US Army Corps
of Engineers ®
Mobile District

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN WATER CONTROL MANUAL

Final Draft

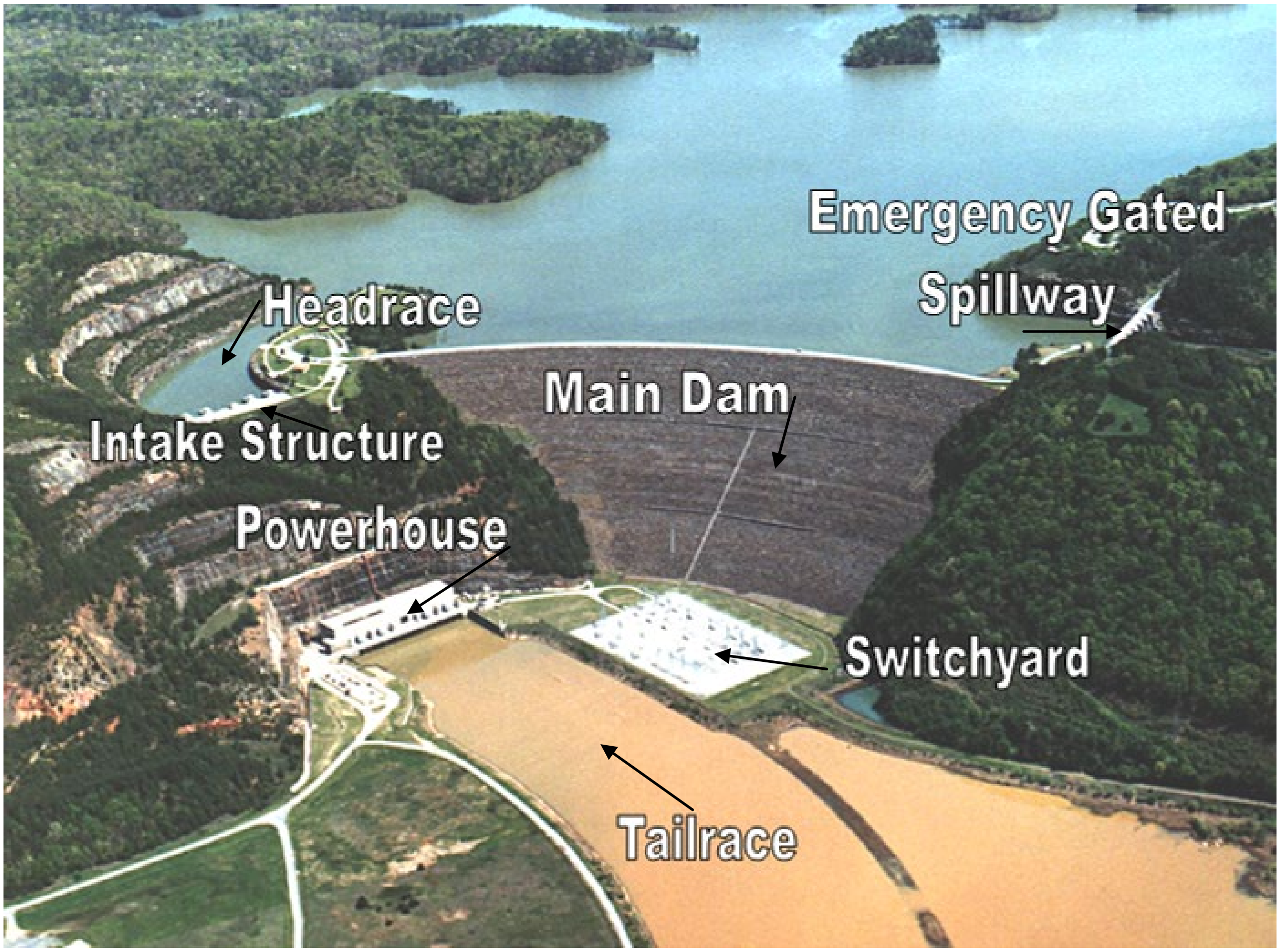
APPENDIX H

CARTERS DAM AND LAKE AND CARTERS REREGULATION DAM

COOSAWATTEE RIVER, GEORGIA

JULY 1979
REVISED XXX 2013

Carters Project
Coosawattee River, Georgia



Carters Main Dam
Coosawattee River, Georgia

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in a hard copy binder with loose-leaf form, and only those sections, or parts thereof, requiring changes be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current. Changes to individual pages must carry the date of revision, which is the South Atlantic Division's approval date.

REGULATION ASSISTANCE PROCEDURES

If unusual conditions arise, contact can be made with the Mobile District Office by phoning (251) 690-2737, during regular duty hours and (251) 490-9535 during non-duty hours. The Carters' Dam Project Manager's Office can be reached at (770) 945-9531 or (770) 780-6224 during non-regular duty hours.

METRIC CONVERSION

Although values presented within this text are shown with English units only, a conversion table is listed in Exhibit B for your convenience.

VERTICAL DATUM

All vertical data presented in this manual are referenced to the project's historical vertical datum, National Geodetic Vertical Datum of 1929 (NGVD29). It is the U.S. Army Corps of Engineer's policy that the designed, constructed, and maintained elevation grades of projects be reliably and accurately referenced to a consistent nationwide framework, or vertical datum - i.e., the National Spatial Reference System (NSRS) or the National Water Level Observation Network (NWLON) maintained by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration. The current orthometric vertical reference datum within the NSRS in the continental United States is the North American Vertical Datum of 1988 (NAVD88). The current NWLON National Tidal Datum Epoch is 1983 - 2001. The relationships among existing, constructed, or maintained project grades that are referenced to local or superseded datums (e.g., NGVD29, MSL), the current NSRS, and/or hydraulic/tidal datums, have been established per the requirements of Engineering Regulation 1110-2-8160 and in accordance with the standards and procedures as outlined in Engineering Manual 1110-2-6056. A Primary Project Control Point has been established at this project and linked to the NSRS. Information on the Primary Project Control Point, designated 9B-2A, and the relationship between current and legacy datums are in Exhibit B.

CARTERS DAM AND LAKE AND CARTERS REREGULATION DAM

WATER CONTROL MANUAL
COOSAWATTEE RIVER, GEORGIA
U.S. Army Corps of Engineers, Mobile District, South Atlantic Division

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PERTINENT DATA

GENERAL

Location – Murray, Gilmer, & Gordon Counties, GA; Coosawattee River, river mile 26.8

Main Dam Drainage Area, sq. mi.	374
Reregulation Dam Drainage Area, sq. mi.	521
Primary flood control pool elevation, ft. above NGVD29	1,099
Max. power pool elev. (dry season), ft. above NGVD29	1,074
Area of primary flood control pool, acres	3,880
Area of maximum power pool, acres	3,275
Flood storage volume, acre-feet (between 1,099-1,072)	95,683
Power storage volume, acre-feet (between 1,074-1,022)	141,402

MAIN DAM AND DIKES

ROCKFILL DAM

Top elevation, feet above NGVD29	1,112.3
Top width, feet	40
Length, feet	2,053

EARTHFILL SADDLE DIKES

Top elevation, feet above NGVD29	1,112.3
Total length, feet	700
Number of dikes	3

EMERGENCY GATED SPILLWAY

Total length, including end piers, ft. (net length 210 ft)	262
Elevation of crest, ft. above NGVD29	1,070.0
Type of gates	tainter
Number of gates	5
Length of Gates	42
Height of Gates	36.58

POWER DATA

Number of units	4
Capacity: 2 @ 140,00 and 2 @ 160,000 kw (declared values)	600,000
Operating head at maximum power pool, ft.	396
Minimum head at full drawdown, ft.	324

I - INTRODUCTION

1-01. Authorization. Section 7 of the Flood Control Act of 1944 instructed the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control (now termed flood risk management) or navigation at all U.S. Army Corps of Engineers (Corps) reservoirs. Therefore, this water control manual has been prepared as directed in the Corps' Water Management Regulations, specifically Engineering Regulation (ER) 1110-2-240, *Water Control Management (date enacted 8 October 1982)*. That regulation prescribes the policies and procedures to be followed in carrying out water management activities, including establishment and updating of water control plans for Corps and non-Corps projects, as required by federal laws and directives. This manual is also prepared in accordance with pertinent sections of the Corps' Engineering Manual (EM) 1110-2-3600, *Management of Water Control Systems (date enacted 30 November 1987)*; under the format and recommendations described in ER 1110-2-8156, *Preparation of Water Control Manuals (date enacted 31 August 1995)*; and ER 1110-2-1941, *Drought Contingency Plans (date enacted 15 September 1981)*. Revisions to this manual are to be processed in accordance with ER 1110-2-240.

1-02. Purpose and Scope. This individual project manual describes the water control plan for the Carters Dam and Lake and Carters Reregulation Dam Project (Carters Project). The description of the project's physical components, history of development, water control activities, and coordination with others are provided as supplemental information to enhance the knowledge and understanding of the water control plan. The Carters Project water control plan must be coordinated with the multiple projects in the Alabama-Coosa-Tallapoosa (ACT) Basin to ensure consistency with the purposes for which the projects were authorized. In conjunction with the ACT Basin master water control manual, this manual provides a general reference source for Allatoona water control regulation. It is intended for use in day-to-day, real-time water management decision making and for training new personnel.

1-03. Related Manuals and Reports.

a. Other manuals related to the Carters Project water control regulation activities include the *Operation and Maintenance* manual for the project, and the ACT Master Manual for the entire basin.

b. One master manual and nine individual project manuals, which are incorporated as appendices, compose the complete set of water control manuals for the ACT Basin:

Appendix A - Allatoona Dam and Lake

Appendix B - Weiss Dam and Lake (Alabama Power Company)

Appendix C - Logan Martin Dam and Lake (Alabama Power Company)

Appendix D - H. Neely Henry Dam and Lake (Alabama Power Company)

Appendix E - Millers Ferry Lock and Dam and William "Bill" Dannelly Lake

Appendix F - Claiborne Lock and Dam and Lake

Appendix G - Robert F. Henry Lock and Dam and R. E. "Bob" Woodruff Lake

Appendix H - Carters Dam and Lake and Carters Reregulation Dam

Appendix I - Harris Dam and Lake (Alabama Power Company)

c. Other pertinent information regarding the ACT River Basin development is in operation and maintenance manuals and emergency action plans for each project. Historical, definite project reports and design memoranda also have useful information.

1-04. Project Owner. The Carters Project is a federally owned project entrusted to the Corps, South Atlantic Division (SAD), Mobile District.

1-05. Operating Agency. Operation and maintenance of the Carters Project is the responsibility of the Mobile District Operations Division. Supervision and direction for this effort is provided by the project's Operations Project Manager.

1-06. Regulating Agencies. Authority for the water control regulation of the Carters Project has been delegated to the SAD Commander. Water control regulation activities are the responsibility of the Mobile District, Engineering Division, Water Management Section. Water control actions for the Carters Project are regulated in a system-wide, balanced approach to meet the federally authorized purposes. It is the responsibility of the Water Management Section to develop water control regulation procedures for the ACT Basin federal projects. The regulating instructions presented in the basin water control plan are issued by the Water Management Section with approval of SAD. The Water Management Section monitors the project for compliance with the approved water control plan and makes water control regulation decisions on the basis of that plan. When necessary, the Water Management Section instructs the project personnel regarding normal procedures and emergencies for unusual circumstances.

II - DESCRIPTION OF PROJECT

2-01. Location. The Carters Project is located on the Coosawattee River approximately 1.5 miles upstream of Carters in northwest Georgia. It is about 60 miles north of Atlanta, Georgia, and approximately 50 miles southeast of Chattanooga, Tennessee. The Carters Reregulation Dam (Reregulation Dam) was constructed about 1.8 miles downstream from the main dam. Both dams are located in Murray County with a large portion of the main reservoir extending into Gilmer County. The upper reaches of the Reregulation Dam pool extends into both Gordon and Gilmer Counties. A vicinity map and location map are shown in Figure 2-1 and Figure 2-2. A basin map is shown on Plate 2-1.

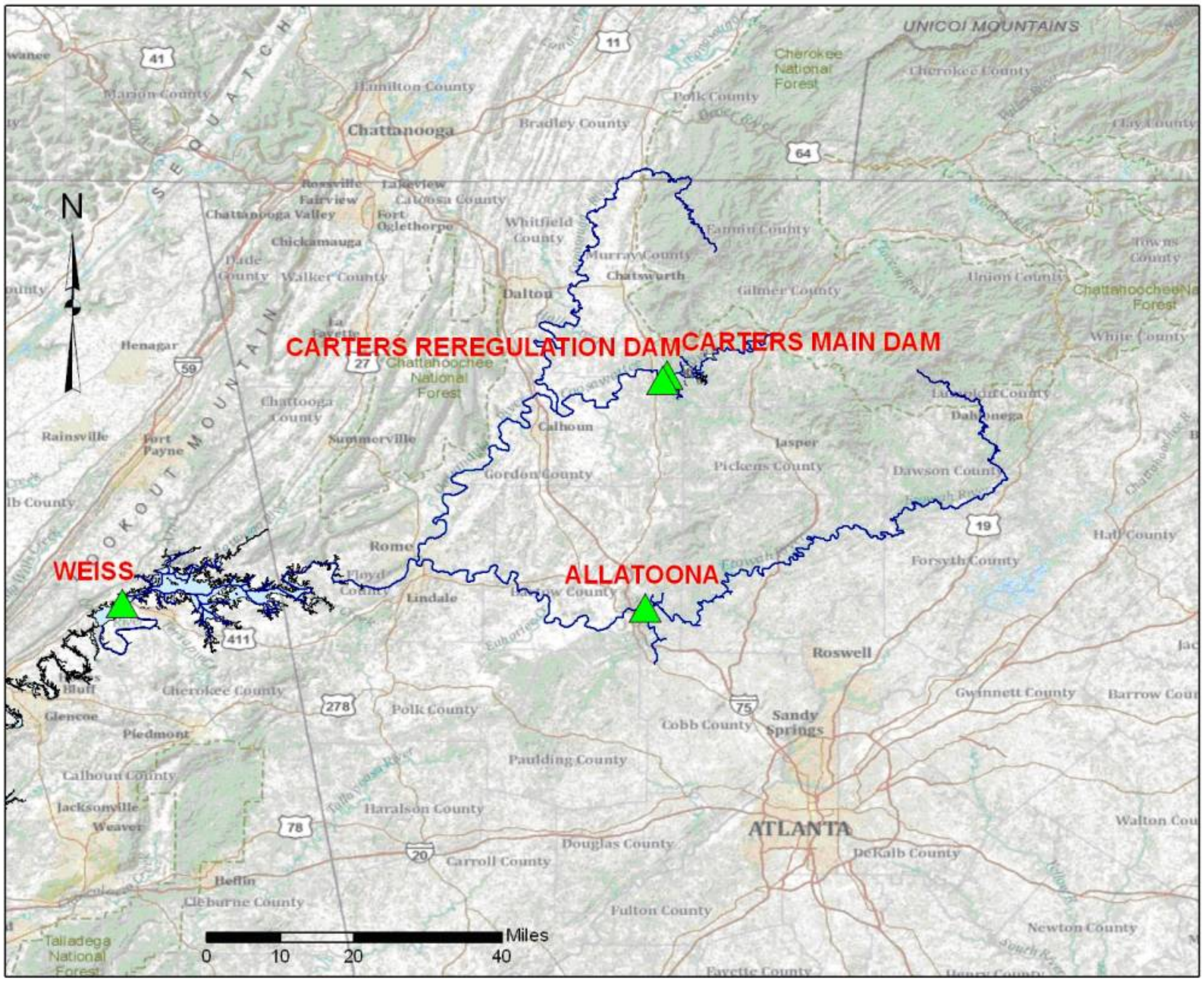


Figure 2-1. Vicinity Map

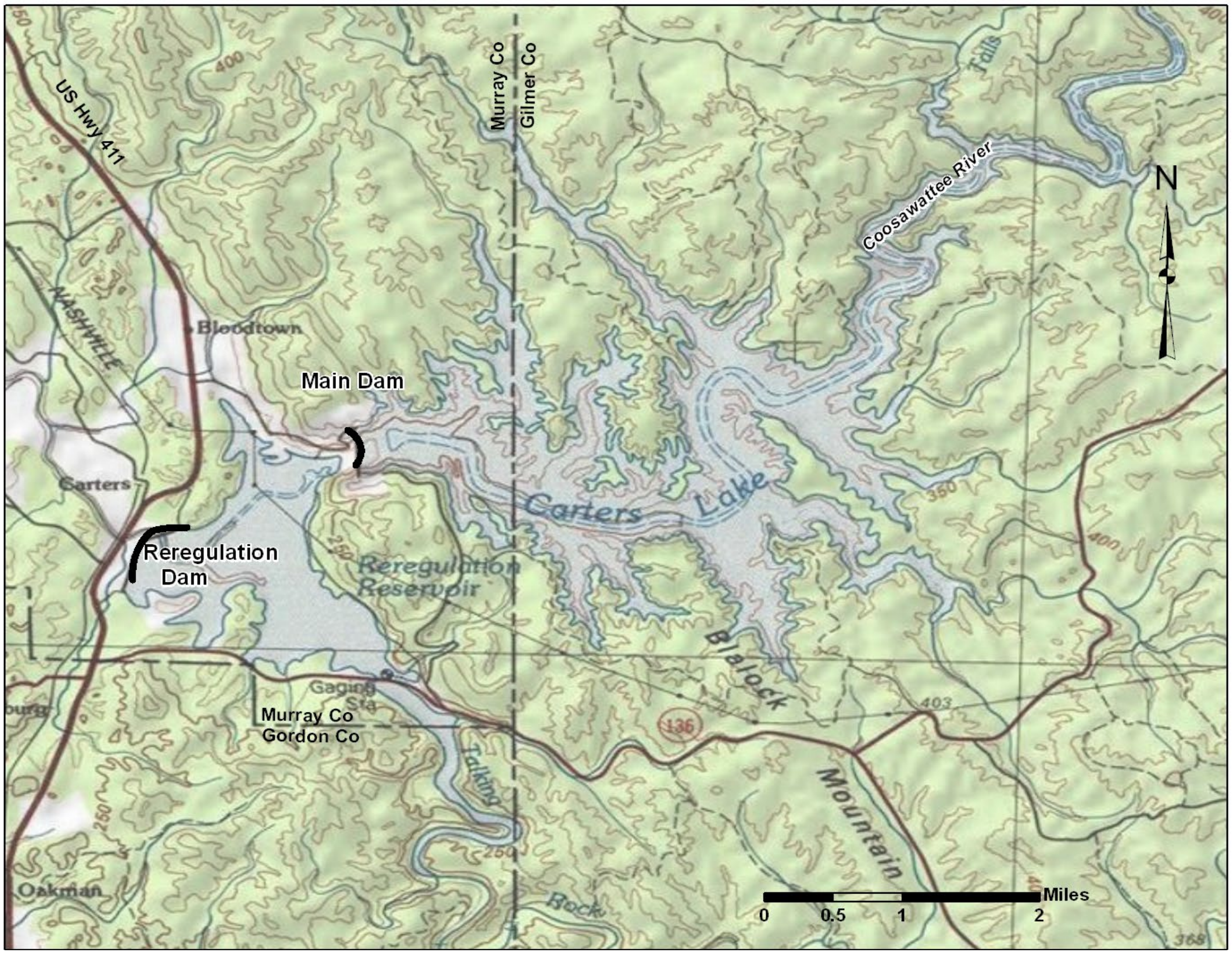


Figure 2-2. Location Map

2-02. Purpose. The Carters Project is designed primarily for flood risk management and hydroelectric power. Water supply, flow regulation, recreation, fish and wildlife conservation and, water quality control are additional benefits of the project. Carters Lake increases flood protection to the rich farm lands along the Coosawattee and Oostanaula River. Peak flood stages are reduced as far downstream as Rome, Georgia, about 72 river miles downstream from the project. Average monthly power generation over the period August 1975 through Mar 2009 has been 36,646 megawatt hours (MWH), and an annual average of 439,757 MWH. A minimum downstream flow of 240 cubic feet per second (cfs) is maintained by releases from the Reregulation Dam. The 240 cfs represents the 7-day average 10-year frequency low flow (7Q10) at the reregulation dam site. Areas below the project are assured of this minimum flow during dry periods as long as sufficient water exists at the project.

The Carters Project has created a scenic mountain lake, 11 miles long with 62.7 miles of shoreline. The lake is about 400 feet deep at the dam. The 10 public use and access areas found at the project provide for a variety of activities.

2-03. Physical Components. The main dam is a massive rolled-rock structure built across the deep Coosawattee River gorge. It rises 445 feet above the foundation and contains nearly 15 million cubic yards of material. The dam has a length of 2,053 feet along the arch of the axis.

The radius of the arch is 2,100 feet. Minimum top elevation is 1,112.3 feet NGVD29 at both ends of the dam with a sloping overbuild to 1,115.3 feet NGVD29 at the center of the dam. Sides slopes are generally one vertical to two horizontal. The upper cofferdam was constructed to form a 30-foot berm on the upstream face at elevation 671.5 feet NGVD29. An impervious earth core, grout curtain and a core trench excavated to sound rock provide seepage control. A 22-foot wide roadway extends across the top of the dam giving easy access to both ends of the structure. A typical section through the dam is shown on Plate 2-2.

An aerial photograph of the main dam area is shown below in Figure 2-3 followed by a general plan of the area including the Reregulation Dam in Figure 2-4.

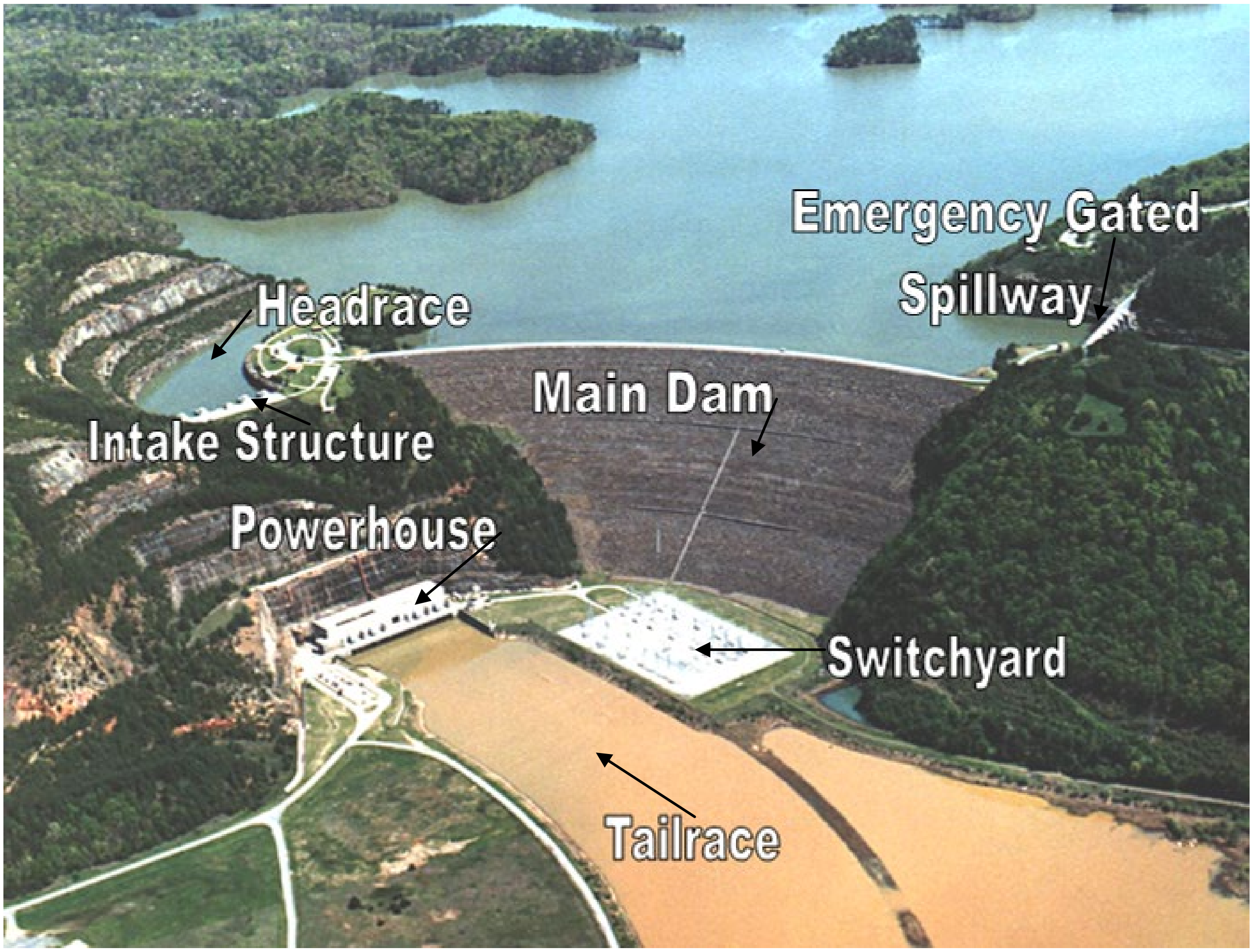


Figure 2-3. Carters Aerial Photo and Features

Figure 2-4. Carters Site Plan

a. Saddle Dikes. Three earth and rock-fill saddle dikes were required on the left bank rim of the main reservoir about 6,000 feet upstream from the main dam. The maximum height of the dikes is about 40 feet with a top elevation of 1,112.3 feet NGVD29. Top width of the dikes is 30 feet and side slopes are 1 vertical to 2.5 horizontal. A typical section through the saddle dikes is shown on Plate 2-3.

b. Emergency Spillway. The level of the main reservoir can normally be controlled by releasing water through the powerhouse turbines. However, unusually high inflows are possible. The emergency gated spillway is designed to help maintain control of the level of the main dam during these critical periods. Also if the powerhouse is forced out of service it may become necessary to use the emergency spillway. Discharge through the emergency spillway is not preferred due to the potential for erosion in the spillway channel, specifically around the emergency sluice access road located below the spillway. The concrete gravity-type structure is 262 feet long and consists of five gate bays each 42 feet wide, two end piers 10 feet wide and four intermediate piers eight feet wide. The crest of the spillway is at elevation 1,070 feet NGVD29. Flow over the crest is controlled by five tainter gates 42 feet wide and 36.58 feet high. The gates are moved by individual electrical hoists located at elevation 1,120.0 feet NGVD29 on top of the piers. Stop logs are not required for repair and maintenance of the gates since the pool level is allowed to drop below the spillway crest during normal power operations. In fact about 25% of the time, merely from normal operation, the project is below elevation 1070 feet.

