CESAM-PD-EI

Date Prepared:
15 November 2007

ENVIRONMENTAL ASSESSMENT
TEMPORARY EXCEPTIONAL DROUGHT OPERATIONS MODIFICATIONS TO THE INTERIM OPERATIONS PLAN FOR SUPPORT OF ENDANGERED AND THREATENED SPECIES AND TEMPORARY WAIVER FROM ACF WATER CONTROL PLAN
JIM WOODRUFF DAM
GADSDEN AND JACKSON COUNTIES, FLORIDA AND DECATUR COUNTY, GEORGIA

Prepared by

U.S. Army Corps of Engineers, Mobile District
Planning and Environmental Division
Environment and Resources Branch
Inland Environment Team

NOVEMBER 2007

Date Prepared:
15 November 2007

**ENVIRONMENTAL ASSESSMENT
TEMPORARY EXCEPTIONAL DROUGHT OPERATIONS MODIFICATIONS
TO THE INTERIM OPERATIONS PLAN
FOR SUPPORT OF ENDANGERED AND THREATENED SPECIES
AND TEMPORARY WAIVER FROM ACF WATER CONTROL PLANS
JIM WOODRUFF DAM
GADSDEN AND JACKSON COUNTIES, FLORIDA
AND DECATUR COUNTY, GEORGIA**

1. INTRODUCTION:

This environmental assessment (EA) was prepared utilizing a systematic, interdisciplinary approach integrating the natural and social sciences and the design arts with planning and decision-making. The EDO and its alternatives are evaluated in multiple contexts for short-term and long-term effects and for adverse and beneficial effects. It is not anticipated that this is a precedent-setting action, nor does it represent a decision in principle about any future consideration. The Apalachicola, Chattahoochee, Flint River (ACF) basins are currently experiencing exceptional drought conditions throughout most of the basin, resulting in extremely low basin inflows, and some reservoirs experienced long periods of negative inflows this past summer and fall. Severe, extreme, and exceptional drought conditions have resulted in a dramatic decrease in available storage in the basin, as measured by basin composite storage. Walter F. George and West Point Lake are currently near the bottom of their conservation storage pool, and Lake Lanier is expected to fall to levels lower than the previous record low levels. Drought conditions began in 2006, have continued into 2007, and are predicted to continue to persist and possibly deteriorate into 2008. Therefore, the U.S. Army Corps of Engineers has proposed a modified drought contingency plan, termed the Exceptional Drought Operations (EDO) plan, in order to prepare for the predicted multi-year drought conditions.

a. Location: Jim Woodruff Dam is located at the confluence of the Chattahoochee and Flint Rivers and marks the upstream extent of the Apalachicola River Navigation project at Navigation Mile (NM) 106.3. The dam is located on the Chattahoochee, Florida U.S. Geological Survey quadrangle map (Figure 1), in Gadsden and Jackson Counties, Florida, and Decatur County, Georgia. Jim Woodruff Dam is the most downstream dam on the ACF system (Figure 2). Releases from Jim Woodruff Dam are made to the Apalachicola River, which is free-flowing from Jim Woodruff Dam to the Gulf of Mexico, a distance of approximately 106 miles, through Jackson, Gadsden, Liberty, Calhoun, Franklin and Gulf Counties, Florida.

The EDO directly impacts flows in the Apalachicola River and utilizes the composite storage of the reservoirs within the ACF system. Therefore the project area includes the ACF system upstream of Jim Woodruff Dam and the Apalachicola River, its distributaries, and Apalachicola Bay downstream of Woodruff Dam.

b. Proposed Action: The EDO is a temporary modification of the Jim Woodruff Dam Interim Operations Plan (IOP) as approved by the U.S. Fish and Wildlife Service (USFWS) on 28 February 2007. The term "exceptional" is not synonymous with the same term used by the National Weather Service, but is used to distinguish current drought conditions from those that were previously addressed for the existing IOP. The IOP describes minimum releases and maximum fall rates for releases from the dam to the Apalachicola River in order to minimize or avoid adverse impacts or provide support to the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*) and critical habitat for the Gulf sturgeon; the endangered fat threeridge mussel (*Amblema neislerii*); the threatened purple bankclimber mussel (*Elliptoideus sloatianus*); and the Chipola slabshell mussel (*Eliptio chipolaensis*). The intent of any modification to the IOP would be to minimize adverse impacts to listed species in the Apalachicola River while making allowances for increased storage opportunities and/or reductions in the demand of storage in order to provide continued support to project purposes, minimize impacts to other water users, and provide greater assurance of future sustained flows for species and other users during a severe multi-year drought, currently being experience in the ACF basin.

The EDO is not a new water control plan for Jim Woodruff Dam. It is a temporary modification of the IOP, which is a definition of temporary discretionary operations within the limits and rule curves established by the existing water control plan. The EDO will require a temporary waiver from the existing water control plan to provide for minimum releases less than 5,000 cfs from Jim Woodruff Dam. The temporary waiver from the existing water control plan would also include provisions to allow temporary storage above the winter pool rule curve at the Walter F. George and West Point projects if the opportunity presents itself and/or begin spring refill operations at an earlier date in order to provide additional conservation storage for future needs. The Corps operates five Federal reservoirs on the ACF as a system, and releases made from Jim Woodruff Dam under the EDO reflect the downstream end-result for system-wide operations measured by daily releases from Jim Woodruff Dam into the Apalachicola River. The EDO does not address operational specifics at the four federal reservoirs upstream of Woodruff or other operational parameters at these reservoirs, other than the use of the composite reservoir storage of the system and releases from the upstream reservoirs as necessary to assure releases from Jim Woodruff Dam support and minimize adverse impacts to endangered or threatened species or critical habitat. Because the listed species and critical habitat areas of concern are predominately located only on the Apalachicola River downstream of Jim Woodruff Dam, the primary operational consideration at this time is the timing and quantity of flows released from the dam.

The IOP specifies two parameters applicable to the daily releases from Jim Woodruff Dam: (1) a minimum discharge in relation to average basin inflows (daily average in cubic feet per second [cfs]) and maximum fall rate (vertical drop in river stage measured in feet/day), with incorporation of a desired minimum flow (6,500cfs) and the required minimum flow (5,000 cfs), and (2) a drought "trigger" to determine those conditions when the required minimum flow would be more prudent than the desired minimum flow. The drought trigger is based upon Composite Storage within the ACF system. The Composite Storage is calculated by combining the storage of Lake Sidney Lanier, West

Point Lake, and Walter F. George Lake. Each of the individual storage reservoirs consists of four Zones. These Zones are determined by the operational guide curve for each project. The Composite Storage utilizes the four Zone concepts as well; i.e., Zone 1 of the Composite Storage represents the combined storage available in Zone 1 for each of the three storage reservoirs. The EDO temporarily suspends the provisions of the IOP until Composite Storage within the basin is replenished to a level that can support the IOP. The EDO specifies a minimum discharge applicable to daily releases from Jim Woodruff Dam. The minimum discharge is determined in relation to Composite Storage and not average basin inflow under the EDO. Consistent with the IOP, the EDO uses Composite Storage to determine when the EDO is required and when various aspects of the EDO are implemented. The EDO is "triggered" whenever the Composite Storage falls below the bottom of Zone 3 into Zone 4. At that time the provisions of the IOP (down-ramping restriction and other storage restrictions for flows greater than the prescribed minimum flow) are suspended and management decisions are based on the provisions of the EDO. The provisions of the EDO remain in place until conditions improve such that the Composite Storage reaches a level above the top of Zone 3 (i.e., within Zone 2). At that time, the temporary EDO provisions are suspended, and the provisions of the IOP are re-instated. Once the IOP is re-instated, the provisions of the EDO, including the "trigger" for implementation, are eliminated and additional consultation under Section 7 of the Endangered Species Act (ESA) will be required if future conditions result in the need to modify the IOP. A detailed description of the EDO is provided in the "DESCRIPTION OF THE RECOMMENDED PLAN" section below.

Operations under the EDO will be implemented and continued until such time as the Composite Storage enters into Zone 2; or until such time as additional formal consultation may again be initiated and completed, either in association with the proposed update and revision of water control plans for the ACF system, or sooner if conditions change or additional information is developed to justify a possible revision to operations. The most recent approved Water Control Plan for the ACF system is dated 1959. However, a draft Water Control Plan for the ACF was completed in 1989. Since that time, operations have been conducted in accordance with the draft Water Control Plan, with minor adjustments as necessary in recent years to accommodate current needs, such as operations in support of fish and wildlife and endangered and threatened species. Finalizing the 1989 draft Water Control Plan awaits resolution of ongoing litigation filed by the State of Alabama in 1990, which is currently consolidated for hearing in the Multiple District Litigation Court, held in the District Court for the Middle District of Florida. It is expected that any update of water control plans would include additional formal consultation under Section 7 and additional National Environmental Policy Act (NEPA) documentation regarding system operations.

Figure 1. Jim Woodruff Dam Location

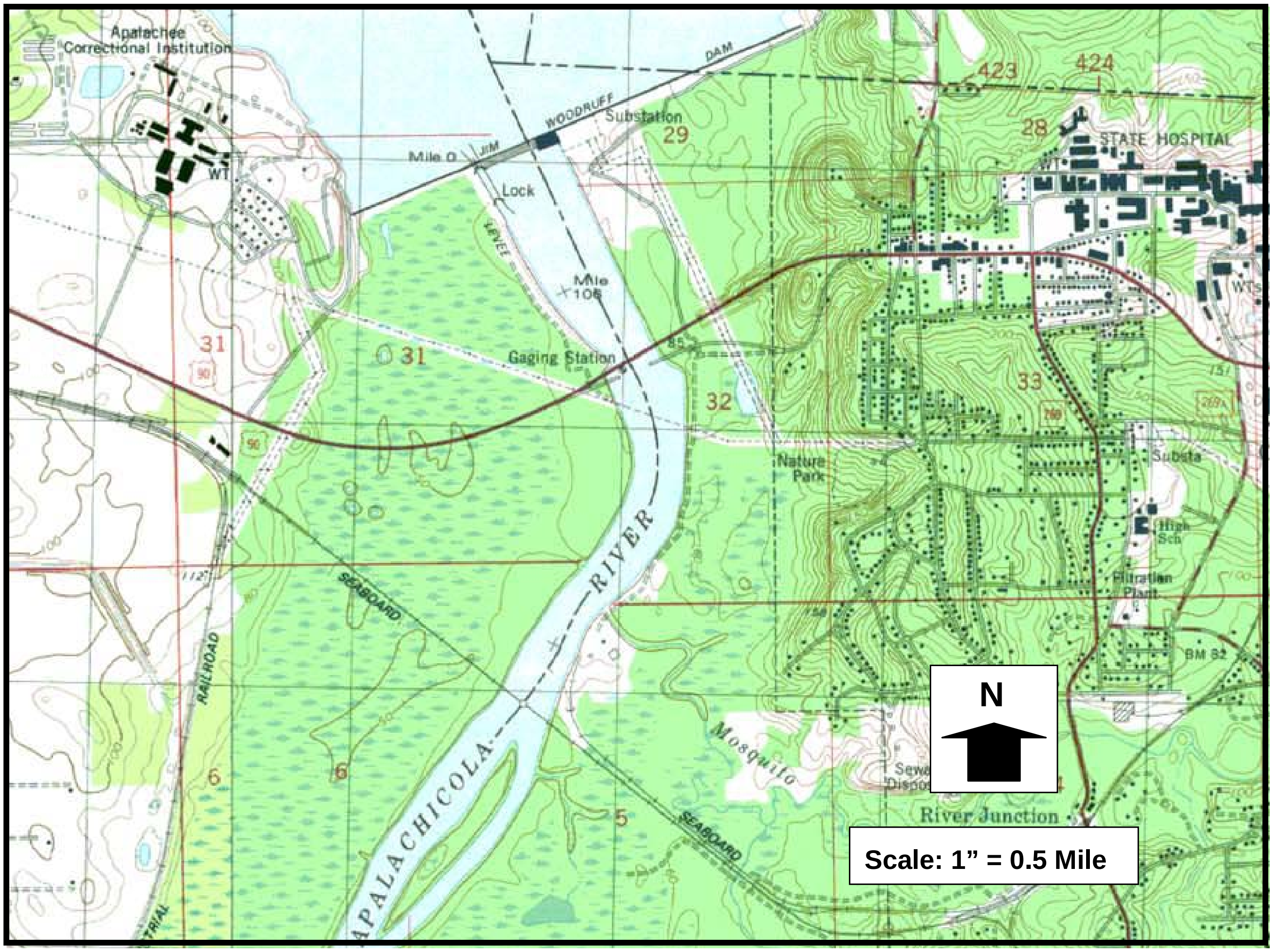
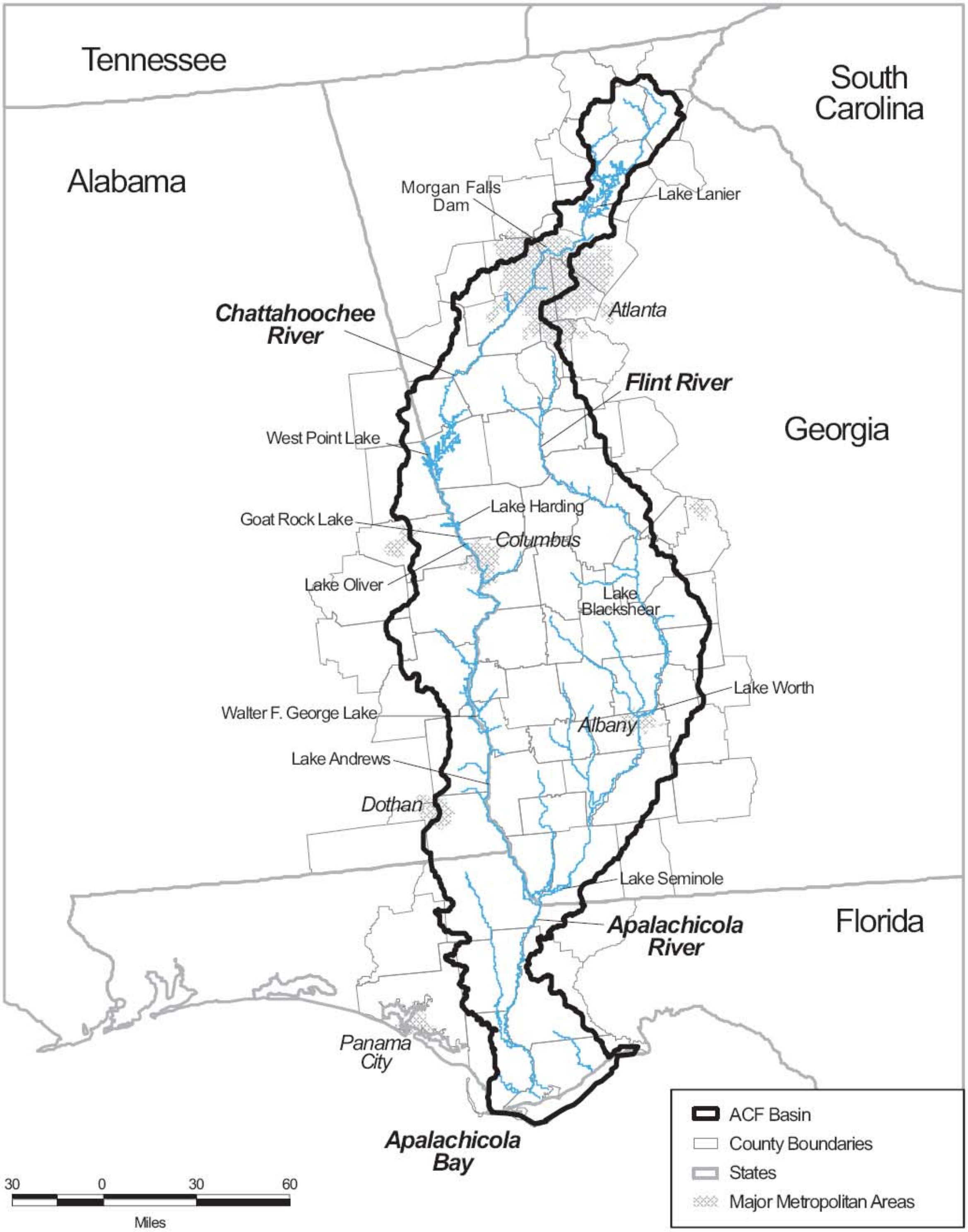


Figure 2. ACF Basin



c. <u>Purpose and Need for the Proposed Action</u>: The purpose of the EDO is to minimize adverse impacts to listed species and designated or proposed critical habitat in the Apalachicola River while making allowances for increased storage opportunities and/or reductions in the demand of storage in order to provide continued support to project purposes; minimize impacts to municipal and industrial water supply, water quality, and fish and wildlife conservation; and provide greater assurance of future sustained flows for species and other users during a severe multi-year drought, currently being experienced in the ACF basin.

By letter to the U.S. Fish and Wildlife Service (USFWS), on 1 November 2007, the Corps requested the initiation of formal Section 7 consultation for the EDO and provided a Biological Assessment (Appendix A) of the proposed action. By letter dated 7 November 2007, the Corps notified the USFWS of an amendment to the EDO to include incremental minimum flow reduction of 4,750 and 4,500 cfs and initial minimum flow reduction to 4,750 cfs; and additional consultation to identify criteria to determine “triggers” for additional reductions to 4,500 and 4,150 cfs. A copy of this letter is provided in Appendix B. A final Biological Opinion (BO) determining no jeopardy associated with the EDO was issued by the USFWS, Panama City Field Office on 15 November 2007 (Appendix C), and incorporates temporary modifications to the IOP that would allow for increased storage to provide for augmentation flows during predicted sustained drought conditions, while still minimizing harm to mussels and sturgeon, and providing for an allowable incidental take of listed mussels associated with the drought contingency operations.

d. <u>Authority:</u> A Federal interest in the ACF River basin dates to the 1800’s when river improvements for navigation were authorized under the River and Harbor Act of 1874. The River and Harbor Acts of 1945 and 1946 provided for the initiation of construction of the Apalachicola River navigation project and a series of multipurpose reservoirs on the system. Modifications of this plan have resulted in the completion of five Corps dams in the basin, four on the Chattahoochee River, and one at the confluence of the Chattahoochee and Flint Rivers. The Buford project was completed in 1956, the Jim Woodruff project in 1957, and the Walter F. George and George W. Andrews projects in 1963. The West Point project was completed in 1984 (operations began in late 1974), pursuant to authorization by the River and Harbor Act of 1962 (Title I) and the Flood Control Act of 1962 (Title II). These projects are operated as a system to provide the authorized project purposes of flood control, fish and wildlife conservation, navigation, hydroelectric power, water supply, water quality, and recreation.

The Endangered Species Act of 1973 (P.L. 93-205) requires consultation with the Department of the Interior, Fish and Wildlife Service or the National Oceanic and Atmospheric Administration, National Marine Fisheries Service and provides authority for operating federal projects to protect endangered and threatened species. The Fish and Wildlife Coordination Act (P.L. 85-624) requires consultation with the Fish and Wildlife Service and State fisheries management agencies regarding project impacts on other fish and wildlife.

2. AFFECTED ENVIRONMENT:

a. General Environmental Setting. The ACF basin drains 19,800 square miles in parts of southeastern Alabama, northwest Florida, and central and western Georgia. About 74 percent of the ACF basin lies in Georgia, 15 percent in Alabama, and the remaining 11 percent in Florida. The basin extends approximately 385 miles from the Blue Ridge Mountains to the Gulf of Mexico and has an average width of approximately 50 miles. The basin covers 50 counties in Georgia, 8 counties in Florida, and 10 counties in Alabama.

The ACF system empties into the Gulf of Mexico. The main tributaries of the basin are the Chattahoochee and Flint Rivers. These tributaries merge at Lake Seminole to form the Apalachicola River near the State lines of Florida and Georgia. The Apalachicola River flows into the Gulf of Mexico at Apalachicola Bay.

The ACF basin is a dynamic hydrologic system containing interactions between aquifers, streams, reservoirs, floodplains, and estuaries. Water resources in the ACF basin have been managed to serve a variety of purposes, including navigation, hydroelectric power, flood control, water quality, fish and wildlife conservation, water supply, and recreation. There are 16 reservoirs on the main stems of the ACF Rivers (5 federal and 11 non-federal projects), which have altered the natural stream flow and provided potential for water supply improvements and recreational opportunities for the public in addition to other project purposes in these resource areas. The interrelationship between operation of the dams and the resulting river flows has resulted in a highly regulated system over much of the basin. The principle rivers, particularly in the lower half of the basin, receive a substantial contribution of water from groundwater baseflow during dry times (Comprehensive Water Resources Study Partners, 1995).

The ACF basin is characterized by a warm and humid, temperate climate due to its latitude, altitude, and proximity to the Gulf of Mexico. Average annual temperature ranges from about 60^{o} Fahrenheit (F) in the north to 70^{o}F in the south. Average daily temperatures in the ACF basin range from about 40 to 50^{o}F in January to 75 to 80^{o}F in July. Summer temperatures are typically in the 70s to the 90s. Freezing temperatures in winter occur for only short periods (USGS, 1996).

Precipitation is highest at the north end of the basin in the mountains and at the south end of the basin near the Gulf of Mexico. Average annual precipitation is about 60 inches per year at both the north and south ends of the basin. The east-central part of the basin receives less precipitation, with an annual average of 45 inches (USGS, 1996). Precipitation varies substantially on an annual basis, however. Precipitation is generally highest in late winter and early spring, and then again in mid- to late summer, when tropical depressions and tropical storms occasionally track up the basin.

Over half the water that falls as precipitation in the ACF basin is returned to the atmosphere as evapotranspiration (direct evaporation plus transpiration by plants). Evapotranspiration ranges from about 32 to 42 inches of water per year in the ACF basin, generally increasing from north to south (USGS, 1996). Average annual runoff basinwide ranges from 12 to 40 inches (or about 25 to 65 percent of average annual precipitation). Runoff is greatest in the Blue Ridge Mountains and near the Gulf coast (USGS, 1996).

The Corps operates five dams in the ACF River Basin: (in downstream order) Buford, West Point, George, Andrews, and Woodruff. All are located wholly on the Chattahoochee River arm of the basin except the downstream-most dam, Woodruff, which is located immediately below the confluence of the Chattahoochee and Flint rivers and marks the upstream extent of the Apalachicola River. Andrews is a lock and dam without any appreciable water storage behind it, but Buford, West Point, George, and Woodruff dams are impound reservoirs (Lakes Lanier, West Point, George, and Seminole, respectively) with a combined conservation storage capacity (relative to the top of each reservoirs' full summer pool) of about 1.6 million acre-feet (1,049,400 acre-feet at Lanier; 306,100 acre-feet at West Point, and 244,000 acre-feet at W.F. George). Because Jim Woodruff Dam/Lake Seminole is operated as a run-of-river project, only very limited storage is available for support of project purposes. For about half of its length, the Chattahoochee River forms the boundary between Georgia and Alabama. Lake Seminole straddles the boundary between Florida and the southwest corner of Georgia.

The ACF system of reservoirs are operated to provide for the authorized purposes of flood control, fish and wildlife conservation, navigation, hydroelectric power, water supply, water quality, and recreation. In order to provide for the authorized project purposes of navigation, certain fish and wildlife needs, hydroelectric power, certain water supply needs, recreation, and water quality; flow must be stored during wetter times of each year, and released from storage during drier periods of each year. Traditionally this means that water is stored in the lakes during the spring, and released for authorized project purposes in the summer and fall months. In contrast, some authorized project purposes such as lakeside recreation, water supply, and lake fish spawn are achieved by retaining water in the lakes, either throughout the year or during specified periods of each year. The flood control purposes at certain reservoirs requires drawing down reservoirs in the fall through winter months to store possible flood waters and refilling of pools in the spring months to be used for multiple project purposes throughout the remainder of the year. The conflicting water demands on the system require that the Corps operate the system in a balanced operation in an attempt to meet all authorized purposes, while continuously monitoring the total system water availability to insure that minimum project purposes can be achieved during critical drought periods. In order to help do this, the Corps has defined four (4) Action Zones in each of the major ACF storage projects of Buford, West Point, and Walter F. George. Action Zone 1 is the highest in each lake, and defines a reservoir condition where all authorized project purposes should be met. As lake levels decline, Action Zones 2 through 4 define increasingly critical system water shortages, and guide the Corps in reducing flow releases as pool levels drop as a result of drier than normal or drought conditions. The Action Zones also provide a guide to the Corps to help balance the remaining storage in each of the three major storage reservoirs. The following describe each of the authorized project purposes in more detail:

1. Flood Control. Flood control is achieved by storing damaging flood waters, thus reducing downstream river levels below that which would have occurred without the dams in place. Of the five (5) Corps reservoirs, only the Buford (Lake Lanier) and West Point projects were designed with space to store flood waters. In addition to providing for space above the conservation pool to hold flood waters throughout the year, the Buford project is drawn down one (1) additional foot, and the West Point project is drawn down at least seven (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.

