEPARTMENT OF INTERIOR
US DEPARTMENT OF ENERGY
US DEPARTMENT HEALTH AND HUMAN SERVICES
US DEPARTMENT OF LABOR
US DEPARTMENT OF STATE
US ECONOMIC DEVELOPMENT ADMINISTRATION, ATLANTA REGIONAL OFFICE, GA
US ENVIRONMENTAL PROTECTION AGENCY
US FISH & WILDLIFE SERVICE
US FOREST SERVICE
US GEOLOGICAL SURVEY
US NAVAL AIR STATION
US PUBLIC HEALTH SERVICE FDA
US FISH & WILDLIFE SERVICE
US FOREST SERVICE
US HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
US HUD
US PUBLIC HEALTH SERVICE FDA
WEEKS BAY NATIONAL RESERVE
WELAKA NATIONAL FISH HATCHER

10.2 State Agencies

AGRICULTURAL STATE SERVICE
AL/MS SEA GRANT CONSORTIUM
ALABAMA ATTORNEY GENERAL'S OFFICE
ALABAMA BUREAU OF TOURISM & TRAVEL
ALABAMA COOPERATIVE EXTENSION SYSTEM
ALABAMA COUNTY COMMISSIONERS ASSOCIATION
ALABAMA DEPARTMENT OF AGRICULTURE & INDUSTRIES

ALABAMA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
ALABAMA DEPARTMENT OF ECONOMIC AND COMMUNITY AFFAIRS
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
ALABAMA DEPARTMENT OF INDUSTRIAL RELATIONS
ALABAMA DEPARTMENT OF PUBLIC HEALTH
ALABAMA DEVELPMENT OFFICE
ALABAMA EMERGENCY MANAGEMENT AGENCY
ALABAMA FORESTRY COMMISSION
ALABAMA GAME & FISH OFFICE
ALABAMA GEOLOGICAL SURVEY
ALABAMA HISTORICAL COMMISSION
ALABAMA INDUSTRIAL DEVELOPMENT TRAINING
ALABAMA MARINE POLICE
ALABAMA NATIONAL GUARD
ALABAMA OFFICE OF WATER RESOURCES
ALABAMA OIL AND GAS BOARD
ALABAMA PUBLIC SERVICE COMMISSION
ALABAMA SOIL AND WATER CONSERVATION DISTRICT
ALABAMA STATE CAPITOL
ALABAMA STATE CLEARINGHOUSE, ADECA
ALABAMA STATE CONSERVATIONIST, NRCS
ALABAMA STATE DOCKS
ALABAMA STATE HIGHWAY DEPT.
ALABAMA STATE OIL & GAS BOARD
ALABAMA STATE PARKS
ALABAMA STATE PORT AUTHORITY
ALABAMA WATER AND WASTEWATER
ANERR
APALACHICOLA NATIONAL ESTAURINE RESEARCH RESERVE
CHATTAHOOCHEE FOREST NATIONAL FISH HATCHERY
COMMISSION ON CHILDREN AND YOUTH
FLORIDA AGRICULTURE COMMISSION
FLORIDA CHAMBER OF COMMERCE
FLORIDA DEPARTMENT OF NATURAL RESOURCES
FLORIDA DEPARTMENT OF TRANSPORTATION
FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
FLORIDA DEPARTMENT OF NATURAL RESOURCES
FLORIDA FARM BUREAU
FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
FLORIDA GOVERNOR'S OFFICE
FLORIDA HOUSE OF REPRESENTATIVES
FLORIDA MARINE FISHERIES COMM.
FLORIDA NATURAL AREAS INVENTORY
FLORIDA OFFICE OF POLICY AND BUDGET
FLORIDA SENATE
FLORIDA STATE CLEARINGHOUSE
FLORIDA STATE CONSERVATIONIST, NRCS
FLORIDA STATE HISTORIC PRESERVATION
FLORIDA WILDLIFE FEDERATION
GEOLOGICAL SURVEY OF ALABAMA
GEORGIA DEPARTMENT OF AGRICULTURE
GEORGIA DEPARTMENT OF NATURAL RESOURCES
GEORGIA DEPARTMENT OF LAW
GEORGIA DWR
GEORGIA EMERGENCY MANAGEMENT AGENCY
GEORGIA ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY
GEORGIA HOUSE OF REPRESENTATIVES
GEORGIA MUSEUM NATURAL HISTORY
GEORGIA PORTS AUTHORITY
GEORGIA SENATE
GEORGIA STATE CLEARINGHOUSE
GEORGIA STATE CONSERVATIONIST, NRCS
GEORGIA WATER TASK FORCE
GEORGIA DNR WILDLIFE RESOURCES DIVISION
KEEP GEORGIA BEAUTIFUL
LA DEPT. OF WILDLIFE & FISHERIES
LAKEPOINT STATE PARK
MS DEPT. OF ARCHIVES & HIST
MS HISTORICAL COMMISSION

MS STATE OIL & GAS BOARD
RED TOP MOUNTAIN STATE PARK
SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
SOUTHEAST ALABAMA REGIONAL PLANNING & DEVELOPMENT COMMISSION
STATE OF FLORIDA
STATE OF GEORGIA
STATE OF MISSISSIPPI
TENNESSEE TOMBIGBEE WATERWAY DEVELOPMENT AUTHORITY
TENNESSEE VALLEY AUTHORITY
TEXAS WATER COMMISSION

10.3 Local Agencies

ABBEVILLE CHAMBER OF COMMERCE
ALABAMA GULF COAST AREA CHAMBER OF COMMERCE
ALABAMA RURAL WATER ASSOCIATION
ALABAMA RURAL WATER ASSOCIATION, INC.
ALBANY-DOUGHERTY CLEAN COMMUNITY COMMISSION
ALBERTVILLE CHAMBER OF COMMERCE
ALEXANDER CITY CHAMBER OF COMMERCE
ALEXANDER CITY WATER DEPARTMENT
ALICEVILLE AREA CHAMBER COMMERCE
ANDALUSIA AREA CHAMBER OF COMMERCE
ANNISTON CHAMBER OF COMMERCE
ANNISTON WATER & FPA
APALACHEE REGIONAL PLANNING COUNCIL
APALACHIAN REGIONAL COMMISSION
APALACHICOLA BAY AREA CHAMBER OF COMMERCE
APALACHICOLA DOWNTOWN IMPROVEMENT AUTHORITY
APALACHICOLA NATIONAL ESTUARINE
ARAB CHAMBER OF COMMERCE
ATHENS-LIMESTONE COUNTY CHAMBER OF COMMERCE
ATLANTA CHAMBER OF COMMERCE
ATLANTA REGIONAL COMMISSION
ATLANTA-FULTON COUNTY WATER RESOURCES
ATMORE AREA CHAMBER OF COMMERCE
ATTALLA CHAMBER OF COMMERCE
AUBURN CHAMBER OF COMMERCE
AUTAUGA COUNTY COMMISSION
BAINBRIDGE-DECATUR COUNTY CHAMBER OF COMMERCE
BALDWIN COUNTY COMMISSION
BALDWIN COUNTY-BUILDING DEPT. & COASTAL PROGRAM OP
BARBOUR COUNTY ALABAMA FARMERS FEDERATION
BARBOUR COUNTY COMMISSION
BARTOW COUNTY WATER DEPARTMENT
BAY COUNTY PUBLIC LIBRARY ASSOCIATION
BAYOU LA BATRE CHAMBER OF COMMERCE
BESSEMER AREA CHAMBER OF COMMERCE
BIBB COUNTY COMMISSION
BIRMINGHAM REGIONAL PLANNING COMMISSION
BIRMINGHAM WATER & SEWER BOARD
BIRMINGHAM WATER WORKS
BLAKELY AND EARLY COUNTY BOARD OF COMMISSIONERS
BLOUNT COUNTY-ONEONTA CHAMBER OF COMMERCE
BOAZ CHAMBER OF COMMERCE
BULLOCK COUNTY CHAMBER OF COMMERCE
BULLOCK COUNTY COMMISSION
BUTLER COUNTY COMMISSION
CALERA CHAMBER OF COMMERCE
CALHOUN COUNTY CHAMBER OF COMMERCE
CALHOUN COUNTY COMMISSION
CALHOUN UTILITIES
CARTERSVILLE
CARTERSVILLE HOUSING AUTHORITY
CARTERSVILLE WATER DEPARTMENT
CARTERSVILLE/BARTOW CITY
CEDAR BLUFF UTILITY BOARD
CENTRAL ALABAMA REGIONAL PLANNING COMMISSION
CENTRAL BALDWIN CHAMBER OF COMMERCE

CENTRAL ELMORE WATER AND SEWER AUTHORITY
CENTRE WATER AND SEWER BOARD
CHAMBER OF COMMERCE OF WALKER COUNTY
CHAMBER OF COMMERCE OF WEST ALABAMA
CHAMBERS COUNTY COMMISSION
CHATSWORTH WATER COMMISSION
CHATSWORTH-MURRAY COUNTY CHAMBER OF COMMERCE
CHATTAHOCHEE FLINT REGIONAL DEVELOPMENT COMMISSION
CHATTAHOOCHEE COUNTY COMMISSION
CHEROKEE COUNTY COMMISSION
CHEROKEE WATER & SEWER AUTHORITY
CHICKASAW CHAMBER OF COMMERCE
CHILDERSBURG CHAMBER OF COMMERCE
CHILDERSBURG WATER SEWER & GAS BOARD
CHILTON COUNTY COMMISSION
CHOCTAW COUNTY CHAMBER OF COMMERCE
CHOCTAWHATCHEE, PEA & YELLOW RIVERS WATERSHED MANAGEMENT AUTHORITY
CITRONELLE AREA CHAMBER OF COMMERCE
CITY COUNCIL OF LAGRANGE, GA
CITY OF ACWORTH, GA
CITY OF ALBANY, GA
CITY OF ANDERSONVILLE, GA
CITY OF APALACHICOLA, FL
CITY OF ASHFORD, AL
CITY OF ASHLAND, AL
CITY OF ATLANTA, GA
CITY OF ATTALLA, AL
CITY OF AUBURN, AL
CITY OF AUSTELL, GA
CITY OF BERKELY LAKE, GA
CITY OF BAINBRIDGE, GA
CITY OF BOAZ, AL
CITY OF BLOUNTSTOWN, FL
CITY OF BOWDON, GA
CITY OF BRENT, AL
CITY OF BRISTOL, FL
CITY OF BUFORD, GA
CITY OF CALHOUN, GA
CITY OF CAMDEN, AL
CITY OF CAMILLA, GA
CITY OF CARRABELLE, FL
CITY OF CARTERSVILLE, GA
CITY OF CENTREVILLE, AL
CITY OF CHATSWORTH, GA
CITY OF CHATTAHOOCHEE, FL
CITY OF CHILDERSBURG, AL
CITY OF CLARKESVILLE, GA
CITY OF CLARKSTON, GA
CITY OF COLUMBUS TRANSPORTATION CHIEF, GA
CITY OF CORDELE, GA
CITY OF CORNELIA, GA
CITY OF CUMMING, GA
CITY OF DACULA, GA
CITY OF DADEVILLE, AL
CITY OF DAHLONEGA, GA
CITY OF DALEVILLE, AL
CITY OF DEMOPOLIS, AL
CITY OF DONALSONVILLE, GA
CITY OF DOTHAN, AL
CITY OF EAST POINT, GA
CITY OF ELLIJAY, GA
CITY OF EUFAULA, AL
CITY OF FAIRHOPE, AL
CITY OF FAYETTEVILLE, GA
CITY OF GADSDEN, AL
CITY OF GAINESVILLE, GA
CITY OF GEORGIANA, AL
CITY OF GLENCOE, AL
CITY OF GOODWATER, AL
CITY OF GRIFFIN, GA
CITY OF GULF SHORES, AL
CITY OF HEADLAND, AL
CITY OF HEFLIN, AL
CITY OF HELENA, AL
CITY OF HIRAM, GA
CITY OF HOKES BLUFF, AL
CITY OF JACKSON, GA
CITY OF JACKSONVILLE, FL
CITY OF KENNESAW, GA
CITY OF LAFAYETTE, GA
CITY OF LA GRANGE, GA
CITY OF LANETT, AL
CITY OF LEESBURG, FL
CITY OF LILBURN, GA
CITY OF LINCOLN, AL
CITY OF LINDEN, AL
CITY OF LINEVILLE, AL
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CITY OF LUMPKIN, GA
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CITY OF MOBILE, AL
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CITY OF MONTGOMERY, AL
CITY OF MONTGOMERY WATER WORKS AND SANITARY SEWER BOARD, AL
CITY OF MOODY, AL
CITY OF MOUNTAIN PARK, GA
CITY OF NORCROSS, GA
CITY OF OAKWOOD, GA
CITY OF OPELIKA, AL
CITY OF ORANGE BEACH, AL
CITY OF OXFORD, AL
CITY OF PELHAM, AL
CITY OF PELL CITY, AL
CITY OF PHENIX CITY, AL
CITY OF POWDER SPRINGS, GA
CITY OF PRATTVILLE, AL
CITY OF RAINBOW CITY, AL
CITY OF RIVERDALE, GA
CITY OF ROME, GA
CITY OF ROSWELL, GA
CITY OF SANDY SPRINGS, GA
CITY OF SATSUMA, AL
CITY OF SELMA, AL
CITY OF SMYRNA, GA
CITY OF SOUTHSIDE, AL
CITY OF SPANISH FORT, AL
CITY OF SUGAR HILL, GA
CITY OF SYLACAUGA, AL
CITY OF SYLVESTER, GA
CITY OF TALLADEGA, AL
CITY OF TALLAPOOSA, GA
CITY OF TALLASSEE, AL
CITY OF TUSCALOOSA, AL
CITY OF TUSKEGEE, AL
CITY OF UNION SPRINGS, AL
CITY OF VALLEY, AL
CITY OF VILLA RICA, GA
CITY OF WAVERLY, AL
CITY OF WEST POINT, GA
CITY OF WETUMPKA, AL
CLARKE COUNTY COMMISSION, GA
CLAY COUNTY BOARD OF COMMISSIONERS, GA
CLAY COUNTY CHAMBER OF COMMERCE, GA
CLAY COUNTY COMMISSION, GA
CLAYTON COUNTY BOARD OF COMMERCE, GA
CLAYTON COUNTY CHAMBER OF COMMERCE, GA
CLAYTON COUNTY COMMISSION, GA
CLAYTON COUNTY WATER AUTHORITY, GA
CLAYTON COUNTY WATER DEPARTMENT, GA
CLEBURNE COUNTY CHAMBER OF COMMERCE, AL
CLEBURNE COUNTY COMMISSION, AL
COASTAL RESOURCES ADVISORY COMMITTEE
COBB CHAMBER OF COMMERCE, GA
COBB COUNTY-MARIETTA WATER AUTHORITY, GA
COBB COUNTY COMMISSION, GA
COBB COUNTY COMMUNITY DEVELOPMENT, GA
COBB COUNTY GOVERNMENT, GA
COBB COUNTY WATER, GA
COBB LIBRARY SYSTEM, GA
COBB LIBRARY SYSTEM CENTRAL, GA
COFFEE COUNTY COMMISSION, GA
COLUMBUS CHAMBER OF COMMERCE, GA
COLUMBUS CONSOLIDATED GOVERNMENT, GA
COLUMBUS WATERWORKS, GA
CONECUH COUNTY COMMISSION, AL
COOSA VALLEY APDC, GA
COOSA VALLEY RC&D, AL
COOSA VALLEY REGIONAL DEVELOPMENT CENTER, GA
CORDELE CITY COMMISSION, GA
COVINGTON COUNTY COMMISSION, AL
COWETA COUNTY PLANNING AND ZONING, GA
COWETA COUNTY WATER & SEWER DEPARTMENT, GA
CRENSHAW COUNTY COMMISSION, AL
CRISP COUNTY, GA
CULLMAN COUNTY CHAMBER OF COMMERCE, AL
DADEVILLE WATER/GAS BOARD, AL
DALLAS COUNTY COMMISSION, AL
DAUPHIN ISLAND CHAMBER OF COMMERCE, AL
DAUPHIN ISLAND PARK & BEACH BOARD, AL