The service building is located about 80 feet west of the spillway and houses the emergency engine generator, air compressor and electrical substation. The spillway is shown below in Figure 2-5 and Figure 2-6. Plan, Elevation and Section of the emergency gated spillway are shown on Plate 2-4 and Plate 2-5.

Figure 2-5. Emergency Gated Spillway (Looking Downstream)

Figure 2-6. Emergency Gated Spillway (Looking Upstream)

c. Intake Structures and Penstocks. There are two reinforced concrete intake structures at Carters. Each is 94 feet long and 51 feet wide at the base. Elevation at the base is 981 feet NGVD29. Each structure has two reinforced concrete towers 138.5 feet high that contain the gate machinery and other devices to regulate flow into the penstocks. Flow into each of the four intake passages is controlled by a 14-foot by 20.5-foot tractor-type head-gate with upstream seals. Each gate is equipped with an electric hoist and an auxiliary hydraulic lowering device for emergency closure located on the tower deck at elevation 1,112.5 feet NGVD29. An enclosed substation on the tower deck provides the power used at the intake structure.

Each tower has a work bay at elevation 1,080 feet NGVD29 for servicing the head gates. A portable electric manlift is used to inspect the gates and penstocks and is operated in the recess immediately downstream from the gate. A road crane is provided to service the removable-type trash racks that protect the entrance to each intake passage. This crane can also be used to insert and remove the one set of steel stoplogs provided at the structure, when dewatering of the intake is required. An aerial photograph of the intake structure is shown below on Figure 2-7. A typical section is shown on Plate 2-6.

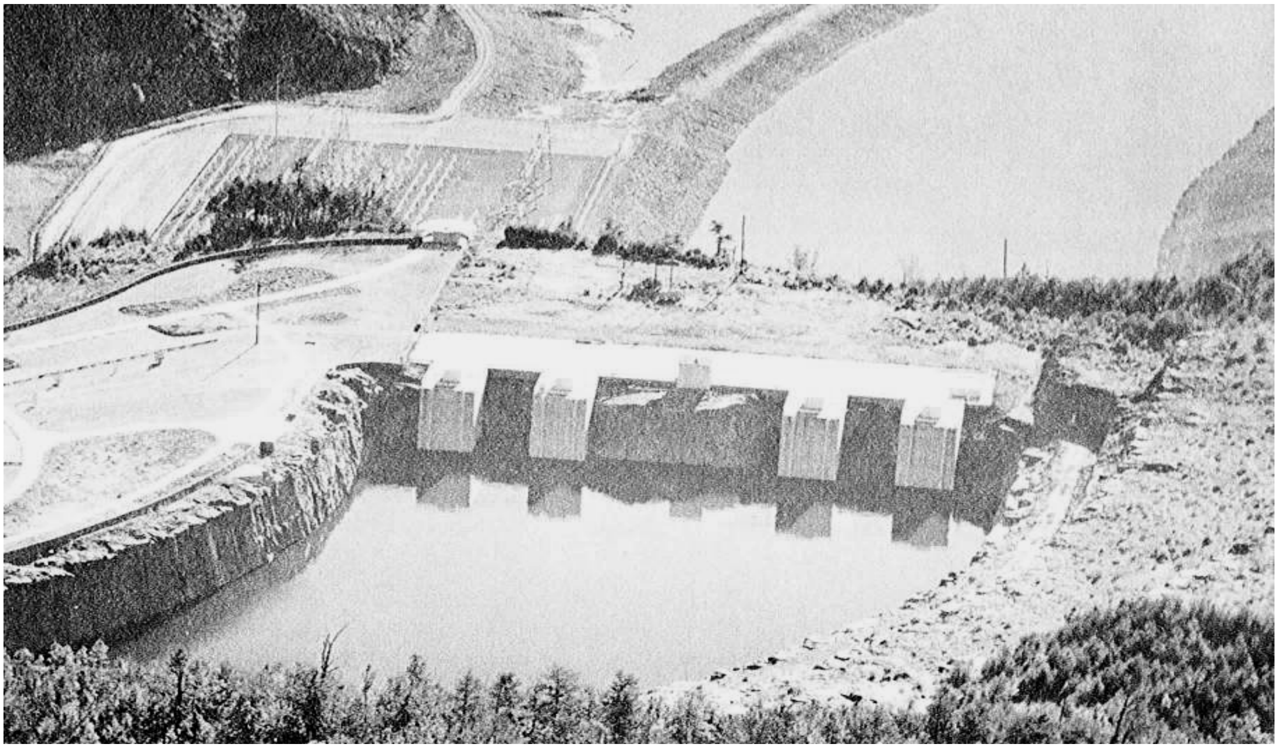


Figure 2-7. Aerial View of Intake Structures

Photographs of the intake structures taken during construction and prior to filling are shown below in Figure 2-8 and in Figure 2-9. A recent photo is shown in Figure 2-10.

Figure 2-8. Upstream of Intake During Construction

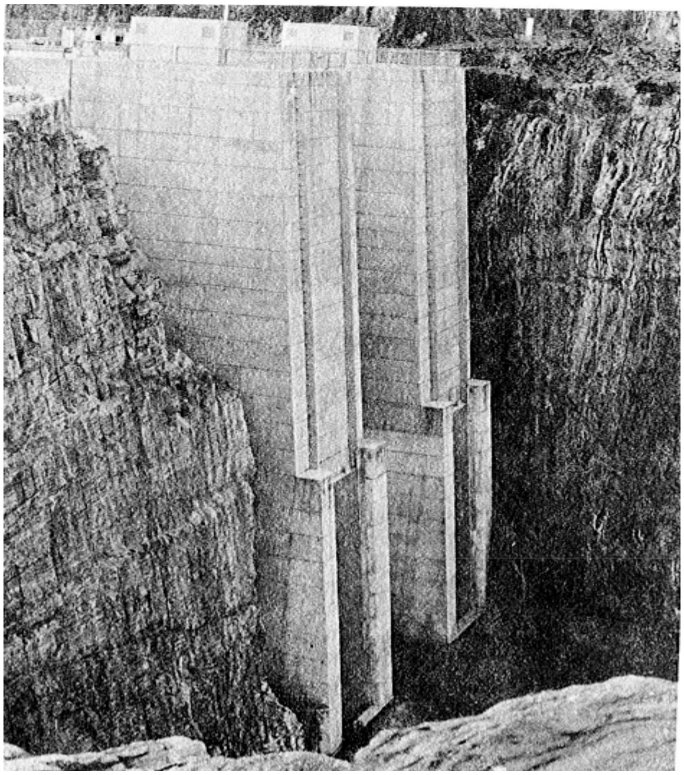


Figure 2-9. Right Bank Intake Prior to Filling

Figure 2-10. Intake Structure Looking Downstream

Four steel-lined penstocks extend from the intake structures to the powerhouse through 23-foot diameter tunnels cut through solid rock. The length of each penstock is about 835 feet. Inside diameter of the steel lining is 18.0 feet and the area between the steel and rock walls is filled with concrete and grouted. The penstocks were designed to be as much alike as possible. The slight differences are due to the characteristics of the conventional versus the pump-turbine units. The penstocks for the pump-turbines have a thicker liner plate to handle greater waterhammer pressures provided by these units. Also, the exit end of the penstocks for the two pump-turbine units transition to a diameter of 13.5 feet. Centerline profiles and typical sections of the penstocks are shown on Plate 2-7.

d. Powerhouse and Switchyard. The powerhouse is located on a rock bench cut into the right river bank about 200 feet below the toe of the main dam. The reinforced concrete structure is 390 feet long and 115 feet wide. The powerhouse contains two conventional 140,000 kilowatts (Kw) (declared value) hydrogenerator units (units 1 and 2), two reversible 160,000 Kw (declared value) pump-turbine units (units 3 and 4), an erection bay, unloading bay and an entrance wing. Declared Power Capacity is defined as the plant's operational capacity declared on a weekly basis to the power marketing agency. The value may vary slightly from week to week depending on factors such as head and cooling capabilities. A photograph of the powerhouse is shown below in Figure 2-11 and longitudinal and transverse sections are shown on Plate 2-8 and Plate 2-9.

Figure 2-11. Carters Powerhouse at Tailrace

The Allis-Chalmers Mfg. Co., produced the generators and the Newport News Ship Building Co., produced the turbines for the conventional units 1 and 2. General Electric manufactured the generators and Allis-Chalmers produced the turbines for the reversible units 3 and 4.

The control room, located in the erection bay at elevation 706.00 feet NGVD29, governs the generation, as well as the reregulation dam gates (up to a two feet opening, then must dispatch onsite personnel) and emergency spillway gate settings at the project. The Carters Project also governs generation at the Corps' Buford and Allatoona Projects from the Carters control room via remote control. Operators from Carters are dispatched to Allatoona or Buford to operate the generators in the advent of loss of communication between the facilities. Local maintenance personnel at Allatoona and Buford operate the spillway and sluice gates at Allatoona and the sluice gates at Buford when needed.

The distributor centerline of the conventional units 1 and 2 is located at elevation 658.0 feet NGVD29. A generator floor at elevation 691 feet NGVD29 and a turbine floor at elevation 676 feet NGVD29 provide access to the units. The distributor centerline for pump-turbine units 3 and 4 is at elevation 649 feet NGVD29 and the generator floor is at elevation 676 feet NGVD29. There is no floor at elevation 691 feet NGVD29 over units 3 or 4 nor is there a turbine floor. Access to the pump-turbines is provided by a passage from the service bay floor at elevation 660 feet NGVD29. A 400-ton overhead crane provides the lifting power for installation and maintenance of all four units. The crane has two trolleys, each with a 200-ton sister hook and a 25-ton auxiliary hook.

The service bay is located on the downstream side of the structure below the draft tube deck and houses the sewage treatment plant, water treatment, oil storage and other services. An extensive collector drain system along the upstream wall of the powerhouse reduces the pore pressures against the powerhouse to a differential head of 10 feet.

The switchyard is located at the center of the downstream base of the main dam. The ground elevation of 708.75 feet NGVD29 reflects approximately 10 feet of freeboard above the 699.0 feet NGVD29 maximum reregulation dam pool elevation. The fenced area containing the switching apparatus is approximately 592 feet long by 343 feet wide. The switching equipment and structures are designed to operate at 230 kilovolts (kv). A photograph of the switchyard is shown below in Figure 2-12.

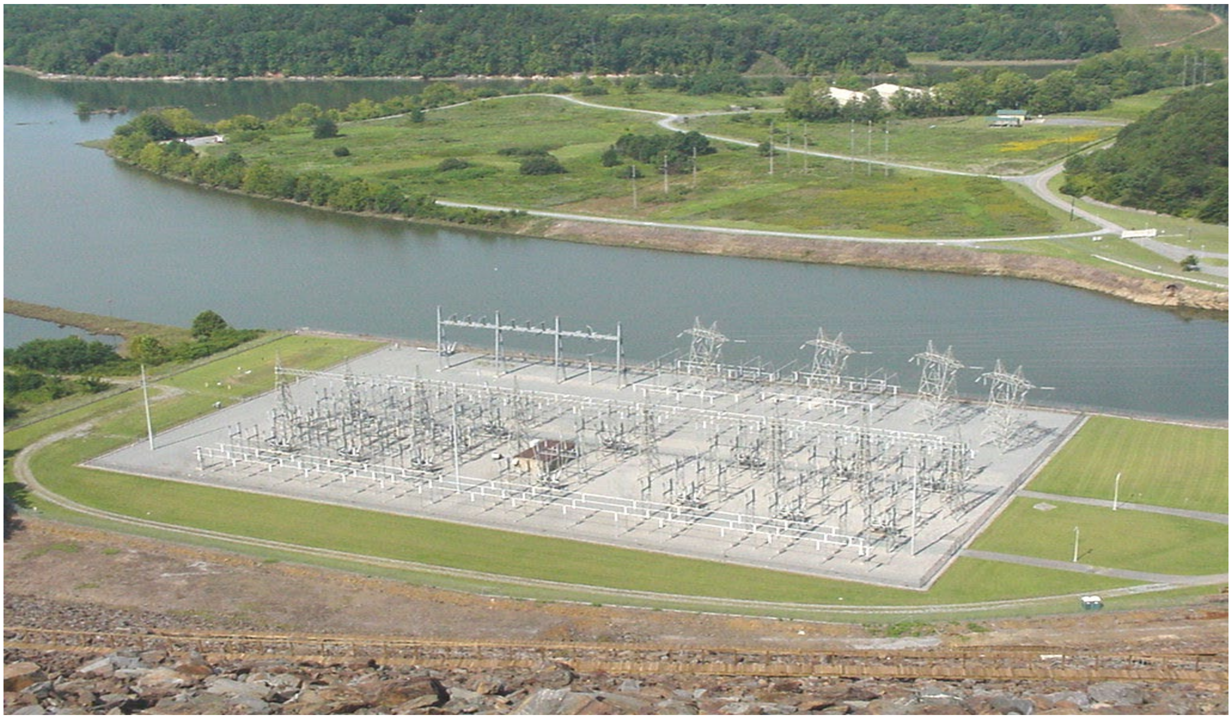


Figure 2-12. Switchyard

e. Emergency Low Level Sluice. The gate-controlled low level sluice was constructed to evacuate water from the main reservoir if repairs to the main dam are required or if aid in controlling the pool elevation is needed. The 2,712-foot long tunnel is located below the left bank abutment of the main dam. The location of the sluice is shown on Figure 2-4.

A circular, concrete-lined 16.5-foot diameter tunnel extends from the upstream portal to the tandem gate machinery. The downstream section is a 22-foot unlined horseshoe-shaped tunnel except that the 200-foot portion immediately downstream from the gate structure has concrete sides and bottom to prevent erosion of the rock. Elevation of the tunnel floor varies from 725 feet NGVD29 at the upstream entrance to 710 feet NGVD29 at the downstream exit. The upstream portal is slotted for the placement of stop logs used for de-watering the tunnel. However, the stop logs and floating plant for placing them are not furnished at the project.

The gate structure has two water passages each five feet wide and 10 feet tall. Flow in each passage is controlled by tandem slide gates. A vertical 10-foot diameter shaft extends approximately 335 feet from the gate structure to the surface between the main dam and the emergency gated spillway. A plan and profile of the sluice are shown in Plate 2-10 and sections are shown on Plate 2-11. Gate sections are shown in Plate 2-12. A photograph of the exit end of the tunnel is shown below in Figure 2-13.

Figure 2-13. Downstream Opening of the Emergency Sluice Tunnel

A small building, covering the shaft contains a remote panel for operation of the gates and provides space for an elevator used for access to the gate structure. The building is shown in Figure 2-14. As of the date of this report, the emergency low level sluice has never been used.

Figure 2-14. Low Level Sluice Control Building

f. Diversion Tunnel. Construction of the main dam at Carters required the Coosawattee River to be rerouted at the dam site. A 23-foot high, 23-foot wide unlined horseshoe-shaped diversion tunnel was drilled approximately 2,407 feet long through the left ridge of the river valley. After completion of the main dam the upstream entrance (shown below in Figure 2-15) was sealed with steel stoplogs and plugged with concrete. Location of the tunnel is shown on Figure 2-4. A plan and profile is shown on Plate 2-13, and sections of the tunnel are shown on Plate 2-14.

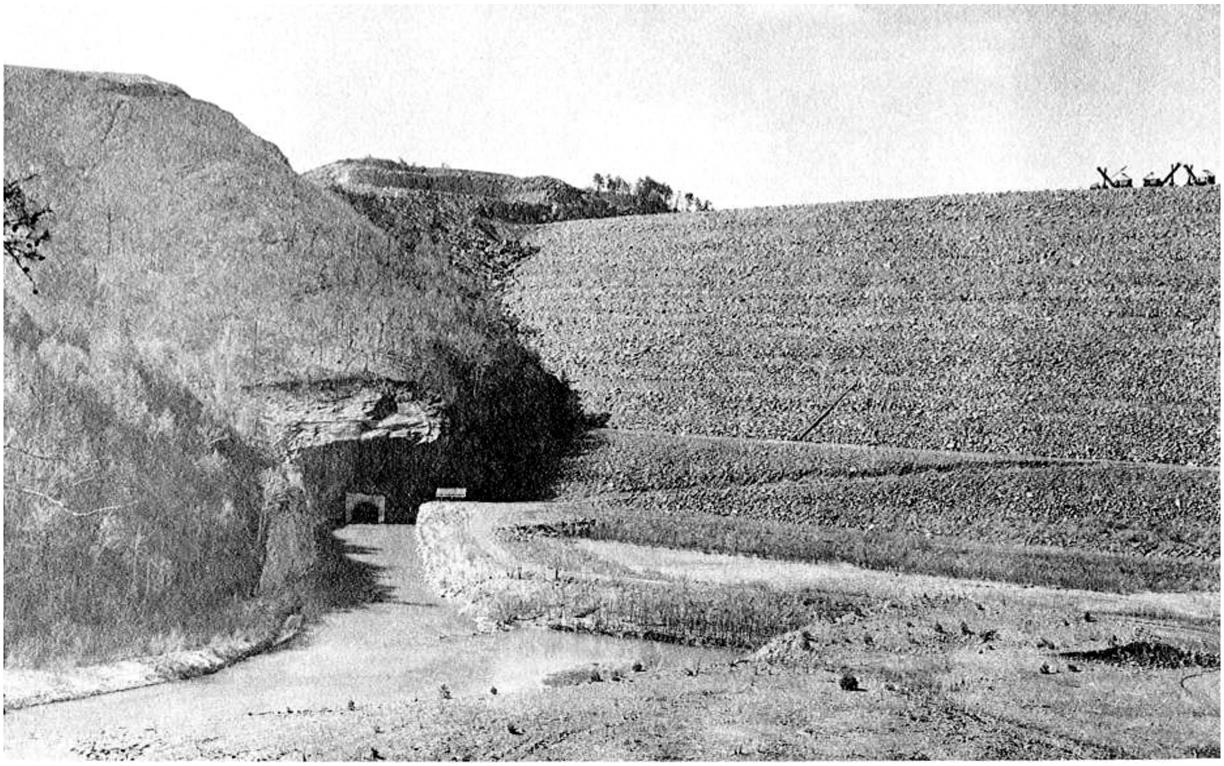


Figure 2-15. Diversion Tunnel Upstream Entrance Prior to Filling

2-04. Related Control Facilities. The Reregulation Dam was constructed about 1.8 miles downstream from the main dam to store water for pump back operations, to regulate the intermittent releases from the power plant, and to control minimum flow downstream. The dam consists of a gated spillway with earth and rock-fill dikes extending on either side to higher ground. Photographs of the Reregulation Dam taken from upstream of the dam and taken from old US Highway (Hwy) 411, looking upstream and downstream from old US Hwy 411 are shown on Figure 2–16, Figure 2-17, and Figure 2-18. A layout of the Reregulation Dam is shown in Figure 2-19.

Figure 2–16. Reregulation Dam, Looking Downstream

Figure 2-17. Reregulation Dam, Looking Upstream From Old US Hwy 411

Figure 2-18. Looking Downstream From Old US Hwy 411

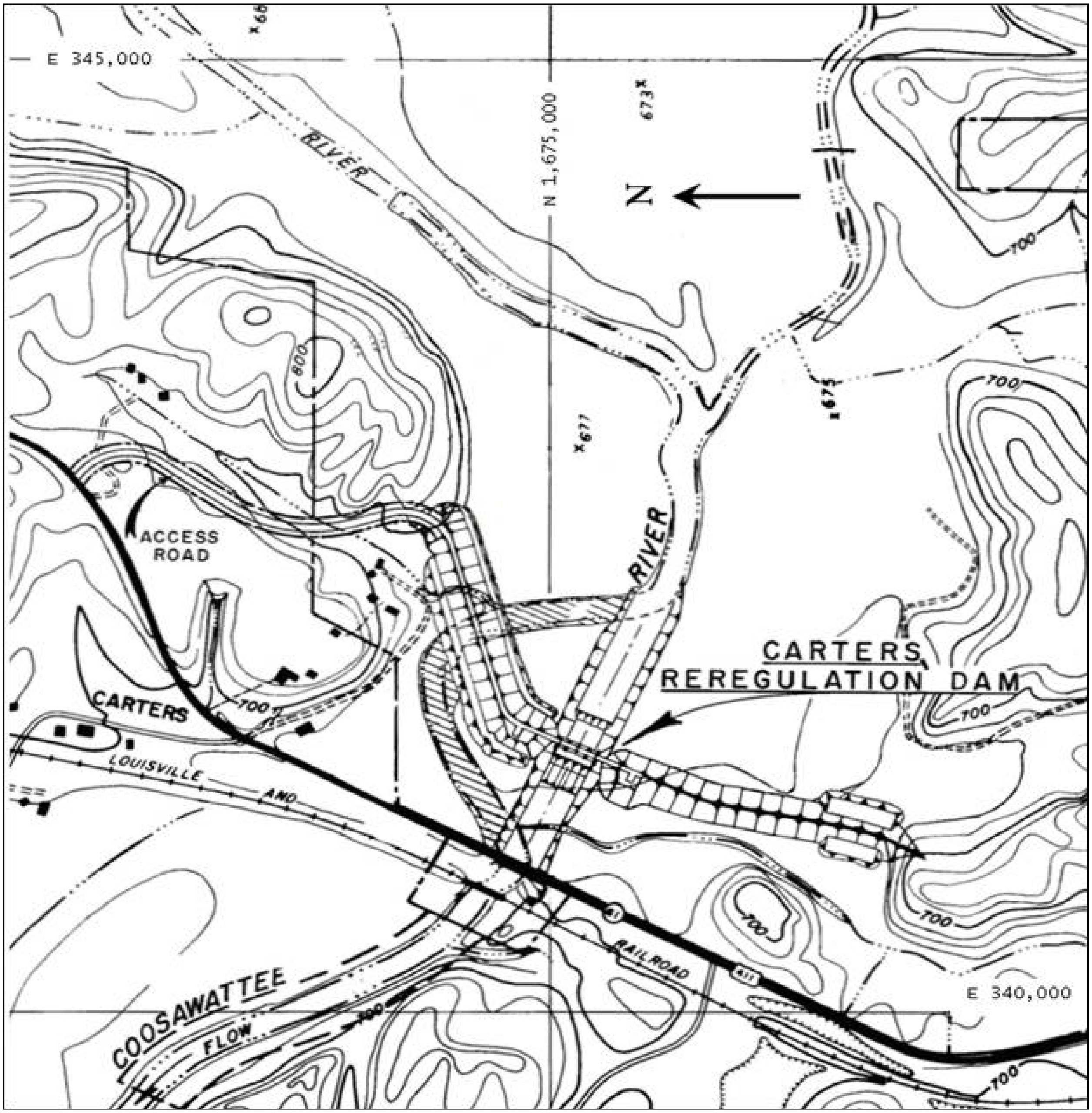


Figure 2-19. Reregulation Dam Plan

a. Gated Spillway. The gated spillway is a concrete gravity-type structure 208 feet long, consisting of four gate bays, 42 feet wide, three intermediate piers, eight feet wide, and two end piers, 10 feet wide. The spillway crest is at elevation 662.5 feet NGVD29. Flow through the dam is controlled by four tainter gates 42 feet wide and each rising 36.5 feet above contact with the sill. The gates are raised and lowered by individual electrical hoists located on top of the piers at elevation 707.0 feet NGVD29. The floor of the basin is at elevation 647.5 feet NGVD29, reinforced, cantilever-type training walls are built on each side of the stilling basin with the top of the walls at elevation 672 feet NGVD29. The Reregulation Dam spillway gates are typically controlled from within the powerhouse. If there is the need to open any gate more than 2 feet, project staff must be dispatched to the spillway to operate the gates on site. A plan and elevation are shown on Plate 2-15 and a typical section through the spillway is shown on Plate 2-16.