2. Fish and Wildlife Conservation. In addition to providing for minimum flow and water quality releases, the Corps operates the system to provide favorable conditions for annual fish spawning, both in the reservoirs and the Apalachicola River. In most water years (1 October – 30 September) it is not possible to hold both lake levels and river stages at a steady or rising level for the entire spawning period, especially when upstream lakes and/or the Apalachicola River spawning periods overlap. During the fish spawning period for each specific water body, the goal of the Corps 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, the Corps consults with the State fishery agencies and the USFWS on balancing needs within the system and minimizing the impacts of fluctuating lake or river levels. These fish spawn operations were incorporated into a draft Mobile District Standard Operating Procedure (CESAM SOP 1130-2-9) in February 2005, following consultation since 2002 with USFWS and state fishery management agencies from Alabama, Florida and Georgia. In addition to fish spawn, the Corps has been in Informal Consultation with the USFWS since 2000, and entered into Formal Consultation on March 7, 2006 regarding the federally-listed Gulf sturgeon and protected mussel species (fat threeridge, purple bankclimber, and Chipola slabshell) in the Apalachicola River. The Corps and the USFWS have agreed since 2004 to implement a low flow operations protocol for the Apalachicola River similar to a “run-of-river” operation. The low flow operations protocol attempts to mimic the hydrologic conditions of a natural flow regime during low flow conditions and thereby minimizes impacts to Gulf sturgeon or protected mussels that occur on the Apalachicola River from falling river stages and discretionary reservoir operations. The low flow operations protocol is implemented whenever it appears that flows on the Apalachicola River are falling or predicted to fall below the levels identified as necessary to support Gulf sturgeon spawning. The low flow operations protocol instituted in 2004 included ensuring that releases to the Apalachicola River approximated or exceeded inflows into the basin whenever basin inflows approached 21,000 cfs or lower during the Gulf sturgeon spawning period. It was also recognized that some reservoir storage should be conserved in the spring months during sustained dry periods in order to provide sustained augmentation flows in support of the needs of protected mussel species during the later summer and fall months, which are typically the driest part of the year. The low flow operations protocol was also implemented when flows approached levels less than 8,000 cfs later in the year in order to minimize the impacts to

the mussel species. Following continued consultation with USFWS, the low flow operations protocol was incorporated into the IOP describing operations in support of endangered and threatened species in early 2006, and included in the request dated 7 March 2006 to initiate formal consultation with the USFWS pursuant to the Endangered Species Act. A final Biological Opinion (BO) for the Jim Woodruff Dam IOP was issued by the U.S. Fish and Wildlife Service, Panama City Field Office on 5 September 2006, and incorporated additional modifications to the IOP in order to avoid or minimize incidental take of listed mussels. This BO included five reasonable and prudent measures (RPMs) for further limiting the amount of incidental take associated with water management operations at Jim Woodruff Dam. For each of the five RPMs, the BO also included specific terms and conditions which must be met in order to assure compliance with the RPMs. The current IOP was developed in accordance with RPM3 of the BO, which required modifying the IOP to provide a higher minimum flow to the Apalachicola River when reservoir storage and hydrologic conditions permit. By letter dated 26 January 2007, an extension was requested until 28 February 2007 to develop the RPM3 drought provision; and by letter dated 2 February 2007, the USFWS approved the extension. On 16 Feburary 2007, the Corps submitted the proposed RPM3 drought provision to the USFWS. In a letter dated 28 February 2007, the USFWS approved immediate implementation of the EDO in accordance with the provisions of RPM3 of the BO. On 8 March 2007, a Finding of No Significant Impact (FONSI) was signed for the RPM3 drought provision modification of the IOP and operations at Jim Woodruff Dam have been implemented accordingly since that time.

Consistent with the operational decisions approved in the September 2006 BO, the current IOP also includes a volumetric balancing of releases in cases where storage is used to follow the ramping rates specified in the IOP. Following rain events, the required ramping rates are often more gradual than the actual decline in basin inflows, and potential over-releases and additional drain on reservoir storage could occur, especially when trying to match releases to the computed 7-day average basin inflow. In order to avoid over-releases and conserve storage during critical periods, the volume of releases can be balanced during and following rain events. Releases after the rainfall events are adjusted to account for any computed under-release or over-release, to assure that net releases are balanced to meet the computed volume of basin inflow over time. The volumetric balancing computations do not include releases for flood control or other special releases not prescribed by the IOP, but primarily account for possible over-releases that occur due to the ramping rate restrictions. Due to a significant credit accumulating in the Corps volumetric balancing account since September 2006 (attributable to down ramping) and subsequent volumetric balancing activities in April 2007, the Corps and USFWS mutually agreed to improvements in the tracking procedures that more clearly address the goals of volumetric balancing were needed, i.e. generally assure required releases are made while recognizing the complexities of water management. Therefore, by letter dated 16 May 2007 the Corps submitted documentation of these clarifications to the volumetric balancing accounting system that simplified a complex computation procedure and refined the decision and accounting system to more clearly demonstrate the impacts on storage and whether releases meet the IOP flow releases schedule.

The IOP was developed in consultation with the USFWS to provide for releases in support of federally listed species on the Apalachicola River, consistent with the requirements of the current water control plan (1989 Draft Water Control Plan for the ACF Basin). During development of the IOP it was agreed that HEC-5 hydrologic modeling data for the 1939-2001 period would be used to analyze the impact of the IOP on listed species. The results of this analysis indicated that the IOP would manage composite storage in the federal reservoirs in a manner that met the needs of consumptive demands and minimum releases through the worst drought of record (1999-2001 drought representing the critical period). However, in the current year (2007) throughout much of the ACF Basin various precipitation and drought indices have reached record lows and reservoir elevations at the federal projects are lower than were observed or simulated with the IOP in place during this time of year for the critical period evaluated.

Throughout the summer of 2007 the Corps has monitored the composite storage within the system and the forecast of an exceptionally severe and long lasting drought. In early September 2007 the Corps and USFWS began informal consultation discussions regarding the potential need to modify the IOP to allow temporary deviations due to the extraordinary drought conditions occurring in the ACF Basin and the likelihood of these conditions persisting throughout the remainder of this year and the following year. As discussed between the Corps and USFWS, in conformance with the Draft Water Control Plan (1989) for the ACF Basin and the provisions of the IOP, the Corps has been releasing a minimum flow of at least 5,000 cfs from Jim Woodruff Dam since late May 2007. The 7-day basin inflows during this same period were considerably lower than 5,000 cfs for substantial periods (average approximately 2,500 cfs during July - September) resulting in a substantial reduction in storage from the upstream reservoirs. In mid October, the Corps informed USFWS that recent 7-day basin inflows were averaging less than 2,000 cfs and that the composite storage for the system was in Zone 4 (lowest zone) and projected to continue to drop significantly over the next 30-60 days. Lake Lanier was the only federal reservoir within the ACF basin with conservation storage remaining to support downstream water users and the 5,000 cfs minimum flow and the extremely dry conditions were resulting in rapidly declining availability of this storage. Due to the likelihood of current conditions continuing through the end of this year and into the winter and spring of 2008, and only a limited amount of conservation storage being available to support the 5,000 cfs minimum flow, it was mutually agreed to consider immediate measures to reduce the continuing drawdown of Composite Storage and to maintain the Corps' ability to serve the various authorized project purposes for the federal reservoirs including fish and wildlife conservation.

During these discussions, it was determined that some of the drought contingency measures under consideration (such as the EDO) would require further evaluation and consultation discussion, but certain measures could be implemented immediately without causing adverse effects to the listed species. Therefore, both agencies agreed on 17 October 2007 to use volumetric balancing credits to allow storage of inflows greater than 5,000 cfs (storage volume limited to account balance) in the event of rainfall within the basin. Also, by letter dated 19 October 2007, the Corps requested a temporary modification of the IOP consisting of an immediate suspension of the maximum fall rate schedule until 1 March 2008. As described in the letter, elimination of the down-ramping provision would improve our ability to conserve storage to the maximum extent practicable. The Corps determined that temporary suspension of the maximum fall rate schedule may affect, but was not likely to adversely effect the threatened Gulf sturgeon, endangered fat threeridge mussel, threatened purple bankclimber mussel, and threatened Chipola slabshell; and would not result in destruction or adverse modification of habitat designated and proposed as critical habitat for the Gulf sturgeon and the mussels. By letter dated 19 October 2007 the USFWS concurred with this determination and approved the immediate suspension of the maximum fall rate schedule until 1 March 2008. The EDO incorporates this modification, among others, in order to reduce the continuing drawdown of Composite Storage and to maintain the Corps' ability to serve the various authorized project purposes for the federal reservoirs including fish and wildlife conservation.

3. <u>Navigation</u>. 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. Conditions on the Apalachicola River have been such in recent years that a 9-foot deep channel has not been available for much of the year. Due to deteriorating channel conditions and limited channel availability during the low flow months, navigation windows were routinely scheduled during the low flow months in the 1990s. Navigation windows were comprised of storing water in the upstream reservoirs for several weeks, and then making increased releases for a 10-day to 2-week period to allow commercial barge navigation to make a round-trip up river for scheduled delivery of commodities. Concerns were raised regarding the fluctuations of both reservoir and river stages associated with navigation window releases, and the continued use of navigation windows became increasingly controversial, especially during sustained low flow periods when observed fluctuations were more extreme. As a result of fluctuating river stages during navigation windows, gradual ramping rates were developed in coordination with the USFWS and Florida Fish and Wildlife Conservation Commission (FWCC), with the goal to provide for ramping down rates of not more than ½ foot per day during fish spawn activities, and no more than one foot per day during other periods of the year, whenever flows were below 20,000 cfs. The last navigation window was provided in the spring of 2000, and precipitated complaints that the navigation window was scheduled during the period of fish spawn and had adversely impacted both reservoir and riverine fish spawn activities. No navigation windows have been scheduled since that time, and none are planned in the foreseeable future. Dredging on the Apalachicola River also was reduced since the 1980s due to a lack of adequate disposal area capacity in certain reaches of the river. No dredging was conducted in 2000 or 2002 due to sustained drought conditions in the basin, and only very limited dredging was conducted in 2001, and then shutdown, due to sustained low flow conditions. No dredging has been conducted since that time, for a variety of reasons related to flow or funding levels, and currently has been indefinitely deferred due to denial of a Clean Water Act (CWA) Section 401 water quality certificate from the State of Florida and recent congressional language that limits funding for dredging operations in the ACF basin. The lack of dredging and routine maintenance has led to inadequate depths in the

Apalachicola River navigation channel, and commercial navigation has only been possible on a seasonal basis when flows in the river are naturally high, with flow support for navigation suspended during drier times of the year. On a case-by-case basis, limited releases for navigation have been made for special shipments when a determination can be made that other project purposes will not be significantly impacted and any fluctuations in reservoir levels or river stages would be minimal.

4. Hydroelectric Power. The Buford, West Point, Walter F. George, and Jim Woodruff projects include hydroelectric power plants as part of those projects. The total generation capacity of these four (4) ACF plants is 336 megawatts. Through the Department of Energy's Southeastern Power Administration (SEPA), these power plants provide power to over 300 preference customers throughout the Southeastern United States. In 2005, the ACF hydroelectric power plants generated nearly 1.1 million megawatt-hours, enough electricity to supply approximately 110,000 households in the region. In 2006 the same power plants generated approximately 717, 178 megawatt-hours which supplied approximately 70,000 households. The decrease in generation was due to a combination of equipment outages and sustained drought conditions. 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 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. Hydropower peaking involves increasing the discharge for a few hours each day to near the full capacity of one or more of the turbines. 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 may be eliminated or limited to conjunctive releases during severe drought conditions.

The main hydropower units and small house unit intakes at Buford Dam/Lake Lanier are located at elevation 919 feet above mean sea level (msl). However, severe cavitations occurs in the main hydropower units when the water surface falls to 1035 ft msl 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 1020 ft msl or below.

Because it does not have the ability to store appreciable amounts of flow, the Jim Woodruff plant is operated as a "run-of-the-river" plant where inflows are passed continuously and electricity is generated around the clock. The current IOP, includes a limited hydropower peaking operation at Jim Woodruff Dam when daily average releases are less than the combined capacity of the powerhouse turbines (about 16,000 cfs) in order to deliver extra power during hours of peak demand for electricity. These peaking releases are included in the daily average discharge computations for the IOP minimum flow provisions. The peaks are also included in the stage computations for the IOP maximum fall rate schedule; however, the maximum fall rate schedule addresses the difference between the average river stage of consecutive calendar days, not the shorter-term differences that result from peaking operations within a calendar day. The relative drop in river stage from the peak to the base release will vary with different flows, but becomes more pronounced as flows decline, typically not more than 2.5 foot fluctuation per day above the base flow. The current IOP includes a provision that discontinues peaking operations at the Jim Woodruff plant as average daily releases approach 6,000 cfs, in order to maintain instantaneous releases greater than or equal to the 5,000 cfs minimum flow requirement.

5. Water Supply. Various municipal and industry (M&I) entities withdraw water directly from Lake Lanier and others withdraw directly from the Chattahoochee River downstream of Lake Lanier. Water releases to the Apalachicola River are also impacted by agricultural water withdrawals on the Flint River. Agricultural demands vary depending on the climatic conditions, but are generally 1.5 to 2 times the withdrawals for M&I (USFWS 2006). Water withdrawals within the State of Georgia are made pursuant to water withdrawal permits issued by the Georgia Department of Natural Resources. Previous water supply contracts issued by the Corps for withdrawals from Lake Lanier expired by 1990 and have not been re-issued. The Water Supply Act of 1958 provides authority for reallocation or addition of storage within Corps reservoirs for water supply, with the cost of storage and associated facilities to be reimbursed by a non-Federal entity via water storage contracts. No storage within the ACF projects is currently allocated to water supply, although there is currently a proposal being considered by the Corps to enter into interim water storage contracts at Lake Lanier for several municipalities and local governments, pursuant to the Southeastern Federal Power Customers, Inc. settlement agreement (1:00CV02954–TPJ), with the potential for the interim water storage contracts to roll over to permanent reallocation storage contracts in the future. The Mobile District has published in the Federal Register on 16 June 2006 a notice of intent to prepare an environmental impact statement (EIS) to address the proposed interim storage contracts. The EIS will address the impacts of the proposed interim storage contracts at Lake Lanier and any changes to project operations at Lake Lanier or the downstream projects required for implementation of the interim storage contracts.

As a result of significantly reduced inflows to the ACF Basin and continued releases necessary to meet minimum flow requirements downstream, there is concern that Lake Lanier may deplete its conservation storage if severe drought conditions continue through the end of the year and into 2008. Even if conservation storage is depleted, over 40% of Lake Lanier's water is located in the "inactive" storage zone (below elevation 1035 msl) and could support water supply and certain other critical water requirements in the system.

Gwinnett County has multiple elevation intakes ranging from 1062, 1045, and 1025, and has withdrawn from the 1025 intake (within the inactive storage zone) for many years.

City of Cumming intakes range from elevation 1053 down to 1032, but the lowest intake is in a "hole" surrounded by lake bottom at elevation 1045. They are currently making adjustments to that intake that should allow withdrawals down to elevation 1032.

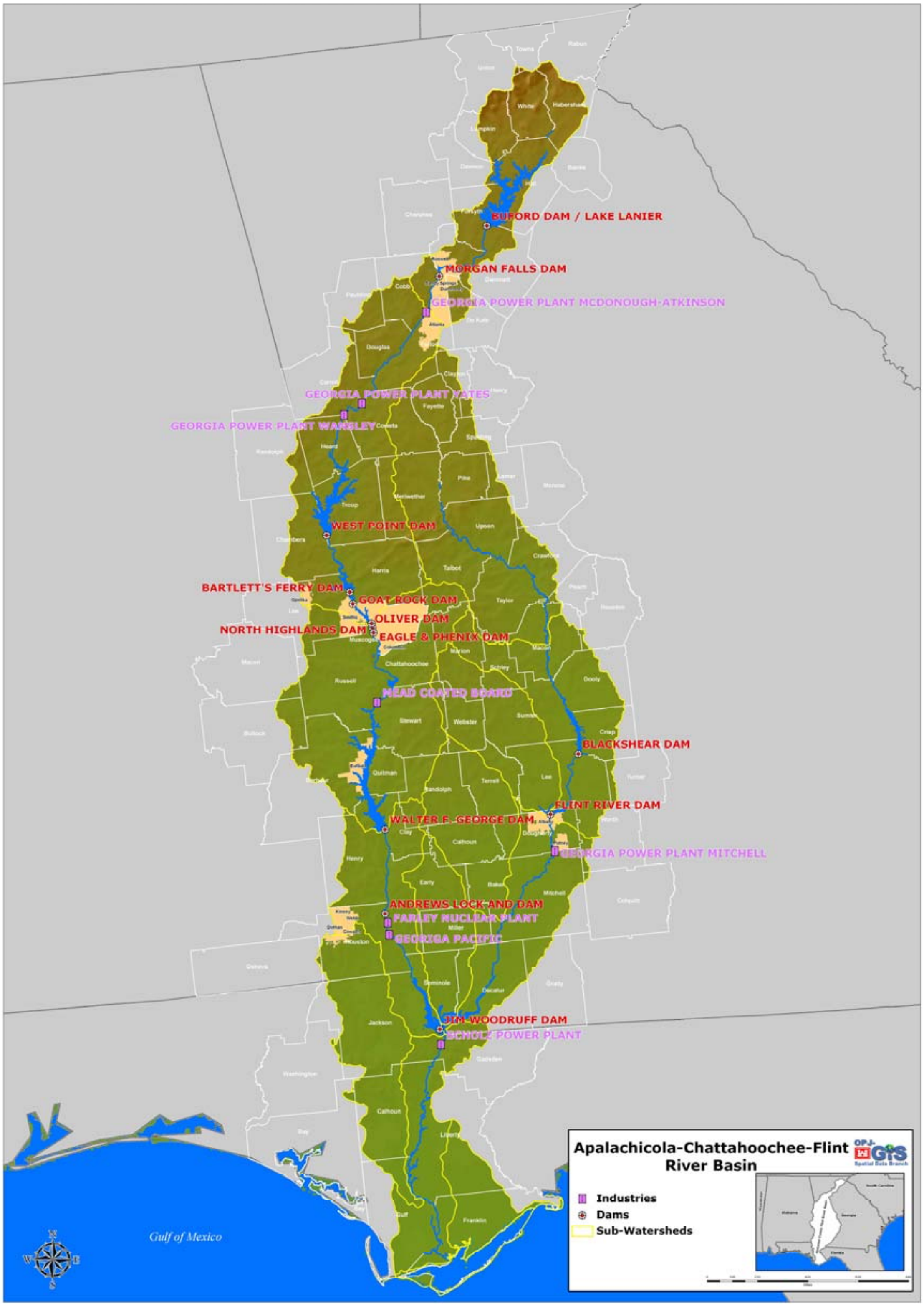
City of Buford intakes are at elevations 1062, 1052, 1042, and 1032. The 1032 intake did have some sediment buildup around it, but that has been removed so that the intake is functional if needed.

City of Gainesville has three intake structures, each with multiple intake ports ranging from elevation 1063 down to 1025 (within the inactive storage zone).

Releases through Buford Dam to the Chattahoochee River currently draw from the inactive storage zone (releases from the hydropower units and the sluice gates), and these release waters make up the Chattahoochee River that flows downstream to the Atlanta area municipal water intakes downstream. Releases from Lake Lanier also support a number of other downstream M&I water supply needs including City of LaGrange , City of West Point, City of Columbus as well as a number of industries shown in Figure 3

Flow releases also support cooling water withdrawals for several industries including critical power plants, such as the Farley Nuclear Plant which requires a minimum elevation of 74.5 ft msl and the Plant Scholz located immediately downstream of Jim Woodruff Dam which requires a minimum flow of 5,000 cfs but can temporarily operate at water elevation of 37.5 ft msl (equivalent to flows of 4200 cfs).

Figure 3 – Municipal and Industries in the ACF basin



6. Water Quality. Buford, West Point, and Jim Woodruff dams all provide continuous flow releases. Walter F. George has no such minimum flow provision; however, when low dissolved oxygen (DO) values are observed below the dam, spillway gates are opened until the DO readings return to an acceptable level. Occasional special releases are also made at Buford to insure adequate DO and water temperature at the Buford Fish Hatchery located downstream of the dam. Additionally, self-aspirating turbines were recently installed at Buford to improve DO levels downstream. At Buford Dam the small turbine-generator is run continuously to provide a minimum flow from the dam which ranges up to approximately 600 cfs. At West Point Dam, a similar 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 Georgia Power Dam at Morgan Falls to insure a minimum instream flow of 750 cfs on the Chattahoochee River at Peachtree Creek to meet State water quality commitments. Currently a 5,000 cfs minimum flow is maintained as a release from the Jim Woodruff Dam to the Apalachicola River, which assures an adequate water supply for downstream industrial use. No water quality problems below Jim Woodruff Dam have been identified in the Apalachicola River in association with project operations. However, the extraordinary drought conditions experienced during much of the IOP implementation period, have resulted in salinity changes in Apalachicola Bay and increased water temperatures and associated localized dissolved oxygen changes due to extended periods of low flow (approximately 5,000 cfs).

Although there is no Corps requirement to maintain minimum flows for assimilative capacity at Columbus, GA, the Georgia Power Projects above Columbus are required in their Federal Energy Regulatory Commission (FERC) licenses to provide 1850 cfs weekly average, 1350 cfs daily average, and 800 cfs instantaneous minimum flow at Columbus. Releases from the Georgia Power Project are dependent on upstream releases from West Point Dam. Georgia Pacific and Farley Nuclear Plant located below George W Andrews Dam have stated a requirement of 2,000 cfs for assimilative capacity needs.

The Florida Department of Environmental Protection (FDEP) has been monitoring salinity levels at several locations in the Apalachicola Bay system throughout the year. Preliminary data provided by USFWS (J. Ziewitz, pers. comm.) provides some insight into the impact of this year’s extended low river flow on salinity levels in the bay. Dataloggers located at Cat Point (an oyster bar on the western end of St. George Sound), Dry Bar (an oyster bar on the eastern end of St. Vincent Sound), and Upper East Bay (the northeastern end of East Bay) continuously (15 minute intervals) collected data throughout the summer. All of these locations occur in areas Livingston (1984) characterized as brackish. Preliminary data indicates that all three locations experienced relatively high salinity levels throughout the recording period (July – September 2007). The Cat Point data indicates salinity levels generally in the range of 23-33 ppt; the Dry Bar data indicated salinity levels generally in the range of 24-35 ppt; and the Upper East Bay data indicated salinity levels generally in the range of 14-23 ppt. This data is consistent with anecdotal information provided by the Shellfish Group at the Florida Department of Agriculture, which observed significant oyster mortality, beginning in late

March, in the western portions of the bay and spread eastward throughout the summer to areas closer to the mouth of the river (Cat Point). They attribute this mortality to dermo (disease) and predation which is exacerbated by the high salinities and high water temperatures which are also attributed to the lack of fresh water flows from the river that cool down the bay (J. Ziewitz, pers. comm.).

Although we do not have water temperature or DO data from this year, it is reasonable to assume that the maintenance of an approximately 5,000 cfs flow in the Apalachicola River for an unprecedented duration (generally from late May to present) during the hottest months of the year has resulted in increased water temperature and localized declines in DO. The most extreme examples of this would occur in shallow backwater areas with little or no connection to the main channel of the river and in shallow isolated pool habitat occurring in distributaries that no longer have a hydrological connection to the main channel of the river (eg., Swift Slough). It should be noted that the exceptional drought conditions would have resulted in "natural flows" less than 5,000 cfs if the storage from the upstream reservoirs had not been used to augment basin inflow in order to maintain the 5,000 cfs minimum flow.

According to the FDEP Notice of Intent for FDEP Permit No. 0129424-001-DF (3 December 1998), the majority of the Apalachicola River is designated as Class III waters, which support the designated uses of recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Apalachicola River is also designated as an Outstanding Florida Water (waters of exceptional recreational or ecological significance). Seasonal flooding of the Apalachicola River provides freshwater flows and significant quantities of nutrients and organic matter to the Apalachicola Bay estuary, which are necessary to maintain salinity gradients and support biological productivity within the estuary.

USGS has recorded water temperature intermittently at the USGS Apalachicola River gage near Chattahoochee, FL. Records were available from 1974-1978 and 1996-1997; however, water temperatures were not available for all of the days in each year. Analysis of this data indicates mean daily water temperatures range from 11^{o} Celsius (C) in the winter to 30^{o} C in the summer

As described in the September 2006 BO, although the State standards adopted consistent with the U.S. Environmental Protection Agency (EPA) criteria generally represent levels that are safe for sturgeon and mussels, these standards are sometimes violated. Point and non-point source pollution have contributed to impaired water quality in the Apalachicola and Chipola rivers resulting in several segments of the rivers within the action area failing to fully serve the designated uses. The impairments identified include turbidity, coliforms, total suspended solids, dissolved oxygen (DO), biology, and unionized ammonia (FDEP 1998 and 2003). Elevated coliform bacteria counts are not known to harm Gulf sturgeon or freshwater mussels; however, elevated unionized ammonia and low DO are associated with adverse effects to fish and mussels (USFWS 2006). The 5-Year Review for seven listed mussel species (including the three occurring in the action area) published by the USFWS this summer states that recent studies have demonstrated early life stages of mussels are generally more sensitive to copper and ammonia than other organisms and that current EPA criteria for copper and ammonia are not protective of mussels (USFWS 2007). The 5-Year Review also notes that these early life stages may be particularly sensitive to pesticides and herbicides such as glyphosate and atrazine (USFWS 2007). Mercury-based fish advisories apply to one or more segments of both watersheds, and organochlorine pesticides were found at levels in ACF Basin streams that often exceeded chronic exposure criteria for the protection of aquatic life (FDEP 2002; Frick et al. 1998).

The Apalachicola River is a fast flowing river that is turbid due to the load of suspended floodplain materials and upstream agricultural runoff. Point and non-point source pollution has also contributed to impaired water quality in the Apalachicola River and Chipola River in the project area. Predominant land uses in the drainage area of the Apalachicola River in Florida include upland forests (53.5 percent), wetlands (30.5 percent), agriculture (8.4 percent), and urban/built-up (2.1 percent). The North West Florida Water Management District (NWFWMD) has completed a study of 12 watersheds in the Apalachicola drainage basin to determine relationships between land use and water quality (Thorpe et al. 1998). Very few water quality differences were noted between silviculture-dominated and naturally forested watersheds. Agriculture-dominated watersheds showed higher loading than natural and silviculture rates for a number of nutrients, such as unionized ammonia, nitrate-nitrogen, total nitrogen, and total phosphorus (Thorpe et al. 1998).

We lack sufficient information to determine if implementation of the IOP has altered the baseline water quality of the action area. However, we recognize that the extraordinary drought conditions experienced during much of the IOP implementation period, have resulted in salinity changes in Apalachicola Bay and increased water temperatures and associated localized dissolved oxygen changes due to extended periods of low flow (approximately 5,000 cfs).