DAUPHIN ISLAND SEA LAB, AL
DECATUR CHAMBER OF COMMERCE, GA
DECATUR COUNTY COMMISSION, GA
DEKALB CHAMBER OF COMMERCE, GA
DEKALB COUNTY, GA
DEKALB COUNTY COMMISSION, GA
DEKALB COUNTY WATER AND SEWER DEPARTMENT, GA
DEKALB PUBLIC WORKS, GA
DEKALB SCHOOL SYSTEM, GA
DEMOPOLIS AREA CHAMBER OF COMMERCE, AL
DONALSONVILLE CHAMBER OF COMMERCE, GA
DOTHAN AREA CHAMBER OF COMMERCE, AL
DOTHAN CITY COMMISSION, AL
DOTHAN UTILITIES, AL
DOTHAN/HOUSTON EMA, AL
DOTHAN-HOUSTON COUNTY CHAMBER OF COMMERCE, AL
DOUGHERTY COUNTY ENVIRONMENTAL HEALTH, GA
DOUGLAS COUNTY, GA
DOUGLAS COUNTY COMMISSION, GA
DOUGLASVILLE-DOUGLAS COUNTY WATER & SEWER AUTHORITY, GA
DULUTH CITY HALL, GA
DURAN JUNIOR HIGH SCHOOL, PELL CITY, AL
EARLY COUNTY BOARD OF COMMISSIONERS, GA
EARLY COUNTY COMMISSION, GA
EAST ALABAMA REGIONAL PLANNING AND DEVELOPMENT COMMISSION
EAST ALABAMA REGIONAL PLANNING COMMISSION
EAST ALABAMA WATER, SEWER, AND FIRE PROTECTION
EAST WALKER CHAMBER OF COMMERCE, AL
EUTAW AREA CHAMBER OF COMMERCE, AL
ELBA CHAMBER OF COMMERCE, AL
ELLIJAY CITY HALL, GA
ELMORE COUNTY COMMISSION, AL
ENSLEY CHAMBER OF COMMERCE, AL
ENTERPRISE CHAMBER OF COMMERCE, AL
ENTERPRISE WATER DEPARTMENT, AL
ESCAMBIA COUNTY COMMISSION, FL
ETOWAH COUNTY COMMISSION, AL
ETOWAH WATER & SEWER AUTHORITY, AL
EUFAULA BARBOUR COUNTY CHAMBER OF COMMERCE, AL
EUFAULA CHAMBER OF COMMERCE, AL
EUFAULA PARKS AND RECREATION, AL
EUFAULA WATER & SEWER DEPARTMENT, AL
EVERGREEN/CONECUH COUNTY AREA CHAMBER OF COMMERCE, AL
EXECUTIVE OFFICE OF THE GOVERNOR, FL
FAYETTE AREA CHAMBER OF COMMERCE, AL
FAYETTE COUNTY COMMISSION, GA
FAYETTE COUNTY WATER SYSTEM, GA
FLOMATON CHAMBER OF COMMERCE, AL
FLOYD COUNTY COMMISSIONERS' OFFICE, GA
FLOYD COUNTY GOVERNMENT, GA
FORSYTH COUNTY, GA
FORSYTH COUNTY BOARD OF COMMISSIONERS, GA
FORSYTH COUNTY COMMISSION, GA
FORSYTH COUNTY PARKS & RECREATION, GA
FRANKLIN COUNTY COMMISSION, FL
FRISCO CITY CHAMBER OF COMMERCE, AL
FULTON COUNTY COMMISSION, GA
FULTON COUNTY-ENVIRONMENT & COMMUNITY DEVELOPMENT, GA
FULTON COUNTY PUBLIC WORKS DEPARTMENT, GA
FULTON COUNTY SOIL AND WATER DISTRICT, GA
FULTON COUNTY WATER DEPARTMENT, GA
GADSDEN BOARD OF COUNTY COMMISSIONERS, CHAIRMAN, FL
GADSDEN COUNTY CHAMBER OF COMMERCE, FL
GADSDEN COUNTY GROWTH MANAGEMENT DEPARTMENT, FL
GADSDEN WATER WORKS & SEWER BOARD, FL
GADSDEN-ETOWAH CHAMBER OF COMMERCE, AL
GAINESVILLE PUBLIC UTILITIES
GAINESVILLE WATER DEPARTMENT, GA

GARDENDALE CHAMBER OF COMMERCE, AL
GENEVA COUNTY COMMISSION, AL
GEORGIA MOUNTAINS REGIONAL DEVELOPMENT CENTER (GMRDC)
GORDON COUNTY COMMISSIONERS OFFICE, GA
GILMER COUNTY COMMISSIONER, GA
GREATER BREWTON AREA CHAMBER OF COMMERCE, AL
GREATER COLUMBUS GEORGIA CHAMBER OF COMMERCE
GREATER HALL CHAMBER OF COMMERCE, GA
GREATER LEEDS AREA CHAMBER OF COMMERCE, AL
GREATER TALLADEGA AREA CHAMBER OF COMMERCE, AL
GREATER VALLEY AREA CHAMBER OF COMMERCE, AL
GREENVILLE AREA CHAMBER OF COMMERCE, AL
GULF COUNTY BOARD OF COUNTY COMMISSIONERS, FL
GULF COUNTY FLORIDA CHAMBER OF COMMERCE
GWINNETT CHAMBER OF COMMERCE, GA
GWINNETT COUNTY COMMISSION, GA
GWINNETT COUNTY BOARD OF COMMISSIONERS, GA
GWINNETT COUNTY DEPARTMENT OF PUBLIC UTILITIES, GA
GWINNETT COUNTY DEPARTMENT OF WATER RESOURCES, GA
GWINNETT COUNTY PLANNING & DEVELOPMENT, GA
GWINNETT COUNTY PUBLIC UTILITIES, GA
GWINNETT COUNTY WATER SYSTEM, GA
HALEYVILLE AREA CHAMBER OF COMMERCE, AL
HALL COUNTY BOARD OF COMMISSIONERS, GA
HAMILTON AREA CHAMBER OF COMMERCE, AL
HARALSON COUNTY, GA
HEADLAND CHAMBER OF COMMERCE, AL
HENRY COUNTY BOARD OF COMMISSIONERS, GA
HISTORIC CHATTAHOOCHEE COMMISSION, EUFAULA, AL
HOMEWOOD CHAMBER OF COMMERCE, AL
HOOVER CHAMBER OF COMMERCE, AL
HOUSTON COUNTY COMMISSION, AL
HOUSTON COUNTY PORT AUTHORITY, AL
HUEYTOWN AREA CHAMBER OF COMMERCE, AL
INDIAN SPRINGS VILLAGE, AL
JACKSON CHAMBER OF COMMERCE, FL
JACKSON COUNTY BOARD OF COUNTY COMMISSIONERS, CHAIRMAN, FL
JACKSON COUNTY CHAMBER OF COMMERCE, FL
JACKSON COUNTY COMMUNITY DEVELOPMENT, FL
JEFFERSON COUNTY COMMISSION, AL
KEEP DEKALB BEAUTIFUL, GA
LAGRANGE CHAMBER OF COMMERCE, GA
LAKE GUNTERSVILLE CHAMBER OF COMMERCE, AL
LEE COUNTY COMMISSIONERS-CHAIRMAN, AL
LEE-RUSSELL COUNCIL OF GOVERNMENTS, AL
LIBERTY COUNTY, FL
LIBERTY COUNTY BOARD OF COUNTY COMMISSIONERS, FL
LIBERTY COUNTY CHAMBER OF COMMERCE, FL
LOWER CHATTAHOOCHEE RDC, GA
LOWNDES COUNTY COMMISSION, GA
LOWNDES COUNTY ROAD DEPARTMENT, GA
LUMPKIN COUNTY, GA
LUMPKIN COUNTY BOARD OF COMMISIONERS, GA
MARIETTA BOARD OF LIGHTS & WATER, GA
MARINE FISHERIES COMMISSION
MCINTOSH TRAIL REGIONAL DEVELOPMENT CENTER, GA
MERIWETHER COUNTY, GA
METRO ATLANTA CHAMBER OF COMMERCE, GA
METROPOLITAN NORTH GEORGIA WATER PLANNING DISTRICT
MIDDLE FLINT REGIONAL DEVELOPMENT CENTER, GA
MIDDLE GEORGIA WATER SYSTEMS, INC.

MILLPORT AREA CHAMBER OF COMMERCE, AL
MITCHELL COUNTY COMMISSION, GA
MOBILE AREA CHAMBER OF COMMERCE, AL
MOBILE AREA WATER AND SEWER SYSTEM, AL
MOBILE COUNTY BUILDING INSPECT., AL
MOBILE COUNTY ENGINEERING DEPT., AL
MOBILE COUNTY PLANNING, AL
MOBILE COUNTY WILDLIFE & CONSRV., GA
MONROE COUNTY COMMISSION, FL
MONROEVILLE AREA CHAMBER OF COMMERCE, AL
MONTGOMERY AREA CHAMBER OF COMMERCE, AL
MONTGOMERY COUNTY COMMISSION, AL
MONTGOMERY WATER WORKS & SEWER BOARD, AL
MURRAY COUNTY COMMISSIONER'S OFFICE, GA
NEWPORT NEWS WATERWORKS, VA
NORTH GA REGIONAL DEVELOPMENT CENTER
NORTHWEST ALABAMA CLG
NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
OPELIKA CHAMBER OF COMMERCE, AL
OPELIKA WATER WORKS BOARD, AL
OPP & COVINGTON COUNTY AREA CHAMBER OF COMMERCE, AL
ORANGE BEACH WATER AUTHORITY, AL
OZARK AREA CHAMBER OF COMMERCE, AR
PAULDING COUNTY WATER AUTHORITY, GA
PERRY COUNTY COMMISSION, AL
PHENIX CITY UTILITIES, AL
PIKE COUNTY COMMISSION, GA
PRATTVILLE AREA CHAMBER OF COMMERCE, AL
RAINSVILLE CHAMBER OF COMMERCE, AL
RANDOLPH COUNTY CHAMBER OF COMMERCE, AL
RANDOLPH COUNTY COMMISSION, AL
REFORM AREA CHAMBER OF COMMERCE, AL
REGIONAL DEVELOPMENT CENTER
ROCKDALE COUNTY, GA
ROCKDALE COUNTY COMMISSION, GA
ROCKDALE COUNTY-PUB. SVS./ENGINEERING, GA
ROME CHAMBER OF COMMERCE, GA
ROME/FLOYD PARKS & RECREATION DEPARTMENT, GA
ROSWELL CITY COUNCIL, GA
RUSSELL COUNTY COMMISSION, AL
SW GEORGIA RDC
SCOTTSBORO-JACKSON COUNTY CHAMBER OF COMMERCE, AL
SELMA-DALLAS COUNTY CHAMBER OF COMMERCE, AL
SHELBY COUNTY COMMISSION, AL
SHOALS CHAMBER OF COMMERCE, AL
SO MS PLANNING & DEVELOPMENT DISTRICT, MS
SOUTH ALABAMA REGIONAL PLANNING COMMISSION
SOUTH BALDWIN CHAMBER OF COMMERCE, AL
SOUTH CENTRAL ALABAMA DEVELOPMENT COMMISSION
SOUTH SHELBY CHAMBER OF COMMERCE, AL
SOUTHWEST GEORGIA REGIONAL DEVELOPMENT COMMISSION
SOWEGA REGIONAL DEVELOPMENT CENTER, GA
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, FL
STEWART COUNTY COMMISSION, GA
SUWANNEE RIVER WATER MANAGEMENT DISTRICT, FL
SW GEORGIA REGIONAL DEVELOPMENT CENTER
SYLACAUGA CHAMBER OF COMMERCE, AL
TALLADEGA WATER AND SEWER, AL
TALLAPOOSA COUNTY COMMISSION, AL
TCPR
THOMASVILLE CHAMBER OF COMMERCE, AL
TOWN OF ARGO, AL
TOWN OF ASHVILLE, AL
TOWN OF AUTAUGAVILLE, AL
TOWN OF AVON, AL
TOWN OF BILLINGSLEY, AL
TOWN OF BLUE SPRINGS, AL
TOWN OF BUTLER, AL
TOWN OF CALERA, AL

TOWN OF CLAYTON, AL
TOWN OF CLIO, AL
TOWN OF COFFEEVILLE, AL
TOWN OF COLLINSVILLE, AL
TOWN OF COLUMBIA, AL
TOWN OF COLUMBIANA, AL
TOWN OF COTTONWOOD, AL
TOWN OF COWARTS, AL
TOWN OF CROSSVILLE, AL
TOWN OF DAUPHIN ISLAND, AL
TOWN OF ECLECTIC, AL
TOWN OF EDWARDSVILLE, AL
TOWN OF EXCEL, AL
TOWN OF FAUNSDALE, AL
TOWN OF FIVE POINTS, AL
TOWN OF FORT DEPOSIT, AL
TOWN OF FRANKLIN, AL
TOWN OF FULTON, AL
TOWN OF GEORGETOWN, GA
TOWN OF GERALDINE, AL
TOWN OF GOLDVILLE, AL
TOWN OF GORDON, AL
TOWN OF GROVE HILL, AL
TOWN OF HALEBURG, AL
TOWN OF HAMMONDVILLE, AL
TOWN OF HARPERSVILLE, AL
TOWN OF HAVANA, FL
TOWN OF HENAGAR, AL
TOWN OF HURTSBORO, AL
TOWN OF IDER, AL
TOWN OF INDIAN SPRINGS, AL
TOWN OF JACKSON'S GAP, AL
TOWN OF KINSEY, AL
TOWN OF LOACHAPOKA, AL
TOWN OF LOUISVILLE, AL
TOWN OF MADRID, AL
TOWN OF MARGARET AL
TOWN OF MCKENZIE, AL
TOWN OF MENTONE, AL
TOWN OF MIDWAY, AL
TOWN OF MILLBROOK, AL
TOWN OF MILLPORT, AL
TOWN OF MOSSES, AL
TOWN OF MOUNTAINBORO, AL
TOWN OF NEWVILLE, AL
TOWN OF ODENVILLE, AL
TOWN OF OHATCHEE, AL
TOWN OF ORRVILLE, AL
TOWN OF PINE APPLE, AL
TOWN OF PINE HILL, AL
TOWN OF PINE RIDGE, AL
TOWN OF POWELL, AL
TOWN OF PROVIDENCE, GA
TOWN OF RANBURNE, AL
TOWN OF REECE CITY, AL
TOWN OF RIVERSIDE, AL
TOWN OF SAND ROCK, AL
TOWN OF SARDIS CITY, AL
TOWN OF SHILOH, GA
TOWN OF SHORTER, AL
TOWN OF SPRINGVILLE, AL
TOWN OF SWEET WATER, AL
TOWN OF TAYLOR, AL
TOWN OF THOMASTON, AL
TOWN OF THORSBY, AL
TOWN OF TURIN, GA
TOWN OF TYRONE, GA
TOWN OF VALLEY HEAD, AL
TOWN OF VINCENT, AL
TOWN OF VREDENBURGH, AL
TOWN OF WALDO, AL
TOWN OF WEAVER, AL
TOWN OF WEBB, AL
TOWN OF WEDOWEE, AL
TOWN OF WHITE HALL, AL
TOWN OF WILSONVILLE, AL
TOWN OF WILTON, AL
TOWN OF WOODLAND, AL
TOWN OF YELLOW BLUFF, AL
TRI RIVERS & JACKSON COUNTY COMMISSION, FL
TROUP COUNTY, GA
TROUP COUNTY BOARD OF COMMISSIONERS, GA
TROUP COUNTY PARKS & REC, GA
TRUSSVILLE AREA CHAMBER OF COMMERCE, AL
UNIFIED GOVERNMENT CUSSETA-CHATTACHOOCHEE COUNTY, GA
UTILITIES BOARD OF TUSKEGEE, AL
UTILITIES, CITY OF LA GRANGE, GA
VERNON CHAMBER OF COMMERCE, AL
WALTON COUNTY BOARD OF COMMISSIONERS, GA
WALTON COUNTY WATER AND SEWERAGE AUTHORITY, GA
WATER PLANT CITY OF CALHOUN, GA
WEWAHITCHKA & APALACHICOLA CITY ATTORNEY, FL
WILCOX COUNTY COMMISSION, AL