The operating house on the right bank end pier monolith houses the controls and equipment necessary to operate the dam. A spillway bridge with a 20-foot roadway (crest elevation 717 feet NGVD29) was constructed to provide easy access to the structure and to enable stoplogs to be placed with a road crane. Access to the gate hoists is provided by a catwalk under the service bridge. A concrete, gravity-type, non-over-flow wall is provided on each side of the spillway to permit transition to the embankment section.

b. <u>Regulation Dam Embankment Dikes</u>. Earth and rock-fill embankment dikes form the damming structures on the overbanks from the non-overflow walls of the gated spillway to high ground. The dikes have a combined length of about 2,855 feet. The top elevation of the dikes, 703.0 feet NGVD29, makes overtopping highly improbable. Left and right dike sections are shown in Plate 2-17. Location of the embankment dikes is shown in Figure 2-19.

2-05. Real Estate Acquisition. Real Estate requirements for the Carters Project include the reservoir areas, public use and access areas, construction areas and the road right-of-way easements. Hydraulic studies indicate that induced surcharge operations will contain the pool near or below elevation 1,107 feet NGVD29. A one-foot free board is considered sufficient to accommodate the adverse effects of saturation and wave action so the acquisition line for the main reservoir was set at elevation 1,108 feet NGVD29. In establishing this line, however, the acquisition of property along minor land subdivisions in accordance with existing policy is generally controlled by the requirement for a 300-foot horizontal clearance from the static full pool rather than by acquisitions directly related to the 1,108 feet NGVD29 contours.

A total of 7,485 acres for the main dam were acquired in fee simple and easements were acquired for 159 acres. In addition 1,415 acres were acquired in fee simple for the Reregulation Dam and reservoir, including all lands below elevation 694.0 feet NGVD29. Easements were taken on another 31 acres. The general limits of land acquisition are shown on Plate 2-18.

2-06. Public Facilities. The public use areas around Carters Lake are shown on Plate 2-19. The two areas at the Reregulation Dam are counted as one in the following Table 2-1.

The recreation facilities at each public use area are listed in the following Table 2-1.

Table 2-1. Public Use Area Recreation Facilities

Recreation Facilities **Public Use Areas**	Visitors Center	Project Management Office	Overlook	Boat Ramp	Drinking Water	Comfort Station	Picnic Area	Campfire Circles	Tent & Trailer Camping	Tent Camping Only	Wash House w/ Comfort Sta.	Swimming Beach	Change House	Foot Trails	Fishing Deck	Marina
Dam Site	o	o	o	o	o	o	o							o		
Carters Lake Marina					o											o
Harris Branch					o	o	o	o		o	o	o	o	o		
Doll Mountain**				o	o	o	o	o	o		o				o	
Ridgeway				o	o	o	o	o		o				o		
Woodring Branch**				o	o	o	o	o	o					o		
North Bank			o		o	o	o							o		
Reregulation Dam site					o	o	o							o	o	

** Has separate campground and day use areas.

III - HISTORY OF PROJECT

3-01. Authorization. Authority for development of a dam on the Coosawattee River near Carters, Georgia, is contained in Section 2 of the River and Harbor Act adopted 2 March 1945 (Public Law 12, 79th Congress, 1st Session). This Act approved the initial and ultimate development of the Alabama-Coosa River and tributaries for flood risk management, power generation, navigation and other purposes as outlined in House Document 414, 77th Congress.

House Document No. 414, 77th Congress, 1st Session, did not prescribe a specific plan for the development of the Coosawattee River. At that time the comprehensive plan for the basin provided for an upper and lower dam on the Coosawattee River with an impounding dam on the Cartecay River. As a result of subsequent studies, a more complete development of the river by a single high dam at the lower site was found to be warranted. Modification of the two-dam plan was therefore authorized.

3-02. Planning and Design. Early studies limited the location of a project on the Coosawattee River to the reach between miles 26 and 35. The possibilities of a single dam, two dams and a single dam with a long tunnel to develop the full head in the reach were investigated. At the suggestion of the Federal Power Commission (FPC), the pumped-storage potential of these dams to develop a greater peaking power capacity was also studied. The results of these analyses and a description of the various plans are given in the "Site Selection Report" submitted on 31 March 1961.

After a single dam was established for the development of the reach, studies were made of the major structures. The basic types of dams investigated included a rock-fill type with separate fixed-crest and gated spillways and the concrete gravity type with a gated spillway. Straight and U-shaped fixed-crest spillways of various length were considered and various types of gated structures were investigated. Power plant and diversion tunnel locations were studied on both banks. The results of these studies were submitted in August 1962, and discussed at a conference with representatives of the Chief of Engineers, the Division Engineer, SAD and special consultants on 26 - 27 September 1962. A description of the alternative plans is given in Appendix IV of Design Memorandum No. 5 and the minutes of the meeting in regard to them is given in Appendix V.

Design Memorandum No. 5, "General Design", dated 22 July 1963, presented plans for a dam at mile 26.8 on the Coosawattee River. Maximum and minimum power pools would be at elevations 1,072 and 1,022 feet NGVD29 respectively and maximum flood risk management pool would be at elevation 1,099 feet NGVD29. This project would have a powerhouse containing two 52,000 Kw units.

Approval for installation of 250,000 Kw of generating capacity at Carters Dam on the Coosawattee River together with a reregulation dam to limit power discharges to the downstream channel capacity was given by the Secretary of the Army on 25 July 1964, in response to a memorandum from the Chief of Engineers dated 6 July 1964, on the subject: Carters Dam and Reservoir, Georgia. The results of investigations made in planning the changed facilities for the project were prepared as a supplement to Design Memorandum No. 5, and was submitted on 30 September 1964.

This plan provided for an intake structure for two powerhouse units. Subsequently, major modifications of the plan were authorized by the following correspondence:

> In a letter dated 12 April 1966, from OCE to SAD, subject: "Carters Dam - Proposed Addition of Two More Units Initially in the Power Plant", four 125 MW units were approved as a basis for further planning.
>
> In a 2nd Endorsement dated 22 April 1966 (basic letter SAMEN-D, 15 April 1966), from OCE to SAD, Subject: "Carters Project - Comparative Costs for 4-Unit Installation - 50-Foot versus 80-Foot Drawdown Provision", a 50-foot drawdown was approved.
>
> In a 2nd Endorsement dated 29 August 1966 (basic letter SAMEN-D, 17 August 1966), from OCE to SAD, subject: "Carters Project - Pump Turbine Studies", the design of the intakes for four 18-foot-diameter penstocks was approved.

At a time when the original design was essentially complete the addition of two pump-turbine units was authorized and a decision was reached to construct the entire powerhouse and associated switchyard under a single contract. Design Memorandum No. 22 was prepared to present the design considerations involved with the addition of the two units.

The following tabulation lists the design publications pertaining to the Carters Project.

Table 3-1. List of Design Memoranda

Design Memorandum Number	Title	Date of Submittal
1	Site Selection Report	31 Mar 1961
2	Basic Hydrology	7 Nov 1961
3A	Preliminary Master Plan – Part of the Master Plan	16 Mar 1962
3-B(C-1)	Public Use and Administrative Facilities	15 Mar 1966
4	Hydroelectric Power Capacity	25 Apr 1962
	Letter Report – Hydraulic Design of Diversion Tunnel	18 Jan 1963
5	General Design	22 Jul 1963
	Supplement to General Design Memorandum Number 5	30 Sep 1964
6	Access Road, Right Bank	23 Feb 1962
	Supplement to Design Memorandum No. 6 – Access Road, Right Bank	3 Aug 1964
7	Reservoir, Additional Construction And Public Use Areas	17 Sep 1963
8	Main Dam and Saddle Dikes; Excavations For Spillway, Headrace, and Powerhouse	18 Sep 1964
9	Emergency Gated Spillway	17 Feb 1965
10	Powerhouse Structure	10 Sep 1965
11	Supervisory Control System	16 Jun 1965
12	Real Estate – Reregulation Dam and Reservoir	5 May 1965
13	Sources of Construction Material	5 Nov 1965
14	Penstocks	1 Dec 1965
15	Gated Spillway for Reregulation Dam	2 Aug 1966
16	Reregulation Dam - Rock and Earth	1 May 1968
17	Intake Structures for Powerhouse	11 Oct 1966
19	Relocations - Georgia Highway 156	19 Jun 1967
20	Relocations - Georgia Power Co. Lines	28 Feb 1969
22	Powerhouse and Appurtenances, Units 3 and 4	1 Dec 1967
23	Buildings, Grounds and Utilities	5 Mar 1970

3-03. Construction. The first of a long series of contracts, for the Carters Project was awarded in 1962. The following tabulation lists some of the major contracts, the contractors and the dates of issuance.

Table 3-2. List of Construction Contracts

Right Bank Access Rd., Site Clearing and Test Fills	Ledbetter Bros., Inc.	3 Nov 1962
Excavation of Diversion Tunnel Portals	Ledbetter Bros., Inc.	20 Feb 1963
Excavation of Diversion Tunnel	Cowin and Co., Inc	1 Mar 1964
Construction of Main Dam Phase I	Roy Tyan Sons Co., Inc.	23 Dec 1964
Construction of Main Dam Phase II	Clement Bros. Co.	15 Mar 1968
Construction of Left Bank Access Rd., & Saddle Dikes	Phillips & Jordan, Inc.	1 Sep 1966
Excavation of Penstock Tunnels	W.L. Hailey & Co., Inc.	23 Apr 1969
Construction of Intake Structure and Penstock Liners	Al Johnson Constr. Co.	26 May 1972
Construction of Emergency Gated Spillway	Rosiek Constr. Co. Inc.	1 Jun 1972
Construction of Carters Reregulation Dam	Kandy, Inc.	15 Nov 1972
Construction of Emergency Low Level Sluice	Al Johnson Constr. Co.	2 Mar 1972
Construction of Powerhouse	Al Johnson Constr. Co.	31 Aug 1975

Photographs of the site during construction are shown below in Figure 3-1 and Figure 3-2.

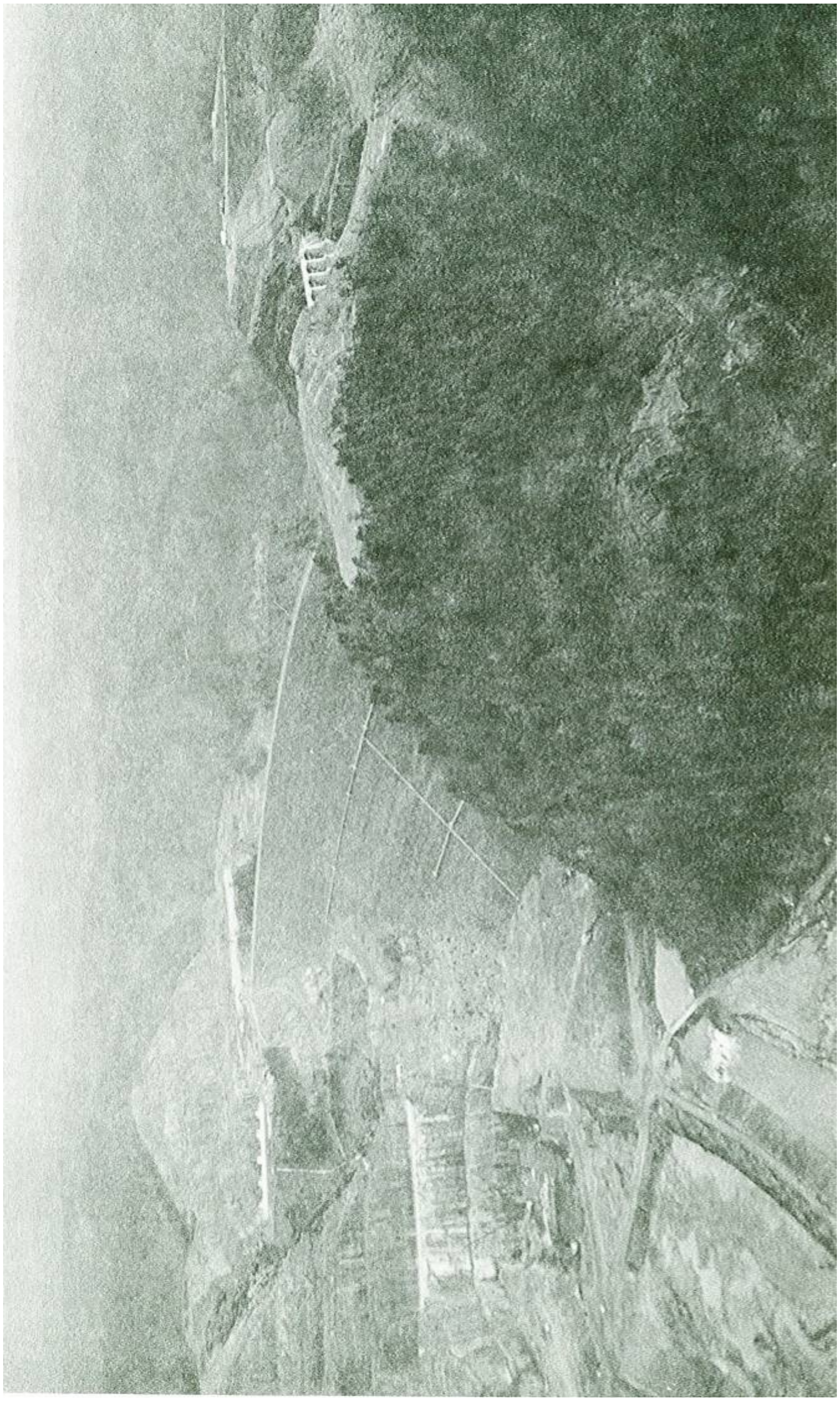


Figure 3-1. Main Dam Site During Construction

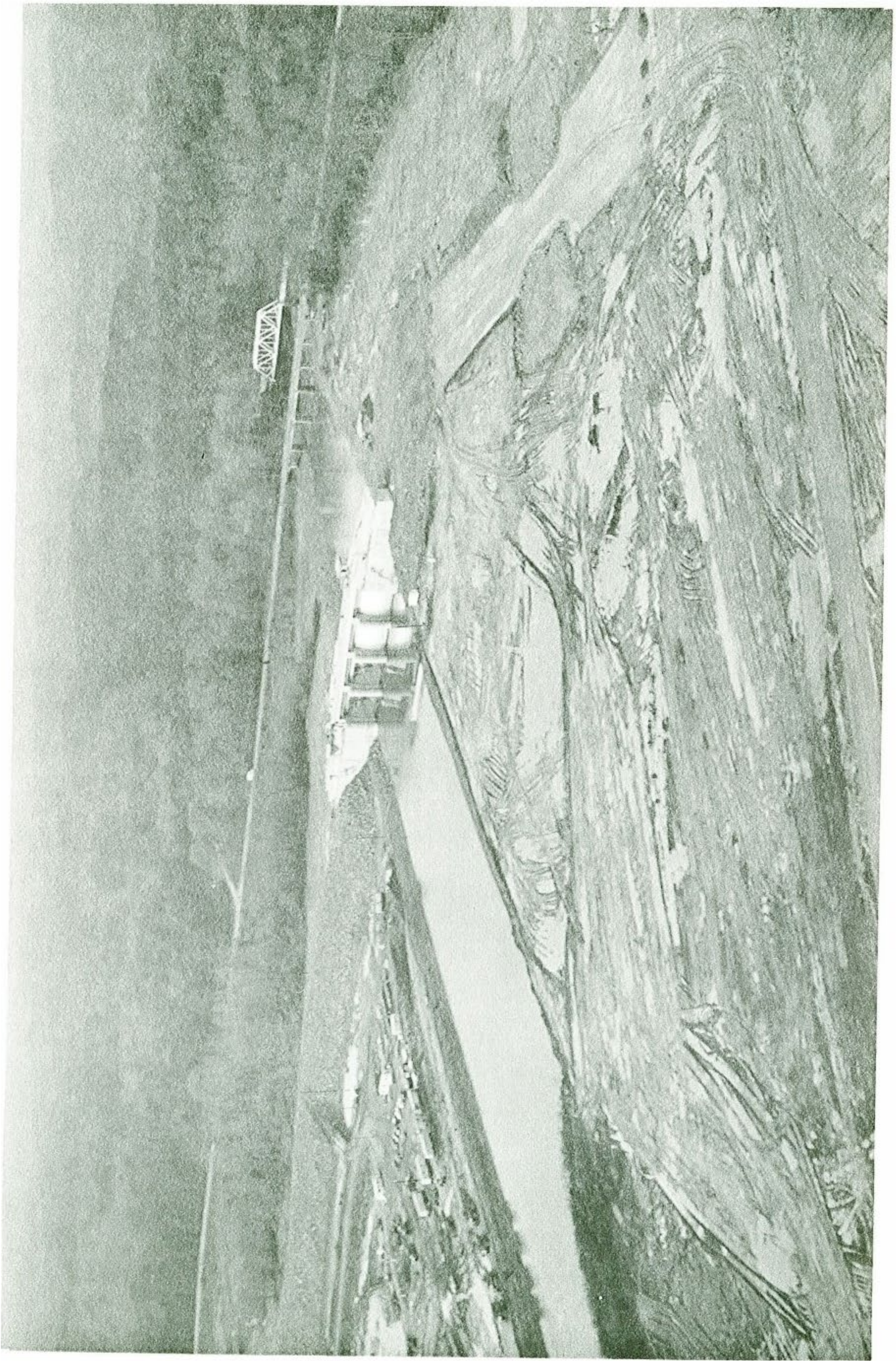


Figure 3-2. Reregulation Dam Site During Construction

Design Memorandum No. 5, General Design, Appendix V considered the minimum flows from Talking Rock Creek adequate to meet low flow requirements downstream. Twenty years of flow records indicated the minimum monthly discharge from Talking Rock Creek was about 100 cfs.

In August of 1970, the Georgia State Water Quality Control Board expressed concern over possible effects of operation of Carters Dam on water quality on the upper Coosa River and requested increased minimum flows at Mayo's Bar. The Mobile District Office, in a letter dated 12 August 1971 to the Georgia State Water Control Board, stated that a guaranteed minimum continuous release of 240 cfs would be provided from the Reregulation Dam. This had been determined to be the seven-day average 10-year frequency low flow at that point.

The pool level reached elevation 725 feet NGVD29 on 16 November 1974. After this date, a minimum continuous flow of 240 cfs was maintained below the Reregulation Dam to support downstream water quality flow requirements. After the pool reached elevation 800 feet NGVD29 on 16 December 1974, the rate of rise was slowed by releasing water through the low-level sluice so that workers in the diversion tunnel would not be endangered. The diversion tunnel was completely sealed with a concrete plug by the middle of January 1975, and the pool was again allowed to rise freely. The pool reached minimum power pool, elevation 1,022 feet NGVD29, on 17 March 1975.

The conventional generating units 1 and 2 were declared commercially available on 17 November and 23 July 1975, respectively. The pump turbine units 4 and 3 became commercially available on 13 June and 8 September 1977, respectively.

A graph of the initial filling rate of the main pool at Carters is shown below in Figure 3-3.

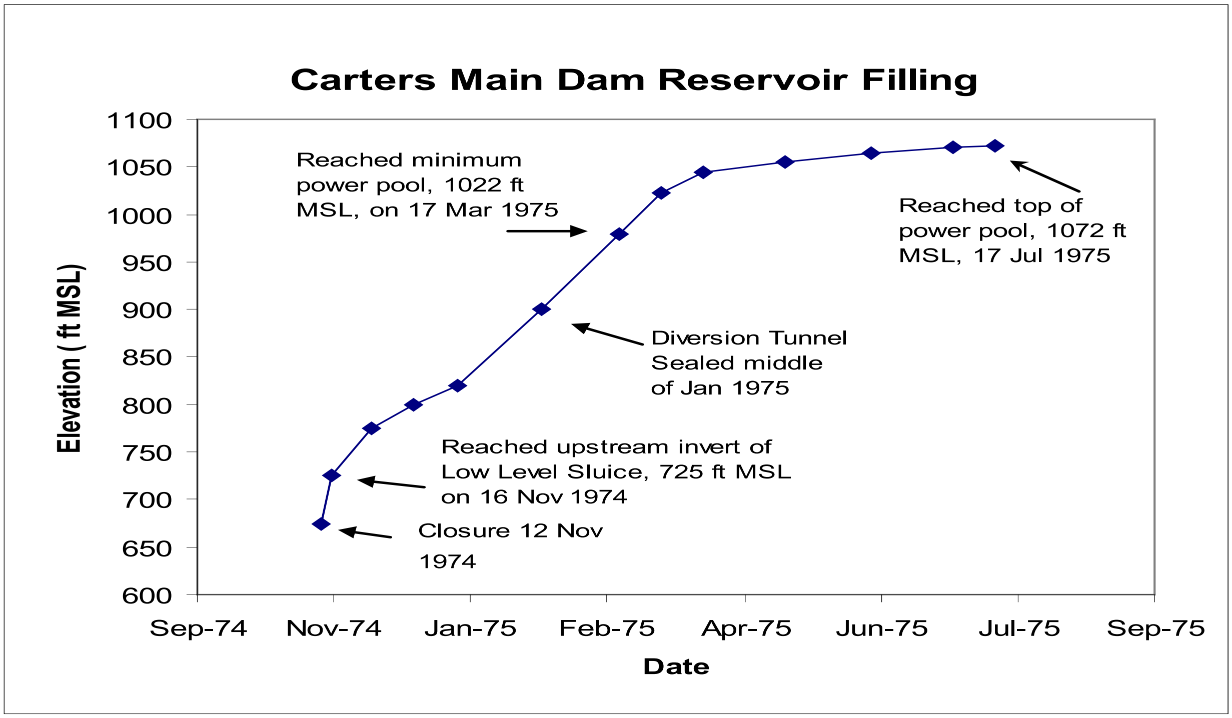


Figure 3-3. Carters Dam Reservoir Filling

3-04. Related Projects. Except for the two dams at the Carters Project there are no other structures within the Coosawattee River Basin requiring special coordination. There is, however, a large multiple purpose reservoir outside the basin on the Etowah River operated by the Corps. This project, Allatoona Dam, affects river stages at Rome, Georgia, where the Etowah and Oostanaula Rivers meet to form the Coosa River. Operations at the Carters Project also affect stages at Rome, although to a lesser degree.

Since the Carters project is equipped with reversible pump-turbines and because a minimum flow of 240 cfs is maintained from the Reregulation Dam at all times, little coordination in the reservoir operations of Carters and Allatoona is normally needed during periods of low to moderate flows. Under extreme low flow conditions, additional water may be released from Carters and/or Allatoona for water supply purposes in the Rome area. During periods when flood waters are being evacuated from Carters and/or Allatoona, releases will be planned and monitored to help prevent aggravating flood conditions near Rome.

Other projects (Corps and non-Corps) in the ACT System that affect water control objectives to varying degrees are Allatoona, Weiss, Logan Martin, H Neely Henry, Millers Ferry, Claiborne, R. F. Henry, and Harris.

3-05. Modifications to Regulations. There have been no changes in the water control plan since the initial manual was published in 1979.

3-06. Principal Regulation Problems. The most significant problems at the project involve the swelling and fracturing of the concrete used in construction of the Reregulation Dam, which is caused by alkali aggregate reaction (AAR). Material for construction of the Reregulation Dam came from Vulcan Material’s quarry in Dalton, Georgia. There was reportedly a bed of reactive aggregate in the Dalton Quarry during the time of construction of the Reregulation Dam. Aggregate was apparently obtained from this bed and shipped to the Carters site at least twice during construction of the Reregulation Dam. There is no record that the first shipment of bad aggregate was noted, but some of the concrete placed prior to 22 June 1971 has been affected by an intense alkali aggregate reaction. The second shipment of bad aggregate was recognized, and a sample of aggregate and ledge rock from the quarry was sent to the SAD lab in late September 1971. Petrographic examination identified both the sample as containing an excessive amount of "soft and potentially deleterious" particles, and the ledge rock as "fine grained argillaceous dolomitic limestone" that should be avoided because "it is soft….as well as being deleteriously reactive". Intense alkali reacted concrete from this second shipment can be found in concrete placed between 11 August 1971 and 9 November 1971. The referenced petrographic report recommended that selective quarrying be utilized at the quarry to eliminate production of the bad aggregate. Concrete placed subsequent to 9 November 1971 only shows occasional cracking due to AAR. Inspection of the Dalton Quarry on this trip indicates that the reactive bed was quarried away years ago. AAR cracking is shown in Figure 3-4 and Figure 3-5.