7. Recreation. The ACF basin contains approximately 2 million acres of public lands and resource protection areas including heavily used federal reservoirs, national forests, national and state parks, and resort communities. The five Corps projects in the basin account for 235,291 total acres of land and water. A wide variety of recreational opportunities are provided at these lakes including boating, fishing, picnicking, sightseeing, water skiing, and camping. These reservoirs support popular sport fisheries, some of which have achieved national acclaim for trophy-size catches of largemouth bass.

Recreation in the Apalachicola River is based primarily on its warm water fishery. Bass, sunfish and catfish are the preferred game species. Public and private land holdings are located throughout the Apalachicola River basin. Significant portions of the Apalachicola River floodplain are owned and managed as natural resource areas by the NWFWMD; the Florida Fish and Wildlife Conservation Commission (FWCC) (Lower Apalachicola River Basin Environmentally Endangered Lands); U.S. Forest Service (Apalachicola National Forest); Florida Department of Environmental Protection (Three

Rivers State Recreation Area, Torreya State Park and the Apalachicola National Estuarine Research Reserve); and The Nature Conservancy (Apalachicola Bluffs and Ravines Preserve, "Garden of Eden"). These publicly held lands include wildlife management areas, reserves, refuges, forests, state parks, recreation areas, conservation lands and special feature sites that are used for hunting, as well as non-consumptive recreational uses such as hiking, nature study, and picnicking.

Apalachicola Bay is part of the Apalachicola National Estuarine Research Reserve and thus provides educational and recreational opportunities as well.

All of the Corps lakes have become important recreational resources on the ACF system. Of these projects, Lake Lanier (Buford Dam) is one of the most visited Corps lakes in the entire United States. The West Point and Walter F. George lakes also rank among the top ten most visited Corps lakes in the United States. Park attendance has been relatively stable at most lakes (Table 1). The exception has been at West Point Lake, Walter F. George Lock and Dam and the Apalachicola and Flint Rivers. West Point Lake experienced a slight decline in attendance in FY07 as did the Apalachicola and Flint Rivers. Walter F. George has experienced alternating years of increase and decline since fiscal year 2002 (FY02).

Table 1 – Annual Park Visitation on the four reservoirs

Annual Park Visitation by Lake

	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007
BUFORD DAM -	7,359,181	7,697,482	7,698,005	7,725,328	7,552,119	7,738,041
WEST POINT LAKE	2,620,642	2,691,920	2,947,170	3,199,052	3,300,836	3,200,083
WALTER F GEORGE LOCK AND DAM	4,397,237	4,384,766	4,423,694	3,693,899	4,340,890	3,792,794
APALACHICOLA CHATTAHOOCHEE AND FLINT RIVERS	252,967	253,289	304,412	269,801	241,980	231,869

In 2007, virtually all marinas have experienced some degree of recreational reductions due to declining water levels. The Corps owned boat launches have also experienced a noticeable reduction in accessibility (Table 2). Nearly all swimming areas have been closed this year.

Table 2- Boat Ramp Availability at the four reservoirs and ACF Rivers.

Boat Ramp Availability

	Total Number of Ramps	Ramps Open	Marginal Ramps
Buford Dam	40	2	1
West Point Lake	27	5	1
ACF (Walter F George, ACF, Seminole)	25	16	4

***Availability as of 14 November 2007**

A wide variety of recreational opportunities are provided at the lakes including boating, fishing, picnicking, sightseeing, water skiing, and camping. The economic benefits of recreation at the lakes is significant resulting in visitor spending in 2005 of over $125 million at Lake Lanier, $36 million at West Point, and $111 million at Walter F. George. Recreation benefits are maximized at the lakes by maintaining full or nearly full pools during the primary recreation season of 1 May through 8 September. In response to meeting other authorized project purposes, lake levels can and do 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 (Table 3). The first impact level is generally characterized by marginal impacts to designated swimming areas, increased safety awareness regarding navigation hazards, minimal impacts to Corps boat ramps, and minimal impacts to private marina and dock owners. More substantial impacts begin to occur at the second impact level and continue as lake elevations drop due to drought conditions.

Table 3. Recreation Impact Levels

Corps Project	First Impact Level	Second Impact Level
Lake Lanier (msl)	1066	1063
West Pont (NGVD)	632.5	629
Walter F. George (NGVD)	187	185
Lake Seminole (msl)	76	NA

b. Significant Resource Description. As described above, the Corps operates the five federal reservoirs on the ACF as a system, and releases made from Jim Woodruff Dam reflect the downstream end-result of system-wide operations. Therefore, the significant resource description and associated impacts to significant resources sections will primarily focus on the resources in the Apalachicola River and Bay system downstream of the dam. However, a general discussion of the upstream reservoir resources (specifically those related to authorized project purposes) is included also.

1. Fishery Resources. The ACF reservoirs support popular sport fisheries, some of which have achieved national acclaim for trophy-size catches of largemouth bass. Important game species in the Federal reservoirs include crappie, largemouth bass, spotted bass, striped bass, walleye, white bass, gizzard shad, hybrid bass (striped bass-white bass hybrid), threadfin shad, bluegill, and redear sunfish.

Warm water fisheries characterize the Apalachicola River. The Apalachicola River and adjacent floodplain tributaries and distributaries support a remarkable assemblage of freshwater fish species from 22 taxonomic families. Over 180 species of fish have been documented from the river and bay system including eight anadromous species, four endemic species and seven introduced species (NERRS 2005). Anadromous fish species that utilize the river during part of their life cycle include the Gulf sturgeon, Gulf striped bass, Alabama shad, and skipjack herring. The Apalachicola River supports the last remaining native breeding population of the Gulf striped bass. The mouths of cool water springs and other off channel deep-water habitats are used as thermal refugia by the striped bass, and possibly by Gulf sturgeon and other fish species during warm water months. Entrenchment of the river has impacted access to a number of these important refuge areas, especially in the upper river. Approximately 80 to 85 percent of the freshwater fish species collected in the Apalachicola River are known to inhabit floodplain habitats. Numerous species are tolerant of still water habitats and low dissolved oxygen levels and utilize isolated floodplain ponds and disconnected stream segments in the floodplain during low water conditions. A number of other fish, including suspected host fish for the listed mussels, utilize the inundated floodplain during high water events as habitats for spawning, feeding, shelter from predators, or as nursery grounds (Light et al. 1998).

The Apalachicola Bay estuary is considered one of the most important commercial fishing resources in North America. The primary commercial fishery species in the estuary include American oyster, penaeid shrimp (brown, white, and pink shrimp), blue crab, and estuarine and marine fish species such as striped mullet, speckled trout, menhaden, red drum, flounders and sharks (NERRS 2005). The most abundant of the true estuarine fish species (resident throughout entire life cycle) in the bay estuary is the bay anchovy.

2. Essential Fish Habitat. The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) mandates designation and protection of essential fish habitat (EFH). EFH is defined as … "those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity." The designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities. The National Marine Fisheries Service (NMFS) has identified EFH habitats for the Gulf of Mexico in its Fishery Management Plan Amendments. These habitats include estuarine areas such as estuarine emergent wetlands, seagrass beds, algal flats, mud, sand, shell and rock substrates, and the estuarine water column. EFH in the project area includes the Apalachicola River/Bay system up to the limit of permanent fresh water. Species managed by NMFS under the Fishery Management Plan that occur in the area of influence for the project include red drum; gray snapper; brown, white, and pink shrimp; and Gulf stone crab.

3. Wildlife Resources. The wildlife assemblages found in the ACF basin vary greatly with the vegetative community, although some generalist species occur throughout the basin in a number of habitat types. Habitat types within the basin include mixed hardwood forests, rock outcrops, grasslands, longleaf pine-turkey oak sandhill communities, bottomland hardwood forests, and maritime communities.

The Apalachicola River floodplain provides natural habitat to a large number of rare, endangered and endemic plant and animal species. The highest species density of amphibians and reptiles in North America north of Mexico occurs in the basin. The Apalachicola River basin is home to more than 40 species of amphibians and 80 species of reptiles including the southern dusky salamander, the gopher frog, Barbour's map turtle (which is endemic to the Apalachicola River), Apalachicola kingsnake and eastern indigo snake (NERRS 2005). Mammals are also abundant within the basin and Apalachicola Bay. More than 50 species are found within the area including opossum, bats, shrews, mice, moles, voles, rabbits, foxes, weasels, black bears, mink, bobcats, coyotes, deer, feral pigs, bottlenose dolphin and the West Indian manatee (NERRS 2005).

The bay and surrounding drainage basin also provide some of the most important bird habitats in the Southeastern United States. Close proximity to the Mississippi flyway allows large numbers of birds (over 300 species have been recorded) from both the Midwest and the Atlantic Seaboard to utilize the area during migratory periods (NERRS 2005).

a. Aquatic Fauna: The Apalachicola River basin supports a high species density of aquatic vertebrates requiring freshwater to complete their lifecycles, including aquatic turtles, salamanders, frogs, snakes, and lizards and the American alligator. Invertebrates also comprise a significant percentage of the biomass in the Apalachicola River basin. Sixty species of snails and clams (Edmiston and Tuck 1987) and 15 species of crayfish (Couch et al. 1996) comprise a large percentage of wildlife food. Aquatic insects probably constitute the largest and most diverse group of aquatic invertebrates in the basin. However, research into the aquatic insects is limited and comprehensive data regarding taxa and habitat is not available. The Apalachicola River supports the largest number of endemic freshwater gastropods and bivalves and the largest percentage of endemics in a total mollusc population of any western Florida river drainage (Couch et al. 1996) including several federally listed threatened and endangered species.

As described above, Apalachicola Bay supports an important commercial fishery for American oyster, penaeid shrimp (brown, white, and pink shrimp), and blue crab. The bay accounts for approximately 90 percent of the oysters harvested in Florida. In addition to the commercial value of the oyster itself, the oyster reefs of the Apalachicola Bay estuary support numerous fish and aquatic invertebrates that are important components of the estuarine foodweb.

b. Terrestrial Fauna: The Apalachicola River basin supports habitats that range from xeric (such as sandhills and clayhills) to fully inundated. Because the basin exhibits a range of habitats and conditions, the Apalachicola River basin also supports a commensurate variety of terrestrial vertebrates and invertebrates.

4. Hydrology. The flow of the Apalachicola River has been altered over time to some degree by land use changes, reservoirs, and various consumptive water uses upstream of Jim Woodruff Dam. The first dam/reservoir completed among the Corps' ACF projects was Buford Dam/Lake Lanier, which began operations in 1956. Therefore the 27-year pre-Lanier flow record of the Apalachicola River's Chattahoochee gage from 1929 to 1955 is used to characterize the pre-impoundment flow regime. The Corps' full complement of ACF projects was not completed until October 1974, when operations of West Point Reservoir began. Therefore the post-West Point years, 1975 to 2005 (31 years) are used to characterize the full history of the present configuration of the Corps' ACF projects. prior to implementation of the IOP (USFWS 2006). Although the IOP attempts to mimic a natural flow regime, the flow of the Apalachicola River has been altered to some degree during the implementation period by provisions for storage of

basin inflow, augmentation to maintain the 5,000 cfs minimum flow, and consumptive water uses which affect the basin inflow calculation. Table 4 illustrates the average annual discharge statistics from the September 2006 BO for the pre-Lanier and post-West Point periods and the calculated average annual discharge for the September 2006-September 2007 period. Since the last column only includes one year of data, the mean value is the only statistic provided. The average annual flow prior to the construction of dams in the ACF basin is comparable to the average annual flow experienced during the post-West Point period. The average annual discharge value for the September 2006-September 2007 period is approximately half that observed in the other periods. This is a reflection of the severe drought conditions experienced during much of the past year. The USGS Apalachicola River discharge data (Chattahoochee gage) used to calculate the average annual discharge for the past year is considered provisional and is subject to change and final approval.

Average Annual Discharge Statistics

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Sep. 2006 - Sep. 2007*
Mean	21287.8	21677.3	10793.0
Median	20130.1	22283.0	
Standard Deviation	7387.5	6375.5	
Minimum	11223.2	9341.0	
Maximum	39579.6	35344.4	

Table 4. Average annual discharge statistics for the pre-Lanier (1922-1955), post-West Point (1975-2005), and September 2006-September 2007 periods.

The Apalachicola River experiences seasonal fluctuations in flow associated with rainfall levels. Peak flooding is most likely to occur in January, February, March, and April of each year. Low flow generally occurs in September, October, and November.

Tables 5-7 compare the distribution of monthly average flow in the pre-Lanier, post-West Point, and September 2006-September 2007 periods. The average monthly discharge values for the September 2006-September 2007 period are considerably lower than observed in the other periods. This is a reflection of the severe drought conditions experienced during much of the past year. The current water control plan requires a minimum flow of 5,000 cfs in the Apalachicola River provided by releases from Jim Woodruff Dam. The average monthly discharge values for the September 2006-September 2007 period would have been significantly lower if conservation storage had not been available to augment basin inflow to meet the 5,000 cfs minimum flow at Jim Woodruff Dam

Average Monthly Discharge Statistics

January

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Jan. 2007*
Mean	27136.5	26115.5	21307.3
Median	23432.3	21103.2	
Standard Deviation	13929.1	12772.9	
Minimum	10748.4	9035.8	
Maximum	62467.7	50896.8	

February

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Feb. 2007*
Mean	29599.1	34350.5	18930.8
Median	28658.6	33196.4	
Standard Deviation	13097.0	13916.8	
Minimum	11233.6	10423.2	
Maximum	64917.2	67314.3	

March

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Mar. 2007*
Mean	40474.2	40827.4	19452.2
Median	32764.5	44600.0	
Standard Deviation	29883.5	18693.5	
Minimum	12780.6	14573.2	
Maximum	171632.3	90332.3	

April

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Apr. 2007*
Mean	34332.5	31342.2	13525.9
Median	31423.3	27553.3	
Standard Deviation	16434.1	16694.8	
Minimum	16750.0	10884.7	
Maximum	80703.3	71786.7	

Table 5. Average monthly discharge statistics (January-April) for the pre-Lanier, post-West Point, and September 2006-September 2007 periods.

Average Monthly Discharge Statistics

May

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*May-07*
Mean	22921.6	20204.7	6855.9
Median	19938.7	17093.5	
Standard Deviation	9990.5	9890.8	
Minimum	9840.3	8325.8	
Maximum	44977.4	43038.7	

June

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Jun. 2007*
Mean	15918.6	16303.0	5148.7
Median	15633.3	14626.7	
Standard Deviation	5403.0	7079.8	
Minimum	7147.7	4825.7	
Maximum	27670.0	37116.7	

July

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Jul. 2007*
Mean	16959.1	18453.0	5350.3
Median	15587.1	12740.0	
Standard Deviation	7060.2	16550.7	
Minimum	9009.7	5116.8	
Maximum	37854.8	87780.6	

August

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Aug. 2007*
Mean	15660.5	14807.5	5138.3
Median	14977.4	12138.7	
Standard Deviation	5569.7	7844.1	
Minimum	8129.0	4750.0	
Maximum	29254.8	32348.4	

Table 6. Average monthly discharge statistics (May-August) for the pre-Lanier, post-West Point, and September 2006-September 2007 periods.

Average Monthly Discharge Statistics

September

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Sep. 2006*
Mean	12174.7	12390.1	6996.5
Median	12003.3	11605.7	
Standard Deviation	3669.0	4958.4	
Minimum	6092.0	5888.7	
Maximum	19716.7	28414.0	

October

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Oct. 2006*
Mean	11787.9	12346.1	6165.6
Median	10574.2	11325.8	
Standard Deviation	6540.8	5749.8	
Minimum	5319.4	5658.7	
Maximum	37509.7	30367.7	

November

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Nov. 2006*
Mean	12696.8	14214.2	12103.9
Median	9960.0	12723.3	
Standard Deviation	7129.3	6371.1	
Minimum	5524.0	5613.7	
Maximum	28990.0	31790.0	

December

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Dec. 2006*
Mean	19450.6	20585.6	9153.9
Median	14870.0	16793.5	
Standard Deviation	13794.5	12570.3	
Minimum	7990.6	7336.8	
Maximum	70393.5	51664.5	

Table 7. Average monthly discharge statistics (September-December) for the pre-Lanier, post-West Point, and September 2006-September 2007 periods.

Differences in monthly flow between the three periods are likely attributable to a combination of climatic differences, higher consumptive uses, and to some degree, reservoir operations. However, hydrologic patterns vary from year to year and may not conform to the seasonal trends during any given year. Table 8 compares the total annual precipitation (inches) for the pre-Lanier, post-West Point, and September 2006-September 2007 periods. The total annual precipitation for the September 2006-September 2007 period is approximately 10 inches less than the average observed in the other periods. This further supports the severity of the drought conditions experienced during much of the past year.

Total Annual Precipitation (Inches)

	Pre Lanier (1922-1955)	*Post West Point (1975-2005)*	*Sep. 2006 - Sep. 2007*
Mean	51.6	52.9	42.9
Median	49.3	52.9	
Standard Deviation	9.2	7.4	
Minimum	31.2	41.3	
Maximum	72.4	68.2	

Table 8. Total annual precipitation (inches) statistics for the pre-Lanier, post-West Point, and September 2006-September 2007 periods.

5. Floodplain/Wetlands. The Apalachicola River's 144,000-acre floodplain is alluvial, broad and flat. The expansive floodplain habitats adjacent to the Apalachicola River provide a source of nutrients to the Apalachicola River and Bay ecosystem, and provide important habitat for various fish species during flooded seasons. One hundred and twenty-one thousand acres are bottomland hardwood forests and tupelo-cypress swamps. Shrub swamps and seasonally flooded basins and flats are other wetland types within the Apalachicola River floodplain. Marsh habitat is restricted to the lower ten (10) miles of the floodplain. The species composition of the floodplain is dependent upon the flooding cycle and changes when the flood cycle is altered or interrupted for a significant period of time. Floodplain connection to the main stem and periods of inundation are important factors determining the makeup of the floodplain. Construction of the Corps reservoir system in the ACF basin has resulted in changes to the Apalachicola River floodplain, due to the degradation of the upper river channel following construction of the upstream dams, and a gradual deepening and widening of the river channel associated with the navigation channel construction and trapping of sediments in the upstream reservoirs. USGS has estimated the amount of adjacent floodplain habitat connected to the Apalachicola River at various flow levels; and has recently documented the gradual decline in river levels over time following construction of the dams (USGS 1998). According to USGS, channel degradation and erosion has apparently stabilized since the late 1970s, but spring and summer water levels continued to decline in recent decades because of seasonal decreases in flow from the upstream watershed. Less flow during the

spring and summer is likely caused by a combination of natural climatic changes and a variety of human activities in the ACF basin, including agricultural irrigation, M&I water use, flow regulation and reservoir evaporation (Light 2006).

Floodplain inundation during the growing season (generally April through October) is critical to the reproduction of many fish species, including some identified host species for the listed mussels. Analysis of the frequency and areal extent of growing-season (April through October) floodplain inundation in the pre-Lanier and post-West Point periods suggests that despite an increase in the annual duration of flows greater than 50,000 cfs during the post-West Point period, the frequency and extent of floodplain inundation during the post-West Point period is decreased relative to the pre-Lanier period, largely due to altered channel morphology. For example, 20,000 floodplain acres were inundated for 32 percent of the growing-season days in the pre-Lanier period, but for only 19 percent of the growing-season days in the post-West Point period (USFWS 2006).

Fish spawning in floodplain habitats requires periods of continuous inundation, because utilization of these floodplain habitats requires time for movement from the main channel into the floodplain, courtship and spawning behaviors, egg incubation, and juvenile growth to a size capable of moving to and surviving in the main channel when water levels recede. An analysis of the maximum floodplain acreage inundated for at least 30 days each year in both the pre-Lanier and post-West Point periods (using a 30-day moving minimum) suggests that inundated floodplain habitat availability during the post-West Point period is substantially less than the pre-Lanier period. In 50 percent of the pre-Lanier years, over 23,500 floodplain acres were inundated for at least 30 continuous growing-season days. The median for the post-West Point period is less than half this amount, about 11,000 acres (USFWS 2006).

During the September 2006-September 2007 period, the maximum discharge value recorded at the Chattahoochee gage was approximately 37,000 cfs and flows have remained near 5,000 cfs since late May 2007. The extraordinary drought conditions experienced during much of the IOP implementation period have resulted in impacts to the amount of floodplain inundated and the duration of inundation during the growing season.

6. Threatened and Endangered Species. In the September 2006 BO, the USFWS identified 37 threatened and endangered species (including critical habitat if designated or proposed) that occur in the ACF River Basin (Table 9), and determined that effects of the IOP are limited to those species that depend primarily on riverine habitat. Operations under the IOP were conducted within the boundaries of the existing water control plans for the upstream reservoir projects, and did not change the top of the flood control pools, conservation pools, or the rule curves of the upstream projects. Therefore, the IOP was determined to have no effect or an insignificant effect (*i.e.*, any impacts should never reach the scale where take occurs) on all but the riverine- and estuarine-dependent species. Only the federally threatened Gulf sturgeon and federally endangered fat threeridge, federally threatened purple bankclimber, and federally threatened Chipola

slabshell mussels and designated Gulf sturgeon critical habitat and proposed critical habitat for the mussels were identified as potentially being adversely affected by the IOP. Since the EDO is a temporary modification of the IOP, the species and critical habitat potentially adversely affected are the same as those identified for the IOP.

A description of the status and distribution of these species in the project area is provided below. Unless otherwise noted, the source for the threatened and endangered species information is the biological opinion and conference report on the IOP (USFWS 2006). Two species of sea turtles and the West Indian manatee may sometimes occur in Apalachicola Bay or the lower Apalachicola River; however, any effects of the EDO to these species would be insignificant also, due to their low numbers and only occasional seasonal residence in the river and bay. Three listed species of fresh water mussels occur in headwater areas upstream of the Corps' ACF projects: the shiny-rayed pocketbook, Gulf moccasinshell, and oval pigtoe. The EDO will have no effect on these mussels as they occur outside of the project area. Altogether, the EDO will have either no effect or an insignificant effect on the species listed in Table 9 and these are not further discussed in this environmental assessment.

Table 9. Species and critical habitat evaluated for effects from the EDO but not discussed further in this Environmental Assessment (USFWS 2006).

Species or Critical Habitat	
Flatwoods salamander (*Ambystoma cingulatum*)	Black-spored quillwort (*Isoetes melanospora*)
Loggerhead turtle (*Caretta caretta caretta*)	Pondberry (*Lindera melissifolia*)
Eastern indigo snake (*Drymarchon corais couperi*)	White birds-in-a-nest (*Macbridea alba*)
Atlantic ridley (*Lepidochelys kempi*)	Canby's dropwort (*Oxypolis canbyi*)
Piping plover (*Charadrius melodus*)	Godfrey's butterwort (*Pinguicula ionantha*)
Bald eagle (*Haliaeetus leucocephalus*)	Harperella (*Ptilimnium nodosum)*
Wood stork (*Mycteria Americana*)	Chapman's rhododendron (*Rhododendron chapmanii*)
Gray bat (*Myotis grisescens*)	Michaux's sumac (*Rhus michauxii*)
Indiana bat (*Myotis sodalis*)	Green pitcherplant (*Sarracenia oreophila*)
West Indian manatee (*Trichechus manatus*)	American chaffseed (*Schwalbea Americana*)
Shiny-rayed pocketbook (*Lampsilis subangulata*)	Florida skullcap (*Scutellaria floridana*)
Gulf moccasinshell (*Medionidus penicillatus*)	Fringed campion (*Silene polypetala*)
Oval pigtoe (*Pleurobema pyriforme*)	Gentian pinkroot (*Spigelia gentianoides*)
Little amphianthus (*Amphianthus pusillus*)	Cooley meadowrue (*Thalictrum cooleyi*)
Apalachicola rosemary (*Conradina glabra*)	Florida torreya (*Torreya taxifolia*)
Telephus spurge (*Euphorbia telephioides*)	Relict trillium (*Trillium reliquum*)
Harper's beauty (*Harperocallis flava*)	

<u>Gulf sturgeon</u>. Prior to completion of Woodruff Dam, Gulf sturgeon were known to migrate to the Flint (Swift *et al.* 1977; Yerger 1977) and Chattahoochee Rivers to spawn (U.S. Army Corps of Engineers 1978). The USFWS has monitored the Gulf sturgeon

subpopulation in the Apalachicola River since 1978. Gulf sturgeon have been documented in the main channel of the Apalachicola River from the Woodruff Dam downstream to its mouth, in Apalachicola Bay, and in various tributaries and distributaries to the main channel, such as the Brothers River. Since 1978 the USFWS has captured and tagged 1,515 Gulf sturgeon in the river, mostly in two areas: in the tailrace of Woodruff Dam (965 fish) and in the Brothers River (550 fish) (Wooley and Crateau 1985; Zehfuss *et al* 1999; Pine and Allen 2005). Gulf sturgeon have also been documented in Apalachicola Bay. The Apalachicola Bay is a highly productive lagoon-and-barrier-island complex that encompasses 54,910 hectares, including East Bay, St. George's Sound, Indian Lagoon, and St. Vincent Sound (Seaman 1988). There is very little data on Gulf sturgeon movements and habitat use in this enormous complex. In 1987, 1989, 1990, 1999, and 2000 the USFWS tracked sonic tagged Gulf sturgeon in Apalachicola Bay. Most of the tracking was limited to only a few hours per fish. Habitat preferences within the bay have not been determined.