10.4 Native American Tribes

ABSENTEE-SHAWNEE TRIBE OF OKLAHOMA
ALABAMA-COUSHATTA TRIBE OF TEXAS
ALABAMA-QUASSARTE TRIBAL TOWN OF THE CREEK NATION OF OKLAHOMA
CHEROKEE NATION
CHEROKEE NATION OF OKLAHOMA
CHOCTAW NATION OF OKLAHOMA
COUSHATTA TRIBE OF LOUISIANA
EASTERN BAND OF THE CHEROKEE NATION
EASTERN SHAWNEE TRIBE OF OKLAHOMA
JENA BAND OF CHOCTAW INDIANS
KIALEGEE TRIBAL TOWN OF THE CREEK NATION OF OKLAHOMA
MICCOSUKEE TRIBE OF FLORIDA
MISSISSIPPI BAND OF CHOCTAW INDIANS
MUSCOGEE (CREEK) NATION OF OKLAHOMA
POARCH BAND OF CREEK INDIANS
SEMINOLE NATION OF OKLAHOMA
SEMINOLE TRIBE OF FLORIDA
SEMINOLE TRIBE OF OKLAHOMA
SHAWNEE TRIBE
THE CHICKASAW NATION
THLOPTHLOCCO TRIBAL TOWN
TUNICA-BILOXI TRIBE OF LOUISIANA
UNITED KEETOOWAH BAND OF CHEROKEE INDIANS IN OKLAHOMA
UNITED SOUTHERN AND EASTERN TRIBE

10.5 State and Local Elected Officials

ALA ATTORNEY GENERAL
ALABAMA-US CONGRESS, 1ST DISTRICT
ALABAMA-US CONGRESS, 2ND
ALABAMA-US CONGRESS, 3RD
ALABAMA-US CONGRESS, 4TH
ALABAMA-US CONGRESS, 5TH
ALABAMA-US CONGRESS, 6TH
ALABAMA-US CONGRESS, 7TH
ALABAMA-US SENATE
ALABAMA HOUSE OF REPRESENTATIVE
ALABAMA HOUSE OF REPRESENTATIVE, DISTRICT 95
ALABAMA HOUSE OF REPRESENTATIVES, DISTRICT 43
ALABAMA HOUSE OF REPRESENTATIVES, DISTRICT 52
ALABAMA HOUSE OF REPRESENTATIVES, DISTRICT 74
ALABAMA SENATE, DISTRICT 30
ALABAMA STATE HOUSE, DISTRICT 1
ALABAMA STATE HOUSE, DISTRICT 10
ALABAMA STATE HOUSE, DISTRICT 100
ALABAMA STATE HOUSE, DISTRICT 101
ALABAMA STATE HOUSE, DISTRICT 102
ALABAMA STATE HOUSE, DISTRICT 103
ALABAMA STATE HOUSE, DISTRICT 104
ALABAMA STATE HOUSE, DISTRICT 105
ALABAMA STATE HOUSE, DISTRICT 11
ALABAMA STATE HOUSE, DISTRICT 12
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ALABAMA STATE HOUSE, DISTRICT 3
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ALABAMA STATE HOUSE, DISTRICT 4

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ALABAMA STATE HOUSE, DISTRICT 99
ALABAMA STATE SENATE, DISTRICT 1
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ALABAMA STATE SENATE, DISTRICT 4
ALABAMA STATE SENATE, DISTRICT 6
ALABAMA STATE SENATE, DISTRICT 7
ALABAMA STATE SENATE, DISTRICT 8
ALABAMA STATE SENATE, DISTRICT 9
ALABAMA STATE SENATOR, DISTRICT 5
ALABAMA, US SENATE
ALABMA HOUSE OF REPRESENTATIVES, DISTRICT 66
FL-HOUSE
FL-HOUSE DISTRICT 1
FL-HOUSE DISTRICT 10
FL-HOUSE DISTRICT 100
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97 FL-HOUSE DISTRICT 95
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99 FL-HOUSE DISTRICT 97
100 FL-HOUSE DISTRICT 98
101 FL-HOUSE DISTRICT 99
102 FLORIDA-US SENATE

1 FLORIDA-US CONGRESS, 10TH
2 FLORIDA-US CONGRESS, 11TH
3 FLORIDA-US CONGRESS, 12TH
4 FLORIDA-US CONGRESS, 13TH
5 FLORIDA-US CONGRESS, 14TH
6 FLORIDA-US CONGRESS, 15TH
7 FLORIDA-US CONGRESS, 16TH
8 FLORIDA-US CONGRESS, 17TH
9 FLORIDA-US CONGRESS, 18TH
10 FLORIDA-US CONGRESS, 19TH
11 FLORIDA-US CONGRESS, 1ST
12 FLORIDA-US CONGRESS, 20TH
13 FLORIDA-US CONGRESS, 21ST
14 FLORIDA-US CONGRESS, 22ND
15 FLORIDA-US CONGRESS, 23RD
16 FLORIDA-US CONGRESS, 24TH
17 FLORIDA-US CONGRESS, 25TH
18 FLORIDA-US CONGRESS, 2ND
19 FLORIDA-US CONGRESS, 3RD
20 FLORIDA-US CONGRESS, 4TH
21 FLORIDA-US CONGRESS, 5TH
22 FLORIDA-US CONGRESS, 6TH
23 FLORIDA-US CONGRESS, 7TH
24 FLORIDA-US CONGRESS, 8TH
25 FLORIDA-US CONGRESS, 9TH
26 FLORIDA, GOVERNOR
27 FL-SENATE
28 FL-SENATE DISTRICT 1
29 FL-SENATE DISTRICT 10
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33 FL-SENATE DISTRICT 14
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67 GA-STATE SENATE 37
68 GA-STATE SENATE, DISTRICT 31
69 GA-STATE SENATE, DISTRICT 49
70 GA-HOUSE DISTRICT 002
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GEORGIA-US CONGRESS, 11TH
GEORGIA-US CONGRESS, 12TH
GEORGIA-US CONGRESS, 13TH
GEORGIA-US CONGRESS, 1ST
GEORGIA-US CONGRESS, 3RD
GEORGIA-US CONGRESS, 5TH
GEORGIA-US CONGRESS, 8TH
GEORGIA-US CONGRESS, 9TH
GEORGIA-U.S. CONGRESS, 2ND
GEORGIA-U.S. CONGRESS, 7TH
GEORGIA-U.S. CONGRESS, 9TH
GEORGIA-US SENATE
GEORGIA HOUSE OF REPRESENTATIVES, DISTRICT 73
GEORGIA STATE REPRESENTATIVE, DISTRICT 26
GEORGIA STATE REPRESENTATIVE, DISTRICT 69
GEORGIA STATE SENATE 1
GEORGIA STATE SENATE 10
GEORGIA STATE SENATE 11
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GEORGIA STATE SENATE 8
GEORGIA STATE SENATE 9
MAYOR, ALBANY, GA
MAYOR, ALPHARETTA, GA

1 MAYOR, ALEXANDER CITY, AL
2 MAYOR, ALTHA, FL
3 MAYOR AMERICUS, GA
4 MAYOR, APALACHICOLA, FL
5 MAYOR, ARABI, GA
6 MAYOR, ARLINGTON, GA
7 MAYOR, AUBURN, GA
8 MAYOR, AVONDALE ESTATES, GA
9 MAYOR, BACONTON, GA
10 MAYOR, BAINBRIDGE, GA
11 MAYOR, BALDWIN, GA
12 MAYOR, BASCOM, FL
13 MAYOR, BARNESVILLE, GA
14 MAYOR, BERKELEY LAKE, GA
15 MAYOR, BLAKELY, GA
16 MAYOR, BLUFFTON, GA
17 MAYOR, BOGALUSA, LA
18 MAYOR, BRASELTON, GA
19 MAYOR, BREMEN, GA
20 MAYOR, BRINSON, GA
21 MAYOR, BRONWOOD, GA
22 MAYOR, BROOKS, GA
23 MAYOR, BUENA VISTA, GA
24 MAYOR, BUTLER, GA
25 MAYOR, BYROMVILLE, GA
26 MAYOR, BYRON, GA
27 MAYOR, CAIRO, GA
28 MAYOR, CARRABELLE, FL
29 MAYOR, CARTERSVILLE
30 MAYOR, CHAMBLEE
31 MAYOR, CLARKESVILLE, GA
32 MAYOR, COLLEGE PARK, GA
33 MAYOR, CONCORD, GA
34 MAYOR, COTTONDALE, FL
35 MAYOR, CUMMING, GA
36 MAYOR, CUTHBERT, GA
37 MAYOR, DAMASCUS, GA
38 MAYOR, DECATUR, GA
39 MAYOR, DEMOREST, GA
40 MAYOR, DONALSONVILLE, GA
41 MAYOR, DORAVILLE
42 MAYOR, DOTHAN, AL
43 MAYOR, DOUGLASVILLE, GA
44 MAYOR, EDISON, GA
45 MAYOR, ELLAVILLE, GA
46 MAYOR, FAIRBURN, GA
47 MAYOR, FOREST PARK, GA
48 MAYOR, FORT GAINES, GA
49 MAYOR, GAINESVILLE, GA
50 MAYOR, GAY, GA
51 MAYOR, GRACEVILLE, FL
52 MAYOR, GRANTVILLE, GA
53 MAYOR, GREENSBORO, FL
54 MAYOR, GREENVILLE, GA
55 MAYOR, GRETNA, FL
56 MAYOR, HAMILTON, GA
57 MAYOR, HAPEVILLE, GA
58 MAYOR, HELEN, GA
59 MAYOR, HOGANSVILLE, GA
60 MAYOR, IDEAL, GA
61 MAYOR, IRON CITY, GA
62 MAYOR, JONESBORO, GA
63 MAYOR, JUNCTION CITY, GA
64 MAYOR, LAFAYETTE, AL
65 MAYOR, LAKE CITY, GA
66 MAYOR, LEESBURG, GA
67 MAYOR, LITHONIA, GA
68 MAYOR, LOGANVILLE, GA
69 MAYOR, MANCHESTER, GA
70 MAYOR, MARSHALLVILLE, GA
71 MAYOR, MEANSVILLE, GA
72 MAYOR, MIDWAY, FL
73 MAYOR, MONTEZUMA, GA
74 MAYOR, MORELAND, GA
75 MAYOR, MORGAN, GA
76 MAYOR, NEWTON, GA
77 MAYOR, MORROW, GA
78 MAYOR, OGLETHORPE, GA
79 MAYOR, OPELIKA, AL
80 MAYOR, ORANGE BEACH, AL
81 MAYOR, ORCHARD HILL, GA
82 MAYOR, PALMETTO, GA
83 MAYOR, PARROTT, GA
84 MAYOR, PEACHTREE CITY, GA
85 MAYOR, PELHAM, GA
86 MAYOR, PERRY, GA
87 MAYOR, PHENIX CITY, AL
88 MAYOR, PINEHURST, GA
89 MAYOR, PLAINS, GA
90 MAYOR, POULAN, GA
91 MAYOR, POWDER SPRINGS, GA
92 MAYOR, PRESTON, GA
93 MAYOR, QUINCY, FL
94 MAYOR, REYNOLDS, GA
95 MAYOR, ROBERTA, GA
96 MAYOR, ROOPVILLE, GA
97 MAYOR, ROSWELL, GA
98 MAYOR, SALE CITY, GA
99 MAYOR, SASSER, GA
100 MAYOR, SENOIA, GA
101 MAYOR, SHILOH, GA
102 MAYOR, SMITHVILLE, GA

MAYOR, STONE MOUNTAIN, GA
MAYOR, SUMMERVILLE, GA
MAYOR, SUMNER, GA
MAYOR, SUWANEE, GA
MAYOR, TALBOTTON, GA
MAYOR, TOCCOA, GA
MAYOR, UNADILLA, GA
MAYOR, UNION CITY, GA
MAYOR, VIENNA, GA
MAYOR, VILLA RICA, GA
MAYOR, WEST POINT, GA
MAYOR, WEWAHITCHKA, FL
MAYOR, WHIGHAM, GA
MAYOR, WOODLAND, GA

10.6 Academic Institutions

A.L. BURRUSS INSTITUTE FOR PUBLIC SERVICE
ALABAMA SOUTHERN COMM. COLLEGE
ALBANY STATE UNIVERSITY
ANDREW COLLEGE
ATHENS STATE COLLEGE
AUBURN MARINE EXTENSION & RESEARCH CENTER
AUBURN UNIVERSITY
AYERS STATE TECHNICAL COLLEGE
BESSEMER STATE TECHNICAL COLLEGE
BEVILL STATE COMMUNITY COLLEGE
BIRMINGHAM-SOUTHERN COLLEGE
BURRUSS INSTITUTE OF PUBLIC SERVICE
CALHOUN COMMUNITY COLLEGE
CENTRAL ALABAMA COMMUNITY COLLEGE
CHATTAHOOCHEE VALLEY COMMUNITY COLLEGE
CHIPOLA COLLEGE
CLARK ATLANTA UNIVSERSITY
CLEMSON
COASTAL PLAINS INSTITUTE
COLORADO STATE UNIVERSITY
COLUMBUS COLLEGE
COLUMBUS STATE UNIVERSITY
DAUPHIN ISLAND SEA LAB
DRAKE STATE TECHNICAL COLLEGE
EASTERN CONNECTICUT STATE UNIVERSITY
EMORY UNIVERSITY
EMORY UNIVERSITY-SCHOOL OF LAW
ENTERPRISE-OZARK COMMUNITY COLLEGE
FAULKNER STATE COMMUNITY COLLEGE
FISHERIES & ALLIED AQUACULTURE
FLORIDA A&M UNIV.-FLORIDA STATE UNIV.
FLORIDA STATE UNIVERSITY
FORT VALLEY STATE UNIVERSITY
FRANKLIN UFIFAS EXTENSION
GA SOUTHWESTERN STATE UNIVERSITY
GADSDEN STATE COMMUNITY COLLEGE
GAINESVILLE JUNIOR COLLEGE
GAINESVILLE STATE COLLEGE
GEORGIA INSTITUTE OF TECHNOLOGY
GEORGIA STATE UNIVERSITY
GULF COAST COMMUNITY COLLEGE
ICAD, OLD COLLEGE
ICAD-UGA
INSTITUTE OF ECOLOGY
INTERDENOMINATIONAL THEOLOGICAL CENTER
JACKSONVILLE STATE UNIVERSITY
JEFFERSON STATE COMMUNITY COLLEGE
KENNESAW STATE
LAGRANGE COLLEGE
LAWSON STATE COMMUNITY COLLEGE
LEVIN COLLEGE OF LAW
LURLEEN B WALLACE JUNIOR COLLEGE
MACARTHUR STATE TECHNICAL COLLEGE
MACLAY SCHOOL
MOREHOUSE COLLEGE
MORRIS BROWN
NATIONAL BIOLOGICAL SURVEY-ALA COOP FISH & WILDLIFE RESOURCE
NORTHEAST ALABAMA COMMUNITY COLLEGE
NORTHWESTERN UNIVERSITY
NORTHWEST-SHOALS COMMUNITY COLLEGE
OREGON STATE UNIVERSITY
PATTERSON STATE TECHNICAL COLLEGE
PIEDMONT COLLEGE
POPE HIGH SCHOOL

REID STATE TECHNICAL COLLEGE
SHELTON STATE COMMUNITY COLLEGE
SOUTHERN UNION STATE COMMUNITY COLLEGE
SPARKS STATE TECHNICAL COLLEGE
SPELMAN COLLEGE
TALL TIMBERS RESEARCH
TROY STATE UNIVERSITY
UNIVERISTY OF FLORIDA
UNIVERSITY OF ALABAMA
UNIVERSITY OF ALABAMA LAW SCHOOL
UNIVERSITY OF ALABAMA, HUNTSVILLE
UNIVERSITY OF ARIZONA
UNIVERSITY OF FLORIDA
UNIVERSITY OF GEORIGA
UNIVERSITY OF MICHIGAN
UNIVERSITY OF MONTEVALLO
UNIVERSITY OF SOUTH ALABAMA
UNIVERSITY OF SOUTHERN FLORIDA
UNIVERSITY OF TEXAS AT AUSTIN
UNIVERSITY OF WASHINGTON
UNIVERSITY OF WEST GEORGIA
VALDOSTA STATE UNIVERSITY
YALE UNIVERSITY
WALLACE STATE COMMUNITY COLLEGE
WEST GA TECH