Because of the AAR, cracking and displacement of the bridge across the spillway has resulted in weakening of the bridge to the degree that it is considered no longer safe to withstand the weight of the crane used to place stoplogs on the upstream face. However, under the American Recovery and Reinvestment Act of 2009, temporary repairs were made to the bridge to allow for a crane to be able to place the stoplogs. In addition, displacement of the abutment and intermediate pier at monolith D9 has resulted in the inability to raise gate number 4 fully. Operation of the gate is limited because there was difficulty in the past closing the gate once it was opened. Further efforts are currently underway to allow for full opening of all gates.

A second is the limitation on head for pump back operations. Whenever the power head reaches 395 feet excessive vibration occurs in the hydropower units and pumping must be discontinued unless the reregulation pool is over 690 feet NGVD29, then the maximum head is 397 feet.

Figure 3-4. Close-up of the crack on the upstream side of gate No. 4

Figure 3-5. Close-up of crack on upstream side (east bridge end) of gate No. 4

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Carters Project, Carters Main Dam and Coosawattee River drainage basins are shown below in Figure 4-1. The Carters Main Dam drainage area does not include Talking Rock Creek Basin, which flows into the Reregulation Dam pool below the main dam. Talking Rock Creek is included in the Carters Project Basin.

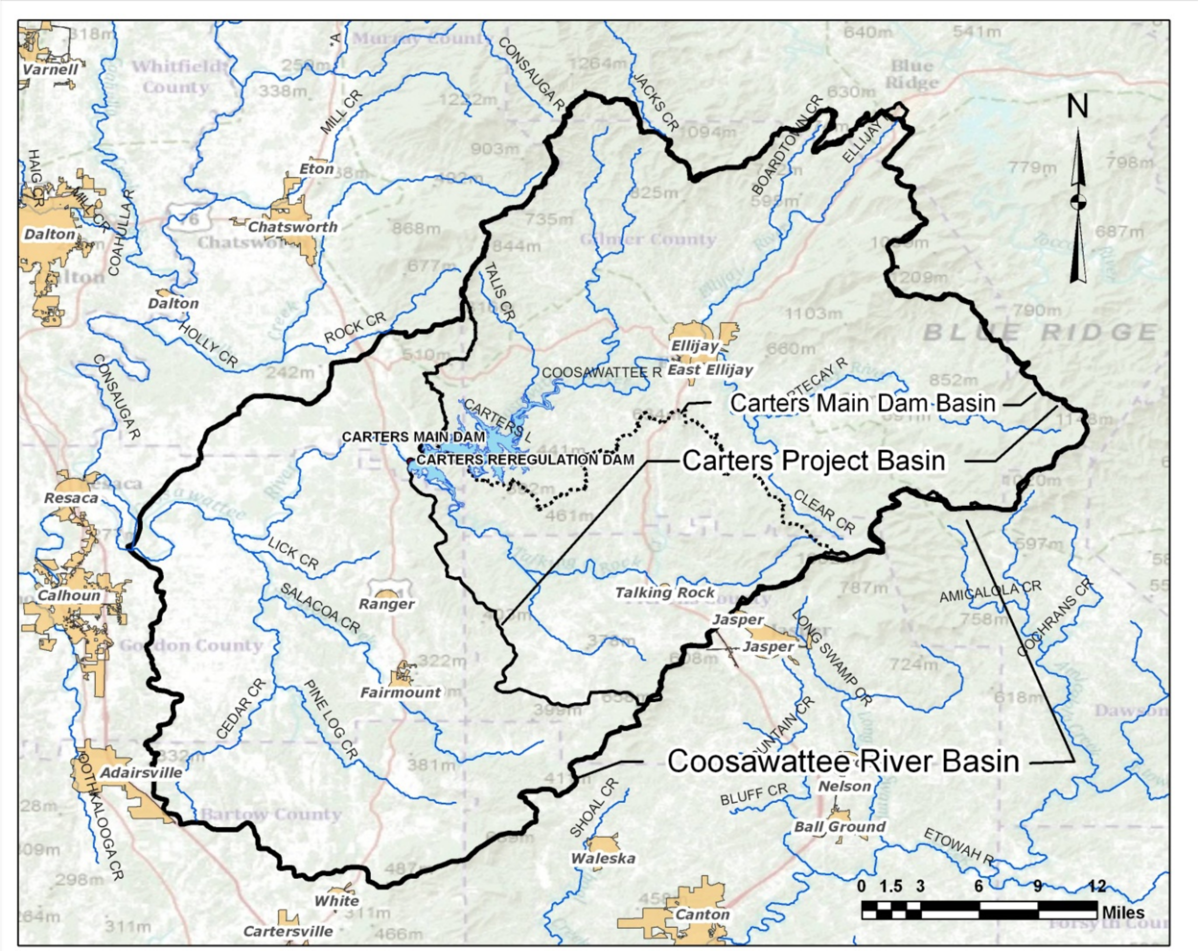


Figure 4-1. Carters Project, Main Dam, and Coosawattee River Basins

The Coosawattee River Basin is located at the northern end of the Alabama-Coosa River Basin. It is roughly rectangular in shape, draining an area of approximately 865 square miles. Maximum length and width of the basin are approximately 40 and 25 miles respectively. The Coosawattee River is formed by the juncture of the Ellijay and Cartecay Rivers at Ellijay, Georgia, about 21 miles upstream from the Carters Project. These tributary streams rise in the Blue Ridge Mountains which have peaks up to 4,000 feet NGVD29. The southern boundary of the basin is shared with the northern boundary of the Allatoona Dam Basin, which drains into the Etowah River. The 48-mile long Coosawattee River has a total fall of 650 feet, or an average of about 13.5 feet per mile. The slope of the river below Carters Project is approximately 1.5 feet per mile. The slope above the project to the confluence of the Ellijay and Cartecay Rivers is approximately 23.5 feet per mile. Above the Carters Main Dam, the drainage basin is approximately 374 square miles of forest area. Above the Reregulation Dam the drainage basin is 521 square miles. The large increase in drainage area is due to the addition of Talking Rock Creek Basin joining the Coosawattee River in the Reregulation Dam Basin.

4-02. Topography. From its source the Coosawattee River flows in a southwest direction through an elevated semi-plateau section for about 10 miles, then about 13 miles through a gorge section, and finally, after emerging from the gorge, about 25 miles through a broad plateau to join the Conasauga River and form the Oostanaula River. Elevations in the Coosawattee River Basin range from approximately 4,000 feet NGVD29 at the basin divide to 600 at the mouth. Channel capacity below the Carters Project is estimated to be about 3,200 cfs. A river bottom profile of the Coosawattee and Oostanaula Rivers is shown below in Figure 4-2.

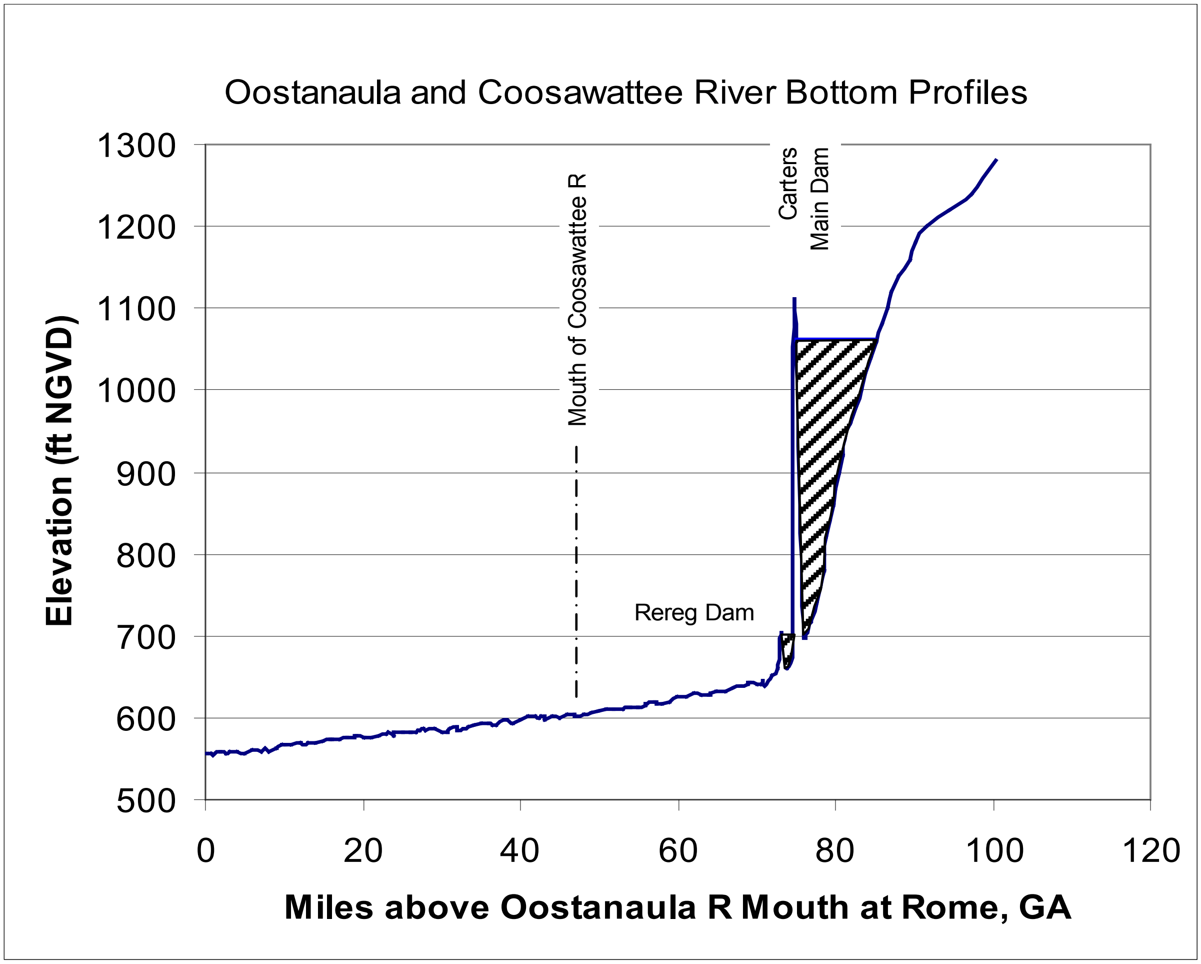


Figure 4-2. River Bottom Profile of the Coosawattee and Oostanaula Rivers

4-03. Geology and Soils. The Carters Project is located in the irregular escarpment which separates the Piedmont Province from the Appalachian Valley Province. The main dam is about one-half mile upstream from the escarpment in a 600-foot deep gorge. Specifically, the main dam and reservoir are in the Dahlonega Plateau Subdivision of the Piedmont Province. This region is characterized by rugged, mountainous terrain. One of the major thrust faults of the United States, the Cartersville Fault, is located along the boundary escarpment. The escarpment is the result of this fault and of differential erosion between the harder crystalline rocks of the Piedmont and the softer sedimentary rocks of the Appalachian Valley. The

Reregulation Dam is located within the Appalachian Valley Province and about 1.8 miles downstream from the main dam. Broad valley lands with occasional north-trending ridges typify this province.

4-04. Sediment. Sediment ranges have been established in the Reregulation and Main Dam pools as well as below the Reregulation Dam to Pine Chapel Road. Surveys have been made above the Main and Reregulation Dams in 1973 and 1992 at the locations shown on Plate 4-1, although they extended no deeper than 200 feet in the main dam pool. Retrogression range locations below the Reregulation Dam are shown in Figure 4-3. All locations above and below the project were re-surveyed in September 2009, with ranges in the main dam pool surveyed to the bottom of the pool. The basin above Carters Project remains largely forested with little development or erosion basin-wide. Erosion downstream of the Reregulation Dam has not been noted in periodic inspections and does not appear to be a problem.

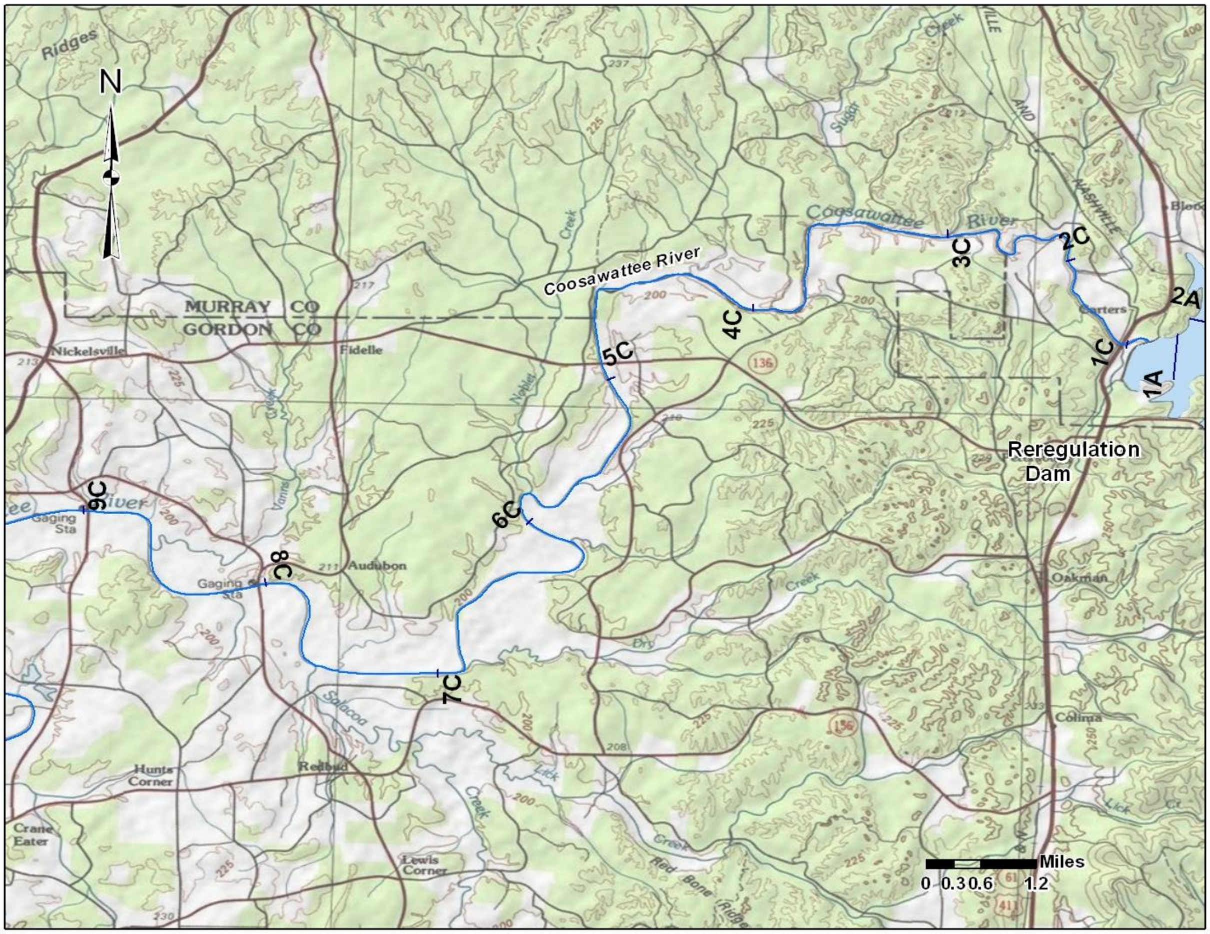


Figure 4-3. Retrogression Ranges below the Reregulation Dam

4-05. Climate. The average annual temperature in the Coosawattee River Basin above Carters Dam is about 60 degrees Fahrenheit (°F). This is based on averages at seven stations near the basin boundary. These stations, Calhoun Experiment Station, Dahlonega, Jasper, Dalton, Cartersville, Lafayette, and Rome are considered representative of the area. Average monthly temperatures range from 40 °F in January, the coldest month to about 78 °F in July and

August, the warmest months. Extreme temperatures recorded in the area range from 109 °F to -14 °F and the frost-free period normally lasts from mid-April to early October.

A map showing the seven representative stations is shown below in Figure 4-4.

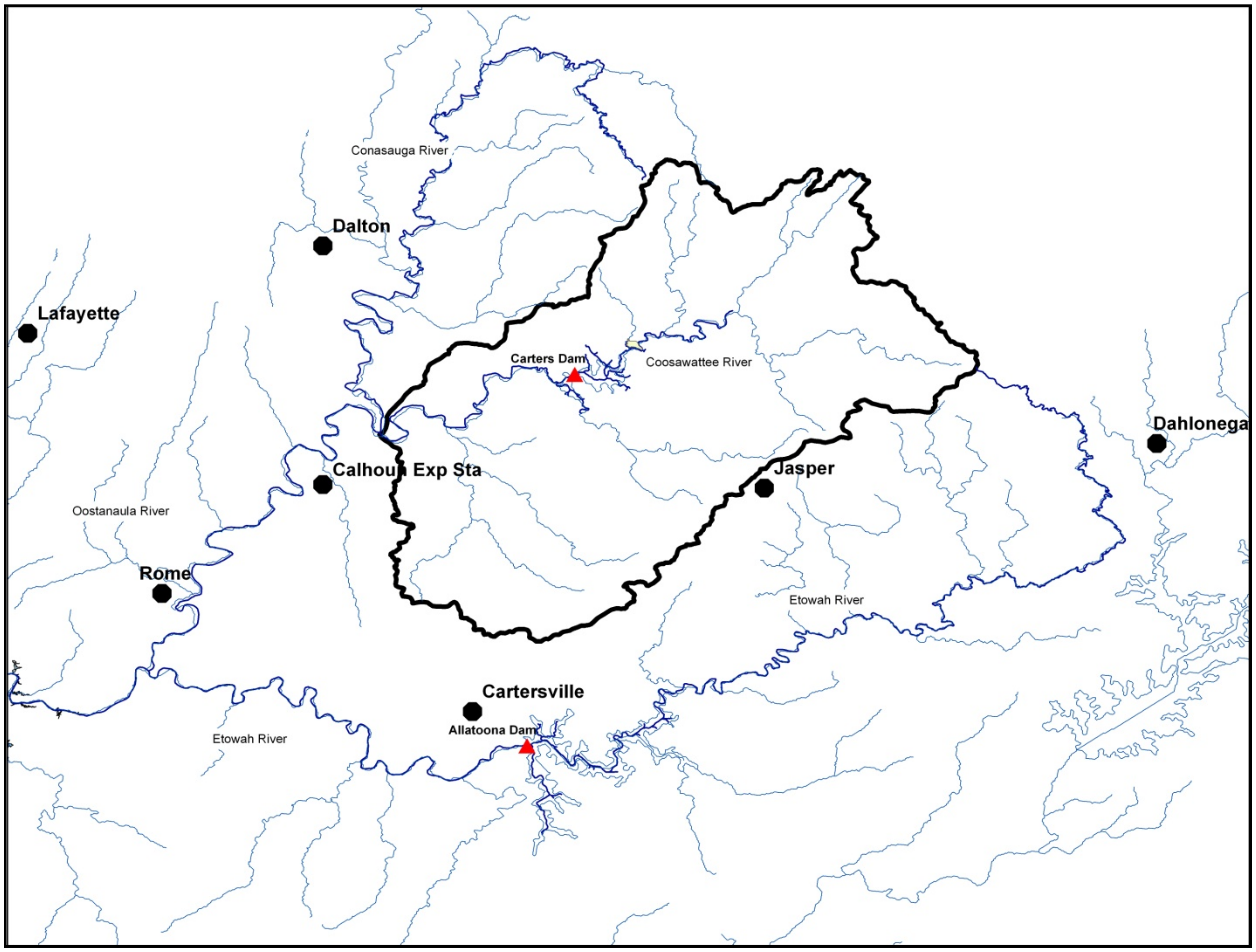


Figure 4-4. Representative temperature stations for the Coosawattee Basin

Monthly maximum, minimum and mean temperatures for the selected stations in the basin are shown below in Table 4-1.

Table 4-1. Average Temperature (1981 – 2010)

Average Temperature Based on 30-Year Period – 1981 Through 2010														
(Degrees F)														
Station		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**ANNUAL**
Calhoun Exp Sta	Max	50.7	55.3	63.5	72.3	79.8	87.5	90.2	89.5	83.4	73.9	63.0	53.1	71.9
	Mean	40.5	44.4	51.7	59.9	67.8	76.1	79.4	78.6	71.8	60.8	51.2	42.9	60.5
	Min	30.3	33.4	40.0	47.5	55.9	64.7	68.6	67.7	60.3	47.7	39.5	32.7	49.1
Dahlonega	Max	50.3	54.9	61.8	70.3	77.4	83.1	86.3	85.2	79.4	71.2	62.3	52.2	69.6
	Mean	38.4	41.9	48.3	55.8	63.2	70.6	74.5	74.0	67.3	57.9	48.7	40.4	56.8
	Min	26.4	28.9	34.7	41.3	49.1	58.1	62.7	62.8	55.2	44.5	35.2	28.6	44.0
Jasper	Max	47.8	52.0	60.6	69.0	76.1	82.7	85.6	84.9	79.2	69.5	60.0	50.3	68.2
	Mean	39.0	42.7	50.3	57.8	65.5	73.0	76.1	75.6	69.6	59.3	50.4	42.0	58.5
	Min	30.2	33.4	40.1	46.7	54.9	63.2	66.7	66.2	59.9	49.0	40.9	33.7	48.8
Dalton	Max	50.1	54.8	64.0	72.1	79.6	86.2	89.6	89.2	83.4	74.0	63.1	52.7	71.6
	Mean	40.1	43.7	51.8	58.9	67.7	75.1	79.0	78.4	72.1	61.5	51.4	42.8	60.3
	Min	30.1	32.6	39.5	45.7	55.5	63.9	68.3	67.6	60.9	49.1	39.7	33.0	48.9
Cartersville	Max	53.2	58.6	67.3	74.9	81.7	88.6	91.5	91.1	85.2	75.5	65.9	55.5	74.2
	Mean	41.4	45.9	53.1	60.7	68.7	76.4	79.7	79.3	73.3	62.1	52.7	43.9	61.5
	Min	29.6	33.2	38.8	46.5	55.7	64.2	67.8	67.5	61.5	48.8	39.6	32.3	48.9
Rome	Max	52.1	56.8	65.7	73.6	80.5	86.9	89.7	89.1	83.3	73.6	64.1	54.2	72.5
	Mean	41.6	45.6	53.2	61.0	68.9	76.6	80.1	79.4	72.9	61.9	52.4	44.1	61.5
	Min	31.1	34.3	40.8	48.3	57.3	66.3	70.5	69.6	62.4	50.1	40.7	34.0	50.5
Lafayette	Max	49.1	53.8	62.5	71.4	78.4	85.3	88.3	88.0	81.9	72.3	61.5	51.2	70.4
	Mean	38.8	42.3	49.6	57.7	65.7	73.4	77.0	76.6	70.3	59.4	49.4	41.1	58.5
	Min	28.5	30.8	36.7	44.0	52.9	61.5	65.7	65.2	58.6	46.5	37.4	31.0	46.6
Basin	Max	50.5	55.2	63.6	71.9	79.1	85.8	88.7	88.1	82.3	72.9	62.8	52.7	71.2
	Mean	40.0	43.8	51.1	58.8	66.8	74.5	78.0	77.4	71.0	60.4	50.9	42.5	59.7
	Min	29.5	32.4	38.7	45.7	54.5	63.1	67.2	66.7	59.8	48.0	39.0	32.2	48.1

Due to the topographic lift of the Blue Ridge Mountains, the upland slopes are subject to intense local storms and to general storms of heavy rainfall lasting days. Heavy rains may occur at any time during the year, but are most frequent between late fall and mid- spring, when the majority of the large floods in the basin have been recorded. The large flood of March 1990 occurred when a storm front extended from Mobile to Montgomery to Rome and subtropical moisture was continuously drawn along the line producing an extended' period of heavy rain. The normal monthly precipitation in the vicinity of the Carters Project is based on the 1981-2010 means of the National Weather Service gages at Resaca, Ellijay, Carters 1 WSW, Jasper, Summerville, Lafayette, and Cartersville. The Coosawattee River above Carters Dam lies in a region of moderately heavy annual precipitation. The average annual rainfall is 53.64 inches of which 56 percent occurs in the winter and spring, 24 percent in the summer and 20 percent in the fall. March is the wettest month averaging 5.09 inches while October is the driest averaging about 3.45 inches. The terms "wet season", "dry season", and "agricultural growing season" are frequently referred to within this manual. The agricultural growing season refers to spring, summer and early fall when crops are planted within the floodway. Summary precipitation data for the basin is shown below in Table 4-2.