Gulf sturgeon catch in the Apalachicola River in the early 1900s ranged from about 9,000 to 27,000 kg/year (U.S. Commission of Fish and Fisheries 1902; Huff 1975). The fishery declined to minimal levels by 1970 (Barkuloo 1987), and in 1984, the State of Florida prohibited all Gulf sturgeon fishing (Rule 46-15.01, Florida Marine Fisheries Commission). The Services (USFWS and NOAA) listed the species as threatened in 1991. Studies to estimate the size of the Gulf sturgeon population below Woodruff Dam have been conducted periodically since 1982. Researchers noted that Gulf sturgeon congregated in the area immediately downstream of Woodruff Dam during the summer months, with little movement out of area during their residency, which provided an opportunity for relatively unbiased population estimates using capture/recapture methods. Population sizes from these studies have ranged from a low of 62 fish in 1989 to 350 fish in 2004 (Wooley and Crateau 1985; Zehfuss *et al* 1999; USFWS Annual Reports 1983-2005). Recent monitoring of Gulf sturgeon suggests that sturgeon are selecting alternate summer habitats elsewhere in the system, such as the Brothers River. A number of telemetered sturgeon did not migrate upstream to Woodruff Dam in the spring of 2005, and instead entered the Brothers River, remaining there until the fall downstream migration.

The Gulf sturgeon population in the Apalachicola River appears to be slowly increasing relative to levels observed in the 1980's and early 1990's (Pine and Allen 2005).

Very little new sturgeon data is available since the time the IOP BO was signed. In spring 2007, Dr. Bill Pine collected Gulf sturgeon migration data in conjunction with an FWCC funded research study on fish movement and spawning patterns in the Battle Bend region of the Apalachicola River. The study included monitoring an array of several passive receivers located at strategic positions along the river to document movement patterns of 13 sturgeon with known viable acoustic tags. Preliminary data from the study indicates that several of the tagged sturgeon migrated up to the documented spawning habitat near NM 105 and at least one of the tagged sturgeon migrated up to the documented spawning habitat near Torreya State Park (B. Pine, pers. comm.). A full analysis of the data has not been completed yet and funding is required to complete the effort. This preliminary data indicates that although March flows this year were lower (maximum approximately 37,000 cfs) than the average observed post-West Point March flows (approximately 45,000 cfs) described in the September 2006 BO (reference Figure 3.3.3A), flows were still of a sufficient magnitude to trigger migratory movements. This represents between 4 and 9 acres of suitable spawning habitat at the rock ledge site at NM 105, and between 5 and 19 acres of suitable spawning habitat at the combined two known spawning sites (NM 105 and NM 99.5). However, there is no data available regarding whether or not spawning occurred or if it was successful.

The USGS also conducted a study during October 2006-May 2007 tracking the movement of juvenile sturgeon within the East Bay-Apalachicola Bay area. Similar to the methods described above, USGS deployed an array of 14 passive receivers and tracked the movement of four juvenile sturgeon (age 1-2 fish) in the size range of 350-750 mm total length (TL). Of the tagged sturgeon, three (429-680 mm TL) reported back numerous times to individual receivers; no reports were obtained for the fourth fish. Additionally, the receivers collected data on larger adult Gulf sturgeon with viable tags from separate studies. A detailed report on this data has not been completed. However, the preliminary data indicates that these juvenile sturgeon remained very close to shore (within 1-3 km), and mostly in the East Bay area. After October 2006, no data was collected from receivers within the Apalachicola River proper or East River proper (until late March, when the fish were moving in). Over the whole monitoring period, no data was obtained from 3 receivers deployed further offshore in the bay. This suggests that early juveniles appear to be utilizing primarily very shallow, nearshore areas as winter feeding grounds. Based on NOAA benthos data, these same areas have high densities of polychaetes and amphipods (important prey items), relative to lower values in deeper bay waters. The USGS also noted that based on the juvenile sturgeon tracking data and the adult sturgeon tracking data, it appears that the really small juveniles stay very close to shore, and are heavily using the East Bay area, while the larger sturgeon are using the same areas, but also additional areas farther out into the bay proper. This further supports the importance of the East Bay area to juvenile sturgeon as it appears that other areas provide suitable foraging habitat as well, but are not being utilized. The USGS study information was provided by USFWS based on discussions with Ken Sulak (USGS).

As described in the September 2006 BO, juvenile sturgeon develop a tolerance to higher salinity gradually during the first year of life, and thereafter exhibit optimum growth at a salinity level of about 9 parts per thousand (ppt). Estuarine and later marine habitats provide the primary feeding areas for the species at some point during the first year hatching; therefore, the salinity regime of Apalachicola Bay is likely an important factor in defining juvenile feeding habitat (USFWS 2006). The high salinity levels observed in Apalachicola Bay (especially the East Bay area) throughout the summer of 2007 likely continued through October. FDEP reported that the East Bay surface datalogger had not recorded salinity values below 12 ppt since July of this year (J. Ziewitz, pers. comm.). Given the apparent importance of the East Bay area to sturgeon (particularly juveniles) and the continuing high salinities, it is possible that juvenile and to some extent adult sturgeon could be impacted by both delayed entry to the feeding areas of the bay and potential reduction in productivity of these normally rich feeding areas. This could result in poor growth and/or lower survival of juvenile sturgeon. Adult sturgeon appear to be better adapted to the higher salinity levels and may be able to exploit other feeding areas in the bay and the Gulf. As noted above, portions of the bay appear to provide high value feeding habitat to juvenile and adult sturgeon. Since the sturgeon do not feed while in the riverine spawning and holding areas, these foraging areas are of particular importance as they provide the first opportunity for feeding when exiting the river. In her dissertation, Putland (2005) analyzed the ecology of phytoplankton and microzooplankton in Apalachicola Bay relative to changes in salinity. The analysis indicated that higher salinity levels in the bay, associated with low river discharge periods, resulted in decreased ingestion and production of microzooplankton. Because microzooplankton are key constituents of the estuarine food web in Apalachicola Bay, the analysis suggests that lower discharges in the river that result in lower nutrients and higher salinity (>20 psu, which is roughly equivalent to 20 ppt) in the bay could reduce higher trophic level productivity as a consequence of reduced microzooplankton production (Putland 2005).

Fat threeridge. Surveys of the Apalachicola River system, generally suggest that the fat threeridge occurs in a limited range, but within that range, is locally abundant (USFWS 1998; Brim Box pers. comm. with Jerry Ziewitz, USFWS, 1994; Williams pers. comm. with Jerry Ziewitz, USFWS, 2000; Brim Box and Williams 2000; Richardson and Yokley 1996; Miller 1998; and Miller 2000). All recent surveys have reported evidence of recruitment in the main channel of the Apalachicola River (RM44.3 and RM46.8; USFWS unpubl. data 2006), Swift Slough (Williams pers. comm. 2000; EnviroScience 2006a; USFWS unpubl. data 2006), and the Chipola River and Cut (Miller 2005; EnviroScience 2006a; USFWS unpubl. data 2006). Brim Box and Williams (2000), Miller (2005), and EnviroScience (2006) systematically surveyed the Apalachicola River for freshwater mussels; however, due to the nature of the survey techniques, it is easy to miss mussels that may be between survey sites. The fat threeridge has been recently collected from the tailrace of Jim Woodruff Dam (RM106) downstream to RM15.3 on the south end of Bloody Bluff Island (USFWS unpubl. data 2006). The bulk of the survey locations occur between RM60 and RM21. Results of extensive sampling in the Apalachicola system in 2005 confirm that the fat threeridge is locally common in the Apalachicola River from RM44 to RM26, the Chipola River and Chipola Cut, and Swift Slough (EnviroScience 2006a). It was also detected in Kennedy Creek and in the inflow of Brushy Creek Feeder B (EnviroScience 2006a; FWCC 2006). Miller located a healthy population at approximate Navigation Mile 74 (Miller 2005). Of note, the fat threeridge was once abundant at the shoal located near RM105; however, live specimens have not been collected there since 1981 (USFWS, unpubl.data 2006).

The fat threeridge is generally found at water depths less than 5 ft in the Apalachicola River (Miller 2005; EnviroScience 2006a; EnviroScience unpubl data 2006). Surveys by Miller (2005) have found that it was most abundant at depths ranging from 3 to 5 ft (highest abundance at 4 ft). It was much less common in waters deeper than 5 ft and shallower than 3 ft likely resulting from erosional conditions in deeper areas and predation and desiccation in shallower areas (Miller 2005). EnviroScience (2006a) also reported that most fat threeridge occurred in the first 5 m from the bank at depths of less than 5 ft. Both of these surveys (Miller 2005; EnviroScience 2006a) were conducted at discharges generally greater than 9000 cfs; however, similar trends in mussel depths were reported when flows were much lower (about 5800-6000 cfs). EnviroScience sampled a main channel location (RM46.8) on 7 August 2006, and found that the majority of the fat threeridge sampled occurred at about 3 ft deep and about 99 percent of fat threeridge were found at depths of less than 4 ft (EnviroScience unpubl data 2006). Because the fat threeridge was found at similar depths at various flows, it likely prefers depths of less than 4-5 ft, and moves to maintain these depths in response to changing river stage.

As noted above, the fat threeridge is most abundant in the middle reach of the Apalachicola from RM44 to RM26, including the Chipola Cutoff and Swift Slough distributaries. This reach has been undergoing substantial sedimentation morphological changes in recent years, likely due to a combination of cessation of maintenance dredging and an increasing amount of flow diverted from the Apalachicola River down the Chipola Cutoff arm (due to the stream hydraulic characteristics, sediment laden waters continue down the Apalachicola River arm and the “cleaner” water is diverted down the Chipola Cutoff arm).

The exposure of several thousand fat threeridge in the middle reach of the river (RM 50 to RM 40) during the summer of 2006 revealed that the species is far more abundant in this reach than previously recognized. In the summer of 2006, thousands of fat threeridge were exposed in portions of this reach during low flows, which resulted in a die-off on a scale never before observed on the Apalachicola River. The USFWS determined that mussel mortality was due to the combined effects of drought, sediment (and mussel) movement during high flows in previous years, channel instability, and depletions to basin inflow. It was not attributed to water management operations at Jim Woodruff, which at that time had been releasing at least basin inflow in accordance with the low flow operations protocol outlined in the IOP.

The 5-Year Review for the seven mussels (USFWS 2007) concluded that status of the fat threeridge is considered declining. This determination is based in part on the significant drought-induced mortality that occurred in 2006 (USFWS 2007). In addition, the USFWS also described fat threeridge as a species with a high degree of threat and low recovery potential. Additional fat threeridge surveys and data analysis were conducted during the summer of 2007. A detailed description of this new information is provided in the November 2007 BO.

Purple bankclimber. Purple bankclimber mussels have been recently collected in the main channel of the Apalachicola River from the Jim Woodruff Dam (RM106) downstream to about RM17.7. They have also been collected in Swift Slough, River Styx, a distributary that flows into Brushy Creek, and the Chipola Cutoff, but not in the Chipola River proper (USFWS, unpubl. data 2006; EnviroScience 2006a; FWCC 2006). There are no population estimates for the purple bankclimber in the project area or a length-at-age relationship from which to infer population structure, annual survival rates, or year class strength. Like the fat threeridge, most of the sampling has been qualitative and only catch per unit effort (CPUE) data is available. Recent survey data suggest purple bankclimber are perhaps the rarest member of the Apalachicola River mussel fauna. It represented less than 2 percent of the Corps' survey findings from 1996 to 2002 (Miller 2005), and 1 percent of the EnviroScience (2006a) survey findings in 2005, half of which were detected at a single location. The species represented much less than 1 percent of the USFWS survey in 2006 (USFWS unpubl data 2006).

While recent surveys have documented fat threeridge recruitment, there is only one report of a relatively small (size class 75-96 mm) purple bankclimber collected recently in the in the Chipola Cutoff (EnviroScience 2006a), which suggests either poor reproductive success or sampling methods that are not suited to detecting juveniles of this species. The purple bankclimber is characterized as a species preferring the deeper portions of main channels (often at depths greater than 3 m) in the larger rivers within its range (Brim Box and Williams 2000; EnviroScience 2006a).

There is very little new data relative to purple bankclimber mussels. In the 5-Year Review for the seven mussels (USFWS 2007) the USFWS concluded the status of the purple bankclimber as stable, based on persisting populations. However, USFWS also described the purple bankclimber as a species with a moderate degree of threat and low recovery potential.

As described in the September 2006 BO, the purple bankclimber is characterized as a species preferring the deeper portions of main channels (often at depths greater than 3 m) in the larger rivers within its range (Brim Box and Williams 2000; Enviroscience 2006a). Although portions of the Apalachicola River contain deep-water habitat in relatively stable condition, these areas have been inadequately sampled for listed mussels. The Corps is unaware of any additional sampling in deep-water habitat than what was described in the 2006 BO. However, the USFWS did observe several purple bankclimber mussels approximately six inches below the water surface elevation at the limestone rock outcrop (NM 105) below the dam earlier this summer (J. Ziewitz, pers. comm.).

<u>Chipola slabshell</u>. Researchers have only recently documented this species in the project area. In 2005, one individual was collected in the Chipola River about 2.3 river miles downstream of its junction with the Chipola Cutoff (EnviroScience 2006a). Eight individuals were collected immediately downstream of Dead Lake (upstream of the Chipola Cutoff) in 1991 (Brim Box and Williams 2000), but before that, the Chipola slabshell was known only upstream of Dead Lake in the Chipola River Basin (all of these accounts are outside of the project area).

There is very little new data relative to Chipola slabshell mussels. In the 5-Year Review for the seven mussels (USFWS 2007) the USFWS concluded the status of the Chipola slabshell is considered unknown due to lack of new data. However, they also describe Chipola slabshell as species with a moderate degree of threat and low recovery potential. USFWS is currently funding a mussel survey to determine the status and distribution of Chipola slabshell and other species in the Chipola Basin. Thus far over 300 individual mussels from ten new subpopulations and six previously documented subpopulations have been collected (USFWS 2007a). The majority of these subpopulations occur upstream of Dead Lake. However, Chipola slabshells were sampled from three locations in the action area, all of which represented new locations for the species (USFWS 2007b).

There are no population estimates for the Chipola slabshell in the project area or a length-at-age relationship from which to infer population structure, annual mortality and survival rates, or year class strength.

7. Historic and Archeological Resources. The Apalachicola River valley is an area rich in cultural history with human occupation currently known to date back almost 11,000 years. Archaeological research in the area began as early as 1928 with William Bartram's travels along the Northwest Florida coast in the 1770s. Clarence Moore ventured up the Apalachicola River in his boat *The Gopher* in the early 1900s and his documentation of the many mounded earthforms left behind by early populations formed the basis for much of the later research by Gordon Willey, and many surveys and excavations by Florida, Alabama, North Carolina, and Ohio universities as well as work by various cultural resources management (CRM) firms.

Because of the dense and lengthy occupational history of the area there are possibly well over one hundred or more historical and archaeological sites near and along the Apalachicola River that have yet to be recorded between the base of Jim Woodruff Dam and Apalachicola Bay to the south. Of the numbers of sites that are recorded, approximately 23 historical and archaeological sites have been listed to the National Register of Historic Places for Jackson, Gadsden, Liberty, Calhoun, Gulf, and Franklin counties. Overall, the listed properties provide a decent representative sample of the history of life along the river, and the types of resources one can expect to find there.

The Bryan (Great Oaks) Mansion in Jackson County is an antebellum Greek Revival home constructed of flush wood siding in 1857 and an important historical property, as is the Marianna Historic District in Marianna, Florida. Also, the Mill Pond Site also in Jackson County is a Late Mississippian Chatot Indian Village consisting of caves and rockshelters dating just before and at the brink of Spanish exploration in the Americas (1200-1500 AD). The U.S. Arsenal-Officers Quarters in Gadsden County constructed of brick in 1839 was first constructed to house the Chattahoochee Arsenal, and then became a center for Confederate troop organization during the Civil War. Two impressive sites in Liberty County include the Yon Mound and Village Site, and Torreya State Park. Yon Mound and Village is believed to be a Mississippian Stage site occupied for hundreds of years beginning around 800 AD. The Torreya State Park encloses a time capsule of significant history beginning with several Late Woodland Stage (800-900 A.D.) archaeological sites, as well as the reconstructed Gregory Mansion which overlooks the Apalachicola and was home to a prominent cotton planter beginning in the late 1840's, and finally several Confederate gunpits and earthen parapets used during the Civil War. Franklin County contains some of the earliest recorded archaeological sites in the area, namely the Yent Mound complex, and the Porters Bar site both originally documented by Clarence B. Moore in 1902 during his journeys up the Apalachicola. These two sites are successive occupations spanning from the Early Woodland through the Late Woodland Stages respectively (~300 B.C. – 600 A.D.). Additionally, it is home to Fort Gadsden, originally constructed by the British during the War of 1812, the fort briefly became a settlement of fugitive slaves and a small contingent of Seminole and Choctaw Indians. The Fort was eventually used as a post for the Confederacy during the Civil War until an outbreak of malaria necessitated its abandonment in 1863. Time periods that are known to have had a significant impact on habitation along the southern Apalachicola River but that are not well documented are the Spanish explorations and colonial settlements beginning in the early 1500's through the early 1800's, and then finally the removal of the Indians beginning in 1823. Finally, at least 26 steamboats were reported to have sunk, snagged, or exploded in Florida's portion of the Apalachicola River between the nineteenth and early twentieth centuries.

8. Soils/Sediments. As a sand-bed alluvial river, the Apalachicola is a dynamic system constantly changing by ongoing processes of erosion and sedimentation. The river banks are dominated by cohesive sediments that include large quantities of silt and clay (Lidstone and Anderson, Inc. 1989). The main channel substrate consists primarily of coarse sand and sandy/silt material. Additional substrates in the main channel include limestone bedrock, cobble, gravel, and a consolidated hard clay-like material (generally these substrates are confined to the upper river between RM 86 and RM105).
Soft muddy substrates comprise about 78 percent of the open water zone in Apalachicola Bay, with the remainder divided between oyster reefs and sandy sediments with submerged aquatic vegetation (Livingston 1984).

9. Hazardous and Toxic Materials. Almost the entire floodplain of the Apalachicola River Basin is forested. Predominant land uses in the drainage area of the Apalachicola River in Florida include upland forests (53.5 percent), wetlands (30.5 percent), agriculture (8.4 percent), and urban/built-up (2.1 percent). There are very few industrial sites located along the river. A USEPA review of published accounts of abandoned contaminated waste sites on the USEPA National Priorities List (NPL) indicated that there are no known contaminated sites in the Apalachicola River Basin (USACE 1998 Draft EIS).

3. DESCRIPTION OF THE RECOMMENDED PLAN:

The EDO was developed in consultation with USFWS and various stakeholders in the ACF Basin and contains the following provisions:

- Immediate suspension of all existing IOP provisions including seasonal storage limitations, maximum fall rate schedule, minimum flow thresholds, and volumetric balancing accounting whenever the Composite Storage falls below the bottom of Zone 3 into Zone 4 (fall rates would be managed to match the fall rate of the basin inflow);

- Immediate reduction of the 5,000 cfs minimum flow requirement in the Apalachicola River, as measured at the Chattahoochee gage, to a 4,750 cfs minimum flow requirement (the reduction to this minimum flow would be implemented gradually, consistent with the IOP maximum fall rate schedule). Additional incremental reductions to 4,500 cfs and 4,150 cfs are anticipated if severe drought conditions persist and will be based on appropriate triggers or criteria;

- Implementation of a monthly monitoring plan that tracks Composite Storage in order to determine water management operations (the first day of each month will represent a decision point) and whether EDO triggers are applied;

- Re-instatement of the 5,000 cfs minimum flow requirement, but none of the other IOP provisions once conditions improve such that the Composite Storage reaches a level above the top of Zone 4 (i.e., within Zone 3);

- Suspension of all EDO provisions and re-instatement of the existing IOP provisions once conditions improve such that the Composite Storage reaches a level above the top of Zone 3 (i.e., within Zone 2); and

- Identification of the appropriate triggers or criteria to determine when additional incremental flow reduction from 4,750 to 4,500 cfs, and from 4,500 to 4,150 cfs may occur. Monitoring data, impacts on composite storage, climatic and hydrological conditions experienced, and meteorological forecasts will be used to assist in the identification of appropriate triggers or criteria.

The Chattahoochee gage (USGS number 02358000) is the point at which Jim Woodruff Dam releases are measured under the EDO. Composite Zone 4 is selected as the trigger for initiating the EDO. The EDO would be triggered immediately since the Composite Storage of the system is currently within Zone 4.

4. ALTERNATIVES TO THE RECOMMENDED PLAN:

a. "No Action" - The CEQ regulations require analysis of the "no action" alternative 40 C.F.R. § 1502.14. Based on the nature of the EDO, "no action" represents "no change" from the current management direction or level of management intensity. This alternative would represent the current water control operations at Jim Woodruff Dam (i.e., implementing the provisions of the IOP as described in the 23 March 2007 letter to USFWS). This alternative is not feasible given the intensity of the drought and the forecast for worsening conditions. Based on our modeling of the no action alternative under an extreme drought hydrology, the Composite Conservation Storage of the system would be depleted thus "breaking" the system in the event of a multi-year drought which has a reasonable chance of occurring given current meteorological forecasts. Therefore, additional alternatives were considered.

b. Suspend Down Ramping Requirement Until 1 March 2008 – This alternative represents the IOP operations at Jim Woodruff Dam since 19 October 2007. At that time the Corps requested and the USFWS approved a temporary modification of the IOP consisting of an immediate suspension of the maximum fall rate schedule until 1

March 2008. Under this temporary modification, fall rates would be managed to match the fall rate of the basin inflow. As described in the request letter, elimination of the down ramping provision would improve our ability to conserve storage to the maximum extent practicable. However, it was noted that additional temporary modifications to the IOP would likely be required in order to avoid depletion of the composite storage in the system. The suspension of the down-ramping requirements would address the situation when increased flows in the system begin to decline and ramp-down occurs. However, this alternative does not address the situation when adequate rainfall does not occur and there is not significant increase in flows to the point that water can be stored in the system. If this does not occur, there may not be many opportunities to take advantage of the suspension in down ramping. Based on the modeling results for the no action alternative, it is apparent that suspension of the down ramping provision alone fails to avoid depletion or near depletion of the composite storage in the system. Therefore, this alternative was not carried forward for further consideration.

c. <u>Maintain 5,000 cfs Minimum Release at Jim Woodruff Dam and Eliminate All Other Provisions of IOP Until Composite Storage Enters Zone 2.</u> The period of June through December is the most critical period during a dry year. This generally represents the period where significant amounts of storage are required to augment the basin inflow to meet the 5,000 cfs minimum flow. Our analysis indicates this period provides the maximum opportunity to conserve storage (not refill) during a drought of the current severity. An opportunity to reduce flow below the 5,000 cfs minimum during this time is necessary. This alternative did not provide sufficient opportunity to conserve storage until basin inflows increase to a level where storage recovery can begin. Furthermore, extended periods with Composite Storage in Zone 4 (the current level) and especially those with Composite Storage levels significantly lower than the top of Zone 4 greatly limit our ability to respond to drought conditions as severe as and more severe than are currently occurring. This alternative was deemed not a fair balance between providing more opportunities to conserve storage for future augmentation flows and continued flow support to threatened and endangered species and the multiple project purposes in the basin. Therefore, this alternative was not carried forward for further consideration.

d. <u>Maintain 5,000 cfs Minimum Release at Jim Woodruff Dam and Eliminate All Other Provisions of IOP Until Composite Storage Enters Zone 2; On 1 June 2008 See if Trigger to 4,150 cfs Flow is Met.</u> Although this alternative is very similar to the two previous alternatives, the minimum flow reduction decision is delayed until next summer. As described above, immediate consideration to lowering the minimum flow must be taken due to the continued need to use storage to augment the basin inflow to meet the 5,000 cfs minimum flow over the next few months and to optimize storage conservation and the likelihood of reservoir refill. Reservoir refill to Composite Storage levels above Zone 4 is critical to our ability to manage the system during an extended drought period and delaying the decision until 1 June, 2008 would also miss the opportunity for supplementing storage during the normally wetter periods (January – April), that occur prior to June. This alternative was deemed not a fair balance between providing more opportunities to conserve storage for future augmentation flows and continued flow support to threatened and endangered species and the multiple project purposes in the basin. Under this operation, more preference was given to immediate support to threatened and endangered species than reservoir refill. Therefore, this alternative was not carried forward for further consideration.

e. Maintain 4,150 cfs Minimum Release at Jim Woodruff Dam and Eliminate All Other Provisions of IOP Until Composite Storage Enters Zone 2. This alternative provided great benefit to storage conservation and reservoir refill. However, model results indicate prolonged periods of flows equal to 4,150 cfs would occur under this operation. This alternative was deemed not a fair balance between providing more opportunities to conserve storage for future augmentation flows and continued flow support to threatened and endangered species and the multiple project purposes in the basin. More preference was given to storage conservation and reservoir refill than to support to threatened and endangered species. Therefore, this alternative was not carried forward for further consideration.

f. Georgia Environmental Protection Division (GAEPD) Recommendation – By letter dated 12 October 2007, the GAEPD requested a temporary modification of the IOP. A copy of the letter is provided in the Biological Assessment provided in Appendix A. The GAEPD recommends that these modifications remain in place until 1 March 2008 at which time additional modifications would likely be required. The GAEPD recommended plan consisted of temporary modifications of the IOP that include changes to two parameters applicable to the daily releases from Jim Woodruff Dam: a minimum discharge in relation to average basin inflows and a maximum fall rate. The recommended changes include:

- Immediate suspension of 5,000 cfs minimum release requirement at Jim Woodruff Dam. Minimum releases from the dam would match basin inflow while basin inflow values are less 5,000 cfs.

- If basin inflow values are 5,000 cfs or higher, then the maximum release from Jim Woodruff Dam would be 5,000 cfs.

- Immediate suspension of maximum fall rate schedule.

GAEPD subsequently revised the proposed modifications in a Motion for Preliminary Injunction filed in the United States District Court for the Middle District of Florida Jacksonville Division on 19 October 2007. A copy of this document is provided in the Biological Assessment provided in Appendix A. GAEPD stated in the motion that these emergency changes to the IOP would remain in effect until the earlier of: 1) 1 March 2008; 2) a decision on the merits of the Georgia II case; or 3) further order of this Court, with the understanding that motions for modification of this relief may be appropriate in the event that conditions improve and the threat of depletion of reservoir system conservation storage is materially reduced. The revised temporary modifications include:

- Immediate suspension of 5,000 cfs minimum release requirement at Jim Woodruff Dam. Minimum releases from the dam would match the adjusted basin inflow while the adjusted basin inflow values are less 5,000 cfs, as measured at the Chattahoochee gage.