10.7 Other Organizations

100 BLACK MEN OF WEST GEORGIA
ACEC/AL
ACES
ADDSCO INDUSTRIES
ADVISORY COUNCIL ON HISTORIC PRESERVATION
AECOM
AESO SYSTEMS, INC.
AGRICULTURAL SERVICES OF ALABAMA, INC.
AJK LLC.
AL RIVERS ALLIANCE
ALA ELECTRIC COOPERATIVE, INC.
ALABAMA ASSOCIATION OF CONSERVATION DISTRICTS
ALABAMA BASS FEDERATION
ALABAMA CATFISH PRODUCERS
ALABAMA CATTLEMEN'S ASSOCIATION
ALABAMA CHEMICAL ASSOCIATION
ALABAMA COAL ASSOCIATION
ALABAMA COASTAL FOUNDATION
ALABAMA CROP IMPROVEMENT ASSO., INC.
ALABAMA ELECTRIC COOPERATIVE, INC
ALABAMA FARMERS COOPERATIVE, INC.
ALABAMA FARMERS FEDERATION
ALABAMA FOREST RESOURCES CENTER
ALABAMA FORESTRY ASSOCIATION
ALABAMA KRAFT CO.
ALABAMA LEAGUE OF MUNICIPALITIES
ALABAMA MOUNTAIN LAKES ASSOCIATION
ALABAMA MUNICIPAL ELECTRIC AUTHORITY
ALABAMA NURSERYMEN'S ASSOCIATION
ALABAMA PEANUT PRODUCERS ASSOCIATION
ALABAMA PETROLEUM COUNCIL
ALABAMA PORK PRODUCERS ASSOCIATION
ALABAMA POULTRY & EGG ASSOCIATION
ALABAMA POWER COMPANY
ALABAMA POWER FOUNDATION
ALABAMA RIVER ALLIANCE
ALABAMA RIVER COMPANIES
ALABAMA RIVER NEWSPRINT COMPANY
ALABAMA RIVER PULP
ALABAMA RIVERS ALLIANCE
ALABAMA RURAL ELECTRIC ASSOCIATION
ALABAMA SIERRA CLUB
ALABAMA SURFACE MINING COMMISSION
ALABAMA WATER & SEWER INSTITUTE, INC.
ALABAMA WATER WATCH PROGRAM COORDINATOR
ALABAMA WILDLIFE FEDERATION
ALBANY BRANCH NAACP
ALEXANDER CITY OUTLOOK
ALFA
ALL SOUTH MACHINE & SUPPLY CO., INC.
ALLATOONA LAKE ASSOCIATION
ALSTON & BIRD
ALUMINUM CO. OF AMERICA
AMAYSINC SERVICES

AMEC
AMERICAN COMM. BARGE LINE CO.
AMERICAN RIVERS ASSOCIATION
AMERICAN SAND & GRAVEL COMPANY
AMERICAN WATER WORKS ASSOCIATION
AMSOUTH BANK NA
ANALYTICAL GROUP
ANDRIE, INC.
ANHEUSER-BUSCH, INC.
APALACHEE AUDUBON SOCIETY
APALACHICOLA BAY CHAMBER
APALACHICOLA BAY OYSTER FARMERS ASSOCIATION
APALACHICOLA MARITIME MUSEUM
APALACHICOLA OYSTER DEALERS ASSOCIATION
APALACHICOLA RIVERKEEPERS
APALACHICOLA TIMES
APPALACHIAN REGIONAL COMMISION
AQUALAND MARINE
ARCO OIL & GAS
ASH REALTY
ASR SYSTEMS
ASSOCIATION OF COUNTY COMMISSIONS
ASSOCIATION OF COUNTY COMMISSIONERS
ATLANTA GAS LIGHT COMPANY
ATLANTA INBOARD
ATLANTA JUNIOR ROWING ASSOCIATION
ATLANTA REGIONAL COMMISSION
ATLANTIC MARINE
ATLANTA ROWING CLUB
ATLAS SOUTHERN CORP. & TRI RIVERS
AUDUBON SOCIETY
BALCH & BINGHAM
BALD RIDGE MARINA
BAREFOOT SAILING CLUB/LAKE LANIER
BARRY A VITTOR & ASSOC.
BATSON-COOK
BAY COUNTY BRANCH NAACP
BEAN DREDGING CORP.
BEEKEEPING / TUPELHONEY
BEN TURNIPSEED ENGINEERS
BENDER SHIPBLDG & REPAIR
BERRY BROTHERS GEN CONTRACTOR
BETBEZE REALTY CO., INC.
BETTER BACKERS, INC.
BIG “K” CLUB
BIG BEND EARTH FIRST
BIG K CLUB-ALDERMAN & GARRISON
BILL HARBERT INT'L CONSTR, INC.
BIRMINGHAM BACKPADDLERS
BOB KERR & ASSOC., LLC
BOH BROTHERS CONSTRUCTION
BOY SCOUTS OF AMERICA, ATLANTA
BOY SCOUTS OF AMERICA, ROME
BOWHEAD
BRADLEY ARANT ROSE & WHITE LLP
BRATS
BROCKINGTON & ASSOCIATES
BROOKWOOD GROUP
BROWN & CALDWELL
BURNS & MCDONNELL
BUSINESS COUNCIL OF ALABAMA
BWSC
CAB INCORPORATED
CAHABA RIVER PUBLISHING, INC.
CAHABA RIVER SOCIETY
CALHOUN-LIBERTY COUNTY BRANCH NAACP
CAMERON POINT PRPOERTY OWNERS ASSOC.
CAR PAINTS, INC.
CARRABELLE CARES
CASTEEL USA, INC.
CATTLEWOMEN'S ASSOCIATION, ALABAMA
CBPG
CDC FEDERAL CREDIT UNION
CDR ASSOCIATES
CELLO FOAM
CENTRAL ATLANTA PROGRAM
CENTRAL ATLANTA PROGRESS
CENTRAL MARINE SERVICES, INC.
CF BEAN DREDGING
CFROC
CG MARINE
CH GUERNSEY & CO.
CH2M HILL
CHAMBERS COUNTY BRANCH NAACP
CHAPMAN CONSULTING, INC.
CHARLES MARINE PRODUCTS
CHAT RIVER INTEREST
CHATTAHOOCHEE CHAPTER TROUTS UNLIMITED
CHATTAHOOCHEE NATURE CENTER
CHATTAHOOCEE RIVER NRA
CHATTAHOOCHEE RIVERKEEPER, INC.
CHATTAHOOCHEE RIVERWARDEN

CHATTAHOOCHEE-FLINT RDC
CHATTOOGA CONSERVANCY
CHEROKEE FLOATING DOCKS
CHILDRESS TOWING
CHIPOLA BASIN FOUNDATION PROTECTION GRP
CHOCTAWHATCHEE, PEA, AND YELLOW RIVERS WATERSHED MANAGEMENT AUTHORITY
CIRCLE OF BLUE
CITIZENS FOR THE FUTURE OF BALDWIN
CIVIC ASSOCIATIES-FORT MORGAN
CIVIL ENGINEERING CONSULTANTS
CLEAN & BEAUTIFUL COORDINATOR
CLEAN COMMUNITY COORDINATOR
COALBED METHANE ASSOCIATION OF ALABAMA
COAST TO COAST COATINGS, INC.
COASTAL MOBILE REFINING CO.
COBB COUNTY WATER SYSTEM
COHUTTA BANKING CO.
COLDWELL BANKER
COLQUITT COUNTY BRANCH NAACP
COLUMBUS BANK & TRUST
COLUMBUS NAACP
COLUMBUS WATER WORKS
CONASAUGA BASS CLUB
CONFEDERATE BASS BUSTERS CLUB
CONTRACT ADMINISTRATION
COOP. TECHNOLOGIES & SERV., INC.
COOSA BASIN WATER GROUP
COOSA RIVER BASIN INITIATIVE
COOSA VALLEY STEEL
COOSA VALLEY TROUT UNLIMITED
COOSA-ALABAMA RIVER IMPROVEMENT ASSOCIATION
CORDELE-CRISP BRANCH NAACP
COUNCIL FOR QUALITY GROWTH
COURTNEY & MORRIS APPRAISALS
CREATIVE LOAFING
CRISP COUNTY POWER COMMISSION
CUMMINGS & WHITE-SPUNNER, INC.
CUSHING PARK
DAILY TIMES LEADER
DAMAYAN WATER PROJECT
DAMES & MOORE
DANGLER REAL ESTATE SERVICE
DANIEL REALTY
DAVID H. MELVIN CONSULTING ENGINEERS
DCA
DELLINGER MANAGEMENT CO., INC.
DEMPSEY, CARSON & STEED, P.C.
DENMAN'S COVE SUBDIVISION
DEP-CAMA
DEV. AUTH. BAINBRIDGE
DH&A
DIXIE SAILING CLUB
DMD
DOBBS REALTY
DOLLAR FARM PRODUCTS
DOOLY COUNTY BRANCH
DOTHAN BASS MASTERS
DOTHAN WIREGRASS BRANCH NAACP
DOWLING ENVIRONMENTAL, INC.
DRAVO BASIC MATERIAL COMPANY, INC.
DRAVO NATURAL RESOURCES
DREDGE & MARINE CORP.
DRI/MCGRAW-HILL
DRUMMOND COMPANY, INC.
DUKE REALTY
DUNBARTON CORPORATION
DUNWOODY NATURE CENTER
DYNAMAC CORPORATION
EARTH BOUND
EARTH JUSTICE LEGAL DEFENSE FUND
EAST ALABAMA FISH FARMERS ASSOCIATION
EASTERN SHORE COURIER
EASTERN TECHNOLOGIES, INC.
ECOLOGICAL STRATEGY
EDGEWATER MARINE CONSTRUCTION
EMERALD PROPERTY OWNERS ASSOCIATION
EMERY & GARRETT GROUNDWATER, INC.
EMPLOYMENT COST INDEX PROGRAMS
ENGINEERING CONCEPTS
ENGINEERING MANAGEMENT
ENGLEHARD CORPORATION
ENTERGY SERVICES, INC.
ENTERPRISE MARINE SERVICES, INC.
ENTRIX
ENVIRONMENTAL COALITION OF CONCERNED CITIZENS
ENVIRONMENTAL GUIDANCE CORP.
ENVIRONMENTAL LICENSING ENG
ENVIRONMENTAL MANAGEMENT DEPARTMENT
ENVIRONMENTAL RESEARCH FOUNDATION

ERNEST CONSTRUCTION COMPANY
EPISCOPAL LODGE
ESSENTIAL SKILLS
ETOWAH YACHT CLUB
EUFAULA AGENCY, INC.
EUFAULA BRANCH NAACP
EUFAULA MANUFACTURING CO.
EWING IRRIGATION
EXECUTIVE ASSISTANT AND CUSTOMER RELATIONS MANAGER
FM WESTON AUDUBON SOCIETY
F&W CONSTRUCTION COMPANY
F/V MARGARITAS, INC.
FARLEY NUCLEAR PLANT
FARM MANAGERS & RURAL APPRAISERS
FARMERS FERTILIZER CO.
FARNER BARLEY AND ASSOCIATION
FAYETTE COUNTY BRANCH NAACP
FCTDC / ABAY CHAMBER
FIDELITY NATIONAL BANK
FIRST ALABAMA BANK
FIRST NATIONAL BANKING CO.
FISH AND WILDLIFE RESEARCH INSTITUTE
FL COASTAL & OCEAN COALITION
FLINT RIVER MILLS, INC.
FLORIDA CHAPTER SIERRA CLUB
FLORIDA DEFENDERS OF THE ENVIRONMENT
FLORIDA FORESTRY ASSOCIATION
FLORIDA PANHANDLE CANOE AND KAYAK CONNECTION
FLORIDA ROCK INDUSTRIES
FLORIDA SEAFOOD FESTIVAL, INC.
FLORIDA WILDLIFE FEDERATION
FLOYD COUNTY
FOLK CONSTRUCTION COMPANY
FORMEX MANUFACTURING, INC.
FORT VALLEY BRANCH NAACP
FOUR SEASONS ON LANIER
FRANKLIN COUNTY OYSTER & SEAFOOD TASK FORCE
FRANKLIN COUNTY SEAFOOD WORKERS ASSOCIATION
FRIENDS OF LOCUST FORK
FRIENDS OF PERDIDO BAY
FRIENDS OF THE APALACHICOLA NATIONAL FOREST
FRIENDS OF THE EVERGLADES
FULLER & MCKAY PC
FUTREN CORPORATION
GA CTR. FOR LAW IN THE PUBLIC INTEREST
GA WATER PLANNING & POLICY CNTR.
GAINESVILLE MARINA
GAINESVILLE TIMES
GALLET & ASSOCIATES, INC.
GALTS COTTAGE SUBDIVISION
GANNETT FLEMING ENG & ARCHITECTS, PC
GE PLASTICS
GEMINI INTERESTS, INC.
GENERAL ELECTRIC PLASTICS
GEO-MARINE, INC.
GEORGIA ASSOCIATION OF WATER PROFESSIONALS
GEORGIA CANOEING ASSOCATION
GEORGIA CHAMBER OF COMMERCE
GEORGIA CHAPTER OF THE SIERRA CLUB-CONSERVATION
GEORGIA CONSERVANCY
GEORGIA CONSTRUCTION AGGREGATE ASSOCIATION
GEORGIA COUNCIL ON AGING
GEORGIA COUNCIL OF TROUT UNLIMITED
GEORGIA ECONOMIC DEVELOPERS ASSOCIATION
GEORGIA FARM BUREAU
GEORGIA MOUNTAINS REGIONAL DEVELOPMENT CENTER
GEORGIA MUNICIPAL ASSOCIATION
GEORGIA OUTDOORD, INC.
GEORGIA PACIFIC CORPORATION
GEORGIA PEANUT COMMISSION
GEORGIA POULTRY FEDERATION
GEORGIA POWER COMPANY
GEORGIA POWER MARKET EVALUATION
GEORGIA RIVER NETWORK
GEORGIA RESERVOIR COMPANY, LLC
GEORGIA WILDLIFE FEDERATION
GEOSYNTEC CONSULTANTS, INC.
GEWC
GIBBS LANDSCAPE
GIBSON VENTURE
GIRL SCOUTS OF AMERICA, ATLANTA
GLOBAL HYDROLOGY & CLIMATE CENTER
GOLDEN ASSOCIATES
GOLDEN STEVEDORING COMPANY

GOLDEN TRIANGLE RESOURCE CONSERVATION AND DEVELOPMENT COUNCIL
GOLDER ASSOCIATES, INC.
GOODYEAR TIRE & RUBBER CO.
GORDON COUNTY SPORTSMEN
GEORGIA PUBLIC POLICY FOUNDATION (GPPF)
GRANGER INNS, INC.
GREAT LAKES & LAND CO.
GREAT SOUTHERN PAPER
GREENPEACE
GROUP SOLUTIONS
GULF ISLANDS NATIONAL SEASHORES
GULF OF MEXICO FISHERY MANAGEMENT
GULF OF MEXICO PROGRAM
GULF OIL CO. US
GULF POWER CORPORATION
GULF RESTORATION NETWORK
GULF SPECIMEN CO., INC.
GWINNETT WINDSONG SAILING
H H JORDAN CONSTRUCTION CO.
HALL COUNTY, YOUTH TASK FORCE
HAND-ARENDALL-BEDSOLE-GREAVES & JOHNSON
HARBOUR POINT YACHT CLUB
HARDING LAWSON ASSOCIATION
HARRISON BROTHERS DRY DOCK
HEERY ENGINEERING, INC.
HEESE & BUTTERWORTH
HELP SAVE THE APALACHICOLA RIVER GROUP
HENRY COUNTY ALABAMA FARMERS FEDERATION
HIDDEN HARBOR HOA
HIGH POINT, INC.
HIGHLAND MARINA & RESORT
HILLHOUSE LODGE
HISTORIC APALACHICOLA
HISTORICAL CHATTAHOOCHEE COMMISION
HIWASSEE LAND COMPANY
HL STRATEGY
HOGAN LOVELLS
HOGANSVILLE SENIOR CENTER
HOLIDAY MARINA
HOLLAND DIVING SERVICE
HOLLINGER'S ISLAND COMM ASSOC.
HORIZON ENVIRONMENTAL SERVS, INC.
HOUSTON COUNTY ALABAMA FARMERS FEDERATION
HR BLOCK
HYDROLOGICS
IDEAL BASIC INDUSTRIES
INDIAN HILLS NEIGHBORHOOD ASSOCIATION
INDUSTRIAL ECONOMICS, INCORPORATED
INLAND RIVERS, PORTS, AND TERMINALS
INSTITUTE OF COMMUNITY AND AREA DEVELOPMENT
INTERFACE FLOORING SYSTEM
INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS, LOCAL UNION 1205
INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS, LOCAL UNION 1316
INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS, LOCAL UNION 1531
INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS, LOCAL UNION 443
INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS, LOCAL UNION 613
INTERNATIONAL PAPER COMPANY
INTERSTATE COUNCIL ON WATER POLICY
IUOE LOCAL 653
JG CAR WASH
JH MENGE & CO., INC.
JACKSON & CRIDER REALTY
JACKSON BURGIN, INC.
JACKSON COUNTY BRANCH NAACP
JACKSON EMC
JACKSON SAWMILL CO.
JACOBS
JACOBS TECHNOLOGY, INC.
JAMES RIVER CORPORATION
JB DONAGHEY, INC.
JB SYSTEMS
JLO ENTERPRISES & REAL ESTATE
JOE TURNER & ASSOCIATES
JOHN E CHANCE & ASSOC., INC.
JOHN HUNSINGER & COMPANY
JONES ECOLOGICAL RESEARCH CENTER
JORDAN INDUSTRIES, INC.