Table 4-2. Average Rainfall (1981 – 2010)

Average Rainfall (inches) Based on 30-Year Period – 1981 Through 2010

Station	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
Resaca*	4.89	4.87	4.73	3.81	4.07	3.69	4.05	3.66	3.72	3.45	4.73	4.73	50.40
Ellijay	5.50	5.47	5.25	4.56	4.59	4.78	5.05	4.14	4.49	3.78	5.22	5.46	58.29
Carters 1 WSW*	5.56	4.91	5.13	4.23	4.41	4.85	4.54	3.89	3.82	3.27	4.77	4.95	54.33
Jasper	5.45	5.18	5.31	4.56	4.07	4.81	5.48	4.41	4.07	3.88	4.87	4.89	56.98
Summerville	5.08	5.17	5.56	4.38	4.32	4.84	4.00	4.18	3.67	3.47	4.84	5.45	54.96
Lafayette	5.57	5.47	5.52	4.55	5.01	4.24	4.80	4.05	4.43	3.68	5.58	5.60	58.50
Cartersville	3.24	4.35	4.12	3.43	2.88	3.25	3.92	3.84	2.81	2.62	3.29	4.30	42.05
Basin	5.04	5.06	5.09	4.22	4.19	4.35	4.55	4.02	3.86	3.45	4.76	5.05	53.64

The location of representative precipitation stations are shown below in Figure 4-5.

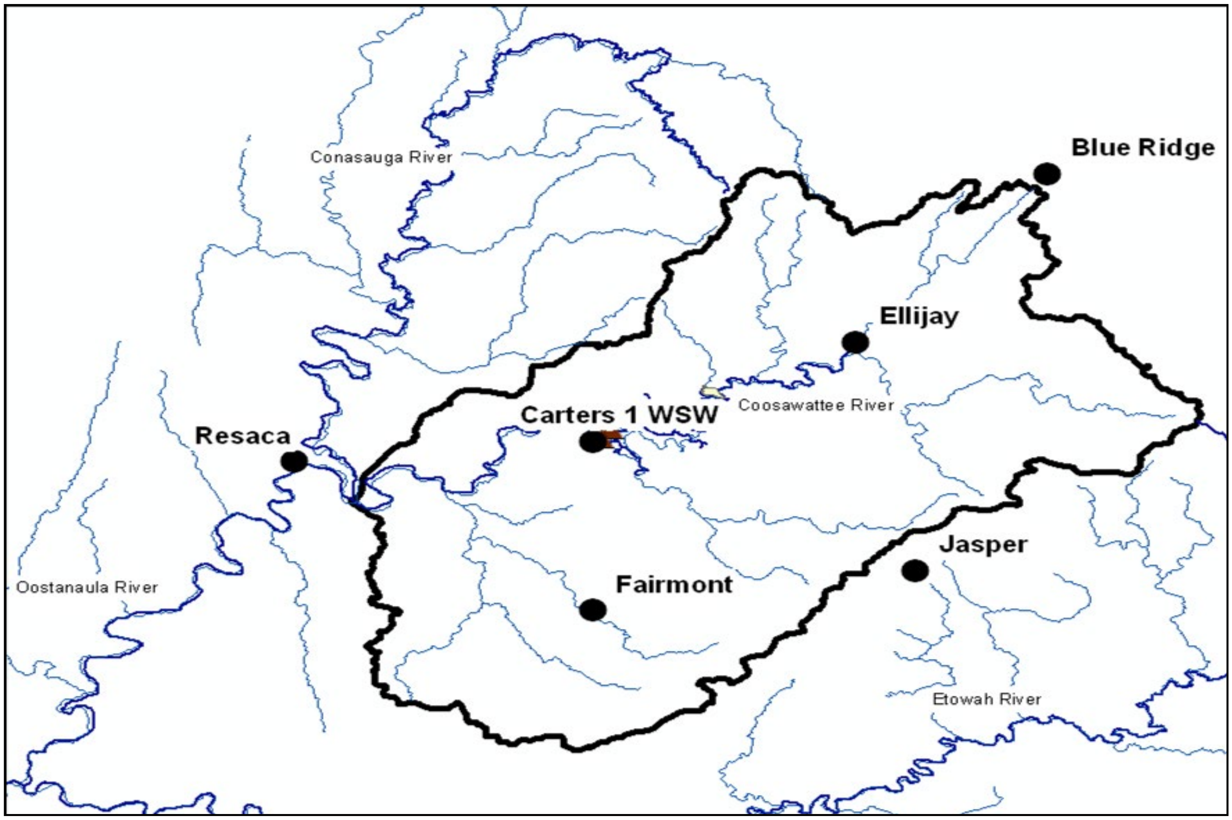


Figure 4-5. Representative Precipitation Stations for the Coosawattee Basin

4-06. Storms and Floods. Major flood-producing storms over the ACT Watershed are usually of the frontal type, occurring in the winter and spring and lasting from two to four days, with their effect on the basin depending on their magnitude and orientation. The axes of the frontal-type storms generally cut across the long, narrow basin. Frequently a flood in the lower reaches is not accompanied by a flood in the upper reaches and vice versa. Occasionally, a tropical storm or hurricane, such as the storms of July 1916 and July 1994, will cause major floods over practically the entire basin. However, summer storms are usually of the thunderstorm type with high intensities over small areas producing serious local floods. With normal runoff conditions, from five to six inches of intense and general rainfall are required to produce wide spread flooding, but on many of the minor tributaries three to four inches are sufficient to produce local floods.

The pre-record flood of March 1886 was the greatest known on the Oostanaula River and, in all probability, was equally severe in that portion of the basin above Carters Dam site. Other major floods of record resulted from the storms of April 1938, January 1947, March 1951 and April 1977. As of August 2012, the highest pool in the main dam, 1,099.16 feet NGVD29, occurred on 8 April, 1977. April 1938 is remarkable because of the even distribution of rainfall over the area. It produced the maximum stage of record at Ellijay and near record stages throughout the Oostanaula River Basin. The storm of January 1947, while not producing as large a peak discharge as some of the other storms, lasted for several days and would have caused a larger volume of water to be held in storage at Carters Dam during flood risk management operations. The storm of March 1951 resulted in record stages at Pine Chapel and Resaca below the Carters site and was of considerable severity in the basin above Carters Dam site.

4-07. Runoff Characteristics. The steep slopes of the mountains and channel gradients of the upper reaches of the tributaries of the Oostanaula River are conducive to flashy storm runoff. Flash floods, resulting from local storms, occurring on the smaller of these streams have endangered lives in the past.

In contrast, the runoff characteristics of the tributary streams in the lower reaches and the main stream itself are more moderate. The wider valleys and relatively flat slopes of the stream channels are the principle factors in effecting moderation in the rate of change in stages. The lower base flows and higher peak discharges are characteristics of streams with valleys underlain to a considerable extent with limestone and with contributing areas that are largely cleared for cultivation. Seasons for extremes of storm runoff rates are uniform throughout the basin with low values occurring in late summer and early fall and high values occurring in winter and early spring. However, the variation is much greater in the lower reaches of the tributaries and along the main stream, with runoff of about 30 and 60 percent in the respective seasons. Runoff during floods for the same periods in the upper reaches is about 25 and 40 percent. Annual runoff from the basin above Carters Dam site averages approximately 27 inches or about 47 percent of the average rainfall.

Table 4-3 shows monthly and annual inflows to the Carters Project, along with minimums, maximums, and averages. Inflows are determined from the relationship “inflow minus outflow equals the change in storage” where outflows and change of storage are measurable quantities. Inflow values can be calculated as negative amounts mainly due to evaporation from the lake. Figure 4-6 present the average monthly runoff for the ACT Basin above Rome, Georgia. This information was computed by comparing unregulated flows with rainfall over the basin. The percent of rainfall appearing as streamflow is presented for each month.

Table 4-3. Average Monthly Inflow (cfs)

Average Monthly Inflow (cfs) at Carters Dam

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min	Max	Avg
1975								498	527	730	765	779	498	779	660
1976	1413	969	1697	1350	1413	1117	1370	569	391	466	439	789	391	1697	999
1977	830	638	1764	2359	926	572	426	345	493	665	1250	848	345	2359	926
1978	1594	966	1103	851	938	594	394	496	256	170	290	604	170	1594	688
1979	1260	1267	2040	2093	1073	872	766	630	510	444	974	605	444	2093	1045
1980	868	927	2845	1926	1320	769	447	294	340	317	329	275	275	2845	888
1981	204	804	531	628	513	624	247	195	220	196	274	525	195	804	413
1982	1718	1986	1284	968	748	482	569	541	351	544	659	1635	351	1986	957
1983	861	1153	960	1432	1314	845	846	361	403	256	690	1380	256	1432	875
1984	1008	1033	1582	1385	1666	706	825	631	315	314	300	445	300	1666	851
1985	476	978	515	510	455	380	371	403	230	323	334	434	230	978	451
1986	346	514	527	331	248	127	41	100	148	306	665	634	41	665	332
1987	906	980	1098	731	481	418	254	87	64	75	124	197	64	1098	451
1988	587	401	374	525	269	63	82	114	195	143	412	263	63	587	286
1989	840	905	1330	1215	896	1564	1058	543	768	1036	990	964	543	1564	1009
1990	1699	3652	3120	1344	1029	615	749	397	382	448	341	1164	341	3652	1245
1991	951	1317	1532	1284	1429	832	625	593	414	297	464	956	297	1532	891
1992	876	1109	1375	1011	598	675	665	485	453	424	1037	1600	424	1600	859
1993	1531	1023	1277	1136	743	407	221	213	109	94	236	443	94	1531	619
1994	639	888	1505	1824	774	752	768	580	390	641	475	683	390	1824	827
1995	849	1463	1362	784	536	467	237	238	247	778	968	553	237	1463	707
1996	1747	1353	1712	1247	997	625	380	328	404	258	527	861	258	1747	870
1997	957	1089	1587	1414	1501	1024	607	400	366	558	448	502	366	1587	871
1998	1054	1389	1438	1947	1066	735	378	333	111	126	293	435	111	1947	775
1999	825	1052	773	533	836	474	801	273	113	183	184	188	113	1052	520
2000	377	340	470	1122	371	296	153	88	143	27	273	223	27	1122	324
2001	601	615	857	646	419	562	419	350	257	173	209	408	173	857	460
2002	808	535	709	649	800	360	234	82	337	302	573	917	82	917	526
2003	605	1193	1102	910	1780	1038	1422	1104	710	351	578	659	351	1780	954
2004	654	871	607	504	501	611	485	276	1622	372	1212	1614	276	1622	777
2005	752	1201	1200	1329	778	762	1195	772	355	275	316	550	275	1329	790
2006	813	615	528	674	542	297	156	100	187	294	424	272	100	813	409
2007	548	326	448	317	151	109	125	25	-18	-2	36	111	-18	548	181
2008	143	325	639	385	272	176	245	195	21	88	53	622	21	639	264
2009	974	471	788	815	1045	393	281	241	807	762	952	1238	241	1238	731
2010	1078	1320	899	803	948	464	277	241	97	165	211	271	97	1320	564
2011	374	358	1254	1155	563	312	133	47	179	74	363	577	47	1254	449
Min	143	325	374	317	151	63	41	25	-18	-2	36	111	-18	548	181
Max	1747	3652	3120	2359	1780	1564	1422	1104	1622	1036	1250	1635	543	3652	1245
Avg	882	1001	1190	1059	832	587	507	352	344	332	497	679	221	1465	688

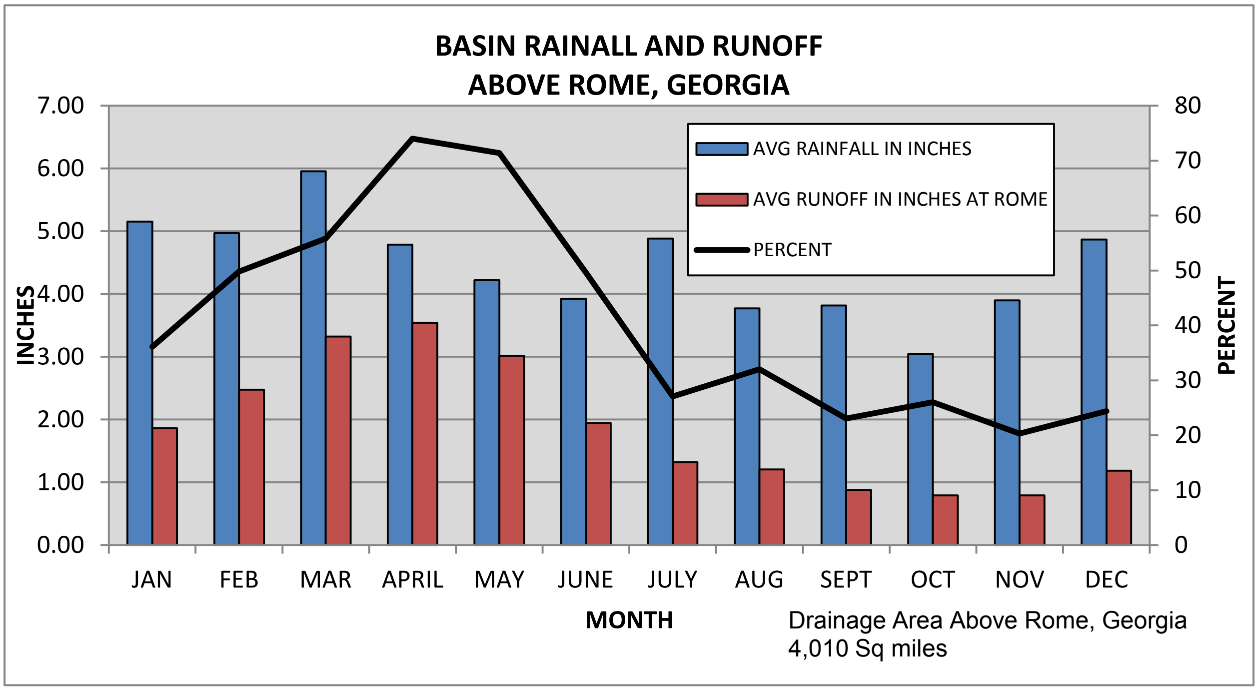


Figure 4-6. Basin Rainfall and Runoff above Rome, Georgia

4-08. Water Quality. Carters Lake is listed by the State of Georgia's 2012 Integrated 305 (b)/303 (d) list (GAEPD, 2010) as currently supporting its designated use with the exception of Coosawattee River embayment and US Woodring Branch/mid-lake area. Both Coosawattee River embayment and the US Woodring Branch/mid-lake area are listed on the 2012 draft Integrated 305(b) and 303(d) list because of chlorophyll a and phosphorus impairment. A draft Total Maximum Daily Load (TDML) has not yet been completed. The lake is now considered eutrophic due to an influx of phosphorus nutrients. Phosphorus levels have increased due to urban runoff and other non-point source pollutants. The reregulation pool downstream of the main lake serves as a buffer to improve water quality and flow condition downstream of the dam.

a. Water Quality Needs. Georgia Department of Natural Resources (GADNR) has classified the use of Carters Lake as "fishing" and the Coosawattee River embayment and US Woodring Branch/mid-lake area in Gilmer County as "recreation" in accordance with Georgia Water Quality Control laws. Georgia has promulgated water quality criteria for various water use classifications. The principal specific criteria related to the use classifications are as follows:

Fishing:

- Bacteria: Fecal coliform not to exceed a geometric mean of 500 colonies per 100 milliliters (ml) during May-October; 4,000 per 100 ml November – April (instantaneous maximum).
- Dissolved oxygen: A daily average greater or equal to 5.0 milligrams per liter (mg/l) and no less than 4.0 mg/l at all times.
- pH: Within the range of 6.0-8.5.
- Temperature: Less than 90 degrees Fahrenheit.

Recreation:

- Bacteria: Fecal coliform not to exceed a geometric mean of 200 colonies per 100 ml.

- Dissolved oxygen: A daily average greater or equal to 5.0 mg/l and no less than 4.0 mg/l at all times.
- pH: Within the range of 6.0-8.5.
- Temperature: Less than 90 degrees Fahrenheit.

The following criteria apply to all use classifications:

- All waters shall be free from materials associated with municipal or domestic sewage, industrial waste or any other waste which will settle to form sludge deposits that becomes putrescent, unsightly or otherwise objectionable.
- All waters shall be free from oil, scum and floating debris associated with municipal or domestic sewage, industrial waste or other discharges in amounts sufficient to be unsightly or to interfere with legitimate water uses.
- All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.
- No material in concentration that after treatment would exceed GAEPD and Federal drinking water standards.

The above listing is not intended to be all-inclusive, and Georgia Water Quality Control regulations and standards should be consulted as necessary.

b. Lake Water Quality Conditions. Georgia's 2012 draft integrated 305(b)/303(d) list of impaired waters designates the mid-lake reaches in Carters Lake and the reregulation lake as supporting designated uses. Two reaches, the Coosawattee River embayment and the US Woodring Branch/mid-lake area, were identified as impaired. Both sections were identified as "not supporting its use" because growing season average chlorophyll *a* exceeded the criteria. chlorophyll *a* standards for Carters Lake are set as a growing season (May through October) average less than 5 micrograms per liter (µg/l) upstream from the Woodring Branch and 10 micrograms per liter (µg/l) at Coosawattee River embayment mouth (Georgia EPD, 2012). In addition, these two sections are listed as impaired for phosphorus. Standards for the annual total phosphorus load were set at 151,500 lbs/year for Coosawattee River at Old Highway 5 and 8,000 lbs/year for Mountaintown Creek at U.S. Highway 76. Measured data at compliance points for dissolved oxygen, total nitrogen, and pH are in compliance with Georgia's standards. The state collects profile data at compliance points in Carters Lake for dissolved oxygen, pH, conductivity, and water temperature during the growing season. The state also collects grab samples of nitrogen, phosphorus, chlorophyll *a*, and bacteria. During some years, algal blooms result in reports of bad tasting or bad smelling drinking water in the city of Chatsworth which withdraws its water supply from Carters Lake and in the downstream town of Calhoun, which draws water from the Coosawattee River.

Georgia has begun efforts to identify sources contributing to high chlorophyll *a* by developing a total maximum daily load. As part of the state's water planning effort, it is also modeling the Coosa River Basin, including the Etowah River portion downstream of Allatoona Dam.

c. Lake Stratification. Carters Lake is unusual because of its extreme water depth of approximately 400 feet in places, resulting in the very lowest levels not mixing with the higher more oxygenated waters. The deepest levels remain anoxic and in a temperature range of 40-50 degree Fahrenheit throughout the year. However, the lake does exhibit typical seasonal mixing in the upper zones.

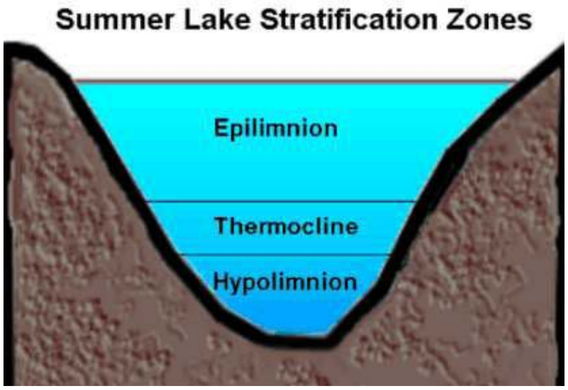


Figure 4-7. Generalized Lake Stratification

During the colder winter months, the water in Carters Lake is generally cold, relatively clear, and with similar temperatures from the top to the bottom. Water on the top and bottom of the lake has similar densities. Wind action keeps the lake well mixed, resulting in adequate dissolved oxygen levels throughout the water column. During winter, water temperature and oxygen concentrations do not limit fish movement in the lake. Lake water, which is released through the hydropower units from near the bottom of the lake into the Coosawattee River below the dam, is cold, relatively clear, and typically low in dissolved oxygen.

During spring and early summer, the lake warms and stratifies into three distinct layers: a surface layer called the epilimnion, a bottom layer called the hypolimnion, and a layer between the two called the metalimnion, or the thermocline. Figure 4-7 shows the typical summer stratification layers; however, in Carters there is also a fourth layer described below.

The warm, upper layer is fairly uniform in temperature and varies from 15 to 30 feet thick throughout the summer. It is well oxygenated from wind action and photosynthesis.

The hypolimnion, the cold (45 to 55 °F) third layer, becomes isolated and no longer mixes with the warm, oxygenated epilimnion. Oxygen is not produced in the hypolimnion because the cold, deep layer does not receive sunlight and is devoid of phytoplankton production. Early in the lake stratification process, the hypolimnion still contains some oxygen but declines throughout the summer as biological and chemical processes consume oxygen. By summer’s end, the lake is strongly stratified. The epilimnion is warm and well oxygenated. Water temperature and oxygen concentrations in the thermocline are both lower but still often provide acceptable habitat for cool-water fish species. In the hypolimnion, the water is cold and low in oxygen (less than 3 mg/l). As oxygen levels fall, some metals and sulfides in the lake sediments become soluble. They dissolve in the water and can be released downstream, entering the river. The river water becomes re-aerated rapidly as it flows downstream, thus releasing the metals and sulfides that have become soluble.

In the fall, the lake begins to lose heat, and the process of destratification begins. The warm water of the epilimnion cools and becomes deeper and denser. As the epilimnion’s density approaches the density of the hypolimnion, mixing of the layers occurs and the stratification is broken. The event is called *lake turnover*, and generally occurs around November – December each year. After mixing, the upper three layers cease to exist, and the entire lake has relatively uniform temperature and oxygen levels.

Regardless of the natural process of thermal stratification, Carters Lake has a “permanent layer” that does not mix with the upper three layers of the lake, thus serving as a unique fourth layer. This layer has a higher concentration of dissolved inorganic compounds that has developed due to extended periods of anoxic conditions. For example, the concentrations of iron and manganese approach 140 and 16 mg/L, respectively in the deepest areas. This phenomenon is described by John Hains in the article "Southeastern Lakes - Changing Impacts, Issues,Demands." This permanent deep chemical zone (monimolimnion) never mixes because the high chemical content increases the water’s density.

It appears that this layer, which exists at an approximate depth of 280 feet, resists mixing during the fall turnover. The monimolimnion is characterized by high conductivity and a rapid change in pH, devoid of oxygen, and contains high levels of iron, manganese, and other constituents and permanently low temperatures in the range of 40 to 50 degrees Fahrenheit as modeled by the Corps. The headgate and headrace channel is located at elevation 979 feet NGVD29, or about 200 feet below the pool elevation. This would indicate that normal operation would not draw water from the monimolimnion. On the other hand, the emergency sluice intake is located at elevation 725 feet NGVD29, or about 350 feet below pool elevation. Any use of this low-level sluice could have adverse impacts on downstream water quality as it would draw water directly from the monimolimnion.

d. Downstream Water Quality Conditions. Water quality conditions in the releases from Carters Dam are typical for hydropower projects in the southeast; i.e., cold water year-round with low dissolved oxygen levels during summer-time lake stratification periods and high dissolved oxygen levels during winter-time lake destratification periods. Turbidity is relatively low year-round. The potential for suspended metals occurs during lake stratification periods when the hypolimnion reaches anoxic conditions. The water use classification established by the State of Georgia for the Coosawattee River below Carters Dam is *fishing*, with corresponding water quality standards as described in paragraph 4-08.a. above. TMDLs for dissolved oxygen, fecal coliforms, and PCBs have been established for the Coosawattee River below Carters Dam. Due to PCB levels in fish tissue, the fishery advisories of one meal per week for spotted bass and one meal per month for smallmouth buffalo have been established by the State of Georgia.

Release water quality from the reregulation dam was monitored for several years from October 1974 and parameters measured were dissolved oxygen, temperature, pH, and conductivity. This data showed that dissolved oxygen consistently exceeded State water quality standards. While Dissolved Oxygen levels are periodically depressed in the releases from the main dam, exposure to the atmosphere in the reregulation pool together with reaeration which occurs in the spillway discharge from the reregulation dam is sufficient to elevate levels above standards. The monitoring is no longer being done by the Corps although the USGS collected water quality data at the site from 2005-2007.

4-09. Channel and Floodway Characteristics.

a. General. Carters Dam and Reregulation Dam Project is a headwater project with no other reservoirs located upstream. The channel capacity of the Coosawattee River downstream from the Carters Reregulation Dam is 3,200 cfs. Low lying areas on both banks of the lower reaches of the Coosawattee, Conasauga, and the beginning of the Oostanaula Rivers are cultivated during the spring, summer and early fall. It is estimated that a downstream flow of 3,200 cfs can be maintained during the planting and growing season without causing appreciable damage in these low lying areas. A downstream flow of 5,000 cfs can be maintained during the non-growing season without causing damages to these same areas.

During moderate to high flows, the backwater effects from the Coosawattee River increases flooding along the Conasauga River at Tilton, Georgia. When possible, releases from Carters Reregulation Dam are reduced during these periods to avoid increasing backwater flooding downstream in these areas.

b. Damage Centers and Key Control Points. In addition to the agricultural areas downstream from Carters Dam and Reregulation Dam Project, there are major flood damage reaches downstream on the Oostanaula River at Resaca and Rome, Georgia. The towns are shown in Figure 4-8.