- If the adjusted basin inflow values are 5,000 cfs or higher, then the maximum release from Jim Woodruff Dam would be that required to maintain a 5,000 cfs flow measured at the Chattahoochee gage.

- Immediate suspension of maximum fall rate schedule.

As defined in the motion, "Adjusted Basin Inflow" is "the amount of water that would flow by Jim Woodruff Dam during a given time period if all of the Corps' reservoirs maintained a constant water surface elevation during that period, plus Georgia's municipal and industrial consumptive demands from the Chattahoochee River and Lake Lanier (which are deemed for purposes of this order to be 457 cfs during October, 369 cfs during November, 352 cfs during December, 302 cfs during January, and 345 cfs during February)". Due to the similarity of the proposed modifications, we address the most recent recommendation in this alternative discussion.

We have incorporated aspects of the Georgia proposal into the EDO, such as the suspension of maximum fall rate schedule; the storage of all basin inflows above 5,000 cfs; and the reduction of the 5,000 cfs flow if certain triggers are reached. The immediate suspension of the 5,000 cfs flow to match the adjusted basin inflows was not incorporated because it may not provide the benefits to Lake Lanier that are key to maintaining storage in the system. It could be beneficial to the lower project but could present a problem with holding the additional storage in the lower projects if they exceed the top of conservation or even a designated level within the flood zone. The provision to match minimum releases to basin inflows when flows are below 5,000 cfs would be more detrimental to the species than the reduction designated in the EDO. The EDO provides a reduction in flow if certain triggers are reached but does not reduce the flows to a level that could occur under this proposal.

g. ARC Recommendation– By letter dated 25 October 2007, the Atlanta Regional Commission (ARC) provided a three-phase Reservoir Recovery Plan that included an Emergency Operations Plan as phase 1. The other two phases include actions that would require additional consultation apart from the intent of the current consultation and therefore are not included in this alternative description. A copy of the letter is provided in the Biological Assessment provided in Appendix A. The ARC recommends that the Emergency Operations Plan remain in place until 1) composite storage within the system is recovered; 2) a new IOP and/or updated Water Control Plan are completed; or 3) composite storage within the system is in Zone 4 on 1

February 2008 (at which time additional modifications would be required). The Emergency Operations Plan consists of temporary modifications of the IOP that include changes to two parameters applicable to the daily releases from Jim Woodruff Dam: a minimum discharge in relation to average basin inflows and a maximum fall rate. In addition, the Emergency Operations Plan includes a temporary waiver of the seasonal drawdown at the West Point and Walter F. George projects (for 2007-2008 only). The recommended minimum discharge changes include:

<u>During the non-spawning season (June-February):</u>

- When Basin Inflow is greater than 5,000 cfs, all flows in excess of those required to meet the 2,000 cfs minimum flow target at Farley Nuclear Plant should be stored in the Chattahoochee reservoirs to the extent possible.

- When Basin Inflow is less than 5,000 cfs, (or whatever alternative minimum flow FWS determines to be appropriate) storage should be released from the Chattahoochee reservoirs to meet the minimum flow.

<u>During the spawning season (March-May):</u>

- When Basin Inflow is greater than 11,000 cfs, all flows in excess of those required to meet the 2,000 cfs minimum flow target at Farley Nuclear Plant should be stored in the Chattahoochee reservoirs to the extent possible.

- When Basin Inflow is between 5,000 cfs and 11,000 cfs, Woodruff Outflow should equal Basin Inflow.

- When Basin Inflow is less than 5,000 cfs, (or whatever alternative minimum flow FWS determines to be appropriate) storage should be released from the Chattahoochee reservoirs to meet the minimum flow.

The ARC Emergency Operation Plan includes a modification of the IOP maximum fall rate schedule that determines maximum fall rate based on (1) the Basin Inflow fall rate; or (2) the IOP maximum fall rate schedule. The recommendation is that the maximum fall rate schedule should follow the higher of these two fall rates.

We have incorporated aspects of the ARC proposal such as storing basin inflow; maintaining the 5,000 cfs minimum flow if certain triggers do not call for a reduction in the minimum flow; storing basin inflow while meeting the minimum target flow for Farley Nuclear Plant and adjustments to the maximum fall rate. The condition in the ARC proposal to provide releases equal to basin inflow when Basin Inflow is between 5,000 cfs and 11,000 cfs was not incorporated into the EDO because it does not provide enough opportunities to store water during the periods that fall into that range. This may occur more frequently during a dry winter and spring and would represent opportunities missed to supplement storage.

5. ENVIRONMENTAL IMPACTS OF THE RECOMMENDED PLAN:

To determine the future environmental impacts of project operations as prescribed by the recommended plan, we compare the environmental conditions expected to occur under the EDO to those expected to occur if no action were taken (current IOP, as described in the 23 March 2007 letter to USFWS). Since the future hydrologic conditions are unknown and the EDO includes incremental changes in the minimum flow requirement from Jim Woodruff Dam, we analyze a range of Apalachicola River flow conditions and reservoir elevations that could occur as a result of two simulated extreme drought conditions under various EDO minimum flow scenarios. For the purposes of this analysis, we assume that drought conditions will continue for the next two years and have synthesized two flow regime scenarios to represent a range of possible conditions that could be experienced under the EDO minimum flow scenarios and "no action". It should be noted that these synthesized flow regimes are based on continuing drought conditions and thus the hydrological data input into the model represents reasonable "worst case scenario" hydrological conditions. HEC-5 model simulations were run for the "no action" and EDO minimum flow scenarios under the two simulated flow regimes and graphical representations of the results were generated for various analyses (reservoir elevations and river flows). The recommended plan represents a temporary modification of the IOP or "no action" alternative to the EDO. These figures are provided in Appendix E. A detailed description of how this hydrological input data for the model was developed is provided below.

As described in the September 2006 BO, basin inflow is the amount of water that would flow by Jim Woodruff Dam during a given time period if all of the Corps reservoirs maintained a constant water surface elevation during that period, such that the reservoirs would only release the net inflow into the dam. Basin inflow is not the natural 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, such as municipal water supply and agricultural irrigation. The "no action" and EDO minimum flow scenarios include these influences, and use the same estimates of reservoir evaporation and current water demands; therefore, the difference between these actions is the net effect of continued operation under each action including the effect of influences that are unrelated to project operations.

The consumptive water demands used in the models represent an estimate of year 2000 levels of the net depletion due to municipal, industrial, and agricultural water uses and evaporative losses from the four largest reservoirs, Lanier, George, West Point, and Seminole. These depletions vary by month and in the case of agricultural demands and reservoir evaporation, also by year (wet, normal, dry). These consumptive demand estimates and the other model settings and techniques are consistent with those utilized during the development of the IOP.

To provide a potential range of flows and reservoir elevations that might be experienced under continuing drought conditions while the EDO is in effect, we have synthesized two flow scenarios. The HEC-5 model simulates river flow and reservoir levels using a daily time series of synthesized flow data for a certain period of record. For the purposes of this analysis we selected hydrological conditions that represent 1) an unprecedented, exceptional drought applied across the entire ACF basin and continuing without relief for a two year period (referred to as the 10 percent hydrology); and 2) an exceptional drought that reflects differences in precipitation within the basin but is still more severe (20 percent reduction) than observed during the critical period prior to the current drought (referred to as the 1999-2001 20 percent reduced hydrology).

The unimpaired flow data set is a product of the Tri-State Comprehensive Study, and has been extended to include water years through 2001. Whereas basin inflow is computed to remove the effects of reservoir operations from observed flow, unimpaired flow is computed to remove the effects of both reservoir operations and consumptive demands from observed flow.

The model simulation period is October 8, 2007 to December 31, 2009 (26 months). The observed elevation for October 7, 2007 is used as the initial elevation for the four ACF reservoirs; Lake Lanier, West Point Lake, Walter F. George Lake and Lake Seminole. The HEC-5 reservoir simulation model uses unimpaired local flow at 25 control points (nodes) as the flow data input for the ACF Model. The Corps' HEC-DSS Vue tool is used to compute the daily 10th percentile local flows at every control point. This synthetic flow data set assumes a uniform distribution of flow throughout the basin based on the local percentile flow. In other words the daily local 10th percentile flow occurs at every location on the same day. The result is a one-year daily time series of the local 10th percentile flows. The one year flow series is repeated for each year during the simulation period. The 1999 to 2001 period represents the driest consecutive 3 year period in the unimpaired flow data set. To increase the drought severity to represent exceptional drought conditions, these flows were further reduced by 20 percent. This reduction was selected to capture an intermediate condition between the 10th percentile and the driest single year in 2000. The annual basin inflow for the "10th percentile" flow and the year 2000 basin inflow is 5,322 cfs and 8,853 cfs respectively. The resulting 20 percent reduction in the 2000 basin inflow is 7,082 cfs and captures an intermediate hydrology. It is unlikely that the actual hydrology occurring over the next two years will match closely these simulated hydrological conditions. However, with the growing threat of La Niña conditions this fall and winter and the resultant continuing exceptional drought conditions, it is likely that whatever hydrology occurs could result in a continuation of significant depletion of Composite Storage within the system.

The HEC-5 model imposes reservoir operations and consumptive demands onto the synthesized flow-time series to simulate flows and levels under those operations and demands. As described above, the minimum flow for the EDO changes incrementally based on Composite Storage in the system (range of 5,000-4,150 cfs) and the minimum flow for the IOP is 5,000 cfs. However, in order to more closely represent the actual operations for releases from Jim Woodruff Dam, we impose slightly higher minimum flow rules in the model. For the EDO we use 5,130 cfs, 4,750 cfs, 4,550 cfs, and 4,200 cfs as the minimum flow rules. For the "no action" we use 5,130 cfs as the minimum flow rule in the model. These values are based on what the operators actually release in order to avoid violating minimum flow floors, and reflect the physical operational constraints and limitations of the dam and powerhouse. The following describes the range of potential environmental impacts associated with implementation of the EDO.

1. Physical Impacts. Physical habitat conditions in the project area are largely determined by flow regime, and channel morphology sets the context for the flow regime. As described previously, in 2006 Light et al. determined that the Apalachicola River has not followed the normal pattern of lateral migration in which erosion and deposition are balanced so that the channel maintains a relatively constant width and bed elevation. This determination was based on studies that suggest that in the past 50 years, many portions of the Apalachicola River have substantially declined in elevation (incised) and/or become substantially wider. . Some significant sedimentation has been observed below the Chipola Cutoff since the effective cessation of dredging in 2000. However, this impact is not attributable to water management operations at Jim Woodruff Dam

In accordance with RPM4 of the September 2006 BO, the Corps conducted an evaluation of the sediment dynamics and channel morphology trends on the Apalachicola River in order to improve our understanding of dynamic conditions and monitor the zone at which take may occur, and to identify possible alternatives to minimize effects to listed mussels in vulnerable locations. By letter dated 30 August 2007, the Corps provided the findings of this evaluation to the USFWS. A copy of this letter and the accompanying enclosures is provided in the Biological Assessment provided in Appendix A.

Based on review of existing information, the reconnaissance field trip, presentations and discussions at the technical workshop, and the summary of findings reports prepared by the river specialists and malacologist, the Corps determined that the current version of the IOP adequately met the intended goal of minimizing or avoiding adverse impacts or providing support to listed species occurring in the Apalachicola River. As documented in the September 2006 BO, the flow regime in the Apalachicola River has not been changed significantly between the pre- and post- dam periods. The river appears to be in a relatively stable dynamic equilibrium. The morphology of the river could have been impacted over time by land use changes, upstream impoundments and consumptive use of water, and tectonic movement, as well as channel alterations, meander cutoffs, and channel dredging and snagging operations. Obvious channel degradation impacts were noted below Jim Woodruff Lock and Dam immediately after construction. However, these impacts appear to be reduced through time. Data from the Blountstown and Wewahitchka gages downstream of the dam indicate that there was a small change in low flow water surface elevations at those sites in response to Jim Woodruff construction, but the changes appear to have stabilized. Field observations and data analysis by the river specialists suggests that the river is not continuing to degrade and that it may have attained a state of relative equilibrium. This is consistent with the findings of Light et al. (2006) who concluded that channel conditions had been relatively stable for the a ten year period (1995-2004). Although a large portion of the middle river (Nautical Mile (NM) 78 to NM 35) is very sinuous and actively meandering, maximum erosion rates on the outside of the bends in this reach are extremely low compared to other large alluvial rivers and appear to be part of the natural down-valley meander migration which is common to most meandering streams. This does not appear to be the result of continuing post-dam system-wide adjustment such as degradation, aggradation, or channel widening. It appears unlikely that erosion rates will increase over time unless there are significant changes of the flow regime or reduction in sediment supply, which do not appear likely to occur under the provisions of the IOP. This evaluation did not include analysis of Apalachicola River flows less than 5,000 cfs. We have no ability at this time to predict specific effects on channel morphology due to the influence of the EDO on the flow regime. However, generally channel morphology alterations are more closely associated with increased duration and frequency of high flow events rather than low flow events as have occurred throughout this year. Moreover, the influence of the EDO on the Apalachicola River flow regime is not expected to adversely impact stream channel stability; nor alter sand, gravel, or cobble bottom substrate. Therefore, the EDO will not significantly impact physical habitat conditions in the project area including conditions within critical habitat areas.

2. Land Use Changes. Predominant land uses in the drainage area of the Apalachicola River in Florida include upland forests (53.5 percent), wetlands (30.5 percent), agriculture (8.4 percent), and urban/built-up (2.1 percent). The recommended plan does not change land use within the project area and will not impact State, area-wide and local plans and programs for land use in the area.

3. Historic and Archaeological Resources. As described above, implementation of the EDO is not expected to impact stream channel stability or alter channel substrates. Therefore, potentially adverse effects to cultural resources, such as increased erosion, increased deposition, and increased access to historic and archaeological sites will not significantly change through implementation of the EDO. Therefore, there should be no effect on historic or archeological properties listed, eligible for listing in the National Register of Historic Places, or otherwise of historical or archaeological value.

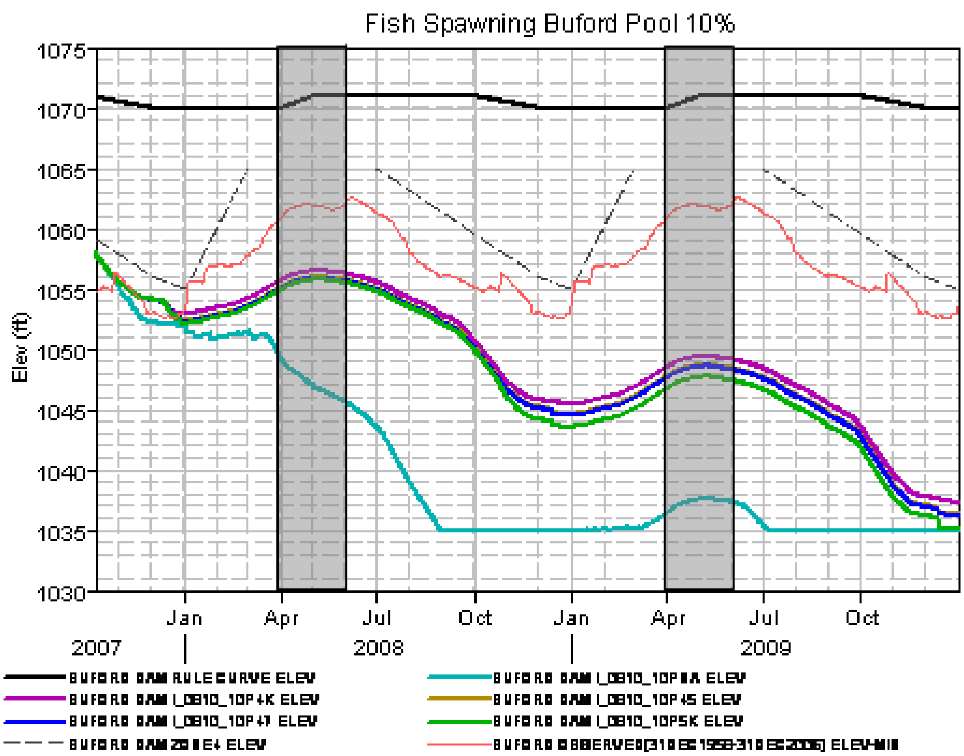
4. Fisheries. The recommended plan is consistent with the Division Regulation DR 1130-2-16 and draft CESAM SOP 1130-2-9 regarding project operations in support of reservoir fish management. The goal of the SOP is to manage the reservoir conditions such that they are relatively stable or rising for a minimum 4-6 week period within the principal fish spawning period for each project site; while also providing for relatively stable or gradually declining Apalachicola River stages for a minimum designated period (Table 10). Under the EDO, during higher flow periods, refill of reservoirs may occur and reservoirs may experience relatively steady or rising levels during the fish spawn period. During low flow period, releases would ramp down matching basin inflows until reaching the minimum flow specified in the EDO, at which time reservoir levels would be held steady or gradually decline. A review of Figure 4 indicates that the 4-6 week goal for holding steady or rising levels at the reservoirs and steady or declining river levels can be met most of the time. Therefore, the implementation of the EDO will not

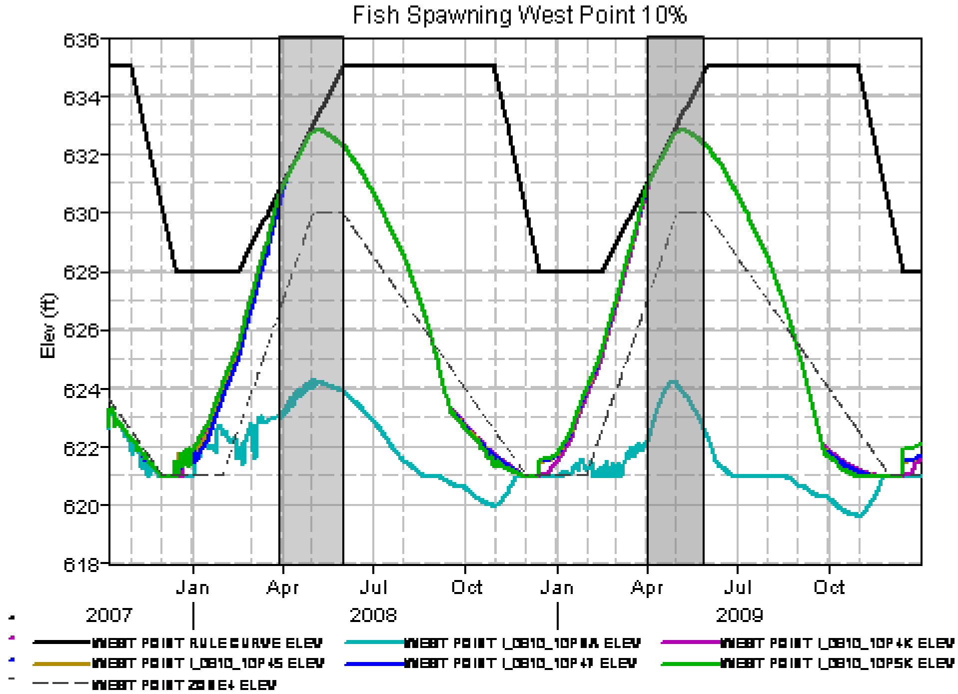
result in a significant impact to fisheries in the reservoirs and the Apalachicola River.

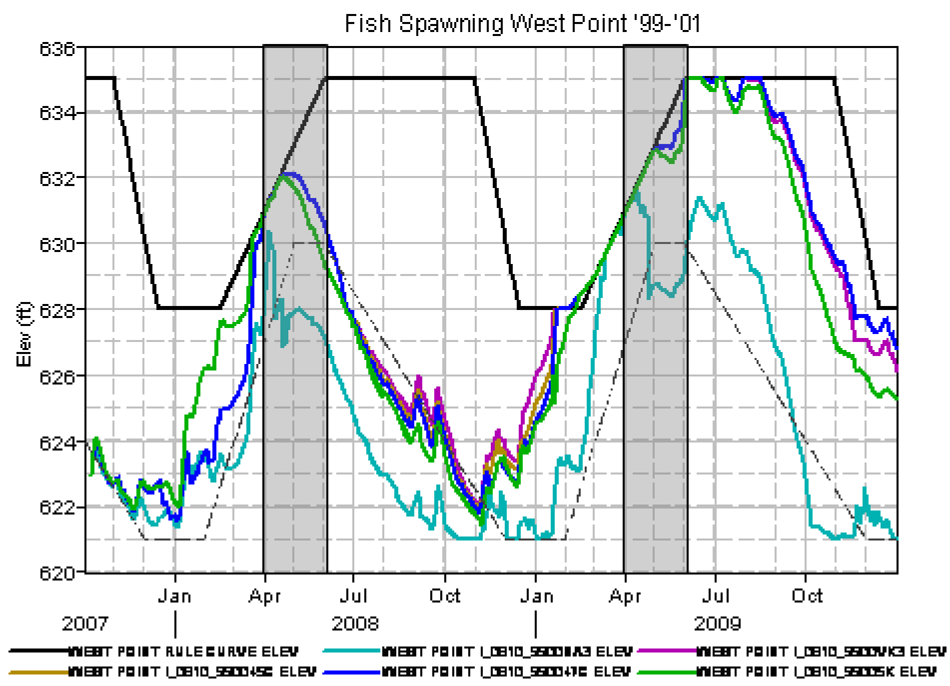
Table 10. Project specific principal fish spawning period for operational considerations.

Project	Fish Spawn Period
Lake Lanier	01 Apr – 01 Jun
West Point	01 Apr – 01 Jun
Walter F. George	15 Mar – 15 May
Lake Seminole	01 Mar – 01 May
Apalachicola River	01 Apr – 01 Jun

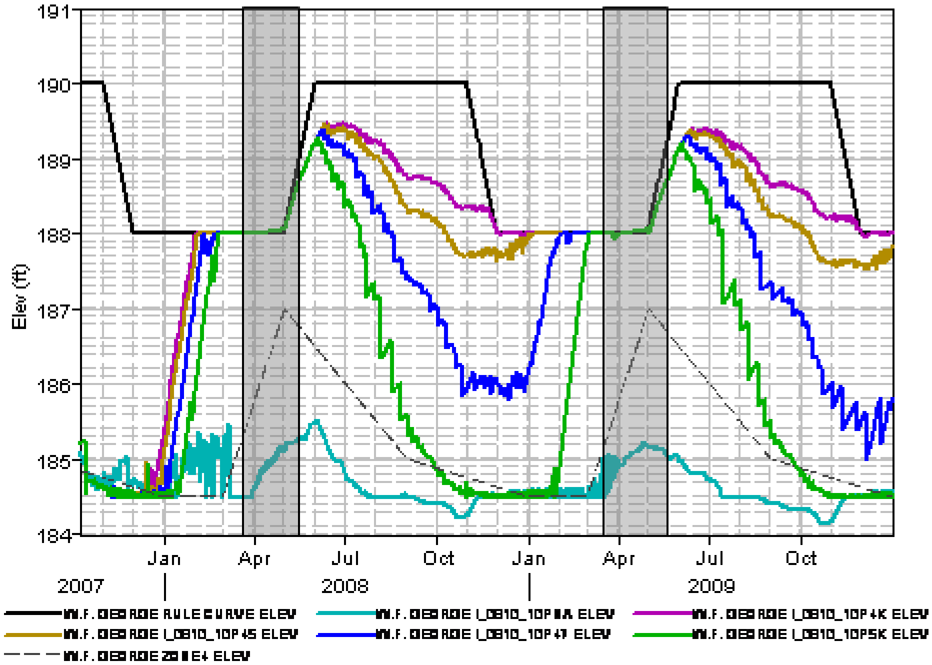
Figure 4 – Fish Spawn Analysis for the Simulated Reservoir Elevations.