JORDAN, JONES & GOULDING, INC.
K CLUB
KAZMAREK GEIGER & LASETER LLP
KBR GOVERNMENT INFRASTRUCTURE
KEEP CLAYTON COUNTY BEAUTIFUL
KEEP TROUP BEUTIFUL
KELLER WILLIAMS REALTY
KIMBERLY-CLARKE CORPORATION
KIMBLE'S FOOD BY DESIGN
KING & SPALDING LLP
KINPAK, INC.
KLEINSCHMIDT
KOSTMAYER CONSTRUCTION
KW REALTY
L & A CONTRACTING COMPANY
LAGRANGE DAILY NEWS (LDN)
LAGRANGE MERCHANT ASSOC.
LAGRANGE SIERRA CLUB
LAKE BLACKSHEAR WATERSHED ASSOCIATION
LAKE JORDAN HOME OWNERS AND BOAT OWNERS ASSOCIATION
LAKE LANIER ADVISORY COUNCIL
LAKE LANIER ASSOCIATION (LLA)
LAKE LANIER HOMEOWNERS ASSOCIATION
LAKE LANIER ISLANDS
LAKE LANIER OLYMPIC CENTER
LAKE LANIER PROPERTY ASSOCIATION
LAKE LANIER REGIONAL WATERSHED COMMISSION
LAKE LANIER ROWING CLUB
LAKE LANIER SAILING CLUB
LAKE MITCHELL HOME OWNERS & BOAT OWNERS ASSOCIATION
LAKE REAL ESTATE
LAKE SEMINOLE ASSOCIATION
LAKE WATCH OF LAKE MARTIN
LAKE WEDOWEE PROPERTY OWNERS' ASSOCIATION (LWPOA)
LAKESIDE ON LANIER NEWS
LAND & MARINE CO.
LAND AND WATER MAGAZINE
LANDMARK LANDSCAPES
LANIER CANOE & KAYAK CLUB
LANIER ENVIRONMENTAL CONSULTANTS
LANIER GOVERNANCE COUNCIL
LANIER LUXURY HOMES
LANIER PROPERTY OWNERS' ASSOCIATION
LAY LAKE HOME OWNERS & BOAT OWNERS ASSOCIATION
LAZY DAYS DRY STORAGE-BUFORD
LAZY-DAYS MARINA
LEAGUE OF WOMEN VOTERS
LEAPING SEAFOOD
LEE COUNTY NAACP
LEGAL SERVICES CORPORATION OF AMERICA
LEMPEL & ROBERT
LES HASSEL EXCURSIONS, INC.
LIGHTFOOT, FRANKLIN & WHITE LLC
LIMNO TECH
LOCKHEED AIRCRAFT CORP.
LOGAN MARTIN LAKE ASSOCIATION
LOGISTICS MANAGEMENT INSTITUTE
LORD NELSON CHARTERS
LORIS BRIDGES REALTOR
LOWE ENGINEERS
M & N OF ALABAMA
MACON COUNTY BRANCH NAACP
MACTEC
MAINSTREAM COMMERICIAL DIVERS
MALCOLM PIRNIE, INC.
MANUFACTURE ALABAMA CHEMISTRY COUNCIL
MARINA & DOCK SUPPLY, INC.
MARINA INNOVATIONS
MARION COUNTY BRANCH NAACP
MARITIME ADMINISTRATION
MARKS INSURANCE AGENCY, INC.
MARTIN DOCKS, INC.
MCCONNELL MARINE SERVICE, INC.
MCDERMOTT MARINE CONSTRUCTION
MCHENNA LONG & ALDRIDGE
MCINNIS LLC
MCKENNA, LONG & ALDRIDGE
MCLEOD REAL ESTATE
MCMILLIAN & ASSOCIATES
MEAD COATED BOARD, INC.
MEAD WESTVACO
MEAG POWER (MUNICIPAL ELECTRIC AUTHORITY OF GEORGIA)
MEMORIAL FUNERAL HOME
METRO ATLANTA CHAMBER OF COMMERCE
METRO BUSINESS FORUM
METRO WATER DISTRICT
MEYER REAL ESTATE
MIDDLE CHATTAHOOCHEE WATER COALITION (MCWC)

MIKE DANIEL RECREATION CENTER
MIKE HOOKS, INC.
MILLER BREWING COMPANY
MILLER DIVER, INC.
MILLIKEN & CO.
MINERALS MANAGEMENT SERVICE
MINUTEMEN RECREATION ASSOCIATION
MISSISSIPPI POWER CO.
MITCHELL COUNTY BRANCH NAACP
MITCHELL MARINE, INC.
MOBILE BAY AUDUBON SOCIETY
MOBILE LAND DEVELOPMENT CORPORATION
MOBILE-CHICKASAW PORT FACILITY
MONSANTO CHEMICAL CORPORATION
MOORE'S SEED AND GRAIN FMS, INC.
MOREHEAD MARINE SVC., INC.
MORGAN DREDGING & PILEDRIVNG, INC.
MORRIS TRACTOR CO.
MOTE MARINE LABORATORY
MS GULF FISHING BANK
MSB ANALYTICS, INC.
NATIONAL PARKS & CONSERVATION ASSOC.
NEWTON FLORTIST CLUB
NPDES TRAINING INSTITUTE
OBV, INC.
O'BRIEN & GERE
PEACH COUNTY, WOOLFOLK CITIZEN RESPONSE GROUP
PHENIX CITY BRANCH NAACP
PRECISION PLANNING, INC.
RANDOLPH CUTHBERT BRANCH NAACP
REGIONAL BUSINESS COALITION OF METRO ATLANTA
REGIONS BANK
REMAX RESULTS LAGRANGE
RESOURCE MANAGEMENT ASSOCIATES
RIVER WATCH
ROBINSON BROTHERS GUIDE SERVICE
ROWE REALTY CO., INC.
SANDY SPRING PERIMETER CHAMBER
SAVE WEISS LAKE
SMOKIN FISHERMAN
SOL ENGINEERING, LLC
SOUTHEAST POWER ADMINISTRATION
SOUTHEAST RIVER FORECAST CENTER
SOUTHEASTERN POWER ADMINISTRATION
SOUTHERN ENVIRONMENTAL LAW CENTER
STEWART COUNTY BRANCH NAACP
SUMTER COUNTY BRANCH
SUPERIOR DIVING CO.
SUPPORTERS OF ST. VINCENT NWR
SYNERGY EDUCATION SERVICES
TALBOT COUNTY BRANCH NAACP
TALLAHASSEE DEMOCRAT
THE CONSERVATION FUND
THE COOSA RIVER BASIN INITIATIVE
THE NATURE CONSERVANCY OF ALABAMA
THE PEOPLE'S VOICE WEEKLY NEWS
THE TIMES
UNION FOUNDRY COMPANY
UNITED STEELWORKERS DISTRICT 9 OFFICE
UNITED STEELWORKERS LOCAL 753L
UPPER CHATTAHOOCHEE RIVERKEEPER
URS CORPORATION
VETERINARY RELIEF SERVICES
W.C. BRADLEY FARMS, INC.

10.8 Individuals

Paul Aalderks
Jeanne Abbott
Wayne Abbott
Denise Abruscato
Georgia Ackeman
Joel Ackerman
Ram Acora
Marc Acree
Laura Adams
Norish Adams
Tom Adams
Millard Adcock
Donna Ahlswede
Felter Alderman
Doug Alderson
Stephen Alford
A. Allen
Barbara Allen
Charles Allen
James Allen, Sr.
Charles Amason
Floyd/Frances Amend
Wayne Andelson
Charles Anderson
Elizabeth Anderson
Jerry & Ginger Anderson
Melvin D. Anderson
Kathy Andrews
Orlando Annette
Robert Ansley
David Archer
Charles Atkins
Frank Atkinson

1 Gary Atz
2 Ethyl Ault
3 Dan and Rosemary Autry
4 Anne Avera
5 Martin Avery
6 Ronnie Avery
7 Shelley Avirett
8 Larry Ayers
9 Jack Bagley
10 Elliott Bailey
11 H. Bailey
12 Michael Bailey
13 Sammy Bailey
14 Don Baker
15 Jerry Baker
16 Roger Baker
17 Steve Baker
18 Mark Baldino
19 Charles Ball
20 Donald Bangs
21 Harold Banks
22 Tommy Barbaree
23 P. Barmeyer
24 Douglas BarrJames Barrios
25 David Barry
26 C.A. Baumhauer
27 Mark Beachler
28 Frank Beadle
29 Jim Beard
30 Gary Beck
31 Jackie Bennett
32 Kent Bennett
33 Wayne and Diane Bennett
34 Jane Bentley
35 Vicki Bentley
36 Jack and Barbara Bernzott
37 Roger Bhandari
38 William and Tammy Bilbo
39 John Blackmon
40 Marilyn Blackwell
41 J. Blackwood
42 John Blair
43 Terri Blair
44 Russell Blanks
45 Nathan Boddie
46 B. Boehlert
47 Helen Bohannon
48 Claudette Bolles
49 H.E. Bolton, Jr.
50 Imogene Bontrager
51 Ginger Booton
52 Lee S. Bowers
53 Bob Boyd
54 Peggy Boyston
55 Jamie Bradfield
56 Rachel Bradford
57 Dorothy C. Bradley
58 Vance Braswell
59 Mike Briggs
60 Philip Brive
61 Mills Brock
62 Patrick Brock
63 Terri Brooke
64 Richard Brookfield
65 Jane Browder
66 Bob Brown
67 Jack and Glenda Brown
68 Karol Brown
69 Roger Brown
70 Dennis Bruggeman
71 Raymond Brundage
72 Nancy Brush
73 Eric Bubniak
74 Louise Bullock
75 Bob Bunker
76 Ila Burdette
77 Rufus and Linda Burdette
78 Jane Burel
79 Alvin Burrell
80 Linda and Tom Bushar
81 Liz Butikofer
82 Lee Butts
83 W. M. Cagle, Jr.
84 James Cahillane
85 Angi Cain
86 Pauline N. Cain
87 Dudley Callais
88 Robert Callaway
89 Jack W Campbell
90 P. Grey Cane, Jr.
91 Robert Carlton
92 Gail Carmody
93 Myrtice Carpenter
94 Pat Carver
95 John Casper
96 Debra Castles
97 Bill Caudill
98 Mr. John Cerino
99 Michael Chadwick
100 Wesley Chafin
101 F.C. Chamberlin
102 Clay Champey
103 Bruce Chapman
104 Carol Chapman
105 Tom Chapman
106 Delmar F. Chastain
107 Lucius B. Chastain
108 Patty Chastain
109 Paige Cherney
110 Tom Child
111 Sue Chisholm
112 Debbie Chrisenberry
113 Jon and Alice Christenson
114 Sheila and Fred Clause
115 Noreen Clough
116 Steve Cole
117 Kim Collicott
118 Eddy Collier
119 John P. Collins
120 Rosemary Colvin
121 Frank Concort
122 Ron Condon
123 Adam Connell
124 M. Conner
125 Monty Conner
126 Keith Cook
127 Marion Cook
128 Walter M Cook, Jr.
129 Leslie Coon
130 Bob Cooper
131 Bud Copeland
132 Erica Copeland
133 Jim and Teri Coryell
134 Patty and Greg Cosnotti
135 Bill Couch
136 Richard Court
137 Ann Cowles
138 Buddy Cox
139 C.J. Cox
140 J. Carlyle Cox
141 Lesley Cox
142 Lesley Cox
143 Daniel H. Cox, P.A.
144 Karen Cox-Dennis
145 Steve Craig
146 Kyle Crawford
147 Mike Criddle
148 Mark Crisp
149 Gregory Crosby
150 Leroy Crosby
151 John Crossman
152 Louis Cue
153 Joe Cumbie

1 Antoinette Cummings
2 William Cunningham
3 Bradley Currey
4 Dr. Fred Cushing
5 Jeff Daigrepont
6 John Danford
7 Tom Daniel
8 Alton Daniel Estate
9 A.E. Daniel III
10 Larry Daniel
11 T.V. Davenport
12 Don L. Davis
13 Ed Davis
14 John D Davis
15 Kay T. Davis
16 Kenneth Davis
17 Andrew Davrik
18 Billy Deal
19 Lee Dehihns
20 Donald Denney
21 John Depalma
22 Harvey Devane
23 Rob Diaz de Villegas
24 R.O. Dice
25 George Dixon
26 Scott Dixon
27 James Dodd
28 Charles Dodgen
29 Jon Dodson
30 Jimmy Doerr
31 Michael E Dombrowski
32 Amy Dove
33 Jean Downing
34 Richard T Dozier
35 Gail Driggle
36 Jamie Driggle
37 William Droze
38 Judy Dube
39 Victor Dube
40 Kip Duchon
41 Tim Duffey
42 Brenda Duggan
43 Jim Duggan
44 Jack Duncan
45 Carol Dunwoody
46 Darrell Durham
47 Mary Ann Durrer
48 Dae Dussway
49 Gene Dussway
50 Pam Eastman
51 Lee and Jean Edwards
52 Peter Edwards
53 Wanda Edwards
54 George K. Elbrecht
55 Judy Ellis
56 Robert Ellis
57 Kris Ellrich
58 Patricia Elton
59 Bill England
60 Arthur Evans
61 Bonnie Evans
62 Jeffery L. Evans
63 Tim Evans
64 Pamela Everett
65 Tom Ewert
66 Eugenia Fagan
67 Beth Farber
68 Kevin Farrell
69 Angelique Feathers
70 Carol Ferguson
71 Jack P. Ferguson
72 Susan Ficklen
73 Ken Fields
74 Bill Finch
75 Dennis Fineout
76 Mary Beth Fineout
77 David Fischer
78 Nancy Fisher
79 Steve and Nancy Fisher
80 Linda Fitzhugh
81 Mr. & Mrs Jerry Fitzpatrick
82 Debbie Flowers
83 Donald and Jeanette Flynn
84 Mike Fogg
85 Vince Foody
86 Dan Forrest
87 Mike Forster
88 J. Fortuna
89 Ray Fortune
90 David Fowler
91 Janet Fox
92 Jim Franks
93 Anthony Fravola
94 Joe Freda
95 Tommy Freeman
96 Matt French
97 Andy Fritchley
98 Phillip Gadilhe
99 Ralph Gage
100 Mr. Jack Gaines
101 Peter Gallant
102 Heath Galloway
103 Susan Garchow
104 Dan Garlick
105 Keith Garner
106 Donne Garrett
107 John A. Garrett
108 Ron Garrett
109 Philip Gasaway
110 R.J. Gaumond
111 James Geist
112 Nancy T. Gell
113 Ron Gempel
114 Etienne Gentin
115 Trent Germano
116 Normie Geske
117 Tim Geske
118 Rich Gibson
119 Francis Giknis
120 Mary Gilbert
121 John Giordano
122 Jack Gleason
123 Ronald Godwin
124 Joe Goode
125 Angie and Dyke Goodin
126 Carole Goodyear
127 John Goodyear
128 Patricia Grace
129 Margaret Gracey
130 Don Graff
131 John Gram
132 Lindsay Granger
133 Stede Granger
134 Mark Gravenhorst
135 Jane Graves
136 Mike Green
137 Wendy and Van Green
138 Adam Gregory
139 Don Gregory
140 B. Griffin
141 C. Grist
142 Glynn Groszmann
143 Richard Grove
144 John Gundlach
145 Miley Gunter, Sr.
146 Charles Gushue
147 Ed Gutzmann
148 Marilyn Haight
149 Jim Hake
150 Mark Hale
151 Scott Hale
152 Chuck Hall
153 Rosemary Hall