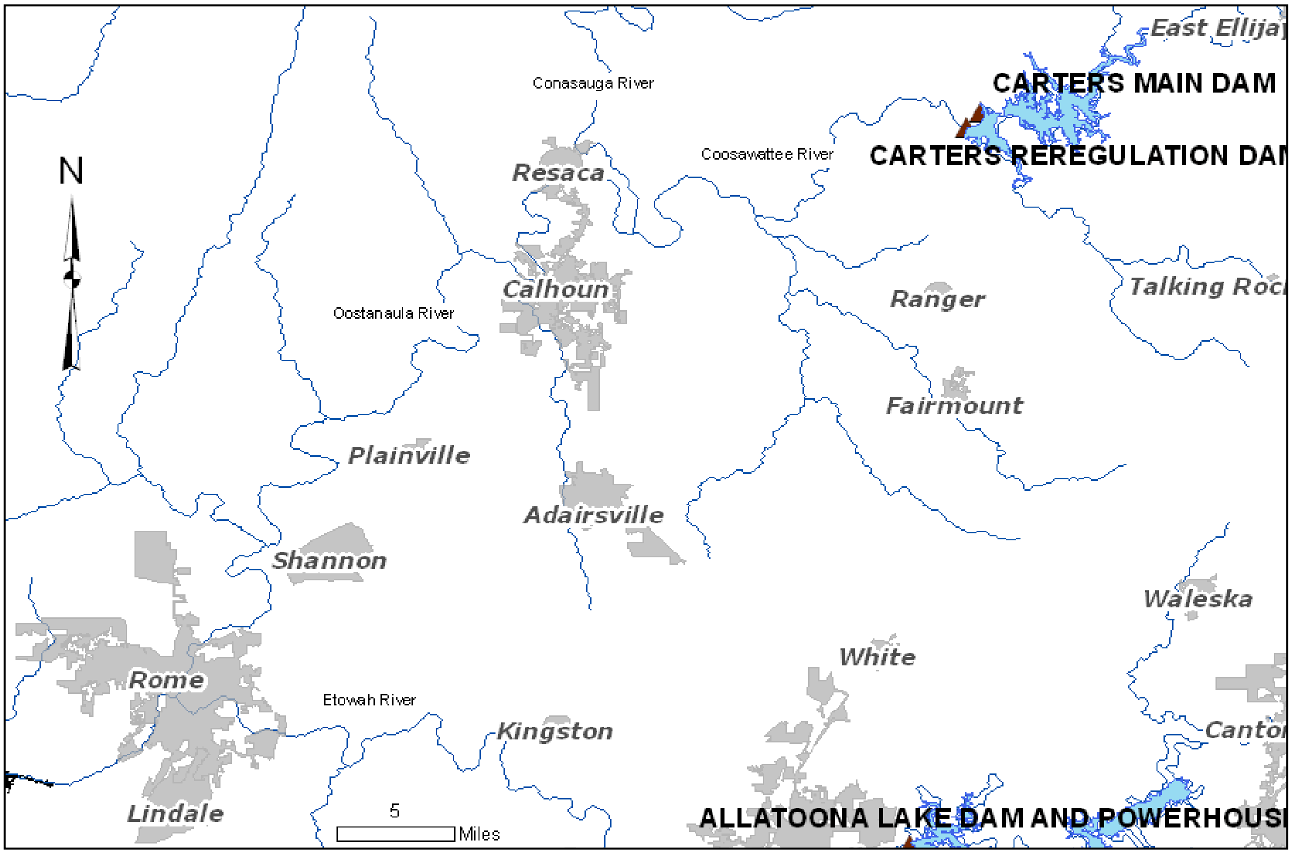


Figure 4-8. Location of Towns below Carters Project

This flooding is due to flood flows exceeding the channel capacity. Since the drainage area has a long travel reach, the flood hydrograph peaks at Rome, Georgia, occur three to four days after the maximum rainfall, and the high flows tend to continue for many days.

The city of Resaca, Georgia, located below Carters Dam and Reregulation Dam Project, experiences flooding when the Oostanaula River stage reaches 22 feet.

The Carters Dam and Reregulation Dam Project is located northeast of Rome, Georgia, on the Coosawattee River and its operation provides some flood damage reduction benefits for Rome, Georgia. However, Carters Dam controls runoff from less than 10 percent of the drainage area above Rome, Georgia, so flood reductions at Rome due to the Carters Project are relatively small. Travel time for water released from Carters Dam and Reregulation Dam Project to reach Rome, Georgia, is approximately 32 hours. Rome, Georgia, is also the major flood damage area protected by the Allatoona Project. Travel time for water released from Allatoona Dam and Lake Project to reach Rome, Georgia, is approximately 12 hours. Efforts are made to coordinate Carters Dam and Reregulation Dam and Allatoona projects when making releases for flood operations. Usually, flood releases will not be made from Allatoona until after the peak flood from the Oostanaula River have peaked at Rome. The USGS gages for the Oostanaula River at Rome US 27 and Coosa River at Mayo’s Bar (Weiss Lake) are used to guide operations of Carters Dam and Reregulation Dam Project to insure maximum flood reductions.

Tables 4-4 and 4-5 provide details for river stages and flood damages at Rome, and Resaca, Georgia. Tables 4-6 and 4-7 provide the dates and heights of historical floods for these locations and the lowest stages on record.

Table 4-4. Flood Impacts for Varying Stage of Oostanaula River at Rome, Georgia (USGS Gage 02388525)

Stage (feet)	Flood impacts at Rome – Oostanaula River
19	Action Stage is reached. Heritage Park Rome Greenway floods within floodplain.
22	Drainage valve must be closed at Second Avenue and Avenue A Pump station outfalls.
24	Drainage valves must be closed at American Legion Outfall and Police Station Outfall.
25	Flood Stage is reached. Mainly minor flooding will develop.
28	Moderate flooding begins. Water will enter basements of lower two city blocks near the gage site. Flood gates on Second Avenue and Avenue A must be closed.
30	Moderate flooding expands. Water enters Georgia Power Maintenance Yard at Etowah River.
32	Major flooding begins. Flooding of Rome Sewage Treatment Plant begins. Fifth Avenue Bridge is closed. Water overflows onto Second Avenue between railroad and bridge.
34.5	Major flooding continues. Six city blocks of basements in Rome near the Oostanaula River will flood. Water will cover the 200 block of East Second Avenue.
36	Major flooding continues. Water overflows at the lowest point of Summerville Road.
38	Major flooding expands. Water will reach Broad Street. This is the 100-year flood.
40.29	The record crest was 40.29 feet on April 1, 1892.
42	The levee of the Oostanaula will reach the top of the city levee. This is a very serious situation. Floyd Medical Center, Law Enforcement Center, and numerous businesses flood.
46	Highway 27 / 5th Avenue bridge floods. Many businesses and homes flooded.

Table 4-5. Flood Impacts for Varying Stage of Oostanaula River at Resaca, Georgia (USGS Gage 02387500)

Stage (feet)	Flood impacts at Resaca – Oostanaula River
19	Action Stage is reached
22	Mainly flooding of agricultural and pasture lands are affected when flood stage is reached.
28	High water will cause extensive flooding of farm lands in the area.
33.5	When the river rises to 33.5 feet...flooding of a textile mill in Calhoun will develop. Widespread flooding will occur.
36	The flood of record was 36.6 feet on April 1, 1886. Widespread flooding will occur. In Calhoun...just downstream...will flood on North River Street and South River Street. A recreational area on South River Street will flood. Mills near the area will not flood...because these locations have a higher elevation.

Table 4-6. Historical Crests for Oostanaula River at Rome, Georgia

Historical Crests for Oostanaula River at Rome	
1) 40.30 ft on 04/01/1886	(19) 30.50 ft on 03/30/1951
(2) 37.20 ft on 01/15/1892	(20) 30.50 ft on 04/05/1920
(3) 34.50 ft on 01/22/1947	(21) 29.90 ft on 01/28/1996
(4) 34.30 ft on 07/12/1916	(22) 29.60 ft on 03/22/1980
(5) 34.26 ft on 03/18/1990	(23) 29.00 ft on 01/04/1982
(6) 34.10 ft on 02/12/1946	(24) 28.90 ft on 03/08/1996
(7) 33.90 ft on 11/30/1948	(25) 28.82 ft on 02/05/1998
(8) 33.80 ft on 01/09/1946	(26) 28.00 ft on 01/20/1925
(9) 33.80 ft on 12/30/1932	(27) 27.70 ft on 05/07/2003
(10) 33.70 ft on 04/08/1936	(28) 27.00 ft on 11/29/1929
(11) 33.30 ft on 02/06/1936	(29) 26.90 ft on 03/10/1998
(12) 33.00 ft on 04/14/1979	(30) 26.50 ft on 04/14/1980
(13) 32.80 ft on 12/11/1919	(31) 26.20 ft on 10/04/1989
(14) 32.64 ft on 02/27/1990	(32) 25.98 ft on 05/04/1997
(15) 32.00 ft on 12/14/1932	(33) 25.65 ft on 01/07/2009
(16) 31.80 ft on 04/05/1977	(34) 25.60 ft on 03/07/2003
(17) 31.80 ft on 12/18/1932	(35) 25.10 ft on 03/01/1987
(18) 30.50 ft on 03/27/1964	(36) 25.04 ft on 01/13/1993
Low Water Records	
(1) 1.75 ft on 10/08/2007	
(2) 1.82 ft on 09/27/2007	

Table 4-7. Historical Crests for Oostanaula River at Resaca, Georgia

Historical Crests for Oostanaula River at Resaca, Georgia	
(1) 36.30 ft on 04/01/1886	(19) 30.20 ft on 03/06/1917
(2) 34.50 ft on 03/31/1951	(20) 30.20 ft on 01/18/1954
(3) 33.20 ft on 01/21/1947	(21) 30.10 ft on 03/17/1964
(4) 32.70 ft on 02/11/1921	(22) 30.10 ft on 03/15/1950
(5) 32.59 ft on 02/18/1990	(23) 30.00 ft on 11/21/1906
(6) 32.50 ft on 02/12/1946	(24) 29.80 ft on 12/31/1942
(7) 32.20 ft on 02/11/1946	(25) 29.80 ft on 12/29/1942
(8) 32.00 ft on 04/14/1920	(26) 29.70 ft on 11/20/1906
(9) 32.00 ft on 04/08/1892	(27) 29.40 ft on 12/14/1961
(10) 31.90 ft on 01/22/1922	(28) 29.20 ft on 02/27/1961
(11) 31.70 ft on 03/14/1909	(29) 28.70 ft on 03/17/1899
(12) 31.70 ft on 04/07/1892	(30) 28.65 ft on 03/30/1994
(13) 31.70 ft on 04/04/1920	(31) 28.58 ft on 03/24/1980
(14) 31.20 ft on 04/09/1938	(32) 28.50 ft on 11/27/1930
(15) 31.10 ft on 11/30/1948	(33) 28.40 ft on 03/19/1973
(16) 30.90 ft on 12/29/1932	(34) 28.40 ft on 04/06/1977
(17) 30.80 ft on 02/04/1957	(35) 28.40 ft on 02/15/1948
(18) 30.60 ft on 04/03/1936	(36) 28.40 ft on 03/31/1944
Low Water Records	
(1) 1.11 ft on 10/17/2007	
(2) 1.15 ft on 09/27/2007	
(3) 1.40 ft on 10/25/1954	
(4) 1.50 ft on 10/30/1978	
(5) 1.70 ft on 09/04/1977	
(6) 1.70 ft on 09/30/1947	
(7) 1.70 ft on 09/23/1956	
(8) 1.80 ft on 10/05/1959	
(9) 1.80 ft on 10/07/1970	
(10) 1.90 ft on 09/03/1962	

4-10. Upstream Structures. Carters Dam is a headwater project with no other reservoirs located upstream.

4-11. Downstream Structures. The entire ACT Basin is extensively developed with nine reservoir projects (10 dams) located downstream from Carters Dam. In addition to reservoirs downstream there are five reservoirs on parallel streams. Reservoir regulation procedures at Carters are not dependent on other projects except for Allatoona Dam. Both Allatoona and Carters are located upstream from Rome, Georgia requiring coordination of flood risk management activities.

The drainage area and river mile for important locations of interest within the basin are shown in Table 4-8. The entire ACT Basin is shown on Plate 2-1.

Table 4-8. River Mile and Drainage Area for Selected Sites in ACT Basin

ACT Reservoir Data				
Reservoirs	***Owner**	**River**	**River Mile**	**Drainage Area (sq miles)**
Carters Dam	F	Coosawattee	26.8	374
Carters Reregulation Dam	F	Coosawattee	25.3	521
Allatoona Dam	F	Etowah	47.8	1,122
Cartersville, GA (Hwy 61)		Etowah	38.2	1,345
Kingston, GA		Etowah	31.4	1,634
Resaca, GA		Oostanaula	43.16	1,602
Rome, GA (Hwy 27)		Oostanaula	0.3	2,149
Weiss Dam	P	Coosa	225.70	5,273
Neely Henry Dam	P	Coosa	146.82	6,600
Logan Martin Dam	P	Coosa	98.47	7,700
Lay Dam	P	Coosa	50.84	9,087
Mitchell Dam	P	Coosa	36.76	9,830
Jordan Dam	P	Coosa	18.86	10,165
Bouldin Dam	P	Coosa	4.2	10,165
Harris Dam	P	Tallapoosa	138.98	1,453
Martin Dam	P	Tallapoosa	60.6	3,000
Yates Dam	P	Tallapoosa	52.70	3,250
Thurlow Dam	P	Tallapoosa	49.70	3,325
Robert F. Henry	F	Alabama	236.3	16,233
Millers Ferry	F	Alabama	133.0	20,637
Claiborne	F	Alabama	72.5	21,473
*P -- Alabama Power Company F -- Federal Project				

4-12. Economic Data. The Carters Dam Watershed extends to the headwaters of the Oostanaula River and consists of eight Georgia counties. The watershed transitions from developed urban and residential land uses to more rural land use within the watershed. The Oostanaula River transitions into the Coosa River at Rome, Georgia which is considered the edge of the Carters Dam Watershed Basin.

a. Population. The 2010 population estimates for the 8 counties composing the Carters Dam project watershed and basin below was 437,344 persons. Table 4-9 shows the 2010 population and the 2006 per capita income for each county. The most recent data available is provided.

Table 4-9. Population and Per Capita Income

	2010	**2006**
	Population	**Per Capita Income**
Chattooga	26,896	$ 20,574
Floyd	96,531	$ 29,730
Gilmer	29,145	$ 24,810
Gordon	53,247	$ 25,387
Murray	40,460	$ 22,935
Pickens	31,375	$ 32,108
Walker	65,012	$ 24,853
Whitfield	94,678	$ 29,838

*US Census Bureau
*US Census Bureau, City and County Data Books, 2007

The city of Rome, Georgia, is the most populated city located within the Carters Dam Project Watershed and Basin. Rome, Georgia, is located within Floyd County and had an estimated population in 2009 of 36,031.

b. Agriculture. The Carters Dam Project Watershed and Basin below consist of approximately 3,708 farms averaging 115 acres per farm. In 2005, the area produced $417 million in farm products sold and total farm earnings of more than $117 million. Agriculture in the Carters Dam Project Watershed and Basin consists primarily of livestock, which account for around 95 percent of the value of farm products sold. Livestock production consists primarily of poultry operations and beef cattle within the basin. The principal crops consist of nursery and greenhouse ornamentals, floriculture, and sod, along with vegetable farms and orchards. Agricultural production information and farm earnings for each of the counties in the Carters Dam Project Watershed and Basin below are shown in Table 4-10.

c. Industry. The leading industrial sectors that provide non-farm employment are wholesale and retail trade, services, and manufacturing. The remaining non-farm employment is provided by construction, finance, insurance, real estate, transportation, and public utilities. In 2005, the Carters Dam project area counties contained 835 manufacturing establishments that provided 62,953 jobs with total earnings of just under $3.1 billion. Additionally, the value added by the area manufactures was just under $5.6 billion. Table 4-11 contains information on the manufacturing activity for each of the counties in the Carters Dam Project Watershed and Basin.

Table 4-10. Farm Earnings and Agricultural Production

County	2005 Farm Earnings ($1,000)	Number of Farms	Total Farm Acres (1,000)	Acres Per Farm	Value of Farm Products Sold ($1,000)	Percent Crops	From Livestock
Georgia							
Chattooga	1,365	329	55	167	6,000	13.7	86.3
Floyd	8,416	663	91	138	29,000	7.9	92.1
Gilmer	29,436	303	25	82	99,000	1.4	98.6
Gordon	25,400	804	76	95	100,000	3.5	96.5
Murray	9,922	306	42	137	27,000	5.8	94.2
Pickens	19,971	243	17	71	48,000	1.2	98.8
Walker	8,021	642	82	127	34,000	3.4	96.6
Whitfield	15,001	418	43	104	74,000	1.3	98.7

*US Census Bureau, City and County Data Books, 2007

Table 4-11. Manufacturing Activity

County	No. of Manufacturing Establishments	Total Manufacturing Employees	Total Earnings ($1,000)	Value Added by Manufactures ($1,000)
Georgia				
Chattooga	22	3,541	135,303	320,027
Floyd	119	9,484	585,524	735,657
Gilmer	31	2,892	106,838	129,857
Gordon	109	8,994	464,194	932,129
Murray	94	6,327	254,046	300,660
Pickens	35	814	38,836	69,577
Walker	71	5,343	235,639	538,472
Whitfield	354	25,558	1,277,433	2,563,777

d. Flood Damages. Carters Lake provides flood damage protection for existing development in along the Oostanaula and Coosa River Floodplain. The Corps' Water Management Office has developed an Annual Damage Reduction Summary that estimates the flood damages prevented by the Carters Lake flood reduction project in the ACT Basin. Table 4-12 shows the Carters Dam and Lake flood damages prevented by year from 1986 through 2011.

Table 4-12. Flood Damages Prevented - Carters Lake

Year	Carters Dam	Year	Carters Dam	Year	Carters Dam
1986	$0	1995	$20,100	2004	N/A
1987	$0	1996	$22,300	2005	N/A
1988	$0	1997	$0	2006	N/A
1989	$0	1998	$0	2007	N/A
1990	$219,000	1999	$0	2008	N/A
1991	$22,900	2000	$0	2009	$8,800
1992	$0	2001	$0	2010	$285,400
1993	$13,000	2002	$0	2011	$28,300
1994	$20,100	2003	$0		

V - DATA COLLECTION AND COMMUNICATION NETWORK

5-01. Hydrometeorological Stations.

a. Facilities. Management of water resources requires continuous, real-time knowledge of hydrologic conditions. The Mobile District contracts out the majority of basin data collection and maintenance to the U.S. Geological Survey (USGS) and National Weather Service (NWS) through cooperative stream gaging and precipitation network programs. The USGS, in cooperation with other federal and state agencies, maintains a network of real-time gaging stations throughout the ACT Basin. The stations continuously collect various types of data including stage, flow, and precipitation. The data are stored at the gage location and are transmitted to orbiting satellites. Figure 5-1 shows a typical encoder with wheel tape housed in a stilling well used for measuring river stage or lake elevation. Figure 5-2 shows a typical precipitation station, with rain gage, solar panel, and Geostationary Operational Environmental Satellite (GOES) antenna for transmission of data. The gage locations are discussed in Chapter VI related to hydrologic forecasting.

Figure 5-1. Encoder with wheel tape for measuring the river stage or lake elevation in the stilling well

Figure 5-2. Typical field installation of a precipitation gage

The Water Management Section employs a staff of hydrologic field technicians and contract work to USGS to operate and maintain Corps' gages throughout the ACT Basin. All rainfall gages equipped as Data Collection Platforms (DCPs) are capable of being part of the reporting network. Data are available from many stations in and adjacent to the ACT Basin. The 13 stations listed in Table 5-1 and shown on Plate 5-1 are considered the rainfall reporting network for the Carters Dam Project. Because Carters Dam regulates flood flows to downstream locations, the reporting network extends to Rome, Georgia. Carters Dam regulation of peak flows does not affect areas below Weiss Dam on the Coosa River but does reduce flood inflows to that project. All river stage gages equipped as DCPs are capable of being part of the reporting network. Data are available from many stations in and adjacent to the ACT Basin. The stations listed in Table 5-2 are in the ACT Basin and provide information for operations for both Carters and Allatoona Dams. The locations of river stage stations are also shown on Plate 5-1**.** River stage – river flow relationship curves for representative river gages are shown on Plates 5-2 through 5-11.

Table 5-1. Corps and NOAA Gages Reporting only Rainfall

Name	Agency	Agency ID	Latitude	Longitude
Wahsega, GA	Corps	WAHG1	34.69028	-84.0644
Amicalola, GA	Corps	AMIG1	34.54583	-84.2772
Mountaintown, GA	Corps	MTNG1	34.77361	-84.5392
Carters Dam	Corps	CTRG1	34.61417	-84.6747
Allatoona Dam	Corps	CVLG1	34.16278	-84.7278
Chatsworth, GA	NOAA	91863	34.7589	-84.765
Rome, GA	NOAA	97600	34.34778	-85.1611
Summerville, GA	NOAA	98436	34.4546	-85.39
Lafayette, GA	NOAA	94941	34.6638	-85.3203
Jasper , GA	NOAA	94648	34.4758	-84.4461
Cartersville, GA	NOAA	91670	34.2043	-84.7925

Table 5-2. Gages Reporting Rainfall and River Stage

USGS Gage	Name	Lat	Long	Drainage Area (sq miles)	River Mile Above Rome, GA	Datum	Flood Stage	Rain Gage
02389150	Etowah River At Ga 9, Near Dawsonville	34.3572	-84.1136	131	131	1022	13	Y
02394670	Etowah River At Ga 61, Near Cartersville	34.1428	-84.8389	1345	38.22	650.81	18	Y
02395000	Etowah Near Kingston	34.2089	-84.9787	1634	21.4	609.97		Y
02395120	Two Run Creek Near Kingston, Ga	34.2428	-84.8897	33.1	na	723.1		N
02395980	Etowah River At Ga 1 Loop, Near Rome	34.2322	-85.1169	1801	1.47	561.7	32	N
02380500	Coosawattee River Near Ellijay, Ga	34.675	-84.5086	236	93.3	1216.04	8	Y
02382200	Talking Rock Creek Near Hinton, Ga	34.5228	-84.6111	119	na	893.69		Y
02382500	Coosawattee River At Carters, Ga	34.6036	-84.6956	521	71.86	650.67		Y
02383500	Coosawattee River Near Pine Chapel	34.5642	-84.8331	831	53.55	616.16		Y
02384500	Conasauga River At Ga 286, Near Eton	34.8278	-84.8508	252	89.62	672.64	12	Y
02385800	Holly Creek Near Chatsworth, Ga	34.7167	-84.77	64	na	689.25		Y
02387000	Conasauga River At Tilton, Ga	34.6667	-84.9283	687	59.09	622.28	18	N
02387500	Oostanaula River At Resaca, Ga	34.5771	-84.9419	1602	43.16	604.14	22	Y
02387520	Oostanaula River At Calhoun Ga	34.5189	-84.9544	1624	36.7		20	Y
02388500	Oostanaula River Near Rome, Ga	34.2983	-85.1381	2115	5	561.7	30	N
02388525	Oostanaula River At US 27 At Rome Ga	34.2606	-85.1708	2149	0.65	561.7	25	Y
02397000	Coosa River Near Rome - Mayo’s Bar	34.2003	-85.2567	4040		553.05		Y
02392000	Etowah River At Canton, Ga	34.2398	-84.4947	613	77.8	844.55	16	N
02393500	Allatoona Lake Near Cartersville, Ga	34.1628	-84.7278	1122	47.8	0		Y
02393501	Etowah River Allatoona Dam Tw, Abv Cartersville, Ga	34.1639	-84.7281	1122	47.73	0		N
02394000	Etowah River At Allatoona Dam, Abv Cartersville, Ga	34.1631	-84.7411	1119	47	686.92		N
02381400	Carters Lake Near Carters, Ga	34.6139	-84.6711	374	73.76	0		Y
02381401	Carters Lake Tailrace Near Carters, Ga	34.6142	-84.6747	374	73.75	0		N
02382400	Carters Re-Regulation Lake Near Carters, Ga	34.6042	-84.6914	520	72.25	651		N

b. Reporting. The Water Management Section operates and maintains a Water Control Data System (WCDS) for the Mobile District that integrates large volumes of hydrometeorological and project data so the basin can be regulated to meet the operational objectives of the system. The WCDS, in combination with the new Corps Water Management System (CWMS), together automate and integrate data acquisition and retrieval to best meet all Corps water management activities. The rainfall reporting network and the river stage reporting network are shown in Plate 5-1.

Data from the Carters Project such as pool, tailwater, and other pertinent data as well as the same data from the Allatoona Project is used to operate the Carters Project and to remotely operate the Allatoona Project. A microwave system between Carters and Allatoona Dam provides for continuous monitoring and regulation of the Allatoona Project. Information such as pool, tailwater, and other pertinent data needed for regulation is continuously transmitted through the microwave system to Carters. Computer systems at the projects store and organize the data and transmit the information to the Water Management Section in Mobile. Forms and river bulletins are automatically formatted, printed and transmitted to other parties.