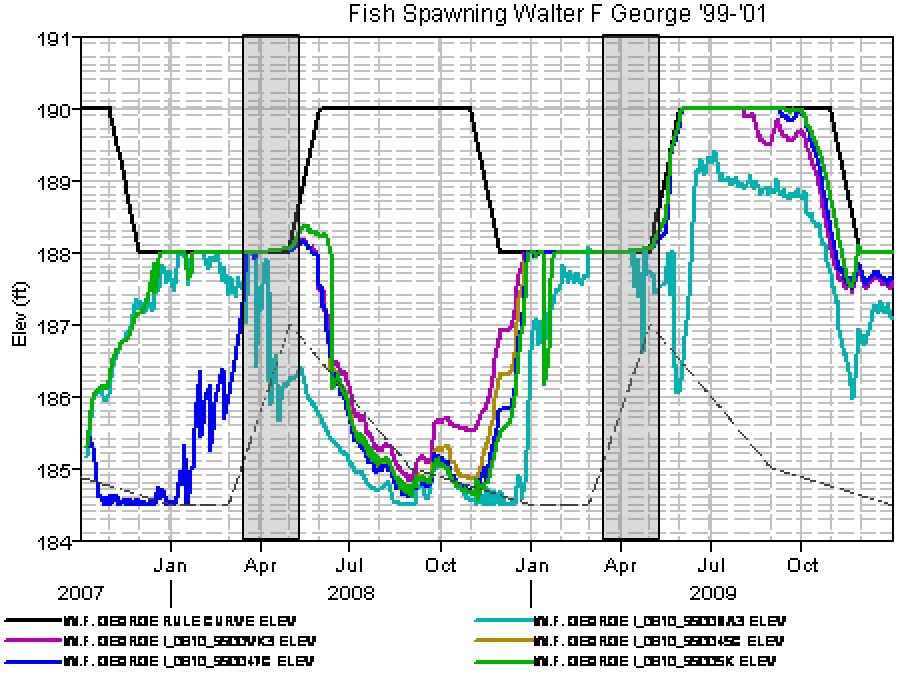

Fish Spawning West Point 10%
Elev (ft)
636
634
632
630
628
626
624
622
620
618
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009
WEST POINT RULE CURVE ELEV
WEST POINT I_0810_10P45 ELEV
WEST POINT I_0810_10P47 ELEV
WEST POINT I_0810_10P4K ELEV
WEST POINT I_0810_10P5K ELEV

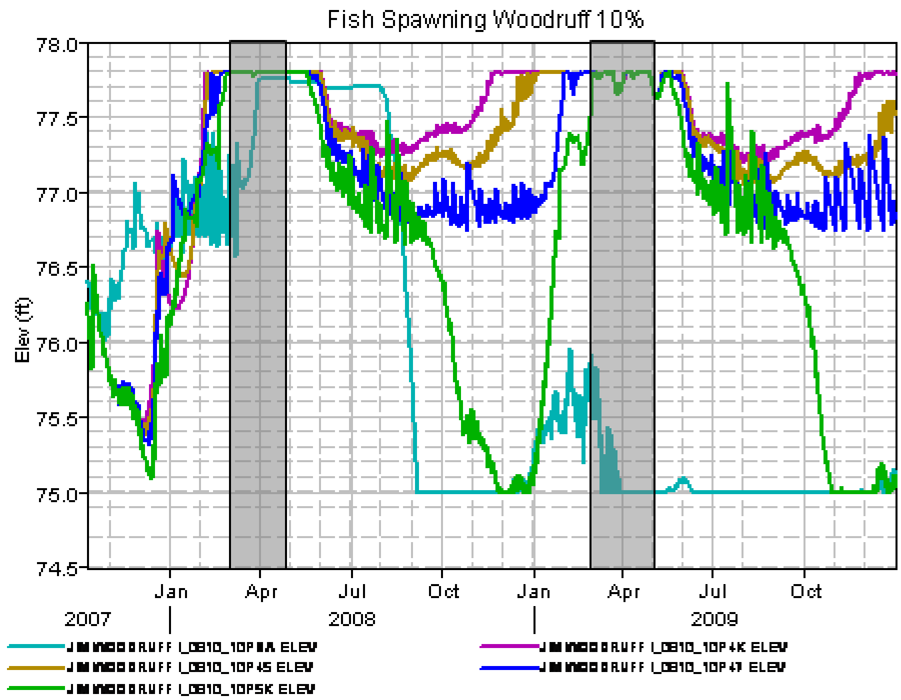

Fish Spawning West Point '99-'01
Elev (ft)
636
634
632
630
628
626
624
622
620
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009
WEST POINT RULE CURVE ELEV

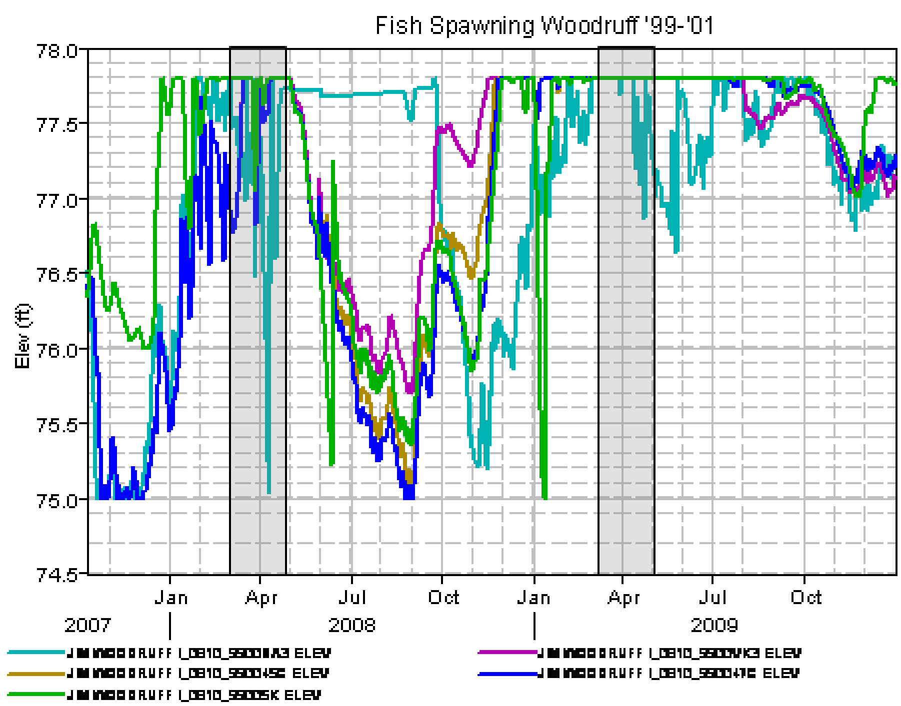
Fish Spawning Walter F George 10%

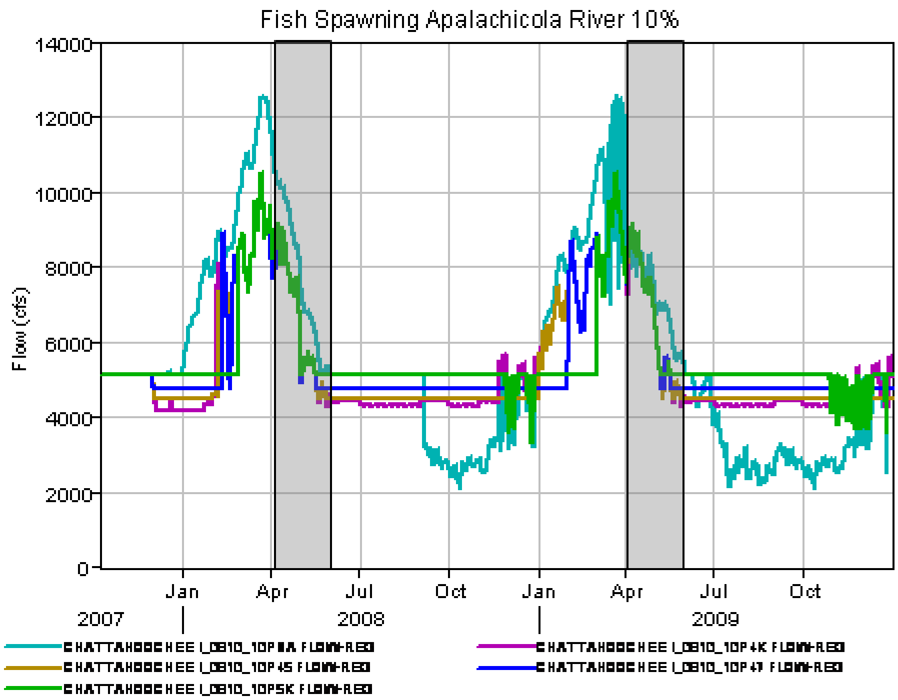


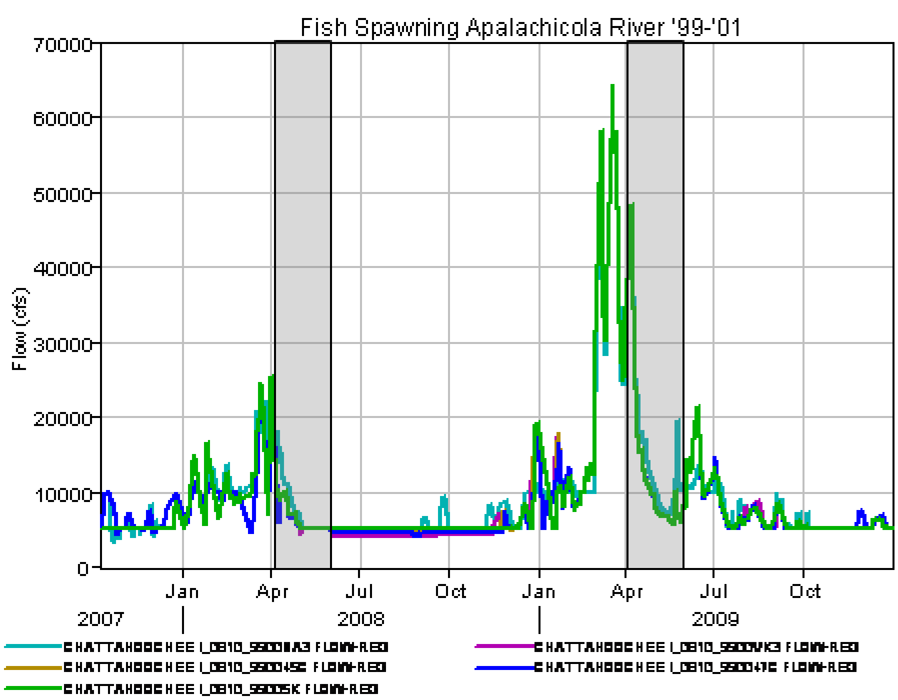
Fish Spawning Walter F George '99-'01




Fish Spawning Woodruff 10%
Elev (ft)
78.0
77.5
77.0
76.5
76.0
75.5
75.0
74.5
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009


Fish Spawning Woodruff '99-'01
Elev (ft)
78.0
77.5
77.0
76.5
76.0
75.5
75.0
74.5
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009


Fish Spawning Apalachicola River 10%
Flow (cfs)
14000
12000
10000
8000
6000
4000
2000
0
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009
CHATTAHOOCHEE I_0810_10P45 FLOW-REG
CHATTAHOOCHEE I_0810_10P47 FLOW-REG
CHATTAHOOCHEE I_0810_10P5K FLOW-REG


Fish Spawning Apalachicola River '99-'01
Flow (cfs)
70000
60000
50000
40000
30000
20000
10000
0
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009

5. Essential Fish Habitat. Implementation of the EDO will not significantly impact hydrology or water quality in the Apalachicola River or Bay. However, there may be temporary salinity increases in the Apalachicola River attributed to the drought conditions not the implementation of the EDO. As described above, higher salinity levels were observed in the Apalachicola Bay throughout the summer/fall 2007. Although, the EDO provides for storage of basin inflows above the minimum flow release from Jim Woodruff Dam, it does not result in only maintenance of a target flow. The storage reservoirs are limited to those occurring at and above Walter F George. Therefore, higher seasonal flows in the lower part of the basin and in the Flint River will result in higher discharges to the Apalachicola River and provide fresh water "flushing" to the Apalachicola Bay. Furthermore, the "no action" and "natural" flows result in periods of time with considerably lower discharges into the Apalachicola River than the EDO; which utilizes storage from upstream reservoirs to augment basin inflows to maintain the minimum flow requirement. Therefore, the EFH in the Apalachicola Bay system will not be significantly impacted by the EDO.

6. Wildlife. Due to the nature of the EDO, the evaluation of potential impacts focused on those species associated with aquatic and riparian communities. Implementation of the EDO will not significantly impact hydrology or water quality in the project area and impacts if any will be temporary. Therefore, aquatic and riparian habitats supporting wildlife species in the Apalachicola River and Bay system should not be adversely impacted. The aquatic and terrestrial wildlife resources occurring in the project area will not be significantly impacted by the EDO.

7. Threatened and Endangered Species: On 15 November 2007, the USFWS issued a Biological Opinion and Conference Report on the EDO at Jim Woodruff Dam, and the associated releases to the Apalachicola River, and its effects on the Gulf sturgeon, fat threeridge mussel, purple bankclimber mussel and Chipola slabshell mussel; and habitat designated and proposed as critical habitat for the Gulf sturgeon and the mussels, respectively, pursuant to Section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq*.). The USFWS determined that implementation of the EDO until June 1, 2008, including its provision to reduce minimum releases from Woodruff Dam initially to 4750 cfs and then to not less than 4500 cfs:

a) will not jeopardize the continued existence of the Gulf sturgeon, fat threeridge, purple bankclimber, and Chipola slabshell;
b) will not destroy or adversely modify designated critical habitat for the Gulf sturgeon; and
c) will not destroy or adversely modify proposed critical habitat for the fat threeridge, purple bankclimber; and Chipola slabshell.

The USFWS determined that the EDO is not anticipated to incidentally take any Gulf sturgeon, but it could result in incidental take of fat threeridge, Chipola slabshell and purple bankclimber. Take of listed species due to the EDO may occur when the releases from Jim Woodruff Dam are reduced to 4,750 cfs and then to 4,500 cfs, once criteria and triggers are developed and conditions warrant. The form of this take is mortality that

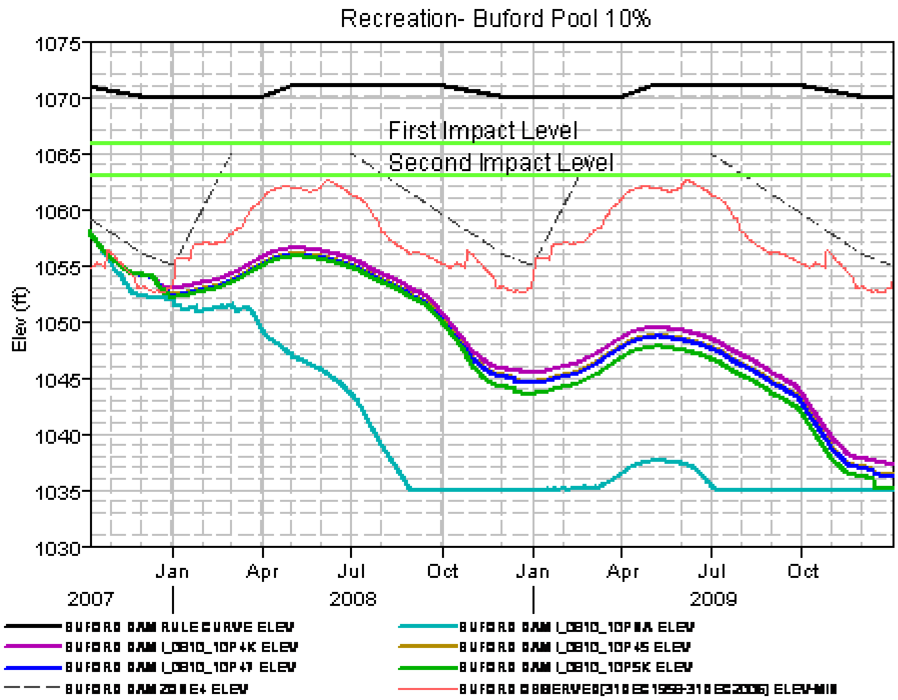
results from habitat modification leading to oxygen stress, temperature stress, and/or increased predation. The take may occur in moderately depositional microhabitats that become exposed or isolated from flowing water when releases from Jim Woodruff Dam are less than 5,000 cfs (or less than the current operational release of 5130 cfs).
For incremental flow reductions to 4750 cfs or 4500 cfs, a maximum of 100 purple bankclimbers may be exposed on the rock shoal at RM105 and at a few locations elsewhere in the Action Area; and a maximum of100 Chipola slabshells may be exposed in the Chipola River downstream of the Chipola Cutoff. A maximum of 5,600 fat threeridge (2.4% of the population) may be exposed in the Apalachicola River, Chipola Cutoff, and Chipola River downstream of the Chipola Cutoff when the minimum flow is reduced to 4750 cfs. A maximum of 15,400 additional fat threeridge (an additional 6.6% of the population) may be exposed in the Apalachicola River, Chipola Cutoff, and Chipola River downstream of the Chipola Cutoff when the minimum flow is reduced to 4500 cfs (total take is 5,600 + 15,400 = 21,000) (USFWS 2007b).

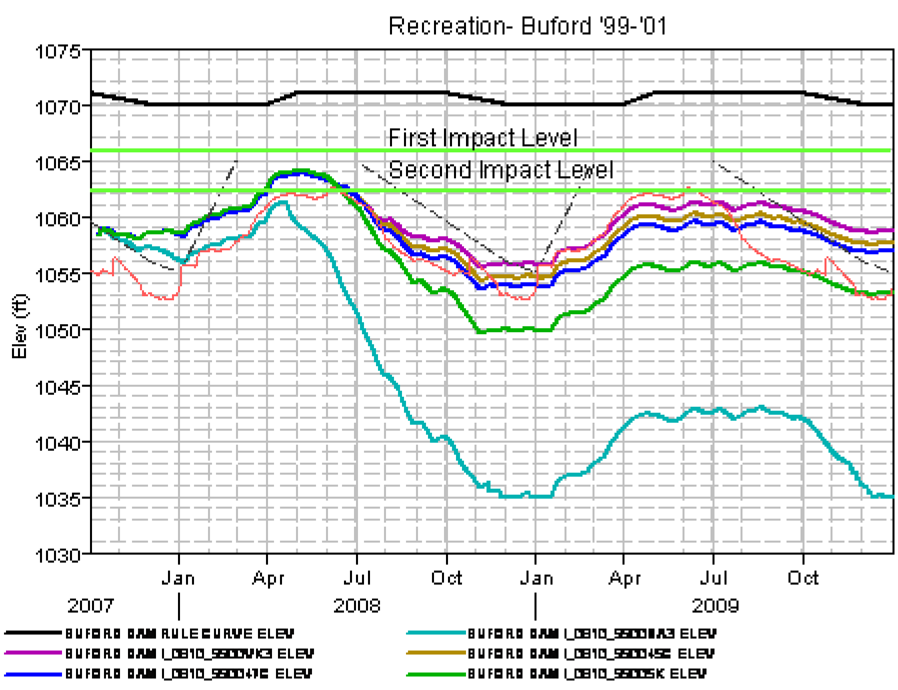
In the 15 November 2007 BO, the USFWS determined that the level of anticipated take for incremental reductions in flow as low as 4500 cfs would not result in jeopardy to the species or destruction or adverse modification of designated or proposed critical habitat. Therefore, the threatened and endangered species occurring in the project area will not be significantly impacted by the EDO.

8 Recreation. Implementation of the EDO will not significantly impact recreational opportunities at the upstream reservoirs. The exceptional drought has resulted in current reservoir levels below the recreational impact elevations. Existing boat ramps in the reservoirs are not being utilized due to current low water conditions. If drought conditions continue it is unlikely that the reservoirs will refill to summer pool elevations under either the no action or the EDO operational plans. The EDO will have less severe impacts on recreation during the peak season (May-September) than the no action. In general, the EDO minimum flow scenarios result in higher reservoir elevations than the no action plan. However, reservoir elevations under both the no action and the EDO minimum flow scenarios generally remain within or below the recreational impact levels at each project. The EDO is also consistent with support of reservoir fish spawning and Apalachicola fish spawn during spring months, and could benefit sport fish accordingly. Impacts to any component of the National Wild and Scenic Rivers System; and any park, parklands, ecologically critical areas or other areas of ecological, recreational, scenic or aesthetic importance are attributable to the continuing exceptional drought conditions and not the EDO.

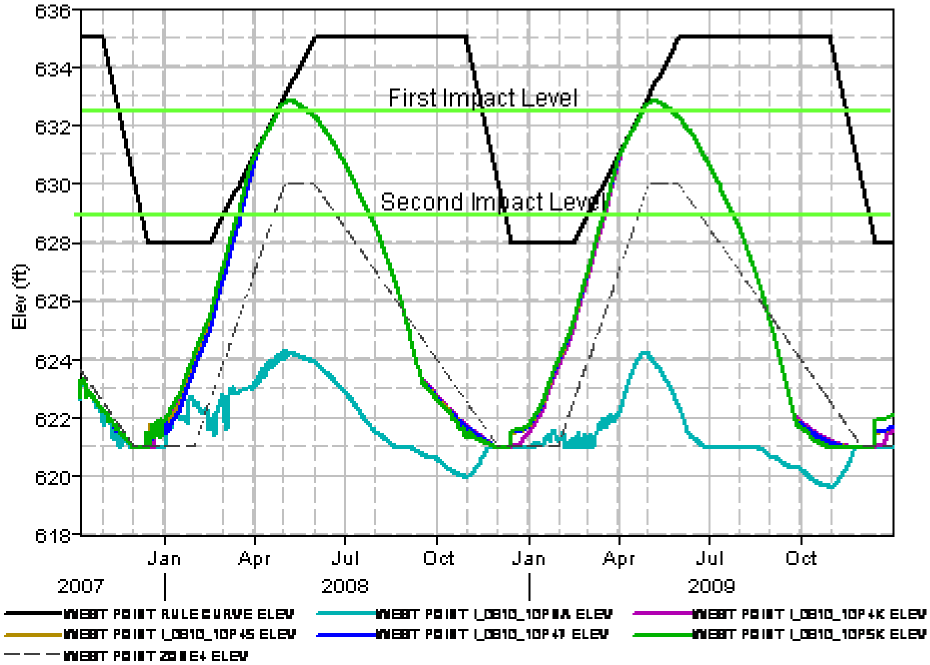
Implementation of the EDO will not significantly impact recreational opportunities on the Apalachicola River or Apalachicola Bay. Reflected in Figure 5, under the various EDOs, reservoir storage and recreational usage will be greater than operations under the no action alternative. Therefore, the implementation of the EDO will not significantly impact recreation at Lakes Lanier, West Point, Walter F. George, and Seminole.

Figure 5. Recreational impact levels plotted against simulated elevations at Buford, West Point, Walter F. George, and Woodruff