1 Frederick Hamilton
2 Ben Hampton
3 Betty Hampton
4 Sam Hancock
5 Elizabeth Hand
6 Ema Hand
7 Elmer Hanners
8 Bruce Hansen
9 Emmette Hanson
10 Greg Harber
11 Delores Hardin
12 Janace Harding
13 Sidney Harrell
14 Billy Harris
15 Brenda Harris
16 Laura Harris
17 Norman Harris
18 Richard E Harris
19 Scott Harris
20 Steve Hart
21 Don and Myralyn Hartsfield
22 Louis P Harvath, III
23 Karen Harvey
24 Palmer Hasty
25 Arthur J. Hausmann
26 Ben Hawkins
27 Doug Hayes
28 Joel A Hayes
29 Daryl Haylwood
30 Glenn Heard
31 Michael Hein
32 Gordon Hendley
33 Jennie Hendley
34 James Hendrix
35 Harvey Hepner
36 Kevin Herbert
37 Laura Herbig
38 Karen Herrington
39 Tom Herson
40 Jim Hesser
41 Adam Hicks
42 John and Virginia Hicks
43 Chapman Hiers
44 Mike and Geri Hildebrand
45 Holly and Forrest Hill
46 Ms. Carol Hines
47 Ana Hiott
48 Dean Hoffman
49 Joyce & Richard Hoge
50 Ms Peggy Holiday
51 Naomi Holland
52 Robert Holz
53 Earl Hood
54 Phil Horton
55 Daniel Houghton
56 Mr. and Mrs. H. C. Hose
57 Billy V. Houston
58 John Howard
59 Don Howell
60 Reginald Hudson
61 Jennifer Humayun
62 Charles Hungerford
63 Tom and Chris Hunkele
64 William Huntley
65 Thomas H. Hutchings
66 Pat Hutchins
67 Boisvert Ian
68 Berny Ilgner
69 Diane Ilgner
70 Betty Ingram
71 Ken Ingram
72 Dr. Larry Innis
73 John Inzetta
74 Mary Iorio
75 Bob Irvin
76 Clifford Ives
77 Pinki Jackel
78 Jean Jackson
79 Robert Jackson
80 Gerald R. Janssen, Jr.
81 Jim Jarzen
82 Joe Jennings
83 L. Jones
84 Betty Johnson
85 Gregg Johnson
86 Jimmy Johnson
87 Shelia O. Johnson
88 Terri Jondahl
89 Jesse S. Jones
90 Judy Jones
91 Lois Jones
92 Myrt Jones
93 Polly Jones
94 Sammie Jones
95 Stephen M. Jones
96 Warren Jones
97 William C. Jones
98 A.J. Jones, LTC, Usar
99 Retired
100 Larry Joyner
101 Judy Judy
102 Myrna and Stewart Kallam
103 Joan Kandzer
104 Beverly Kardoes
105 Dale Karr
106 Leah K. Karvelas
107 Robert Kaufmann
108 James Keelin
109 Miriam Kelly
110 Donna Kendall
111 John P. Kerr
112 Mary Kerries
113 Gary and Roxann Killco
114 Patsy Kilmartin
115 Kwan Kim
116 Susan Kincaid
117 Rey Kineard
118 Helen B. King
119 Ted King
120 Mark Kirves
121 Johnny R. Kistler, Sr.
122 Betti Klein
123 Adelle Knight
124 Charles Knight
125 Isabelle and Charles Knight
126 Majorie Knipp
127 Barry Kohl
128 Dale and Joyce Kramer
129 Lewis Krebs
130 Ross Kuhl
131 Judith Kump
132 John Lamay
133 Scott and Sue Landa
134 Henry D. Landers
135 Michael A. Lane
136 Deborah Lang
137 Ward Lang
138 Lee Langley
139 Casey Lanier
140 Lawrence Lauer
141 Robert Lauer
142 James Lauro
143 Holly Lawrence-Neyman
144 Bobby and Sissy Lawson
145 Roy Leach
146 Dong Lee
147 Timothy Lee
148 Steve Leitman
149 Paul Lemay
150 Scott Leonard
151 Jim Levesque
152 Lauren Levi
153 Van Lewis

1 Mary J. Lieblang
2 Britt Lifsey
3 Kelly Linch
4 Pat Little
5 Richard Little
6 Gloria Livinston
7 Ada Long
8 Anne Bowen Long
9 Teresa and Pat Longo
10 Ms. Nora Loper
11 Danny Lowery
12 Barry Lucas
13 Michael T. Ludvigsen
14 Tim Lull
15 John Maderia
16 Michael Mallini
17 Sarah Beth Mallory
18 Mark Maloney
19 Joe Maltese
20 Joy Maltese
21 Chuck Mangan
22 Chris Manganiello
23 Peter Mansolillo
24 Mr. Wilmer Manuel
25 Carolyn Markert
26 Phil Markert
27 Faye and Dave Markey
28 Sam Marley
29 Ben Martin
30 E. Joy Martin
31 Hall Martin
32 Linda Martin
33 Charles Mason, Jr.
34 Robert E. Mcalister
35 Carley McBride
36 Mike McBride
37 William F. McBride
38 Jack McCarthy
39 Joey McCartney
40 N.D. McClure
41 Gary McConnell
42 Johnnie McCoy
43 Mickey McCoy
44 Ralph McCurdy
45 Dianne McGee
46 Marianne McGee
47 O.W. “Mac” McGowan
48 Charles McGuire
49 Jim McGuire
50 Lee McKinstrey
51 James McLaughlin
52 Tom McLaughlin
53 Lee McLemore
54 Mea McLeod
55 W.C. McNeal
56 James and Glenda McNeil
57 W.C. McNeil
58 Hugh McQueen
59 Joseph L. Meaher
60 Margaret Melcher
61 Peter Melech
62 Linda Mendenhall
63 Jane Merritt
64 Ira Meyer
65 Sharon Michel
66 Tex Middlebroo
67 Wade Milam
68 Kelly Ann Miles
69 Lee D. Miller
70 Robert Miller
71 Willie Miller
72 Tom Mills
73 Kay and Greg Minchew
74 Archie Mitchell
75 Kristina Mitchell
76 Sharon Mitchell
77 Sue Mitchell
78 Alex Mitchem
79 Linda Mock
80 Henry Mock
81 Colleen Monchilovich
82 Dave Montrois
83 Colin Moore
84 Ralph Moore
85 William Moore
86 Chris Moran
87 Eddie Morgan
88 Tom and Carilyn Morgan
89 Clyde Morris
90 Joe Morris
91 Rick Morris
92 Bill Morrison
93 Evelyn Morrison
94 Dean Mosher
95 Jerry Moss
96 Paul Mueller
97 James and Linda Murchison
98 Colleen Murphy
99 Dan Murphy
100 Gary Myers
101 Richard Myers
102 Sandra Myers
103 Richard Nash
104 Steve Naughton
105 Janet Neal
106 Charles Neely
107 Robert C. Neibling
108 Allen Nelson
109 Alton Nelson
110 David Nelson
111 Mike Nepote
112 Charles Newman
113 Eugenia Newman
114 Kathy and Charles Newman
115 Raymond Newman
116 Brogdon Nichols
117 Bill Nivens
118 Charley Nix
119 Ann Nixon
120 James Norman
121 Beth Norred
122 Ralph Norris
123 Cana Nudi
124 Eric O’Kelley
125 Gayle O’Neal
126 Rachel O’Neal
127 Thomas O’Shea
128 Thomas Oark
129 William Ogletree
130 Donald H. Olds
131 John (Jack) Oliaro
132 Mr. Mike A. Oliver, OP
133 Ron Orr
134 Mel Osingd
135 Brian Otte
136 James Owen
137 Kathy Owen
138 Oysterling Family
139 Lisa Parker
140 Robert Parker
141 Steve Parker
142 Gathana Parmenas
143 Mr. Thad Partridge
144 Gary E. Patrick
145 Mrs. Robert Patterson
146 Robert Patton
147 Michael Paul
148 Robert and Verna Paul
149 Steve Peene
150 Craig Pendergrast
151 Frederick Peters
152 Robert N. Peterson
153 Tommy Phillips

1 Max Picklesimer
2 Charles Pierce
3 Darby Pippin
4 Ronald Pitts
5 Janet Plumlee
6 Ron Plumlee
7 Robert W. Poellnitz
8 Coy Poitevitit
9 Mr. Charles Polite
10 Karen Porter
11 Linda Poston
12 Wilbur Poston
13 Frank Powe, Jr.
14 Andy Powell
15 Billy Powell
16 Charlene and Mark Powell
17 Dr. William E. Powell
18 Charles and Linda Pratt
19 William Prescott
20 Roland C. Prestonbac
21 Daniel Price
22 Daniel Pridgeon
23 Mr. Tom Pritchard
24 Dan Provence
25 Ronnie Purcell
26 Barry Raines
27 Ian W. Ramsay
28 Aku Rainio
29 Pam Ramsay
30 Donal Ratigan
31 Randall Raven
32 Bill & Martha Rawson
33 Helga and John Ray
34 Hugh Ray
35 Ronald Ready
36 Heidi Recksiek
37 Susan Reddaway
38 Carla Reid
39 Robert R. Reid, Jr.
40 William M. Rezak
41 Adam Richards
42 Darrel Richardson
43 John Richardson
44 Gail Riegelmayer
45 Paul Riegelmayer
46 Dave Rigdon
47 Ron Riggs
48 Sid W. Riley
49 Bruce Ritchie
50 Betty V. Ritter
51 Doug & Mary Robbins
52 Bill Robinson
53 Mary Anna Robinson
54 Peter Robinson
55 Danny Rock
56 Tommy Rockwell
57 Linda Rogers
58 Mark Rogers
59 J. Roland
60 Don Romero
61 Wilton Rooks
62 Bruce A. Rotella
63 Dan Rothwell
64 Jyll Rowe
65 Marilyn Royal
66 Jim Ruane
67 Don Russell
68 Sheri Russo
69 David Rybick
70 Robert Staines
71 Mr. & Mrs. Sager
72 Kim Sak
73 John Salo
74 John Sblendorio
75 J. Schiffman
76 Tony Schlich
77 Cathy Schmidt
78 Pamela Schock
79 Terrell Schroder
80 Carol Schwarz
81 Bill Schwendler
82 Wm. T. Schwendler, Jr.
83 Paul Sconyers
84 Graham Scott
85 Hollie Scott
86 Monica Scott
87 Sandra Seagraves
88 Ronald Seder
89 A. George Seelke
90 Anna Seely
91 Christopher Seely
92 Kayd Selden
93 Alma Sequin
94 George Sexton
95 Jim Sexton
96 Robin Shaneay
97 C. Keith Shannon
98 Faye P. Sharit
99 Alan Shedd
100 Robert Shiply
101 Kathy Shipman
102 Jane Shiver
103 Kathy Shoaf
104 Warren Short
105 Peter J. Shuba
106 Jay Shuler
107 Lawrance Simmons
108 Kathryn Simpson
109 Tal Simpson
110 Terrence Simpson
111 Leo Singleton
112 William Sirmons
113 Leonies Skaar
114 John Sliger
115 Frank and Leslie Smalley
116 Greg Smallwood
117 Rick Smathers
118 Charles Smith
119 Edward Smith
120 Gail Smith
121 Kenneth Smith
122 Larry Smith
123 Lori Smith
124 Phillip Smith
125 W. Allen Smith
126 Ben Snowden
127 Wil Sommer
128 Eddie Sosebee
129 Andy Sparks
130 Chris Spivey
131 John Splendorio
132 N.P. Standland
133 Katherine Stanford
134 Lee Stanton
135 Frank Steinhilper
136 Janice Stever
137 Robert J. Stewart, Sr.
138 L. E. Stiffler
139 Elizabeth and James Stinson
140 Marjorie Stitt
141 Dell Stone
142 Beverley Stout
143 Charles Stradcutter
144 Daniel Strickland
145 Richard Strickland
146 A.E. Stuardi
147 Mrs. Betty Stuart
148 Donald Styml
149 Kathy Swaggerty
150 Charles Sweat
151 Micheal Taber
152 Bill Tannahill
153 Pete Taylor

Wanda Teat
Patrick Terrell
Sidell Tilghman
Mack Tharpe
Art Thompson
Arthur Thompson
Bill Thompson
Denise Thompson
Paul C. Thompson
Tommy Thompson
Scott Tiffin
Sidell Tilghman
Marlene Timmerberg
Carol Todd
Hugh and Janice Toles
Minnich Tom
Donald Towers
Dale Townsend
Clayton Triggs
Billy Trotter
Helen Tudor
Russ Turner
Tony Tye
Tullis Tye
Joel Upchurch
Ken Uyl
Katie Van Schoor
David Vaughn
Nicki Vaughn
Jim Vearil
Richard Vickers
Tripp Vickers
Eucle Vickery
Pirjo Vihma
Charles Vining
Dr. Barry Vittor
Thomas Vivelo
Steve Volino
Sam Vrachalus
Stacy Wade
Dr. David B. Wagner
Randy Wakem
Tammi Wakem
Nancy Waldrup
Becky Walker
Martha Walker
Matthew Walker
Rebecca Wallace
Joseph Waller
Kevin Waller
Carol Walston
Brian Wanamaker
George Wangemann
Steven Ward
Steve Warlzek
Gene Watford
David Watts
Gregory Watts
Jerry Webb
Martha Webster
Dan Weintraut
Margie Welch
John Thomas West
Lynn Westmoreland
David Wetstone
Leo Whalen
John F. Whelchel
Bruce White
Charles White
Alan Whitehouse
D.B. Whiting
Freddie Whitley
Chad Whitmire
Jean Whitney
Lloyd Whittall
Diane Lynn Wickman
Lynn Wilder
David Wilkes
Benton Williams
Doug Williams
Elizabeth S. Williams
Jo Williams
Karol Williams
Mike Williams
Carolyn Willis
Kathi Wilson
Lynn Wilson
Ted Wilson
Jack L. Winburn
Steve Windom
James C. Wingo
Sam O. Wolford
Terry Wolsifer
Jack and Elaine Wood
Cre Woodard
Marsha Woodward
William Wooten
Dr. William E Workman
Don Wright
Elizabeth Wright
T.J. Wright, LT.
Bob Yarbrough
Nancy and Bob Yate
Jane Yates
Nelle Yates
Warren Yeager
Evelyn Zarate
Rick Zelznak
Brian Zimmel
Shawn Zwilling