A system of automatic reporting rainfall and river stage stations has been installed covering the drainage basin above both Carters and Allatoona Dams, and extending downstream to Rome, Georgia. These reporting stations, along with thousands throughout the Nation are part of a comprehensive data gathering system. The basis for automated data collection is the satellite Data Collection Platform (DCP). The DCP is a computer microprocessor physically located at the gage sites. A DCP has the capability to interrogate sensors at regular intervals to obtain real-time information (e.g., river stages, reservoir elevations, and water and air temperatures, precipitation), save the information, perform simple analyses of this information, and then transmit this information to a fixed geostationary satellite. DCPs transmit real-time data at regular intervals to the GOES System operated by the National Oceanic and Atmospheric Administration (NOAA). The GOES Satellite sends this data directly down to the NOAA Satellite and Information Service in Wallops Island, Virginia. This data is then re-broadcast over a domestic communications satellite (DOMSAT). The Mobile District maintains a Local Readout Ground Station (LRGS) that collects the DCP-transmitted, real-time data from the DOMSAT. Figure 5-3 depicts a typical schematic of how the system operates.

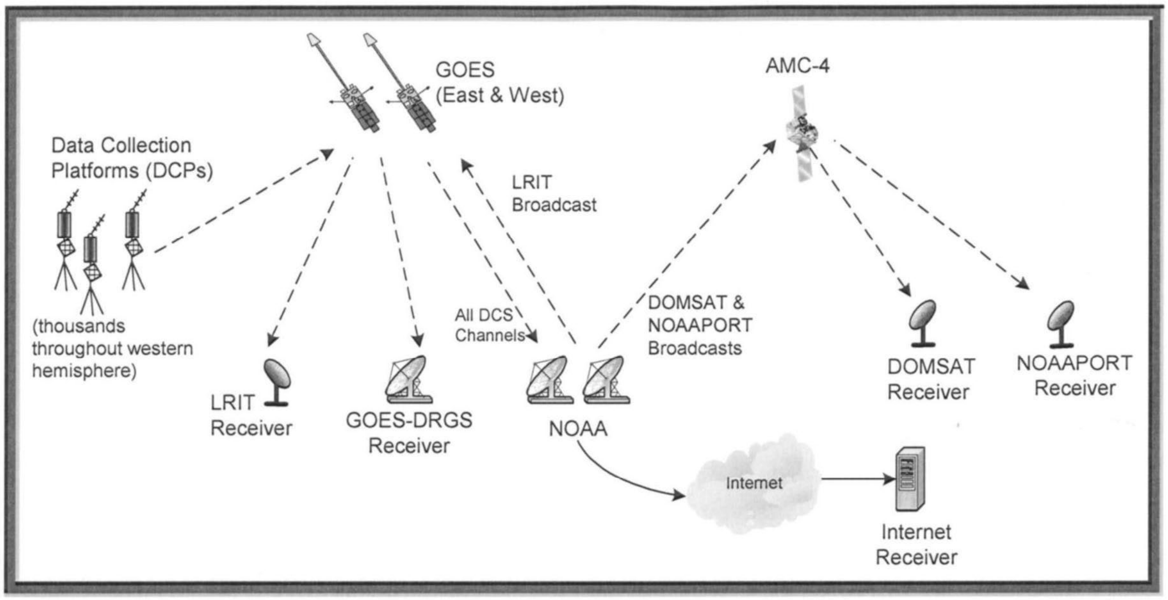


Figure 5-3. Typical Configuration of the GOES System

Typically, reporting stations log 15-minute data that are transmitted every hour. A few remaining gages report every four hours, but they are being transitioned to the hourly increment. All river stage and precipitation gages equipped with a DCP and GOES antenna are capable of being part of the reporting network.

Other reservoir project data are obtained directly at a project is collected through each project's SCADA system. The Water Management Section downloads the data both daily and hourly through the Corps' server network.

c. Maintenance. Maintenance of data reporting equipment is a cooperative effort among the Corps, USGS, and NWS. The USGS, in cooperation with other federal and state agencies, maintains a network of real-time DCP stream gaging stations throughout the ACT Basin. The USGS is responsible for the supervision and maintenance of the real-time DCP gaging stations and the collection and distribution of streamflow data. In addition, the USGS maintains a systematic measurement program at the stations so the stage-discharge relationship for each station is current. Through cooperative arrangements with the USGS, discharge measurements at key ACT Basin locations are made to maintain the most current stage-discharge relationships at the stations. The NWS also maintains precipitation data for the FC-13 precipitation network. For Corps-maintained facilities in the ACT Basin, gages are typically visited six to eight times per year to validate stage, flow, and accuracy of gage equipment.

If gages appear to be out of service, the following agencies can be contacted for repair:

U.S. Army Corps of Engineers, Mobile District, 109 Saint Joseph Street, Mobile, AL 36602-3630
Phone: (251) 690-2737 Web: http://water.sam.usace.army.mil

USGS Georgia Water Science Center, 3039 Amwiler Road, Suite 130, Atlanta, GA 30022-5803
Phone: (770) 903-9100 Web: http://ga.water.usgs.gov

NWS Southern Region, 819 Taylor Street, Room 10E09, Fort Worth, TX 76102
Phone: (817) 978-1100 Web: http://www.srh.noaa.gov/

5-02. Water Quality Stations. The Corps does not operate any water quality stations in the ACT Basin. In most cases, other federal and state agencies maintain water quality stations for general water quality monitoring in the ACT Basin. In addition, some real-time water quality parameters are collected at some stream gage locations maintained by the USGS.

5-03. Sediment Stations. In order to provide an adequate surveillance of sedimentation, a network of sediment ranges were established for Carters Lake and the reregulation pool. Quantitative computations can be made from these ranges to compute storage depletion rates. The network also serves as an index of any bank sloughing that may occur. General conditions and changes have been measured and recorded using this network. The network of sediment stations is shown on Plate 4-1. In order to monitor degradation and gradation of the Coosawattee River below the Reregulation Dam a network of retrogression ranges were established to Pine Chapel Road downstream of the Reregulation dam. This network is shown on Figure 4-3. Sedimentation ranges in the Carters Lake were conducted in 2009, and the sedimentation and retrogression ranges for the Reregulation pool and downstream were conducted in 1973, with resurveys conducted on a periodic basis. Two such periodic surveys were made in 1992 and in 2009 for the Reregulation Dam. The Carters Lake has only been surveyed in 2009.

Sediment surveys were conducted in 2009. Tetra Tech, Inc. was retained to conduct an analysis of the data and determine the extent and degree of sedimentation and erosion that has occurred in the lake and its tributaries over the years, and where appropriate, to speculate on the causes of those changes. This analysis and results are presented in a report entitled; “Sedimentation and Erosion Analysis for Carters Lake, Carters Dam and Lake and Reregulation Pool, GA”. Sedimentation and erosion classifications were developed for each range. Based on the percentage change for the entire cross section, range cross sections were classified for sedimentation as “Heavy” (greater than 15 percent change), “Medium” (5 to 15 percent change), “Light” (0 to 5 percent), and “None” (0 or negative change). Erosion classifications were also developed from bank retreat and advance rates. A bank retreat or advance rate is the average change in location, measured in feet, of the shoreline. It is the area bounded between two cross section profiles at the shore erosion zone (square feet) divided by the height of shore erosion zone (feet). The shorelines were separated into two groups, erosional and depositional. The erosional group was further divided into three classes by percentile. The 25 percent of shorelines showing the greatest bank retreat were classes as “Acute,” the middle 50 percent in bank retreat were classes as “Moderate,” and the 25 percent with the least bank retreat were classes as “Slight.” Shorelines in the depositional group were classes as “Deposition.”

Analysis revealed that the Reregulation pool has undergone sedimentation primarily along the Talking Rock Creek arm with deposits limited primarily to the historic, now-submerged, stream channel. “Acute” erosion is found only on the left bank of range 3A with “Slight” and “Moderate” erosion noted on both shorelines of ranges 1A and 2A. Although the lake has large portion of bedrock shoreline, the large and frequent fluctuation in pool elevation promote continued erosion above the bedrock. The Talking Rock Creek embayment has undergone several feet of overbank sedimentation between elevations 687 and 689 feet NGVD29.

Bathymetry was obtained for Carters Lake for the first time during 2009 to provide a base for monitoring of Carters lake sedimentation. No sedimentation analysis was performed for Carters Lake; however a qualitative shoreline erosion analysis was made from observations and photographs. Thirteen of 18 locations were stable due to bedrock and boulder shorelines. Historically the erosion rates have been high shortly after the lake was impounded, but presently these locations appear stable. Four locations were classifies as “Slight” and one as “Acute” for bank erosion. All these locations are characterized as shorelines composed of unconsolidated soil materials or bedrock weathered to the point of being friable. One extended shoreline between rangelines was noted for active mass wasting.

In summary Talking Rock Creek is the dominant sediment source for the Reregulation Pool, and the Coosawattee River is the dominant sediment source for Carters Lake with present and potential land use activities driving sediment load. The amount of sediment deposition that has occurred has not affected the operation of the project and it is not expected to in the near future.

5-04. Recording Hydrologic Data. The Water Control Data Support System (WCDSS) is an integrated system of computer hardware and software packages readily usable by water managers and operators as an aid for making and implementing decisions. An effective decision support system requires efficient data input, storage, retrieval; and capable information processing. Corps-wide standard software and database structure are used for real-time water control. Time series hydrometeorological data are stored and retrieved using HEC Data Storage System (DSS) databases and programs.

To provide the data needed to support proper analysis, a DOMSAT Receive Station (DRS) is used to retrieve DCP data from gages throughout the ACT Basin. The DRS equipment and software then receives the DOMSAT data stream, decodes the DCPs of interest and reformats the data for direct ingest into a HEC-DSS database.

Each morning (or other times when needed) reservoir data is examined and recorded in water control models. This information is used for management purposes. However, most reservoir data is transmitted in hourly increments for inclusion in daily log sheets that are retained indefinitely. Gage data is transmitted in increments of 15 minutes, one hour or other time intervals. The data is automatically transferred to forecast models.

Automated timed processes also provide provisional real-time data needed for the Decision Support System. Interagency data exchange has been implemented with the USGS and NWS Southeast River Forecast Center (SERFC).

A direct link to the NWS, SERFC is maintained to provide real-time products generated by NWS offices. Information includes weather and flood forecasts and warnings, tropical storm information, NEXRAD radar rainfall, graphical weather maps and more.

5-05. Communication Network. The global network of the Corps consists of private, dedicated, leased lines between every Division and District office worldwide. Those lines are procured through a minimum of two General Services Administration-approved telephone vendors, and each office has a minimum of two connections, one for each vendor. The primary protocol of the entire Corps network is Ethernet. The reliability of the Corps' network is considered a command priority and, as such, supports a dedicated 24 hours per day Network Operations Center. The use of multiple telephone companies supplying the network connections minimizes the risk of a one cable cut causing an outage for any office. Such dual redundancy, plus the use of satellite data acquisition, makes for a very reliable water control network infrastructure.

The Water Management Section has a critical demand for emergency standby for operation of the ACT Basin and to ensure data acquisition and storage remain functional. The Water Management Section must be able to function in cases of flooding or other disasters, which typically are followed by the loss of commercial electricity. The WCDS servers and the LRGS each have individual UPS (uninterruptable power supply) and a large UPS unit specifically for the portion of Mobile District Office in which the Water Management Section resides to maintain power for operational needs.

The primary communication network of the Carters Project is a SCADA system network. The SCADA network includes a microwave link between Carters, Allatoona, and Buford. The SCADA network also monitors powerhouse conditions and digitally records real-time project data hourly. Computer servers at Carters are connected to the Mobile District through the Corps Network, permitting data transfer at any time. The data include physical conditions at each of the reservoirs such as pool elevations, outflow, river stages, generation, and rainfall. Special instructions or deviations are usually transmitted by e-mail, telephone, or fax.

Emergency communication is available at the following numbers:

Water Management Section	251-690-2737
Chief of Water Management	251-690-2730 or 251-490-9535 (cell)
Carters Powerhouse	706-334-2906

5-06. Communication with the Project Office.

a. Regulating Office With Project Office. The Carters Powerhouse should be contacted regarding any operational issues regarding Carters, Allatoona, and Buford. There are a variety of methods for communication between the Mobile District and Carters Dam. Satellite communication is available for some data transmission. Telephone and fax communication are available. Computer servers at Carters Dam are connected to the Mobile District through the Internet, permitting data transfer at any time. The data includes physical conditions at each of the reservoirs that include pool elevations, outflow, river stages, generation and rainfall. Special instructions or deviations are usually transmitted by telephone, email, or fax. For local communication in the reservoir area above and below the Carters Dam, there are two fixed base station remotes and several mobile units and hand held two-way radios. The fixed VHF base station is located in the Reservoir Manager's office map building and the mobile stations are located in boats and motor vehicles. For communication between Carters Dam, Reregulation Dam and other elements of the Carters Project, there is a private Mitel PBX telephone system installed which allows direct dialing between any and all elements of the project.

Data from the Carters, Allatoona, and Buford Projects are automatically collected at the Carters Project and transmitted through the network to the Mobile District. Telephone is another communications option if there are problems receiving the data over the network. Data for the project and the DCPs are downloaded to the Mobile District’s computer system. Daily reports are automatically generated for review.

b. Between Project Office and Others. Information is automatically sent to those with need. The National Weather Service and the River Forecast Center receive the data. Both the Corps and the River Forecast Center prepare forecasts for areas of concern. In addition, water resources information is available to the public at the Corps’ Web site, http://water.sam.usace.army.mil. The site contains real-time information, historical data, and general information.

5-07. Project Reporting Instructions. In addition to automated data, project operators maintain record logs of gate position, water elevation, and other relevant hydrological information including inflow and discharge. That information is stored and available to the Mobile District through the Corps’ network. The Mobile District maintains constant contact with project operators. Operators notify the Mobile District if changes in conditions occur. Unforeseen or emergency conditions at the project that require unscheduled manipulations of the reservoir should be reported to the Water Management Section as soon as possible.

If the automatic data collection and transfer are not working, projects are required to fax or email daily or hourly project data to the Water Management Section. Water Management staff will manually input the information into the database. In addition, Mobile District Power projects must verify pool level gauge readings each week, in accordance with Standard Operating Procedure, Weekly Verification of Gauge Readings, Mobile District Power Projects dated 19 February 2008, and CESAD SOP 1130-2-6 dated 21 July 2006. Those procedures require that powerhouse operators check the accuracy of pool monitoring equipment by verifying readings of the equipment against gauge readings at each plant. That information is logged into the Official Log upon completion and furnished to the master plant. A Trouble Report to management communicates any discrepancies with the readings. Operations Division, Hydropower Section will be notified by e-mail when verification is complete. The e-mail notification will include findings of the verification.

Project personnel or the Hydropower Section within the Operations Division or both are responsible for requesting any scheduled system hydropower unit outages in excess of two hours. The hydropower unit out-of-service times are reported back to the Water Management Section on completion of outages. Forced outages are also reported with an estimated return time, if possible. Any forced or scheduled outages causing the project to miss scheduled water release targets must be immediately reported to the Water Management Section. In such cases, minimum flow requirements can be met through spill.

5-08. Warnings. During floods, dangerous flow conditions or other emergencies, the proper authorities and the public must be informed. In general flood warnings are coupled with river forecasting. The NWS has the legal responsibility for issuing flood forecast to the public and that agency will have the lead role for disseminating the information. For emergencies involving the project the operator on duty should notify the Water Management Section, Operations Division and the Resource Manager at the project. If needed the Resource Manager will notify local law enforcement, government officials and emergency management agencies.

5-09. Role of Regulating Office. The Water Management Section of the Mobile District Office is responsible for developing operating procedures for both flood and non-flood conditions. Plans are developed to most fully use the water resources potential of each project within the constraints of authorized functions. Those plans are presented in reservoir regulation manuals such as this one. Reservoir regulation manual preparation and updating is a routine operation of the section. In addition, the section maintains information on current and anticipated conditions, precipitation, and river-stage data to provide the background necessary for best overall operation. The Water Management Section arranges the communication channels to the Power Project Manager and other necessary personnel. Instructions pertaining to reservoir regulation are issued to the Power Project Manager; however, routine instructions are normally issued directly to the powerhouse operator on duty.

5-10. Role of Power Project Manager. The Power Project Manager must be completely familiar with the approved operating plan for the Carters. The Power Project Manager is responsible for implementing actions under the approved water control plan and carrying out special instructions from the Water Management Section. The Power Project Manager is expected to maintain and furnish records requested from him by the Water Management Section. Training sessions should be held as needed to ensure that an adequate number of personnel are informed of proper operating procedures for reservoir regulation. Unforeseen or emergency conditions at the project that require unscheduled manipulation of the reservoir should be reported to the Water Management Section as soon as practicable.

VI - HYDROLOGIC FORECASTS

6-01. General. Reservoir operations for the Carters Project are scheduled by the Water Management Section in accordance with forecasts of reservoir inflow and river stages. Operations at the Carters Project are coordinated with the Allatoona Project to reduce the flood damage at Rome, Georgia.

The Corps has developed techniques to conduct forecasting in support of the regulation of the ACT Basin. In addition, the Corps relies on other federal agencies such as the NWS and the USGS to help maintain accurate data and forecast products to aid in making the most prudent water management decisions. The regulation of multipurpose projects requires scheduling releases and storage on the basis of both observed and forecasted hydrologic events throughout the basin. During both normal and below-normal runoff conditions, releases through the power plants are scheduled on the basis of water availability, to the extent reasonably possible, during peak periods to enhance revenue returned to the Federal Government. The release level and schedules are dependent on current and anticipated hydrologic events. The most efficient use of water is always a goal, especially during the course of a hydrologic cycle when below-normal streamflow is occurring. Reliable forecasts of reservoir inflow and other hydrologic events that influence streamflow are critical to the efficient regulation of the ACT System.

a. Role of The Corps. The Water Management Section maintains real-time observation of river and weather conditions in the Mobile District. The Water Management Section has capabilities to make forecasts for several areas in the ACT Basin. Those areas include all the federal projects and other locations. Observation of real-time stream conditions provides guidance of the accuracy of the forecasts. The Corps maintains contact with the River Forecast Center to receive forecast and other data as needed. Daily operation of the ACT River Basin during normal, flood risk management, and drought conservation regulation requires accurate, continual short-range and long-range elevation, streamflow, and river-stage forecasting. These short-range inflow forecasts are used as input in computer model simulations so that project release determinations can be optimized to achieve the regulation objectives stated in this manual. The Water Management Section continuously monitors the weather conditions occurring throughout the basin and the weather and hydrologic forecasts issued by the NWS. The Water Management Section then develops forecasts that are to meet the regulation objectives of regulating the ACT projects. The Water Management Section prepares five-week inflow and lake elevation forecasts weekly based on estimates of rainfall and historical observed data in the basin. These projections assist in maintaining system balance and providing project staff and the public lake level trends based on the current hydrology and operational goals of the period. In addition, the Water Management Section provides weekly hydropower generation forecasts based on current power plant capacity, latest hydrological conditions, and system water availability.

b. Role of Other Agencies. The NWS is responsible for preparing and publicly disseminating forecasts relating to precipitation, temperatures, and other meteorological elements related to weather and weather-related forecasting in the ACT Basin. The Water Management Section uses the NWS as a key source of information for weather forecasts. The meteorological forecasting provided by the Birmingham, Alabama and Peachtree City, Georgia offices of the NWS is considered critical to the Corps' water resources management mission. The 24- and 48-hour Quantitative Precipitation Forecasts (QPFs) are invaluable in providing guidance for basin release determinations. Using precipitation forecasts and subsequent runoff directly relates to project release decisions.

1) The NWS is the federal agency responsible for preparing and issuing streamflow and river-stage forecasts for public dissemination. That role is the responsibility of the Southeast River Forecast Center (SERFC) co-located in Peachtree City, Georgia with the Peachtree City Weather Forecast Office. SERFC is responsible for the supervision and coordination of streamflow and river-stage forecasting services provided by the NWS Weather Service Forecast Office in Peachtree City, Georgia. SERFC routinely prepares and distributes five-day streamflow and river-stage forecasts at key gaging stations along the Alabama, Coosa, and Tallapoosa Rivers. Streamflow forecasts are available at additional forecast points during periods above normal rainfall. In addition, SERFC provides a revised regional QPF on the basis of local expertise beyond the NWS Hydrologic Prediction Center QPF. SERFC also provides the Water Management Section with flow forecasts for selected locations on request.

2) The Corps and SERFC have a cyclical procedure for providing forecast data between federal agencies. As soon as reservoir release decisions have been planned and scheduled for the proceeding days, the release decision data are sent to SERFC. Taking release decision data, coupled with local inflow forecasts at forecast points along the ACT, SERFC can provide inflow forecasts into Corps projects. Having revised inflow forecasts from SERFC, the Corps has up-to-date forecast data to make the following days' release decisions.

6-02. Flood Condition Forecasts. During flood conditions, forecasts are made for two conditions: rainfall that has already fallen, and for potential rainfall (or expected rainfall). Decisions can be made on the basis of known events and *what if* scenarios. The Water Management Section prepares forecasts and receives the official forecasts from the SERFC.

a. Requirements. Accurate flood forecasting requires a knowledge of antecedent conditions, rainfall and runoff that has occurred, and tables or unit hydrographs to apply the runoff to existing flow conditions. Predictive QPF data are needed for reviewing what if scenarios. Six-hour unit hydrographs for several sub-basins around the Carters Project are shown on Plate 6-1. The historical data for inflow, outflow, and pool curves for Carters Lake from July 1975 through December 2010 are shown on Plates 6-2 through 6-7.

b. Methods. In determining the expected inflow into the Carters Lake, it is necessary to forecast the flows of the Coosawattee River above Carters Dam. Runoff or rainfall excess for the area is estimated using the seasonal correlation values shown in Table 6-1, depending on antecedent conditions. For very dry conditions, initial runoff can be near zero and then increase as rainfall continues. During wet conditions, most of the rainfall appears as runoff into the lake. The rainfall excess is distributed over the area by using the unit hydrograph shown in Table 6-2. During the next several hours and days, the observed inflow is compared to the forecasts and adjustments are applied. Additional rainfall/runoff is accumulated with the continuing forecasts.

The Corps provides a link to the NWS website so that the Water Management Section, the affected county emergency management officials, and the public can obtain this vital information in a timely fashion. When hydrologic conditions exist so that all or portions of the ACT Basin are considered to be flooding, existing Corps streamflow and short and long-range forecasting runoff models are run on a more frequent, as-needed basis. Experience demonstrates that the sooner a significant flood event can be recognized and the appropriate release of flows scheduled, an improvement in overall flood risk management can be achieved. Stored storm water that has accumulated from significant rainfall events must be evacuated following the event and as downstream conditions permit to provide effective flood risk management. Flood risk management carries the highest priority during significant runoff events that pose a threat to human health and safety. The accumulation and evacuation of storage for the authorized purpose of flood risk management is accomplished in a manner that will prevent, insofar as possible, flows exceeding those which will cause flood damage downstream. During periods of significant basin flooding, the frequency of contacts between the Water Management Section and SERFC staff are increased to allow a complete interchange of available data upon which the most reliable forecasts and subsequent project regulation can be based.

Carters is located about 72 river miles above the primary damage points at Rome, Georgia, and 17.9 river miles above Resaca, Georgia. The forecasting procedure requires routing Carters releases and adding the local runoff at Rome, and Resaca, Georgia. Forecasting stage at Rome, Georgia, is further complicated by being located at the junction of the Etowah and Oostanaula Rivers. Flood events lasting several days produce double flood peaks, and at times, the two rivers are at different water surface elevations. The first peak at Rome, Georgia, is a result of runoff in the Etowah River Basin. Allatoona Lake controls runoff from 1,122 square miles or about 61 percent of the Etowah River Basin. Releases from the Allatoona project take approximately 18 hours to reach Rome, Georgia. The area above Carters Lake is 374 square miles or about 17 percent of the Oostanaula River Basin. Releases from Carters take about 36 hours to reach Rome, Georgia. Releases from Carters are typically timed until after the first peak at Rome from the Etowah River has receded.

In determining the expected inflow into Carters Lake, current conditions must be examined. The runoff from rainfall varies significantly depending on antecedent conditions. For very dry conditions, initial runoff can be near zero and then increase as rainfall continues. During wet conditions, most of the rainfall appears as runoff into the lake. During the next several hours and days, the observed inflow is compared to the forecasts and adjustments are applied. Additional rainfall/runoff is accumulated with the continuing forecasts. Table 6-1 and Figure 6-1 are used as a guide to estimate runoff and its impact on Carters Lake. This runoff value is applied to the unit hydrograph in Table 6-2 and added to the present inflow. Table 6-2 presents unit hydrographs for Carters Dam, Carters Reregulation Dam, Redbud, Tilton, Resaca, and flows from the Oostanaula River at Rome. Outflow from the Carters project is determined at the Reregulation Dam. A combination of local flows, generation, and pump-back determines the outflow from the Reregulation Dam. During the next several hours and days, the observed inflow is compared to the forecasts and adjustments are applied. Additional rainfall/runoff is accumulated with the continuing forecasts.