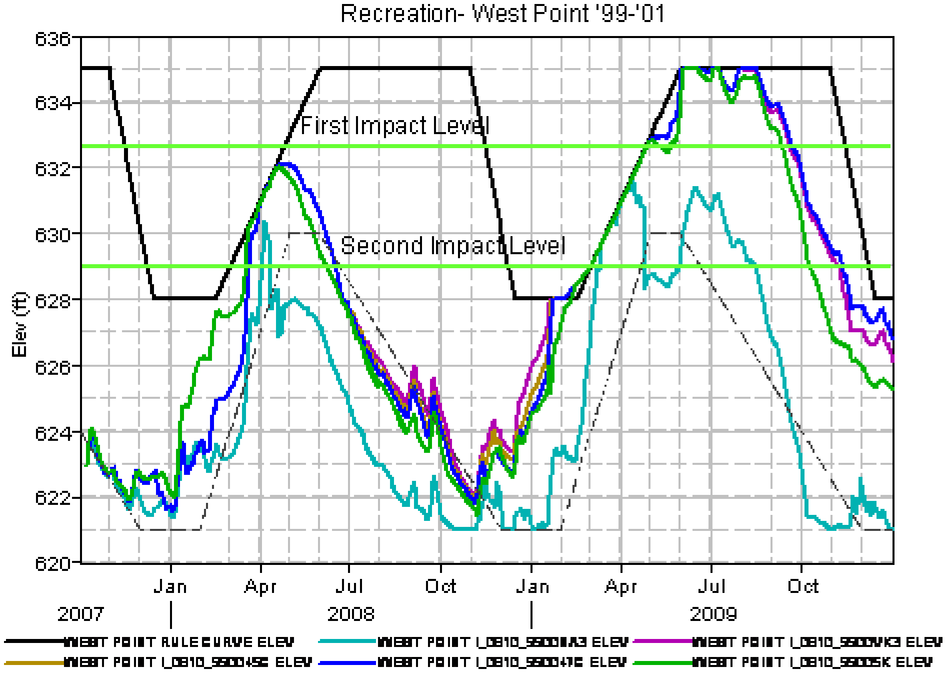


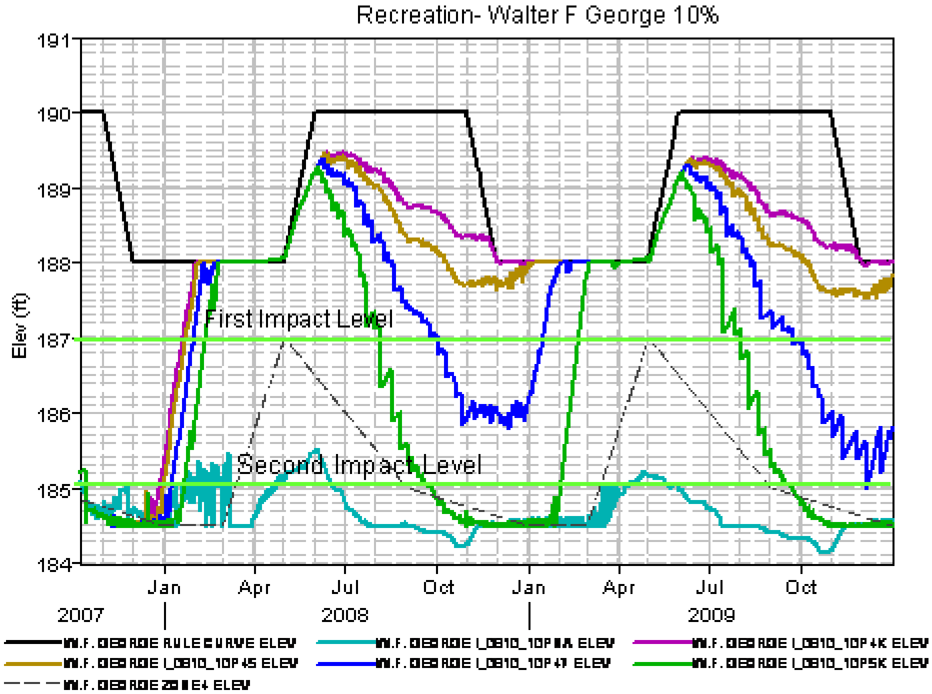


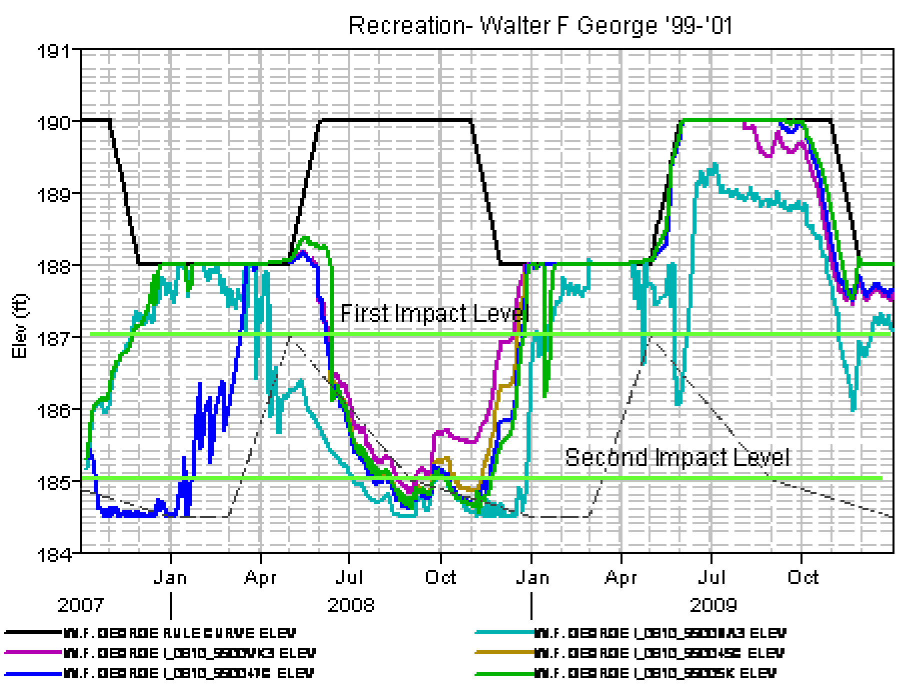
Recreation - West Point 10%

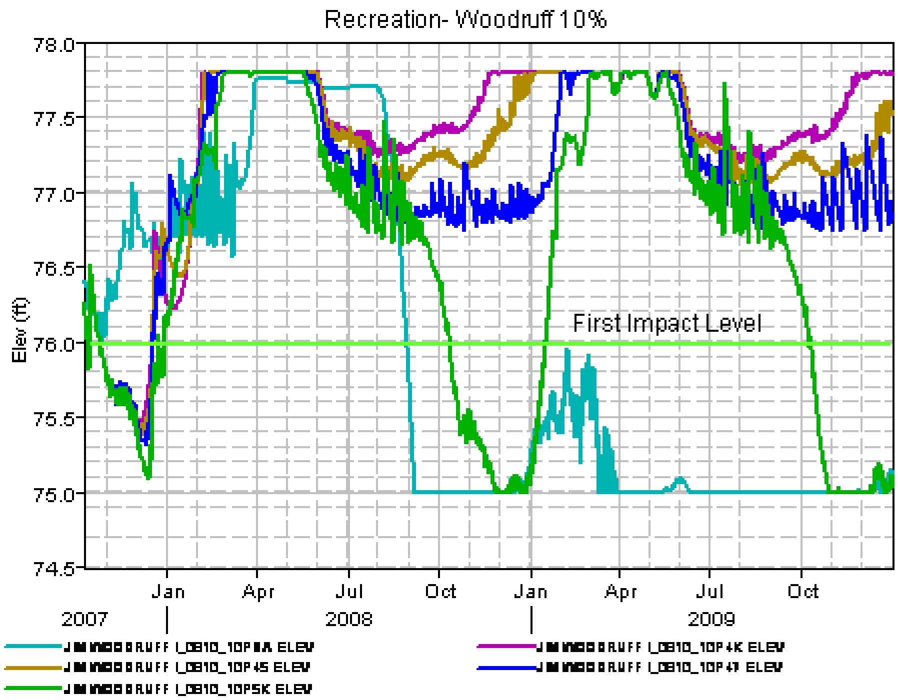


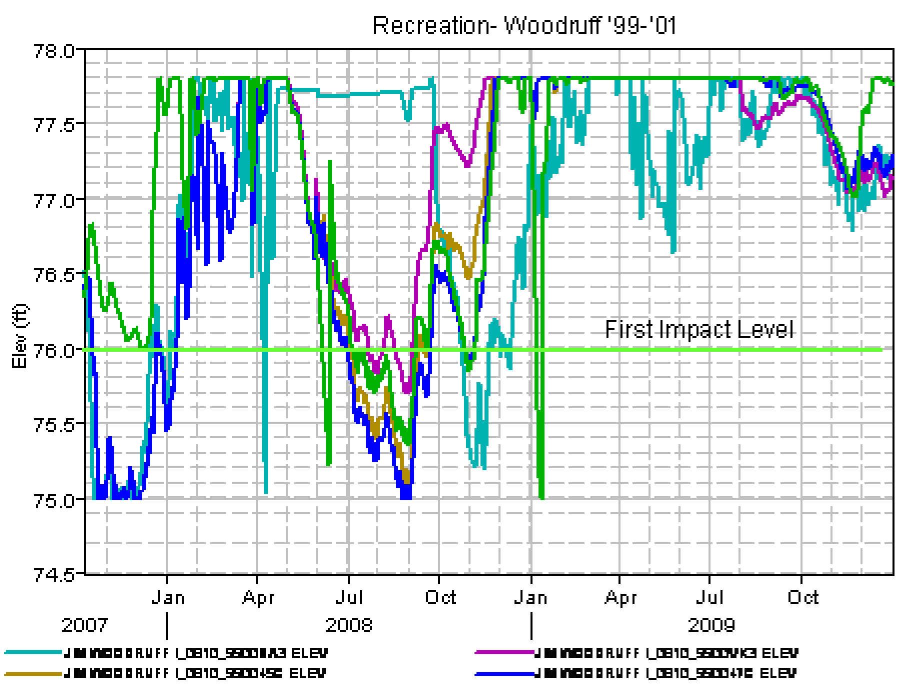
Recreation- West Point '99-'01




Recreation- Walter F George 10%
Elev (ft)
191
190
189
188
187
186
185
184
First Impact Level
Second Impact Level
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009
W.F. GEORGE RULE CURVE ELEV


Recreation- Walter F George '99-'01
Elev (ft)
191
190
189
188
187
186
185
184
First Impact Level
Second Impact Level
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009
W.F. GEORGE RULE CURVE ELEV


Recreation- Woodruff 10%
Elev (ft)
78.0
77.5
77.0
76.5
76.0
75.5
75.0
74.5
First Impact Level
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009


Recreation- Woodruff '99-'01
Elev (ft)
78.0
77.5
77.0
76.5
76.0
75.5
75.0
74.5
First Impact Level
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009

9. Hydrology: As illustrated in the figure above, implementation of the various EDO minimum flow scenarios does not result in significantly different reservoir levels. However, the "no action" simulation results in substantially lower reservoir levels during most of the simulated period.

Flows in the Apalachicola River are essentially the same under the simulated 1999-2001 20 percent reduced hydrology under the various EDO minimum flow scenarios and the no action. However, the more severe drought hydrology simulation shows that the no action plan results in greater discharges in the Apalachicola River during the wet season than the EDO minimum flow scenarios, but also results in significantly lower discharges during the dry season. These lower flows could result in substantial adverse effects to listed mussel species. The EDO minimizes these adverse effects by maintaining minimum flows of at least 4,150 cfs throughout the simulated period. Adverse effects associated with lower flows on the Apalachicola River are generally attributable to the continuing exceptional drought and not discretionary operations of the Corps. Therefore, the implementation of the recommended plan will not significantly impact the hydrology of the Apalachicola River and bay system, or the upstream reservoirs.

10. Water Quality: Buford, West Point, and Jim Woodruff dams all provide minimum continuous flow releases to meet State water quality commitments. Walter F. George provides occasional releases, as needed, to maintain acceptable DO values below the dam. Occasional special releases are also made at Buford to insure adequate DO and water temperature at the Buford Fish Hatchery located downstream of the dam. Implementation of the EDO will not affect water quality releases at these reservoirs. The implementation of the EDO will not result in reservoir levels that limit the ability to support water quality releases. Releases from the upstream reservoirs are able to meet the 750 cfs minimum flow on the Chattahoochee River near Peachtree Creek and provide adequate flows for the estimated assimilative capacity needs on the Chattahoochee River near Columbus, Georgia. The no action simulation results in periods where these water quality criteria are not met. Implementation of the EDO will result in Apalachicola River flows lower than the current 5,000 cfs minimum flow requirement (down to 4,150 cfs.). however, the no action could result in significantly lower flows on the Apalachicola River than this if the current exceptional drought conditions continue for an extended period. We lack sufficient information to determine if the minimum flows prescribed by the EDO would alter baseline water quality of the action area. However, we recognize that extended periods of low flow on the river will likely result in increased salinity levels in Apalachicola Bay and increased water temperatures and associated localized DO changes. These impacts are generally attributable to the continuing exceptional drought conditions and not the discretionary operations of the Corps.

The EDO minimal flow scenario is applicable until revised or until composite storage returns to zone 2. The nature of its effects to the river system is such that none are permanent. Reservoir operations may conceivably be altered at any time; therefore, flow alterations that may result from the EDO will not result in permanent impacts. Since the EDO is applicable year round, changes to the flow regime and water quality parameters may occur at any time and/or continuously until such time as it is revised or composite storage returns to zone 2. With regard to disturbance intensity and severity, the EDO provides for discretionary alteration of the flow regime when basin inflow is greater than 4,150 cfs, but maintains a minimum flow from Jim Woodruff Dam beginning immediately with 4,750 cfs with possible additional reductions based on criteria and triggers. Therefore, the implementation of the EDO will not significantly impact water quality as compared to the No Action Alternative.

11. Aesthetics: The EDO will not permanently affect the aesthetics in the project area. The Federal reservoirs could result in sustained low water conditions during the EDO and still be in low water conditions during the prime recreational season. Exposed shoreline and bottom areas could continue, and boat docks could still be exposed, which could affect property values along the lake shore areas. However this impact is due to the regional drought conditions, and not the EDO, which should mitigate some of the anticipated drought impacts.

12. Water Supply: Concerns have been addressed by the public that drought conditions could restrict water supply withdrawals from the Corps reservoirs to deeper waters within the inactive storage zone which could potentially present water quality problems to the public drinking supply. However, investigations have confirmed that the quality of water in inactive storage is suitable for consumers. In fact, several water supply users already withdraw from this part of the lake. In order to address the public concerns, several water samples were collected from the inactive storage zone this fall, and subjected to independent water quality testing by the City of Gainesville. City of Gainesville, City of Buford and Gwinnett County currently withdraw and treat water from the inactive zone using standard water treatment methods for possible increased levels of manganese, iron, or other chemical parameters affecting odor or taste. Dr. Soballe (water quality expert from the Corps Engineering Research and Development Center) has stated very clearly that upon analysis of the field data taken from various locations and depths within the inactive storage zone that even at the very bottom of the lake the physical/chemical makeup "could easily be reduced to acceptable drinking water levels....by conventional treatment [methods]". If Lake Lanier continues to decline, there may be additional costs for water treatment, but safe water will still be available for water supply and other critical water needs in the ACF system.

Implementation of the EDO will not affect water supply for M&I use at the upstream reservoirs or the Apalachicola River. The EDO will not result in reservoir levels or river levels that limit the ability to support water supply, and its intent is to conserve storage as much as possible in order to support water supply, water quality, and fish and wildlife needs. Modeling data illustrates the no action alternative could deplete conservation storage in the reservoirs. Therefore, the implementation of the EDO will not significantly impact water supply.

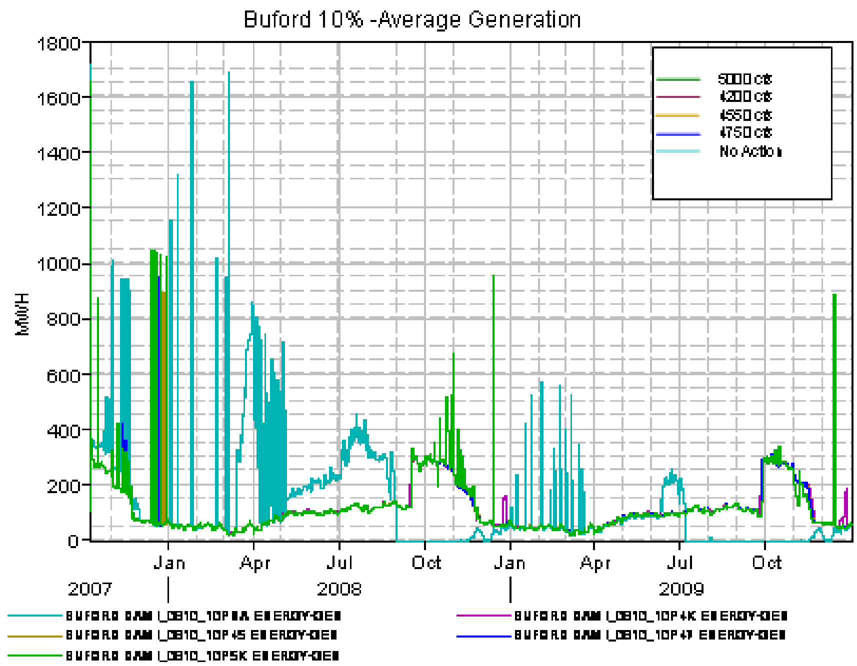
13. Flood Control. Implementation of the EDO will not significantly affect flood control operations at the upstream reservoirs. The purpose of the EDO, in part, is to replenish storage in the Federal reservoirs. The temporary waiver from the existing water control plan would also include provisions to allow temporary storage above the winter

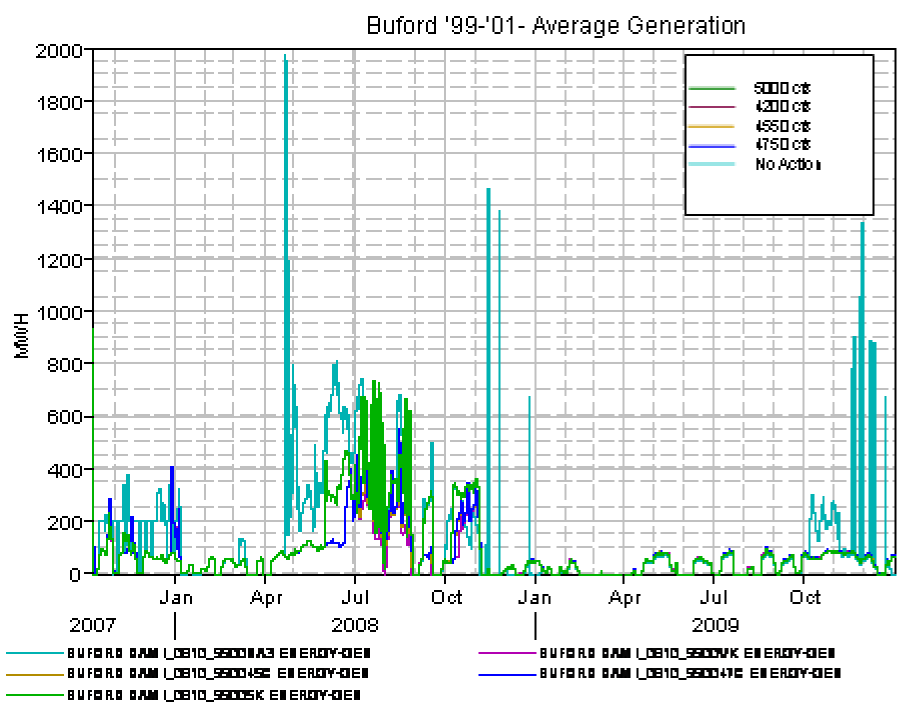
pool rule curve at the Walter F. George and West Point projects if the opportunity presents itself and/or begin spring refill operations at an earlier date in order to provide additional conservation storage for future needs. However, the EDO will be implemented in a manner that would not result in reservoir levels that limit the ability to manage flood waters. Therefore, the implementation of the EDO will not significantly impact flood control.

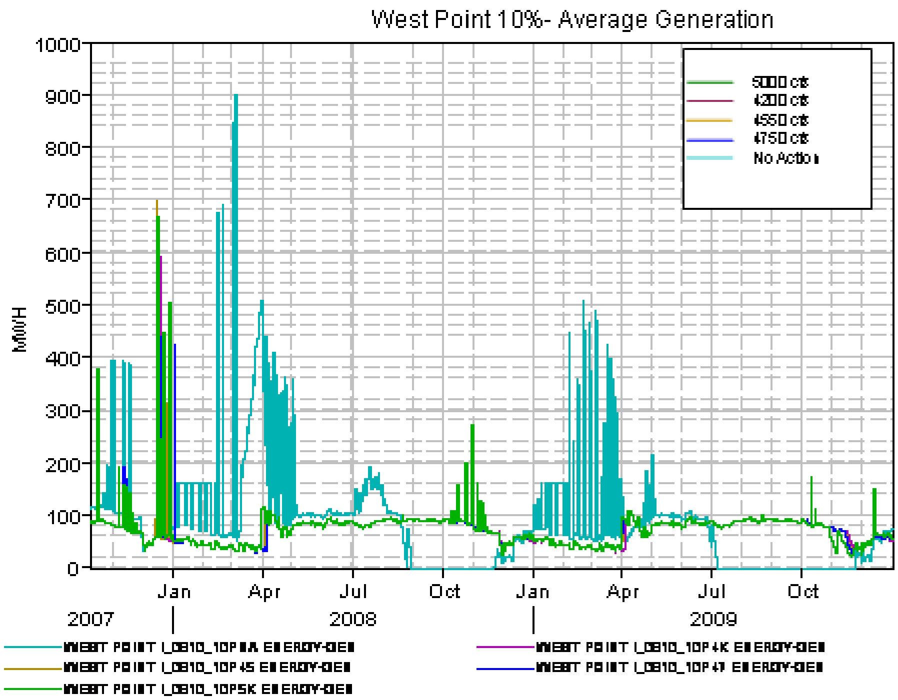
14. Navigation. The lack of dredging and routine maintenance has led to inadequate depths in the Apalachicola River navigation channel, and commercial navigation has only been possible on a seasonal basis when flows in the river are naturally high, with flow support for navigation suspended during drier times of the year. On a case-by-case basis, limited releases for navigation have been made for special shipments when a determination can be made that other project purposes will not be significantly impacted and any fluctuations in reservoir levels or river stages would be minimal. During sustained drought or low flow periods, as Lake levels fall below Zone 1 and lower, navigation support is reduced and eventually eliminated in accordance with the water control plan, since navigation support typically requires such large volumes of flow support. Since releases for navigation support have already been eliminated due to the severe drought conditions, implementation of the EDO is not expected to affect commercial navigation. Therefore the implementation of the EDO will not significantly impact navigation.

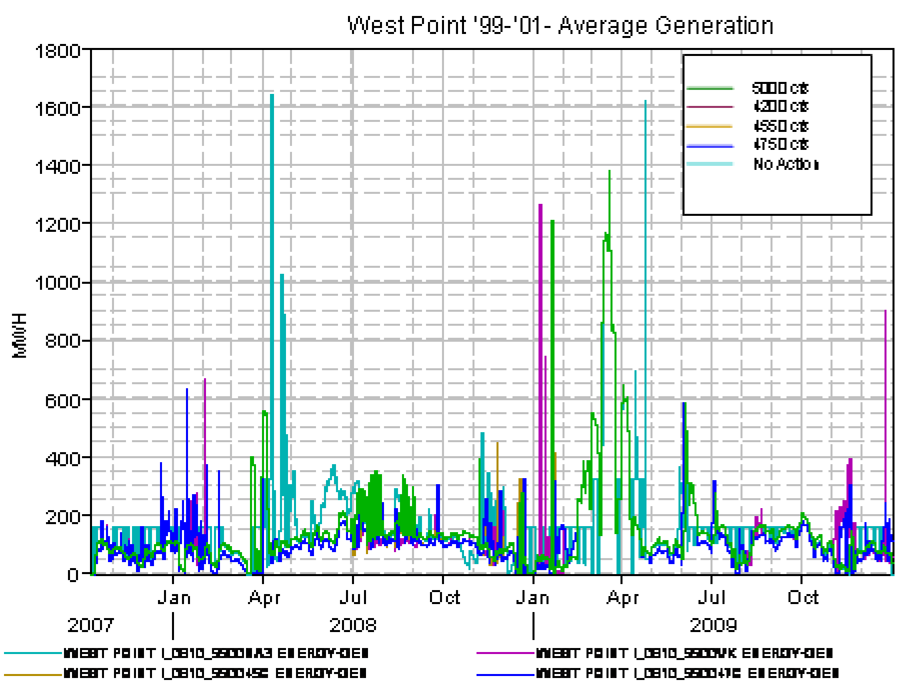
15 Hydropower. Figure 6 illustrates average generation at the four Federal reservoirs under the simulated no action and EDO minimum flow scenarios. Most of the impacts to hydropower generation at the four reservoirs are attributable to the continuing exceptional drought conditions. Although the no action generally provides more average generation at each of the four reservoirs during January to April time period, under the more severe drought conditions, the various EDO minimum flow scenarios minimize the extent and duration of periods where little or no hydropower generation occurs during summer to fall months (2008-2009). June to September represents the critical demand period. Inability to generate during the critical demand period represents a significant impact to hydropower which would be mitigated to some degree by the EDO alternatives. Therefore the implementation of the EDO will not significantly impact hydropower generation at Jim Woodruff or the upstream dams as compared to the No Action Alternative.

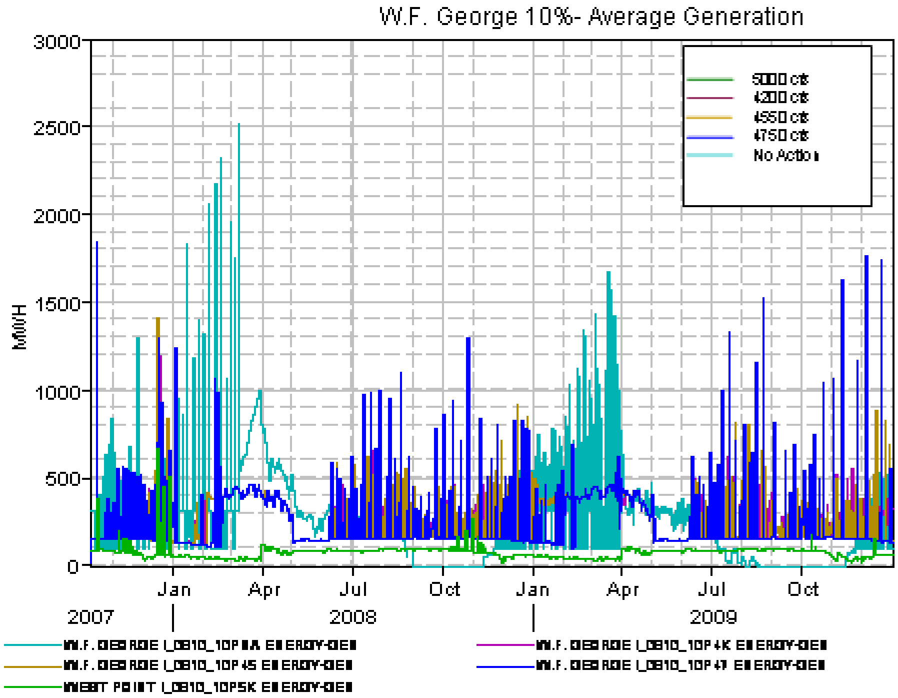
Figure 6- Average generation at Buford, West Point, Walter F. George, and Woodruff under the no action (10% hydrology HEC-5 simulated flow and 1999-2001 20% reduction hydrology HEC-5 simulated flow) and EDO minimum flow scenarios (10% hydrology HEC-5 simulated flow and 1999-2001 20% reduction hydrology HEC-5 simulated flow).