10.9 Libraries

Eufaula Carnegie Library
Eufaula, AL

H. Grady Bradshaw-Chambers County Library
Valley, AL

Lafayette Pilot Public Library
Lafayette, AL

Abbeville Memorial Library
Abbeville, AL

Blanche R. Solomon Memorial Library
Headland, AL

Ashford Branch Library
Ashford, AL

Columbia Branch Library
Columbia, AL

Lewis Cooper Jr. Memorial Library
Opelika, AL

Annie L. Awbrey Public Library
Roanoke, AL

Phenix City–Russell County Public Library
Phenix City, AL

Dothan Houston County Main Branch Library
Dothan, AL

Calhoun County Public Library Blountstown Branch
Blountstown, FL

Altha Public Library
Altha, FL

Hugh Creek Park Public Library
Blountstown, FL

Kinard Park Public Libraries
Kinard, FL

Apalachicola Municipal Library
Apalachicola, FL

Franklin County Public Library Eastpoint Branch
Eastpoint, FL

Franklin County Public Library Carrabelle Branch
Carrabelle, FL

Cowen Public Library
Chattachoochee, FL

Gulf County Public Library
Port St. Joe, FL

Charles Whitehead Wewahitchka Public Library
Wewahitchka, FL

Jackson County Public Library
Marianna, FL

Harrell Memorial Library of Liberty County
Bristol, FL

Baker County Library
Newton, GA

Calhoun County Library
Edison, GA

Whitesburg Public Library
Whitesburg, GA

Cusseta-Chattahoochee County Public Library
Cusseta, GA

Clayton County Headquarters Library
Jonesboro, GA

Lovejoy Library
Hampton, GA

Riverdale Library
Riverdale, GA

Central Library, Cobb Co. PLS
Marietta, GA

East Marietta Library
Marietta, GA

Hattie G. Wilson Library
Marietta, GA

Kemp Memorial Library
Marietta, GA

Lewis A Ray Library
Smyrna, GA

East Cobb Library
Marietta, GA

Mountain View Regional Library
Marietta, GA

Powder Springs Library
Powder Springs, GA

Sibley Library
Marietta, GA

South Cobb Library
Mableton, GA

Stratton Library
Marietta, GA

Sweetwater Valley Library
Austell, GA

Vinings Library
Atlanta, GA

Central Library—Coweta
Newnan, GA

Grantville Public Library
Grantville, GA

Newnan-Coweta Public Library
Newnan, GA

Senoia Public Library
Senoia, GA

Crawford County Public Library
Roberta, GA

Cordele-Crisp Carnegie Library
Cordele, GA

Decatur County-Gilbert H. Gragg Library
Bainbridge, GA

Briarcliff Library
Atlanta, GA

Brookhaven Library
Atlanta, GA

Chamblee Library
Chamblee, GA

Clarkston Library
Clarkston, GA

Decatur Library
Decatur, GA

Doraville Library
Doraville, GA

Dunwoody Library
Dunwoody, GA

Embry Hills Library
Chamblee, GA

Northlake-Barbara Loar Branch
Tucker, GA

Scottdale-Tobie Grant Library
Scottdale, GA

Toco Hill-Avis G. Williams Library
Decatur, GA

Tucker-Reid H. Cofer Library
Tucker, GA

Byromville Public Library
Byromville, GA

Dooly County Library
Vienna, GA

Central Library
Albany, GA

Northwest Library
Albany, GA

Southside Library
Albany, GA

Tallulah Massey Library
Albany, GA

Westtown Library
Albany, GA

Douglas County Public Library
Douglasville, GA

Lithia Springs Public Library
Lithia Springs, GA

Jakin Public Library
Jakin, GA

Lucy Maddox Memorial Library
Blakely, GA

Fayette County Public Library
Fayetteville, GA

Peachtree City Library
Peachtree City, GA

Tyrone Public Library
Tyrone, GA

Cumming Branch & Headquarters
Cumming, GA

Sharon Forks Library
Cumming, GA

Adams Park Branch
Atlanta, GA

Adamsville-Collier Heights Branch
Atlanta, GA

Alpharetta Branch
Alpharetta, GA

Auburn Avenue Research Library
Atlanta, GA

Bankhead Courts Branch
Atlanta, GA

Bowen/Bankhead Branch
Atlanta, GA

Buckhead Branch
Atlanta, GA

Central Library (Atlanta-Fulton PLS)
Atlanta, GA

College Park Branch
College Park, GA

Dogwood Branch
Atlanta, GA

East Point Branch
East Point, GA

Fairburn Branch
Fairburn, GA

Martin Luther King Jr Branch
Atlanta, GA

Northeast/Spruill Oaks Branch
Johns Creek, GA

Northside Branch
Atlanta, GA

Ocee Branch
Johns Creek, GA

Peachtree Brach
Atlanta, GA

Perry Homs Branch
Atlanta, GA

Perry Homs Branch
Atlanta, GA

Roswell Branch
Roswell, GA

Sandy Springs Branch
Atlanta, GA

South Fulton Branch
Union City, GA

Southwest Branch
Atlanta, GA

Washington Park Branch
Atlanta, GA

West End Branch
Atlanta, GA

Buford-Sugar Hill Branch
Buford, GA

Duluth Branch
Duluth, GA

Peachtree Corners Branch
Norcross, GA

Suwanee Branch Library
Suwanee, GA

Clarkesville-Habersham County Library
Clarkeville, GA

Cornelia-Habersham Co. Lib.
Cornelia, GA

Clermont Branch
Clermont Branch, GA

Hall County Headquarters Library
Gainesville, GA

Murrayville Branch
Gainesville, GA

Harris County Public Library
Hamilton, GA

Williams Memorial Library
Fortson, GA

Heard County Public Library
Franklin, GA

Fortson Public Library
Hampton, GA

Leesburg Library
Leesburg, GA

Redbone Library
Leesburg, GA

Smithville Library
Smithville, GA

Lumpkin County Library
Dahlonega, GA

Ideal Public Library
Ideal, GA

Marshallville Public Library
Marshallville, GA

Montezuma Public Library
Montezuma, GA

Oglethorpe Public Library
Oglethrope, GA

Marion County Library
Buena Vista, GA

Greeneville Area Public Library
Greenville, GA

Manchester Public Library
Manchester, GA

James W. Merritt, Jr. Memorial Library
Colquitt, GA

DeSoto Trail Regional Library
Camilla, GA

Columbus Public Library
Columbus, GA

Mildred L Terry Branch Library
Columbus, GA

North Columbus Branch Library
Columbus, GA

South Columbus Branch Library
Columbus, GA

Maude P Ragsdale Library
Hiram, GA

New Georgia Public Library
Dallas, GA

J. Joel Edwards Public Library
Zebulon, GA

Quitman County Library
Georgetown, GA

Randolph County Library
Cuthbert, GA

Schley County Library
Ellaville, GA

Seminole County Public Library
Donalsonville, GA

Griffin-Spalding County Library
Griffin, GA

Lumpkin Library
Lumpkin, GA

Parks Memorial Public Library
Richland, GA

Lake Blackshear Headquarters Library
Americus, GA

Talbot County Library
Talbotton, GA

Butler Public Library
Butler, GA

Reynolds Community Library
Reynolds, GA

Terrell County Public Library
Dawson, GA

Hogansonville Public Library
Hogansville, GA

LaGrange Memorial Library
LaGrange, GA

Hightower Memorial Library
Thomaston, GA

Webster County Library
Preston, GA

White County Library – Cleveland Branch
Cleveland, Georgia

White County Library – Helen Branch
Helen, GA

10.10 Media

Eufaula Tribune
Eufaula, AL

Valley Times News
Lanett, AL

Dothan Eagle
Dothan, AL

Dothan Progress
Dothan, AL

The Auburn Plainsman
Auburn, AL

The Auburn Villager
Auburn AL

The Corner
Auburn, AL

OANow
Opelika, AL

The Tuskegee News
Tuskegee, AL

The Campus Digest
Tuskegee, AL

The Randolph Leader
Roanoke, AL

WTBF-AM 970 & FM 94.7
Troy, Alabama

WTLS-AM 1300
Tallassee, AL

WBAM-FM Star 98.9
Montgomery, AL

WKMX-FM 106.7
Dothan, AL

WDJR-FM 96.9
Dothan, AL

WESP-FM 102.5
Dothan, AL

WOOF-AM 560 & FM 99.7
Dothan, AL

WTVY-FM 95.5
Dothan, AL

WTSU / WRWA / WTJB
Troy, AL

WDHN (Ch. 18)
ABC
Dothan, AL

WDFX (Ch. 34)
Fox
Dothan, Alabama

WAKA (Ch. 8)
CBS
Montgomery, Alabama

WCOV (Ch. 20)
Fox
Montgomery, AL

WSFA (Ch. 12)
NBC
Montgomery, AL

The Bay County Press
Fountain, FL

The News Herald
Panama City, FL 32401

The County Record
Blountstown, FL

The Apalachicola Times
Apalachicola, FL

The Franklin Chronicle
Eastpoint, FL

The Gadsden County Times
Quincy, FL

Havana Herald
Havana, FL

The Star
Port St. Joe, FL

JC Floridan
Marianna, FL

Jackson County Times
Marianna, FL32448

The Calhoun-Liberty Journal
Bristol, FL

Washington County News
Chipley, FL

WOYS 100.5 FM
Eastpoint, Florida

WFSY 98.5 FM
Panama City, FL

WFSL 90.7 FM
Tallahassee, FL

WFSU 89.1 FM
Tallahassee, FL

WYYX 97.7 FM
Panama City Beach, Florida

WRBA 95.9 FM
Panama City Beach, FL

WPAP 92.5 FM
Panama City, FL

WLHR 107.9 FM
Panama City, FL

WJHG (7)
NBC
Panama City Beach, FL

WMBB (13)
ABC
Panama City, FL

WCTV (6)
CBS
Tallahassee, FL

WTLH (49)
FOX
Midway, FL

WTWC (40)
NBC
Tallahassee, FL

WTXL (27)
ABC
Midway, FL

WFSU
Public TV
Tallahassee, FL

Banks County News
Jefferson, GA

Times Georgian
Carrollton, GA

West Georgian
Carrollton, GA

Clayton News Daily
Jonesboro, GA

Clayton Neighbor
Forest Park, GA

Clayton Tribune
Clayton, GA

Stormy Petrel
Atlanta, GA

Signal
Atlanta, GA

Atlanta Business Chronicle
Atlanta, GA

The Sentinel
Kennesaw, GA

Panther
Atlanta, GA

Northside Neighbor
Atlanta, GA

Mundo Hispanico
Atlanta, GA

Southeast Farm Press
XXXXX, XX

Georgia Bulletin
Smyrna, GA

Emory Wheel
Atlanta, GA

Atlanta Voice
Atlanta, GA

Daily Report
Atlanta, GA

Creative Loafing
Atlanta, GA

Atlanta Jewish Times
XXXXX, XX

Atlanta Intown
Sandy Springs, GA

Atlanta Chinese News
Atlanta, GA

Sunday Paper
Atlanta, GA

Technique
Atlanta, GA

The Moultrie Observer
Moultrie, GA

Newnan Times-Herald
Newnan, GA

The Cordele Dispatch
Cordele, GA

Dawson News & Advertiser
Dawsonville, GA

Dawson Community News
Dawsonville, GA

Champion Newspaper
Decatur, GA

Dekalb Neighbor
Roswell, GA

The Post Search light
Bainbridge, GA

News Observer
Vienna, GA

Citizen Georgian
Montezuma, GA

The Albany Herald
Albany, GA

The Early County News
Blakely,GA

Citizen
Fayetteville, GA

Fayette Daily News
Fayetteville, GA

Fayette Neighbor
Atlanta, GA

Forsyth County News
Cumming, GA

Forsyth Herald
Alpharetta, GA

Dunwoody Crier
Dunwoody, GA

S. Fulton Neighbor
Forest Park, GA

Roswell Neighbor
Roswell, GA

Revue News
Alpharetta, GA

Johns Creek Herald
Alpharetta, GA

Milton Herald
Alpharetta, GA

Cairo Messenger
Cairo, GA

Weekly
Peachtree Corners, GA

Gwinnett Citizen
Grayson GA

Gwinnett Daily Post
Lawrenceville, GA

Johns Creek Herald
Alpharetta, GA

Loganville Times
Monroe, GA

The Northeast Georgian
Cornelia, GA

The Gainesville Times
Gainesville, GA

Lakeside on Lanier
Gainesville, GA

Atlanta Daily World
Atlanta, GA

Harris County Journal
Hamilton, GA

Henry Neighbor
Forest Park, GA

Daily Herald
Forest Park, GA

Henry Herald
McDonough, GA

Henry County Times
McDonough, GA

Houston Home Journal
Perry, GA

Herald Gazette
Barnesville, GA

Lee County Ledger
Leesburg, GA

Dahlonega Nugget
Dahlonega,GA

Tri County Journal & Chattahoochee Chronicle
Buena Vista, GA

Manchester Star Mercury
Manchester, GA

Meriwether Vindicator
Manchester, GA

Miller County Liberal
Colquitt, GA

Mitchell County GA
Pelham, GA

Monroe County Reporter
Forsyth, GA

Paulding Neighbor
Hiram, GA

Leader Tribune
Fort Valley, GA

Journal Reporter
Zebulon, GA

Donalsonville News
Donalsonville, GA

Griffin Daily News
Griffin, GA

Toccoa Record
Toccoa, GA

Talbotton New Era
Tallbotton, GA

LaGrange Daily News
LaGrange, GA

Hogansville Home News
Manchester, GA

West Georgia Beacon
Hogansville, GA

Thomaston Times
Thomaston, GA

White County News
Cleveland, GA

WUNV (91.7 FM)
Albany, GA

WUOG (90.5 FM)
Athens, GA

WGST (640 AM)
Atlanta, GA

WSB (750 AM and 95.5 FM)
Atlanta, GA

WCNN (680 AM and 93.7 FM)
Atlanta, GA

WABE (90.1 FM)
Atlanta, GA

WREK (91.1 FM)
Atlanta, GA

WRFG (89.3 FM)
Atlanta, GA

WSTH-FM 106.1
Columbus, GA

WUWG (90.7 FM)
Carrollton, GA

WRCG (1420 AM)
Columbus, GA

WTJB (91.7 FM)
Troy, Alabama

WGFS (1430 AM)
Covington, GA

WPPR (88.3 FM)
Atlanta, GA

WJWV (90.9 FM)
Atlanta, GA

WDUN (550 AM and 102.9 FM)
Gainesville GA

WLAG (1240 AM)
Lagrange, GA

WFXL (Channel 31)
Fox
Albany, GA

WALB (Channel 10)
NBC
Albany, GA

WABW (Channel 14)
PBS
Atlanta, GA

WSB (Channel 2)
ABC
Atlanta, GA

WGLC (Channel 46)
CBS
Atlanta, GA

WAGA (Channel 5)
Fox 5 Atlanta
Atlanta, GA

WTBS (Channel 26)
Independent
Norcross, GA

WXIA (Channel 11)
NBC
Atlanta, GA

WGTV (Channel 8)
PBS
Atlanta, GA

WPBA (Channel 30)
PBS
Atlanta, GA

WUPA (Channel 69)
CW
Atlanta, GA

WATL (Channel 36)
My Network TV
Atlanta, GA

WTVM (Channel 9)
ABC
Columbus, GA

WRBL (Channel 3)
CBS
Columbus, GA

WLTZ (Channel 38)
NBC
Columbus, GA

WJSP (Channel 28)
PBS
Atlanta, GA

WYBU (Channel 16)
Independent
Phenix City , AL

WSST (Channel 55)
Independent
Cordele, GA

WACS (Channel 25)
PBS
Atlanta, GA

WPGA (Channel 58)
ABC
Macon, GA

WMAZ (Channel 13)
CBS
Macon, GA

WGXA (Channel 24)
Fox
Macon, GA

WMGT (Channel 41)
NBC
Macon, GA

WDCO (Channel 29)
PBS
Atlanta, GA

11 Glossary

Number/Symbol

7Q10 flow: The lowest 7-day average flow that occurs on average once every 10 years at a flow-measuring station or gage.

A

Action zones: Partitions of a reservoir's conservation storage, as defined in the reservoir water control manual, and designated according to a range of surface elevations of the water pool for a reservoir; action zones are used to guide reservoir managers in meeting project purposes under a wide variety of hydrologic conditions. Each action zone has a set of specific operational rules or guidelines that govern water management operations for the reservoir when the pool elevation lies within that zone.

Allocation formula: See *water allocation formula.*

Anadromous fish: Fish with a migratory life cycle in which they live most of adult life in ocean water but breed in freshwater, with individual adults often returning from the sea to the rivers where they were spawned.

Assimilative capacity: The amount of pollutants that a water body can accommodate without violating a water quality standard or impairing the designated use.

Authorized project purpose: The legally mandated purpose for which USACE must manage each ACF project.

Available precipitation: The net available moisture in a system resulting from the balance between total precipitation (input) and potential evapotranspiration (loss). Also see *evapotranspiration*.

B

Bankfull capacity (or channel capacity: The discharge, or stage, at which a stream or river is at the top of its banks such that any further increase or rise would result in water moving into the flood plain.

Baseflow: The portion of streamflow from groundwater; not attributed to overland runoff.

Brackish: Describes water at the interface of freshwater and saltwater where river discharge is diluting salinity concentrations and average water salinity is between that of seawater (about 35 parts per thousand) and freshwater (upper threshold of about 0.5 parts per thousand).

C

Canopy: Tallest vegetation in a community, usually trees more than 30 feet tall or 3 inches in diameter; the tallest grasses or other herbaceous species.

Catadromous fish: Fish with a migratory life cycle in which they live most of adult life in freshwater but breed in the ocean.