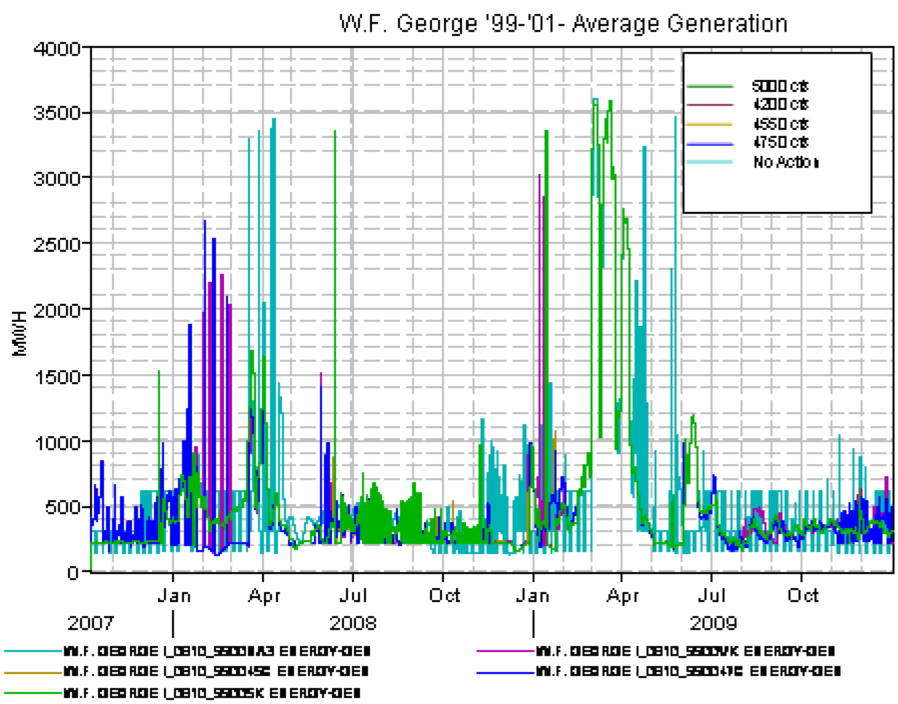


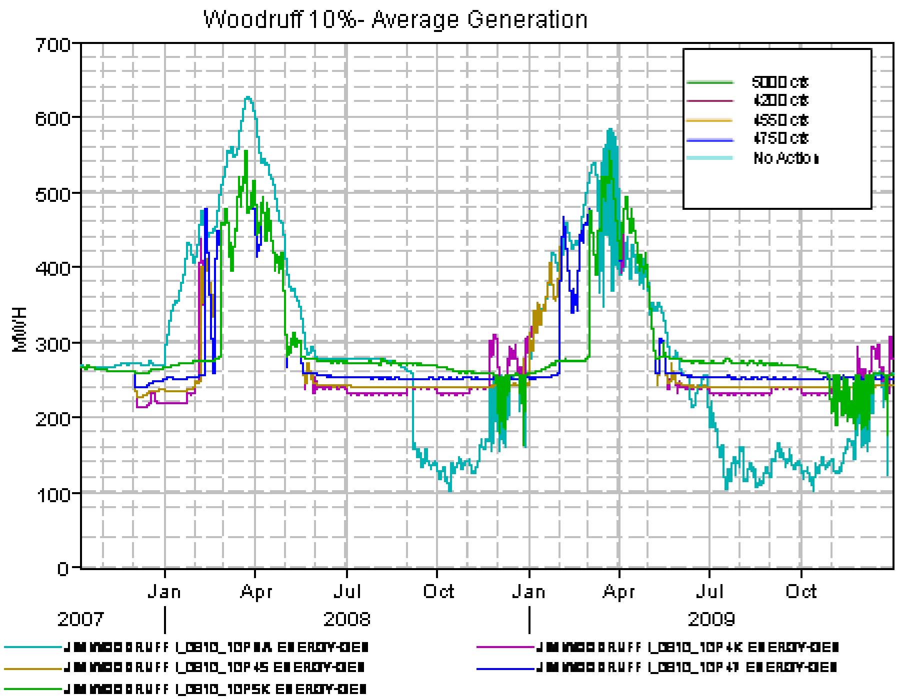


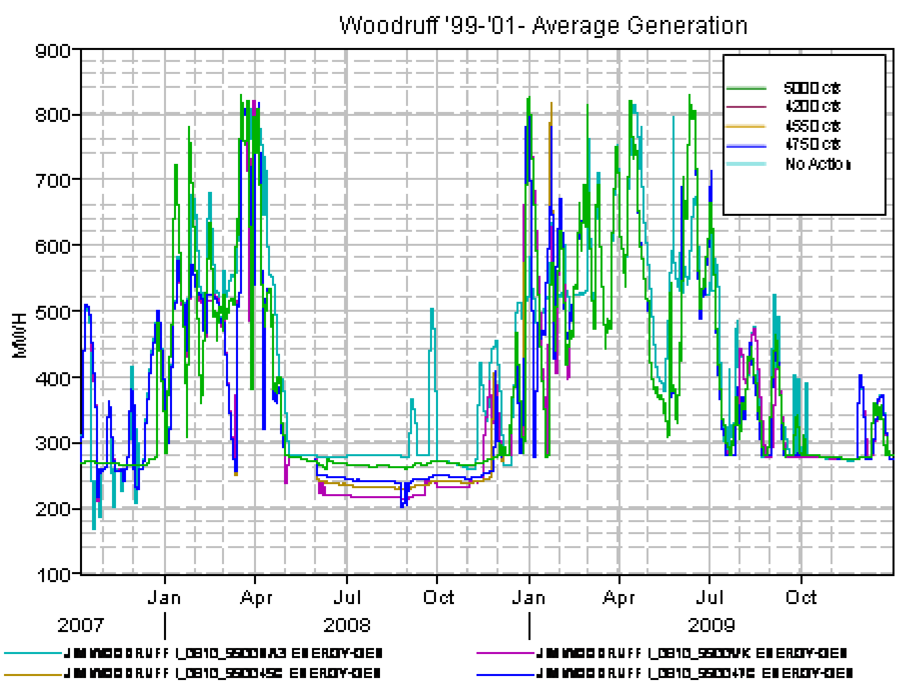

West Point 10%- Average Generation
MWH
1000
900
800
700
600
500
400
300
200
100
0
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009
5000 cfs
4200 cfs
4550 cfs
4750 cfs
No Action


West Point '99-'01- Average Generation
MWH
1800
1600
1400
1200
1000
800
600
400
200
0
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009
5000 cfs
4200 cfs
4550 cfs
4750 cfs
No Action


W.F. George 10%- Average Generation
MWH
5000 cfs
4200 cfs
4550 cfs
4750 cfs
No Action
Jan
Apr
Jul
Oct
2007
2008
2009


W.F. George '99-'01- Average Generation
MWH
5000 cfs
4200 cfs
4550 cfs
4750 cfs
No Action
Jan
Apr
Jul
Oct
2007
2008
2009


Woodruff 10%- Average Generation
MWH
700
600
500
400
300
200
100
0
5000 cfs
4200 cfs
4550 cfs
4750 cfs
No Action
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009


Woodruff '99-'01- Average Generation
MWH
900
800
700
600
500
400
300
200
100
5000 cfs
4200 cfs
4550 cfs
4750 cfs
No Action
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
2007
2008
2009

16 Floodplain/Wetlands. The amount and duration of inundated floodplain habitat is mostly driven by the severity of the drought conditions that occur rather than discretionary actions of the Corps. However, the no action flow regime generally provides more acres of floodplain connectivity to the main channel than the EDO. This discrepancy between the EDO and no action flow regimes is due to operational provisions allowing for storage of all basin inflow above that required to meet the minimum flow discharge under the EDO and limitations to storage during the months of April and May under the no action (especially when basin inflow is less than 18,000 cfs which allows for no storage).

The storage restrictions of the no action allow the passage of a greater percentage of total basin inflow, which provides greater floodplain connectivity under both simulated hydrology scenarios. However, floodplain connectivity is extremely limited under all the no action and various EDO minimum flow scenarios in the growing season (April – October). Under these dry hydrologic conditions, floodplain connectivity is minimal with or without the implementation of the EDO. Therefore the implementation of the EDO will not significantly impact floodplain habitat as compared to the No Action Alternative.

17. Prime and Unique Farmland: The EDO will have no effect on prime farmlands or unique agricultural lands.

18. Environmental Justice: Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations (11 February 1994) requires that Federal agencies conduct their programs, policies, and activities that substantially affect human health or the environment in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under such programs, policies, and activities because of their race, color, or national origin.

The EDO is not designed to create a benefit for any group or individual. The EDO does not create disproportionately high or adverse human health or environmental impacts on any low-income populations of the surrounding area. Review and evaluation of the EDO have not disclosed the existence of any identifiable minority or low-income communities that would be adversely affected by implementation of the EDO.

19. Protection of Children: The EO 13045, Protection of Children from Environmental Health Risks and Safety Risks (21 April 1997), recognizes a growing body of scientific knowledge that demonstrates that children may suffer disproportionately from environmental health risks and safety risks. These risks arise because children's bodily systems are not fully developed; because children eat, drink, and breathe more in proportion to their body weight; because their behavior patterns may make them more susceptible to accidents. Based on these factors, the President directed each Federal agency to make it a high priority to identify and assess environmental health

risks and safety risks that may disproportionately affect children. The President also directed each Federal agency to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Implementation of the EDO does not involve activities that would pose any disproportionate environmental health risk or safety risk to children.

20. Cumulative Impacts. The CEQ regulations define cumulative impacts 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 regardless of what agency (Federal or non-Federal) or person undertakes such other action." 40 C.F.R. § 1508.7. Actions considered in the cumulative impacts analysis include implementation of the EDO and other Federal, State, Tribal, local or private actions that impact the resources affected by the EDO. The resources affected by the EDO are described above and are generally limited to habitat conditions and species closely linked to the flow regime in the Apalachicola River.

Within the project area, various past Federal, State, and private actions have impacted the ACF basin and Apalachicola River habitat and natural flow regime including construction of the Corps' dams, urban development, agricultural activities, navigation channel maintenance dredging and disposal, water withdrawals, and small impoundments. The five Corps' dams continue to affect the Apalachicola River by trapping sediment in reservoirs that would otherwise move as bed load through the system. The interruption of this bed load movement and past navigation channel maintenance dredging and disposal activities have contributed to the altered channel morphology in the project area. Channel morphology sets the context for the flow regime. Urban development and agricultural activities have adversely affected water quality and riverine and floodplain habitat. The associated water withdrawals have also impacted the flow regime.

Adverse effects to riverine habitat from continued urbanization and agricultural activities in the ACF basin are reasonably certain to occur. However, state and local governments have regulations in place to minimize these effects, including regulations regarding construction best management practices, storm water control, and treatment of wastewater.

Additionally, an increase in net consumptive depletions due to water supply are reasonably certain to occur based on increased M&I demands in the ACF basin (particularly in the upper basin) and agricultural withdrawals. The Georgia Environmental Protection Division has determined that the most acres in the basin for which irrigation is economically feasible are already irrigated, and that agricultural demand has likely "plateaued" at close to the year 2000 demands. However, increases in the amount of water applied per acre would occur if the current crops are converted to more water intensive crops. Implementation of the EDO would not contribute to cumulative impacts affecting resources on the Flint River since there are no Corps projects controlling water releases in this system. However, increases in consumptive depletions in the ACF Basin could adversely affect habitat in the Apalachicola River and Apalachicola Bay by further altering the natural flow regime.

Accordingly, due to the short duration and intensity of the EDO, the cumulative adverse effects associated with this action on the ACF River Basin resources (including fish and wildlife, water supply, and water quality) are considered minor. The implementation of the EDO could include potential beneficial cumulative impacts, as it provides a method to store water, which might be essential for these resources if the severe drought conditions continue or worsen.

6. ANY IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS WHICH WOULD BE INVOLVED SHOULD THE RECOMMENDED PLAN BE IMPLEMENTED:

Any irreversible or irretrievable commitments of resources involved in the EDO have been considered and are either unanticipated at this time, or have been considered and determined to present only minor impacts.

7. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED:

Any adverse environmental effects, which cannot be avoided during implementation of the recommended project, are expected to be minor both individually and cumulatively. Unavoidable impacts to threatened and endangered species will be minimal and short term impacts so augmentation flows higher than basin inflows can continue to be sustained over the long term.

8. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY:

The proposed project constitutes a short-term use of man's environment. The EDO is a temporary modification of the IOP and existing water control plan in order to respond to exceptional drought conditions currently being experienced within the basin, and provides for temporary drought contingency operations in order to prepare for predicted sustained multi-year drought conditions. Short term impacts on water resources and endangered and threatened species are anticipated in order to provide for increased potential for storage which would allow for sustaining augmentation flows above basin inflows for a longer term in the event drought conditions persist or continue to deteriorate in the basin. Although some impacts will occur to listed mussels and Gulf sturgeon, and host fish for mussels, as well as other aquatic resources in the rivers and estuarine areas, over the short-term, the EDO is planned to avoid the potential catastrophic loss of storage capable of sustaining augmentation flows over the long term. The no action alternative could result in depletion of conservation storage and more severe impacts to aquatic resources within the basin, possible jeopardy to listed mussels, and potential closure of industries to include critical power plants due to lack of flow support for cooling water intakes and assimilative capacity for discharges to the river. It is anticipated that the EDO would only be implemented until such time as composite storage within the basin is restored above critically low conditions and drought conditions abate (at which time operations would return to those prescribed by the IOP); or at such time as the existing water control plan is revised or updated and a new Water Control Plan is implemented. At that time, additional public coordination, consultation, and NEPA documentation would be prepared for the new water control plan, and elements of the IOP could change at that time. Also, in the event of additional information or changed conditions, consultation would be re-initiated with the USFWS to determine if any additional changes to the EDO would be necessary. At this time we do not have an estimate of when that will occur. Operations under the EDO are not expected to result in any permanent changes or impacts to listed species, critical habitat for listed species or other project purposes or resources within the basin. The conditions of the BO for the EDO also include monitoring and adaptive management, so adjustments could be made in the future, pursuant to additional consultation, in the event any unanticipated impacts are documented.

9. COORDINATION:

Coordination associated with development and implementation of the proposed EDO is summarized below. Referenced correspondence is included as appendices to the enclosed Biological Assessment dated 1 November 2007 (Appendix A), or incorporated separately in Appendix D.

The ACF basin is experiencing the second year of severe drought conditions within the basin. The National Weather Service has classified significant portions of the basin as an exceptional drought, and predictions are that drought conditions will likely continue through the winter and spring of 2008. In late summer 2007, it became apparent to the Mobile District that exceptional drought conditions were developing in the basin that were more sever than any drought conditions previously considered or modeled to predict impacts of the IOP. By September 2007, it was clear that record drought conditions were being experienced in significant portions of the ACF basin. Because of the significantly reduced inflows to ACF Basin and continued releases necessary to meet minimum flow requirements downstream, there was concern that Lake Lanier may deplete its conservation storage if severe drought conditions continue through the end of the year and into 2008. Therefore, on 7 September 2007, a teleconference was conducted with USFWS to share preliminary modeling results of the predicted impacts of the IOP operations on system hydrology if the severe drought conditions were to persist as predicted and to initiate informal consultation discussions on possible modifications to the IOP as drought contingency measures. In accordance with the adaptive management provisions of RPM1 of the IOP, Mobile District and the USFWS attempted to identify additional drought contingency measures considered necessary to conserve storage within the reservoir system in order to be in a better position to continue to provide support for the multiple project purposes in the basin, including continued support to listed endangered and threatened species and critical habitat during the predicted multi-year drought conditions.

By letter on 14 September 2007, Georgia Department of Natural Resources, Environmental Protection Division (GA-EPD) expressed concern regarding the status of the Federal reservoirs as a result of the continued drought conditions and advised that extreme caution be exercised in operating the ACF system in the face of the predicted multi-year drought; and suggested that modifications of the IOP be considered as necessary to assure sustainability of the reservoirs in continuing severe drought conditions.

On 20 September 2007, the Corps began conducting bi-weekly Stakeholder Drought Summit Teleconferences for the ACF basin, in order to inform the stakeholders and water users within the basin of developing drought conditions in the basin, planned drought contingency operations planned by the Corps, allow the stakeholders to inform the Corps of other user needs and contingency actions being taken, and in order to provide sufficient notice to the stakeholders so their drought contingency measures can be taken. These bi-weekly teleconferences are continuing to date. Additional information has been obtained from these teleconferences, to include minimum flow needs from the critical power plants, status of water intake structures, and the needs of other users within the basin.

Additional informal consultation discussions were conducted with USFWS on 25 September 2007 during the fall bi-annual meeting, and in subsequent teleconferences.

By letter dated 12 October 2007, GA-EPD repeated concerns regarding impacts to the reservoirs due to severe drought. GA-EPD provided modeling results reflecting predicted 2007 climatic and hydrologic conditions, and requested that the IOP be modified immediately to eliminate any augmentation to maintain minimum flows below Jim Woodruff Dam (with releases to be equivalent to basin inflows); and that any ramp down restrictions be eliminated.

On 15 October 2007, Mobile District provided a draft report on the effects of reductions of minimum flow on listed mussels on the Apalachicola River, with mussel density and percentage data estimated at on-foot depth increments, corresponding to flow increments of 4,150 cfs, 3,200 cfs and 2,200 cfs.

By letter dated 17 October 2007, Florida Department of Environmental Protection (FDEP) expressed concern that the proposed modifications requested by GA-EPD would severely impact Florida’s resources; and suggested that the States and Federal agencies work together toward addressing drought contingency measures.

By letter dated 17 October 2007, Mobile District responded to the GA-EPD that due to the severe nature and predicted duration of the continuing drought conditions, discussions had been initiated with the USFWS to address concerns that remaining storage within the ACF system may be depleted before drought conditions abate, which could result in the Corps inability to fulfill the authorized, multiple project purposes, comply with provisions of the Endangered Species Act, and minimize impacts on other water uses and needs throughout the basin. Discussions included possible drought contingency options that may provide some temporary modifications to the IOP and could allow some additional water to be stored to place the reservoirs in a better position to meet minimum needs if the drought conditions continue into 2008 as predicted.

On 17 October 2007, as a result of continuing discussions with USFWS, Mobile District announced the intent, by email correspondence, to use volumetric balancing to store some additional rainfall that may occur in the event basin inflow increased above 5,000 cfs, within the balance of previously accumulated credits. USFWS concurred that this action would be consistent with the currently approved volumetric balancing procedures under the IOP.

Based on continuing information consultation discussions with USFWS, Mobile District requested by letter to USFWS dated 19 October 2007, that the ramping restrictions be discontinued until 1 March 2008. By letter dated 19 October 2007, USFWS concurred with the requested temporary modification to the IOP.

On 19 October 2007, the State of Georgia filed a motion for a preliminary injunction against the Corps of Engineers, requesting that immediate modifications to the IOP be ordered, similar to the proposals of the GA-EPD letter dated 12 October 2007, with a minor change to base releases on an adjusted basin inflow amount. A hearing was scheduled for 19 November 2007, but was converted to a status hearing on the multiple district litigation following withdrawal of the motion by Georgia on 6 November 2007. The withdrawal was based on submittal of the request for formal consultation on the proposed EDO modifications to the IOP.

By letter dated 20 October 2007 to President Bush, Georgia Governor Perdue requested that major disaster be declared for the State of Georgia due to the prolonged drought, that an exemption from the Endangered Species Act be determined to allow drought contingency measures to be implemented; and that the drought contingency measures proposed in the GA-EPD 12 October letter be implemented. This action was immediately followed by letters to the President dated 22 October 2007 from Alabama Governor Riley and dated 24 October from Florida Governor Crist objecting to such a disaster determination or exemption from the Endangered Species Act due to anticipated adverse impacts that would be suffered in their downstream river reaches.

On 25 October 2007, Atlanta Regional Commission provided modeling results using 200-2001 hydrological conditions reduced by 15 percent to reflect forecast of worst case drought conditions, and requested the consideration of modification to the IOP to relax ramping rates, consider reduced minimum flows, and suggested additional modifications to allow additional storage during the projected drought conditions.

By telecom on 26 October 2007, Mobile District and USFWS outlined various options that may improve conservation storage at the reservoirs and/or minimize harm to listed species. On 31 October 2007, Mobile District then provided USFWS with preliminary modeling results for a proposed reduction in minimum flows at Jim Woodruff Dam to

4,150 cfs, based on anticipated impacts on mussels from up to a 1-foot drop in stage, as addressed in the above 15 October report.

On 1 November 2007, Mobile District submitted a request to USFWS requesting the initiation of formal consultation on the proposed EDO plan to relax the IOP provision and consider reduction of the minimum release from Jim Woodruff Dam to 4,150 cfs. A copy of a biological assessment of the impacts of the EDO was enclosed. At that time it was noted that both agencies had agreed to complete expedited formal consultation with the issuance of a biological opinion by the USFWS by 1 November 2007, due to the urgency presented by the severe drought conditions.

On 1 November 2007, the governors from Alabama, Florida and Georgia met with a task force formed by the President, led by the Secretary of the Interior and the Director of the Council of Environmental Quality in Washington, D.C. to facilitate discussions regarding drought contingency measures and possible resolution of long-standing differences regarding water allocation between the three States. It was agreed in that meeting that the States would meet in December 2007, and attempt to develop a drought management plan for the ACF basin by 15 February 2008.

Mobile District submitted on 7 November 2007 an amendment to the biological assessment for the EDO including the consideration of incremental reductions in flow of 4,750 cfs and 4,500 cfs in order to minimize potential harm to mussels. This amendment was based on additional data provided by USFWS on 1 November 2007 regarding mussel distribution and anticipated impacts, and additional modeling completed by Mobile District on 3 November 2007.

By letter dated 8 November 2007 to both Mobile District and USFWS, FDEP expressed their opposition to the proposed EDO as described in the 1 November 2007 request to initiate formal Section consultation. FDEP requested that any biological opinion on the EDO be limited in scope and expire by 15 February 2007 in order to allow implementation of any drought contingency plan developed by the States in accordance with the above-referenced 1 November facilitated agreements.

On 15 November 2007, USFWS issue a final Biological Opinion for the propose EDO. The Biological Opinion included an Incidental Take Statement for incremental reductions in flow of 4,750 cfs and 4,500 cfs. Additional triggers would have to be developed and agreed to by both agencies prior to reduction to 4,500 cfs or 4,150 cfs; and re-initiation of consultation would be required prior to reduction to 4,150 cfs . Additional monitoring requirements would also be required for the proposed reductions in flow.

REFERENCES CITED:

Barkaloo, J.M. 1987. *Report on the conservation status of the Gulf of Mexico sturgeon. Acipenser oxyrhynchus desotoi*. U.S. Fish and Wildlife Service, Panama City, Florida.

Brim Box, J. and J. D. Williams. 2000. Unionid mollusks of the Apalachicola Basin in Alabama, Florida, and Georgia. Alabama Museum of Natural History, Bulletin

Comprehensive Water Resource Study Partners. September 1995. *Alabama-Coosa-Tallapoosa, Apalachicola-Chattahoochee-Flint River Basins Water Resources Study* Status Report.

Couch, C.A, E.H. Hopkins, and P.S. Hardy. 1996. *Influences on Environmental Settings on Aquatic Ecosystems in the Apalachicola-Chattahoochee-*

EnviroScience. 2006. Freshwater mussel and habitat surveys of the Apalachicola River, Chipola River and selected sloughs / tributaries October 23 – November 10, 2005, final report.

EnviroScience. 2006. Unpublished Data. 3781 Darrow Rd. Stow, OH.

Frick, E. A., D.J. Hippe, G. R. Buell, C.A. Couch, E.H. Hopkins, D.J. Wangness, and J.W. Garrett. 1998. *Water Quality in the Apalachicola-Chattahoochee-Flint River Basin, Georgia, Alabama, and Florida, 1992-95*. U.S. Geological Survey Circular 1164

Florida Department of Environmental Protection. 1998. *Section 303(d) List of Impaired Waters.*

Florida Department of Environmental Protection (FDEP). 1998. *Notice of Intent to Issue FDEP Permit No. 0129424-001-DF*. (3 December 1998),

Florida Department of Environmental Protection (FDEP). 2002. *Division of Water Resource Management, Basin Status Report, Northwest District, Group 2 Basin, Apalachicola-Chipola*

Light, H.M., M.R. Darst, and J.W. Grubbs. 1998. *Aquatic habitats in relation to river flow in the Apalachicola River floodplain, Florida.* U.S. Geological Survey Professional Paper 1594.

Light, H.M., K.R.Vincent, M.R. Darst, and F.D. Price. 2006. *Water-Level Decline in the Apalachicola River, Florida, from 1954 to 2004, and Effects on Floodplain Habitats.* U.S. Geological Survey Scientific Investigations Report 2006-5173.

Livingston, R.J. 1984. The ecology of the Apalachicola Bay system: an estuarine profile. U.S. Fish and Wildlife Service, USFWS/OBS-82/05.

Miller, A.C. 1998. *An analysis of freshwater mussels (Unionidae) at dredged material disposal areas along the Apalachicola River, Florida*. Technical Report EL-98-16, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Miller, A.C. 2000. *An analysis of freshwater mussels (Unionidae) at dredged material areas along the Apalachicola River, FL 1999 Studies*. DRAFT Technical Report EL-00-, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

National Estuarine Research Reserve System. October 2005. Online. Internet. National Oceanic & Atmospheric Administration. September 2006. http://nerrs.noaa.gov/Apalachicola/Fauna.html.

Pine, W.E. and M.S. Allen. 2005. *Assessing the impact of reduced spawning habitat on Gulf sturgeon recruitment and population viability in the Apalachicola Bay system*. A final report to the U.S. Fish and Wildlife Service. Agreement No: 401814G069.

Richardson, T.D., and P. Yokley, Jr. 1996. *A note on sampling technique and evidence of recruitment in freshwater mussels (Unionidae)*. Arachiv fur Hydrobiologie.

Seaman, W., Jr. 1988. *Florida aquatic habitat and fishery resources*. Florida Chapter of the American Fisheries Society, Eustis, Florida.

Swift, C., R.W. Yerger, and P.R. Parrish. 1977. *Distribution and natural history of the fresh and brackish water fishes of the Ochlockonee River, Florida and Georgia.* Bull. Tall Timbers Res. Sta. No. 20. October. Tallahassee, FL.

Thorpe, P., N. Wooten, P. Krottje, and F. Sultana. 1998. *Land use management practices, and water quality in the Apalachicola River and Bay watershed.* Northwest Florida Water Management District Water Resources Assessment 98-1.

U.S. Army Corps of Engineers. 1978. *Appendix III. A study of diadromous fishery resources of the Apalachicola-Chattahoochee-Flint River system, Alabama, Georgia and Florida.* In Coordination report of navigational improvements for Apalachicola River below Jim Woodruff Dam, Florida. U.S. Army Corps of Engineers, Mobile District.

U.S. Geological Survey (USGS). 1996. *Influences of Environmental Settings on Aquatic Ecosystems in the Apalachicola-Chattahoochee-Flint River Basin.* USGS Water Resources Investigations Report 95-4278.

U.S. Army Corps of Engineers. 1998. *Water allocation for the Apalachicola-Chattahoochee-Flint (ACF) River Basin, Alabama, Florida, and Georgia; Draft Environmental Impact Statement*. U.S. Army Corps of Engineers, Mobile District

U.S. Army Corps of Engineers (USACE). 2006. *Environmental Assessment Interim Operations Plan for Support of Endangered and Threatened Species Jim Woodruff Dam*.

U.S. Army Corps of Engineers (USACE). 2007. *Biological Assessment Modifications to the Interim Operating Plan for Jim Woodruff Dam and the Associated Releases to the Apalachicola River*.

U.S. Commission on Fish and Fisheries. 1902. *Report of the Commissioner (Part XXVII) for the year ending June 30, 1901*. Government Printing Office

U.S. Fish and Wildlife Service (USFWS). 2006. *Biological Opinion and Conference Report on the U.S. Army Corps of Engineers, Mobile District, Interim Operations Plan at Jim Woodruff Dam and the Associated Releases to the Apalachicola River*.

U.S. Fish and Wildlife Service (USFWS). 2007. *Biological Opinion and Conference Report on the U.S. Army Corps of Engineers, Mobile District, Exceptional Drought Operations for the Interim Operating Plan for Jim Woodruff Dam and the Associated Releases to the Apalachicola River*

Wooley, C.M. and E.J. Crateau. 1985. *Movement, microhabitat, exploitation, and management of Gulf of Mexico sturgeon, Apalachicola River, Florida*. North American Journal of Fish Management.

Yerger, R.W. 1977. *Fishes of the Apalachicola River*. Proceedings of the conference on the Apalachicola drainage system. Publication 26. Florida Marine Resources, St. Petersburg, Florida.

Zehfuss, K.P., J.E. Hightower, and K.H. Pollock. 1999. *Abundance of Gulf sturgeon in the Apalachicola River, Florida*. Transactions of the American Fisheries Society.