Channel forming discharge: High river flows, with recurrence intervals of about 1.5 years, which are dominant in shaping the river channel.

Compact: See *River basin compact*.

Comprehensive Study: Consensus-based study in the 1990s to determine the capabilities of the water resources of the basin, describe the water resource demands of the basin, and evaluate alternatives that would use the water resources to benefit all user groups within the basin. The Comprehensive Study was commissioned in the 1992 tri-state (Alabama, Florida, Georgia) Memorandum of Agreement. It collected much valuable data but was never completed.

Composite conservation storage: The total available conservation storage (in ac-ft) at any point during the year within the federal projects in the ACF Basin, calculated by combining the total available conservation storage of Lake Sidney Lanier, West Point Lake, and Walter F. George Lake.

Confluence: The point of juncture of two or more streams.

Conservation pool: The portion of reservoir storage usually reserved for power production and water supply.

Conservation storage: The volume of reservoir storage available to meet authorized project purposes other than flood risk management (e.g., hydropower, water supply, recreation, etc.); equivalent to the storage volume between the top of the inactive pool and the top of the conservation pool.

Consumptive use (or, consumptive water use): The portion of water withdrawn from a water body for beneficial use that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the environment.

Critical drought: The most severe drought for a region, either recorded or constructed.

Critical period: The time period containing the critical drought. Usually the time starts as the drought begins and reservoirs are full. The time ends after the reservoirs have been returned to full condition.

Critical yield: The maximum amount of water that can be consistently removed from a reservoir(s) through releases from the dam and/or withdrawals from the reservoir, during the most severe drought in the hydrologic period of record, exactly depleting the reservoir conservation storage once during the period of record.

D

Delta: An increment of a variable; measure of change in a variable.

Designated use: A use that is established by state or tribal regulation as appropriate for individual waterbodies (rivers, streams, lakes, and such) under their jurisdiction and that is to be achieved or protected under water quality standards; regulatory designated uses include public water supply; aquatic life protection (protection of macroinvertebrates, fish, shellfish, and wildlife); and recreational (fishing and swimming); agricultural; industrial; and navigational purposes.

Detritus (detrital carbon): Fresh to partly decomposed plant and animal matter.

Draft Environmental Impact Statement (EIS): The publication that documents the environmental conditions, issues, and effects associated with an action affecting the environment and on which the

public is invited to review and comment. Comments received from regulatory agencies, organizations, and individuals are addressed in the final EIS (see *final EIS*).

Drainage area: All of the surface area, including land and any water bodies, from which water upstream of a location on a stream, river, or water body drains to that location (see *drainage basin, drainage divide*).

Drainage basin: The region or area drained by a river and all of its tributaries, where water from rain and melting snow or ice drains downhill to that river (see *drainage area,* and *drainage divide*).

Drainage divide: The boundary line, along a topographic ridge or other landform, that separates adjacent drainage basins (see *drainage area, drainage basin*).

Drawdown: The act of lowering a reservoir's water level by beginning or increasing reservoir releases.

Drought Zone: A volume of water equivalent to the inactive storage in lakes Lanier, West Point, and Walter F. George plus Zone 4 storage in Lake Lanier (see *Action zones*).

E

Ecoregion: An *ecological region*; a geographic area of broadly similar physiographic and environmental conditions (e.g., landforms, climate, and soil conditions) such that it supports broadly similar terrestrial and aquatic plant and animal communities.

Emergent: Describes plants that are entirely above water or mostly above water, with only the base remaining submerged.

Endemic: Characteristic of, or prevalent in, a particular area or environment.

Estuarine: Describes deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land.

Euryhaline: Describes an aquatic organism that is able to tolerate wide fluctuations in salinity (contrast *stenohaline*).

Eutrophic (noun: *eutrophication)*: Describes a body of water—commonly a nonflowing body such as a lake, pond, or reservoir—that has high primary productivity resulting from excessive nutrients and can be subject to algal blooms resulting in poor water quality (compare *mesotrophic*).

Evapotranspiration: From *evapo*ration + *transpiration*; the combined discharge of water from the earth's surface to the atmosphere by evaporation from lakes, streams, and soils and by transpiration from plants.

F

Fall rate (ramping rate): The vertical drop in water surface elevation that occurs over a given period.

Final EIS: The final product of the environmental impact statement process, which reflects comments received on the draft EIS (see *draft EIS*).

Fish Passage Operations: The USACE operation of the lock at Jim Woodruff Dam to facilitate downstream-to-upstream passage of Alabama shad and other anadromous fish.

Fish Spawning Operations: The USACE operation of the ACF Basin to provide favorable conditions for annual fish spawning in reservoirs and in the Apalachicola River. The goal is to operate for a generally stable or rising lake level and a generally stable or gradually declining river stage on the Apalachicola River for approximately 4 to 6 weeks during designated fish spawning periods.

Flood pool: Space above the conservation pool to hold waters throughout the year. Lake Lanier and West Point Lake are drawn down beginning in the fall through winter and into early spring to provide additional capacity to protect life and property in the basin.

Flood risk management: A systematic approach to both manage flood waters to reduce the probability of flooding (through structural measures such as levees and dams) and floodplains to reduce the consequences of flooding when it occurs. In the context of reservoirs, flood risk management includes water management operations to draw down reservoirs beginning in the fall through winter and into early spring to provide additional storage capacity to protect life and property in the basin. Section 2 of the River and Harbor Act of 1945 (Public Law 79-14) approved the general plan recommended in House Document 342, 76th Congress, for development of the Apalachicola, Chattahoochee, and Flint Rivers, Georgia and Florida, for multiple purposes, including flood damage reduction.

Flood storage: The volume of reservoir storage between the elevation of the top of the conservation pool and top of the flood storage pool, specifically for storing peak flows into the reservoir until those inflows can safely be passed through the downstream channel system with no or minimal flood damage.

G

Guide curve: The seasonally variable desired pool elevation in a reservoir, normally defined as the elevation at the top of the conservation storage (synonymous with *rule curve*).

H

HEC: Hydrologic Engineering Center, an organization within the USACE that, among other things, developed the ResSim hydrologic modeling software used to analyze reservoir operations (see *ResSim*).

HEC-5Q: Water quality computer modeling software linked to reservoir operations modeling software, developed by the USACE Hydrologic Engineering Center (see *HEC*).

HEC-ResSim: Reservoir operations computer modeling software, developed by the USACE's Hydrologic Engineering Center.

Herbaceous: Describes nonwoody plant species, such as grasses.

Hydroelectric power (hydropower): Electricity produced by converting the energy released by water falling, flowing downhill, moving tidally, or moving in some other way into electrical energy. Section 2 of the River and Harbor Act of 1945 (Public Law 79-14) approved the general plan recommended in House Document 342, 76th Congress, for development of the Apalachicola, Chattahoochee, and Flint Rivers, Georgia and Florida, for the multiple purposes including hydroelectric power generation. Hydroelectric power generation is achieved by passing flow releases to the maximum extent possible through the turbines at each project, even when making releases to support other project purposes. The hours of operation are dependent on reservoir action

zones. In the ACF Basin, Buford Dam, West Point Dam, Walter F. George Dam, and Jim Woodruff Dam include hydroelectric power plants.

I

Inactive pool: The portion of reservoir storage below the conservation pool that contains *inactive storage.* The top level of the inactive pool is defined for each reservoir as the elevation below which, if the reservoir surface drops to that level, no reservoir releases are made.

Inactive storage: The portion of reservoir storage in the *inactive pool.*

Interbasin transfer: The process of withdrawal of water from one river basin for beneficial use in another basin that is not naturally connected, resulting in a net loss of water from the donor basin and a net increase to the receiving basin.

L

Land use: Includes existing and planned land use activities and land ownership, as defined in an applicable land use planning document for the potentially affected area. Land use compatibility of a proposed action is determined by comparing the proposed use of the affected area to the existing and planned uses of the adjacent area.

M

Master Water Control Manual (Master Manual): A record of basin-wide water control objectives and operational guidelines developed with thorough consideration of all project purposes to cover a full array of all foreseeable hydrologic conditions, from flood to drought.

Mesic: Describes a condition of moderate moistness, as in a mesic soil.

Minimum flow (minimum stream flow): A low river flow at a specified point in a river. The minimum flow may be a regulated minimum flow or a specific level needed for water supply or other purposes.

Mitigation: Additional actions taken to avoid, minimize, rectify, reduce, eliminate, or compensate for impacts. The Council on Environmental Quality requires Federal agencies, in preparing an environmental impact statement, to identify appropriate mitigation measures not already included in the proposed action or alternatives.

N

Navigation: The act of conveying waterborne vessels from place to place. Section 2 of the River and Harbor Act of 1945 (Public Law 79-14) approved the general plan recommended in House Document 342, 76th Congress, for development of the Apalachicola, Chattahoochee, and Flint Rivers, Georgia and Florida, for multiple purposes, including navigation. The existing project authorizes a 9-foot-deep by 100-foot-wide waterway from Apalachicola, Florida, to Columbus, Georgia, on the Chattahoochee River, and to Bainbridge, Georgia, on the Flint River.

Navigation window: Typically, a 10-day to 2-week period in which stored water is released to the river and held at specified levels so that shippers have a predetermined depth and adequate lead time to move into the system.

No Action Alternative: The baseline or current operation condition against which the action alternatives are compared. The No Action Alternative provides the baseline flows needed to assess the impacts of the Proposed Action Alternative.

Non-consumptive use (or, *non-consumptive water use*): An activity, such as hydroelectric power generation, that uses water from the basin without any withdrawal or loss of water from the system.

Nonpoint source: Describes water pollution that does not originate only or exclusively from a single location (such as a pipe discharge) but rather is diffuse in origin. Nonpoint sources generally include runoff from broad areas of land wherein the runoff accumulates varieties of pollutants, such as from urban, industrial, agricultural, or silvicultural land areas, and delivers them to waterbodies.

O

Orographic effect: The effect that occurs when a moving air mass approaches a mountain range and is rapidly forced upward by the elevated land surface, thereby causing the air temperature to cool and the moisture in the air to condense and fall as precipitation.

P

Palustrine wetlands: Generally, refers to nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand.

Peaking project: A project in which hydroelectric power is generated several hours a day, typically on weekdays in the afternoons and early evenings, in response to peak demands on the power system, in response to system demands. Flows downstream of a peaking project can fluctuate rapidly.

Period of record: Typically, the time period for which there are published records for a data collecting station, usually referring to a streamflow gauging station. The ResSim hydrologic modeling efforts used data from gauges with periods of record ranging between 1939 and 2011.

Project site: For the proposed action of this EIS, the entire ACF Basin.

Proposed Action Alternative: Also known as the Preferred Action Alternative, this is the alternative that the USACE proposes to implement in the ACF Basin.

R

Reallocation (of storage): The reassignment of the use of existing storage space in a reservoir project from a currently authorized purpose to an alternate use for water supply (per the Water Supply Act of 1958). If provision of water supply would seriously affect a project's authorized purposes or cause a major operational change, the reallocation would require congressional authorization. Otherwise, it may be accomplished administratively. Reallocation of storage from a currently authorized purpose (e.g., hydropower or navigation) to municipal and industrial water supply use changes the types of benefits produced by a reservoir and the stakeholders served.

Record of Decision (ROD): Document that states the decision with respect to the update of the ACF Basin Master Manual and the individual project water control manuals, summarizes alternatives that were considered and relevant factors that were balanced in making the decision, and identifies means that have been adopted to mitigate for adverse effects. Federal agencies are required to prepare a public

decision document that demonstrates consideration of the environmental impacts described in the EIS before a decision or a major Federal action. The ROD may also outline additional actions or conditions that may be required prior to implementation of the allocation formula or other management actions in the basin.

Region of Influence (ROI): An area with natural boundaries or geopolitical boundaries that covers the likely extent of impacts on a particular resource.

Regolith: The layer of loose material (consisting of soil, sand, weathered rock pieces, volcanic ash, glacial till, or other unconsolidated residual or transported earthen material) covering bedrock that constitutes the surface of most land.

Relocation contract (agreement): A legal instrument that provides for Fifth Amendment compensation to a property owner for the taking of property for purposes of a public works project construction.

ResSim: Reservoir operations computer modeling software, developed by the USACE Hydrologic Engineering Center (see *HEC*).

Return flow: Surface water withdrawn from the ACF system that is not consumed when used (see *consumptive use*) and that, subsequent to use, is returned (discharged with appropriate treatment) to the surface water system, generally at or near the point of withdrawal.

River basin compact (compact): An interstate agreement to equitably apportion the surface waters of the river basin. Compact negotiations to reach agreement on water allocation formulas took place between 1998 and 2003 without success, and the compacts were allowed to expire in August 2003 (ACF Basin) and in July 2004 (ACT Basin).

River reach: The stream length between two specified points.

Riverine: Relating to, resembling, or having to do with a river.

Rock outcrop: Area of exposed bedrock.

Run-of-river project: A project in which the reservoir does not fluctuate on a seasonal basis or does not seasonally redistribute flows.

S

Salinity: Measure of the salt concentration in water.

Saprolite: Soft, disintegrated, mostly to thoroughly decomposed rock, often rich in clay, formed by the in-place weathering of rock and that remains in its original place.

Scoping: The process used to determine the range of issues to be addressed and to identify the significant issues to be analyzed in depth with respect to the proposed action and alternatives.

Shoreline: The points in a lake, river, or the ocean where the body of water and the land meet.

Stakeholders: Members of the public and representatives of various interest groups, all of whom have a vested interest, or "stake," in the outcome of a project and might have differing or competing values.

Stenohaline: Describes an aquatic organism that can only survive within a narrow range of salinity, e.g., a freshwater fish that cannot survive in seawater or an ocean fish that cannot survive in freshwater (contrast *euryhaline*).

Storage project: A reservoir designed to re-regulate natural streamflow, providing more dependable yield during the low-flow season. This involves redistributing flow volumes on a seasonal basis. In general, reservoirs are filled in high-flow seasons (winter and spring) and lowered during low-flow seasons (summer and fall).

Streamflow gage: Data-collecting location and device on a river at which water levels, streamflows, and sometimes other data are measured.

Subcanopy: Vegetation less than 30 feet tall or 3 inches in diameter in a vegetative community.

Submersed: In reference to vegetation, refers to plants that are adapted to living in and normally occur entirely below water.

Summer deficit: The available precipitation minus reservoir water withdrawals in June, July, and August—typically the three warmest months of the year which correspond to increased municipal, thermoelectric cooling, and irrigation water demand.

Surcharge storage: The portion of reservoir storage above the flood damage reduction level that stores water above the emergency spillway.

T

Tailwater: The water immediately downstream of a hydraulic structure, such a dam.

Tailwater rating: The unique relationship between flow (cfs) and water surface elevation (feet), that exists immediately downstream of a dam.

Transpiration: Discharge of water vapor from land plants into the atmosphere through a variety of biological processes, including evaporation through pores in leaves and through root surfaces; the continuous process caused by the evaporation of water from leaves of plants and the corresponding uptake of water from the soil by plant roots. See *evapotranspiration*.

Trophic level: Classification of organisms in an ecosystem according to feeding relationships.

U

Unimpaired flow: Historically observed flows adjusted to account for, and computationally remove the effects of, some of the human influence within river basins, such as the construction of large surface water reservoirs, withdrawals and returns for municipal and industrial water uses, and withdrawals for crop irrigation, that have altered the otherwise naturally expected flow regime of the system. An unimpaired flow data set is necessary to determine *critical yield* by removing (to the extent possible) identifiable and quantifiable alterations in flow regime attributable to man-made changes in the river basin.

Unregulated flow: Flows that would be present in a stream, at a specific location, if no reservoirs existed. This term also applies to flows after the effects of a reservoir have been removed by some computational method.

W

Water allocation formula (allocation formula): As defined by the river basin compact, a means of equitably apportioning the surface waters of the basin while protecting water quality, ecology, and biodiversity. Compact negotiations began in early 1998, with a December 31, 1998, deadline for reaching agreement on a water allocation formula. The state commissioners (governors of each state) were unable to reach an agreement on an equitable apportionment of the waters, and the compact was allowed to expire in August 2003.

Water control manual: Document in which water control objectives and operational guidelines for USACE reservoirs in the ACF Basin are recorded. These manuals include water control plans for each project, as well as a master water control manual for the basin as a whole (see *Master Water Control Manual*).

Withdrawal: The act of removing water from a river system; water so removed from a river system.

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