Table 6-1. Rainfall - Runoff Relationship for Basin Above Rome, Georgia

		Runoff - Etowah Basin							**Runoff - Oostanaula Basin**				
	Rainfall	0	0.20	0.4	0.6	0.8		**Rainfall**	0	0.2	0.4	0.6	0.8
Wet condition	0	0.00	0.10	0.30	0.05	0.08		0	0.00	0.04	0.90	0.15	0.21
	1	0.12	0.16	0.20	0.24	0.30		1	0.28	0.36	0.44	0.54	0.64
	2	0.37	0.44	0.51	0.58	0.66		2	0.74	0.84	0.96	1.08	1.22
	3	0.75	0.84	0.53	1.02	1.14		3	1.37	1.52	1.67	1.81	1.97
	4	1.27	1.44	1.62	1.80	1.98		4	2.12	2.27	2.41	2.56	2.71
	5	2.16	2.34	2.52	2.70	2.88		5	2.85	3.00	3.15	3.30	3.45
	6	3.06	3.26	3.46	3.66	3.86		6	3.60	3.75	3.89	4.04	4.19
Normal condition	0	0.00	0.01	0.02	0.04	0.06		0	0.00	0.03	0.06	0.08	0.11
	1	0.08	0.10	0.13	0.16	0.20		1	0.14	0.18	0.22	0.26	0.30
	2	0.24	0.30	0.36	0.42	0.47		2	0.36	0.40	0.44	0.50	0.58
	3	0.53	0.59	0.67	0.72	0.77		3	0.65	0.73	0.81	0.90	0.98
	4	0.83	0.90	0.97	1.05	1.14		4	1.07	1.14	1.21	1.29	1.38
	5	1.22	1.32	1.43	1.56	1.68		5	1.46	1.56	1.67	1.80	1.92
	6	1.80	1.94	2.08	2.22	2.36		6	2.04	2.18	2.32	2.48	2.60
Dry condition	0	0.00	0.00	0.01	0.02	0.04		0	0.00	0.02	0.04	0.05	0.06
	1	0.05	0.07	0.08	0.09	0.11		1	0.08	0.10	0.12	0.14	0.16
	2	0.13	0.15	0.18	0.20	0.23		2	0.18	0.20	0.23	0.27	0.32
	3	0.25	0.28	0.31	0.34	0.37		3	0.36	0.44	0.50	0.57	0.64
	4	0.40	0.43	0.46	0.49	0.52		4	0.72	0.80	0.88	0.96	1.04
	5	0.56	0.60	0.64	0.69	0.75		5	1.12	1.20	1.29	1.37	1.45
	6	0.82	0.90	0.98	1.06	1.14		6	1.54	1.60	1.70	1.76	1.86

Table 6-2. 6-hour Unit Hydrographs in Oostanaula River Basin

6-hour unit hydrographs in Etowah River Basin						
	Coosawattee River			Conasauga - Oostanaula Rivers		
	Carters Main Dam	Carters Reregulation Dam	Redbud	Tilton	Resaca	Rome
Area between gages (square miles)	376	154	335	682	72	510
Time in hours	Flow in cfs					
6	1740	960	2470	190	1810	820
12	5900	3100	7740	690	2800	2170
18	9050	4190	9830	1360	1500	4200
24	8260	3290	7090	2120	780	6400
30	5530	1990	3940	2910	400	8040
36	3550	1200	2190	3710	210	8160
42	2280	720	1220	44'60	110	6990
48	1470	440	680	5050	60	5390
54	940	260	380	5420	30	3880
60	610	160	210	5590		2720
66	390	100	120	5560		1920
72	250	60		5300		1370
78	160	40		4730		990
84	100			4020		720
90				3410		520
96				2880		370
102				2440		270
108				2070		200
114				1750		150
120				1480		120
126				1250		90
132				1060		60
138				900		30
144				760		
150				640		
156				550		
162				460		
168				390		
174				330		
180				280		
186				240		
192				210		
198				180		
204				150		
210				120		
216				100		
222				80		
228				60		

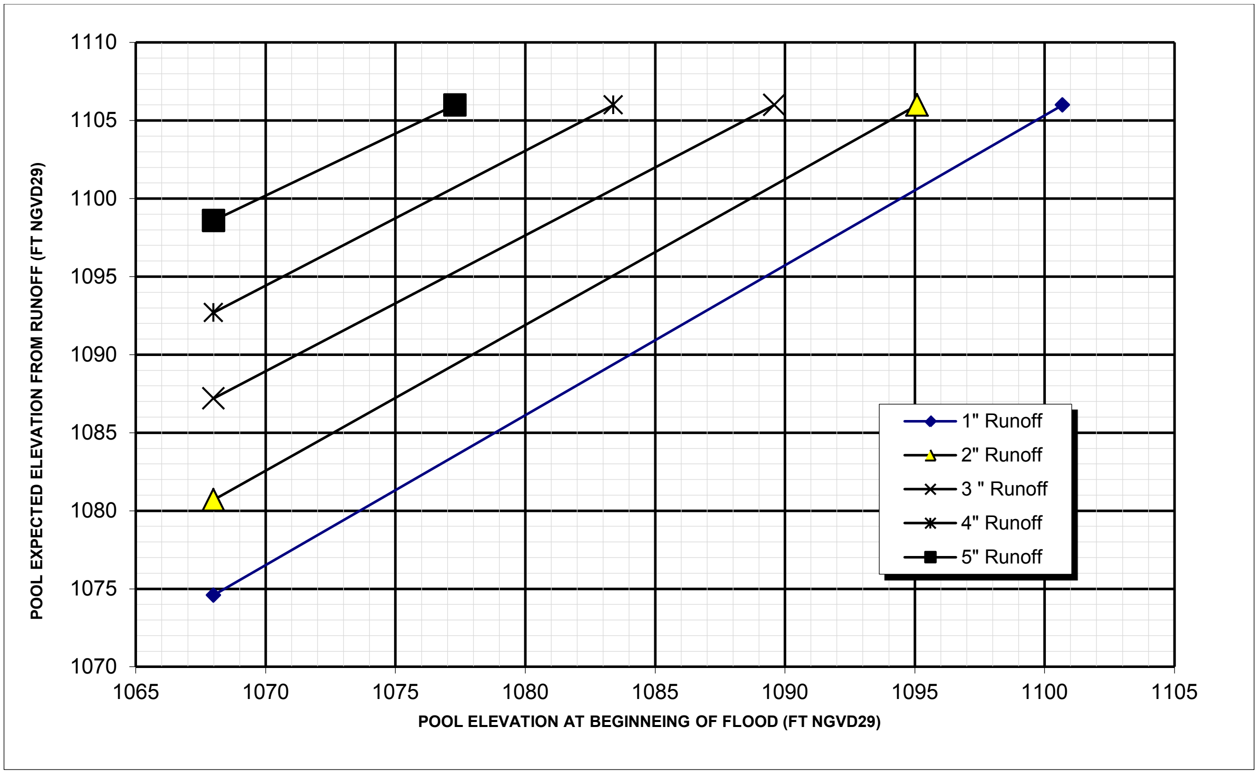


Figure 6-1. Rainfall Runoff versus Expected Pool Elevation

c. Downstream Forecasts. In addition to locations below Carters Dam, it is important to know conditions in the Etowah River Basin. Table 6-3 presents unit hydrographs for the Allatoona Dam, Cartersville, Kingston, and Etowah River at Rome. The values from Table 6-3 can be applied to the Rainfall - Runoff Relationship from Table 6-1.

6-03. Conservation Purpose Forecasts. Forecasts for conservation operations are accomplished similarly to flood condition forecasts.

a. Requirements. Conservation requirements are the same as for flood conditions with the added need to respond to the basin-wide drought plan. Existing basin conditions and expected inflows are needed for meeting the Water Control Plan.

b. Methods. The Water Management Section prepares five-week inflow and lake elevation forecasts weekly based on estimates of rainfall and historical observed data in the basin. These projections assist in maintaining system balance and providing project staff and the public lake level trends based on the current hydrology and operational goals of the period. In addition, the Water Management Section provides weekly hydropower generation forecasts based on current power plant capacity, latest hydrological conditions, and system water availability.

6-04. Long-Range Forecasts. During normal conditions, the long-range outlook produced by the Corps is a five-week forecast. For normal operating conditions, a forecast longer than that incorporates a greater level of uncertainty and less reliability. In extreme conditions, three-month and six-month forecasts can be produced on the basis of observed hydrology and comparative percentage hydrology inflows into the ACT Basin. One-month and three-month outlooks for temperature and precipitation produced by the NWS Climate Prediction Center are used in long-range planning for prudent water management of the ACT System.

Table 6-3. 6-hour Unit Hydrographs in Etowah River Basin

6-hour unit hydrographs in Etowah River basin				
	Allatoona	Cartersville	Kingston	Rome
Area between gages (square miles)	1110	230	290	180
Time in hours	Flow in cfs			
6	15600	2600	1660	2860
12	20000	4370	5110	5550
18	17000	3640	6340	4320
24	14000	3400	4980	2610
30	11400	2920	3620	1580
36	9100	2300	2620	960
42	7100	1760	1900	570
48	5550	1320	1380	350
54	4300	920	1000	210
60	3400	600	730	130
66	2600	360	530	80
72	2100	240	380	40
78	1700	160	280	
84	1350	100	200	
90	1000	40	150	
96	800	10	110	
102	600		80	
108	500		60	
114	400			
120	300			
126	200			
132	150			
138	100			
144	70			
150	50			
156	20			

6-05. Drought Forecast.

a. Requirements. Engineering Regulation (ER) 1110-2-1941, Drought Contingency Plans, dated 15 September 1981, called for developing drought contingency plans for all Corps' reservoirs. Drought recognition and drought forecast information can be used in conjunction with the drought contingency plan.

b. Methods. Various products are used to detect the extent and severity of basin drought conditions. One key indicator is the U.S. Drought Monitor. The Palmer Drought Severity Index is also used as a drought reference. However, the index requires detailed data and cannot reflect an operation of a reservoir system. The Alabama Office of State Climatologist also produces a Lawn and Garden Index which gives a basin-wide ability to determine the extent and severity of drought. The runoff forecasts developed for both short and long-range time periods reflect drought conditions when appropriate. There is also a heavy reliance on latest ENSO (El Niño/La Niña-Southern Oscillation) forecast modeling to represent the potential impacts of La Nina on drought conditions and spring inflows. Long-range models are used with greater frequency during drought conditions to forecast potential impacts to reservoir elevations, ability to meet minimum flows, and water supply availability. A long-term, numerical model, Extended Streamflow Prediction developed by the NWS, provides probabilistic forecasts of streamflow on the basis of climatic, streamflow, and soil moisture. Extended Streamflow Prediction results are used in projecting possible future drought conditions. Other parameters and models can indicate a lack of rainfall and runoff and the degree of severity and continuance of a drought. Models using data of previous droughts or a percent of current to mean monthly flows with several operational schemes have proven helpful in planning. Other parameters are the ability of Carters Lake to meet the demands placed on its storage, the probability that Carters Lake pool elevation will return to normal seasonal levels, the conditions at other basin impoundments, basin streamflows, basin groundwater table levels, and the total available storage to meet hydropower marketing system demands.

c. Reference Documents. The drought contingency plan for the Carters Project is summarized in Section 7-12 below. The complete ACT Drought Contingency Plan is provided in the *Master Water Control Manual for the ACT River Basin, Exhibit C*.

VII - WATER CONTROL PLAN

7.01. General Objectives. Carters Project is a multipurpose project authorized for flood risk management, hydropower, recreation, fish and wildlife, navigation, water quality, and water supply. The Carters Reservoir is a pumped-storage peaking facility. The Reregulation Dam serves three purposes: as a lower pool for the pumped storage operation, to reregulate peaking flows from Carters Lake to provide a more stable downstream flow, and to temporarily provide flood storage between elevation 677 to 696 feet NGVD29. The regulation plan seeks to balance the needs of all project purposes at the Carters Project and at other projects in the ACT Basin and is intended for use in day-to-day, real-time water management decision making and for training new personnel.

7-02. Constraints. The most significant problems at the project involve the swelling and fracturing of the concrete used in construction of the Reregulation Dam, which is caused by alkali aggregate reaction (AAR). Because of the AAR, cracking and displacement of the bridge across the Reregulation Dam spillway has resulted in weakening of the bridge to the degree that it is considered no longer safe to withstand the weight of the crane used to place stoplogs on the upstream face. However, under the American Recovery and Reinvestment Act of 2009, temporary repairs were made to the bridge to allow for a crane to be able to place the stoplogs.

Displacement of the abutment and intermediate pier at monolith D9 has resulted in the inability to raise gate number 4 fully. Operation of the gate is limited because there was difficulty in the past closing the gate once it was opened. Further efforts are currently underway to allow for full opening of all gates. This is considered a temporary problem.

In addition, pumping will discontinue when the reregulation dam pool falls below elevation 677 feet NGVD29 or to the minimum elevation necessary to maintain the constant discharge downstream to insure an orderly and timely evacuation of stored flood waters.

Whenever the power head reaches 395 feet excessive vibration occurs in the hydropower units and pumping must be discontinued unless the reregulation pool is over 690 feet NGVD29, then the maximum head is 397 feet.

7-03. Overall Plan for Water Control

a. General Regulation. The water control regulation of the Carters project is in accordance with the regulation schedule as outlined in the following paragraphs. The Corps regulates the Carters main reservoir and reregulation pool to provide for the authorized project purposes of the project. All authorized project purposes are considered when making water control regulation decisions, and those decisions affect how water is stored and released from the project. Deviations from the prescribed water control plan, which can occur due to planned or unplanned events as described in Section 7-15, will be at the direction of the Water Management Section. Additionally, if communication between the District office and the dam is interrupted, the operator will follow an emergency operation schedule, Exhibit C *Instructions to the Damtenders for Water Control*. The Reregulation Dam provides a minimum continuous flow of 240 cfs to the Coosawattee River.

b. Conservation Pool. The Carters Lake conservation storage pool was designed to provide the necessary capacity to store water for subsequent use to meet the multiple conservation purposes for which the project was constructed. The conservation pool elevation, shown on Plate 7-1, is the lake's normal maximum operating level for conservation storage purposes. If the elevation is higher than the conservation limit, the lake level is in the flood pool. Area-Capacity Curves for Carters Lake and the reregulation pool, which indicate the amount of storage and the surface area of the lake for the complete range of possible pool elevations, are shown on Plate 7-2 and Plate 7-3.

c. Guide Curves and Action Zones. Multiple project purposes and water demands in the basin require that the Corps regulate the use of conservation storage in a balanced manner in an attempt to meet all authorized purposes, while continuously monitoring the climatological conditions to ensure that project purposes can at least be minimally satisfied during critical drought periods. The balanced water management strategy for Carters does not prioritize any project function but seeks to balance all project authorized purposes. A seasonal conservation pool regulation guide curve and conservation storage action zones have been developed to guide the water control management decisions in meeting the balanced strategy. Table 7-1 provides key elevations of the top of conservation pool and action zones. The action zones are shown on Plate 7-1.

1) A regulation guide curve for the Carters main pool has been prescribed to facilitate the water control regulation of the project. The guide curve defines the seasonal top of conservation storage water surface elevation. Water management operational decisions strive to maintain the pool elevation at the top of conservation elevation or at the highest elevation possible while meeting project purposes. Normally, the pool elevation will be lower than the guide curve as available conservation storage is utilized to meet project purposes except when storing flood waters or during conservative lake level regulation when drought conditions exist within the project watershed. Carters Lake is regulated between the minimum year-round conservation pool elevation of 1,072 feet NGVD29 and a seasonal maximum conservation pool elevation of 1,074 feet NGVD29 during 1 May to 1 October and 1,072 feet NGVD29 from 15 October to 15 April, with two week transition periods in April and October. The normal year-round operating range for the reregulation pool is 677 to 696 feet NGVD29.

2) The water control plan also establishes action zones within the conservation storage pool. The action zones are used to manage the lake at the highest level possible within the conservation storage pool while balancing the needs of all authorized purposes with water conservation as a national priority used as a guideline. Carters Lake conservation pool includes two action zones. These zones are used as a general guide to determine the minimum discharge release available from the Reregulation Dam. The action zones were based on the general ability of the project to meet seasonal environmental flows below the Reregulation Dam. Other factors or activities might cause the lakes to operate differently than the action zones described. Examples of the factors or activities include exceptional flood damage reduction measures; fish spawn operations; maintenance and repair of turbines; emergency situations such as a drowning or chemical spill; draw-downs because of shoreline maintenance; drought recovery; increased or decreased hydropower demand; and other circumstances. Carters Project is unique from other Mobile District projects in that the main dam pool level or zone does not often determine the hours of daily hydropower generation. This is due to the pumping capabilities from the Reregulation Dam. The following provides a general description of each zone.

Zone 1: Hydrologic conditions are likely to be normal to wetter than normal. Within Zone 1, a seasonally variable release will be made from the Reregulation Dam as shown in Figure 7-1.

Zone 2: Hydrologic conditions are likely to indicate severe drought conditions. Careful, long range analyses and projections of inflows, pool levels, and upstream and downstream water needs will be made when pool levels are in Zone 2. The seasonally-varying minimum flow is suspended, and a continuous minimum flow of 240 cfs is released from the Reregulation Dam.

Table 7-1. Top of Conservation and Action Zone Table for Carters Lake

Date	Elevation (ft NGVD29)	
	Top of Conservation	Top of Zone 2
1 Jan	1,072	1,066
1 Apr	1,072	1,070
15 Apr	1,072	1,070.5
1 May	1,074	1,071
1 Oct	1,074	1,070
15 Oct	1,072	1,066
31 Dec	1,072	1,066

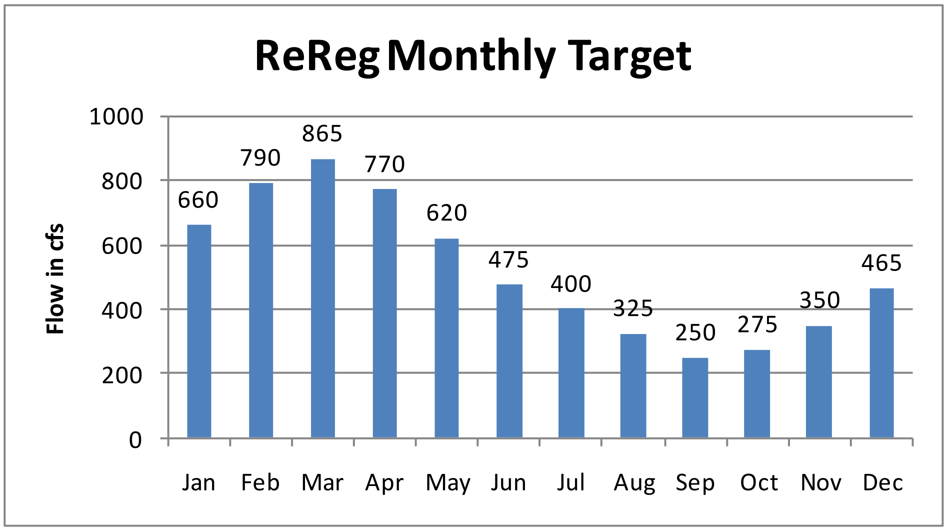


Figure 7-1. Seasonal Reregulation Dam Releases

1) Normal Operations. Under normal flow conditions the main reservoir level is controlled by discharges through the generators. The Carters Project is operated by the "balance point method" to account for the composite storage in the Main Dam and Reregulation Dam. When the Main Dam and Reregulation Dam pools are "balanced", there is just enough water in the reregulation dam pool between its present elevation and elevation 677 feet NGVD29 to allow the pumping units to restore the main reservoir to the top of conservation pool. In a balanced state it would be necessary to release all inflows into the project through the Reregulation Dam to maintain balance.

2) Reregulation Dam. The normal year-round operating range for the reregulation dam pool is 677 to 696 feet NGVD29. The pool level is managed by releases through the Reregulation Dam gates. Gate discharge capabilities are shown on Table 7-2. Pumping ceases below

elevation 677 feet NGVD29 but the storage between elevations 674 to 677 feet NGVD29 is available to provide a minimum flow of 240 cfs downstream over a three-day period. Whenever the power head reaches 395 feet excessive vibration occurs in the hydropower units and pumping must be discontinued unless the reregulation pool is over 690 feet NGVD29, then the maximum head is 397 feet. Reductions in Reregulation Dam releases should not exceed 200 cfs in any six-hour period to mitigate erosion along the stream banks of farmlands downstream.

Table 7-2. Carters Reregulation Dam – Spillway Discharge Table

STEP NO.	GATE NUMBER				POOL ELEVATION																													
	1	2	3	4	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699
	GATE OPENING (FEET)				DISCHARGE (CFS)																													
1	0.00	0.05	0.00	0.00	16	17	18	19	20	21	21	22	23	24	24	25	26	27	27	28	28	29	30	30	31	31	32	32	33	34	34	35	35	36
2	0.00	0.10	0.00	0.00	32	34	36	38	40	42	43	45	47	48	50	51	52	54	55	56	57	59	60	61	62	63	64	66	67	68	69	70	71	72
3	0.00	0.15	0.00	0.00	49	52	55	58	60	63	66	68	70	73	75	77	79	81	83	85	87	89	90	92	94	96	97	99	100	102	104	105	107	108
4	0.00	0.20	0.00	0.00	65	70	74	77	81	84	88	91	94	97	100	103	106	108	111	113	116	118	121	123	126	128	130	132	134	136	139	141	143	145
5	0.00	0.25	0.00	0.00	93	99	104	110	115	120	125	129	134	138	142	146	150	154	158	161	165	168	172	175	178	181	185	188	191	194	197	200	203	205
6	0.00	0.30	0.00	0.00	140	150	158	166	174	182	189	196	202	209	215	221	227	233	238	244	249	255	260	265	270	275	280	284	289	293	298	302	307	311
7	0.00	0.35	0.00	0.00	154	164	176	182	190	199	206	214	221	228	235	242	248	255	261	267	273	278	284	290	295	300	306	311	316	321	326	330	335	340
8	0.00	0.40	0.00	0.00	186	198	209	220	230	240	249	258	267	276	284	292	300	308	315	322	329	336	343	350	356	363	369	375	381	388	393	399	405	411
9	0.00	0.45	0.00	0.00	224	239	252	265	278	290	301	312	323	333	353	353	362	371	380	389	398	406	414	422	430	438	446	453	461	468	475	482	489	496
10	0.00	0.50	0.00	0.00	264	281	297	312	327	341	354	367	380	392	404	415	426	437	448	458	468	478	488	497	507	516	525	534	542	551	559	568	576	584
11	0.00	0.55	0.00	0.00	281	299	316	332	348	363	377	391	404	417	430	442	454	465	477	488	498	509	519	529	539	549	559	568	577	586	595	604	613	621
12	0.00	0.60	0.00	0.00	309	329	348	366	384	400	416	431	446	460	474	487	500	513	525	529	549	561	572	584	594	605	616	626	636	646	656	666	676	685
13	0.00	0.65	0.00	0.00	361	334	407	428	448	467	485	503	520	537	553	569	584	599	613	627	641	655	668	684	694	706	719	731	743	754	766	777	788	799
14	0.00	0.70	0.00	0.00	384	409	433	455	476	497	516	535	553	571	588	605	621	637	625	667	682	696	711	724	738	751	764	777	790	802	815	827	839	851
15	0.00	0.75	0.00	0.00	421	449	474	499	522	545	566	587	607	627	645	664	681	699	716	732	748	764	780	795	810	824	839	853	867	880	894	907	920	933
16	0.00	0.80	0.00	0.00	436	464	491	516	541	564	586	608	628	648	668	687	705	723	741	758	774	791	807	822	838	853	868	883	897	911	925	939	952	966
17	0.00	0.85	0.00	0.00	567	604	639	672	703	733	762	790	817	843	869	893	917	940	963	985	1007	1028	1049	1070	1090	1110	1129	1148	1167	1185	1203	1221	1239	1256
18	0.00	0.90	0.00	0.00	586	624	661	695	727	759	789	818	845	872	899	924	949	973	997	1020	1042	1064	1086	1107	1128	1148	1163	1188	1207	1226	1245	1264	1282	1300
19	0.00	0.95	0.00	0.00	604	644	681	717	750	782	813	843	872	900	927	953	979	1004	1028	1052	1075	1098	1120	1142	1163	1184	1205	1225	1245	1265	1284	1303	1322	1341
20	0.00	1.00	0.00	0.00	622	663	701	738	772	805	837	868	898	926	954	981	1007	1033	1058	1083	1106	1130	1153	1175	1197	1219	1240	1261	1282	1302	1322	1342	1361	1380
21	0.00	1.00	0.05	0.00	644	687	726	764	800	834	867	899	930	959	988	1016	1044	1070	1096	1121	1146	1170	1194	1218	1240	1263	1285	1307	1328	1349	1370	1390	1410	1430
22	0.00	1.00	0.10	0.00	666	709	751	790	827	862	896	929	961	992	1022	1050	1079	1106	1133	1159	1185	1210	1234	1258	1282	1305	1328	1351	1373	1394	1416	1437	1457	1478
23	0.00	1.00	0.15	0.00	720	768	812	854	892	933	970	1006	1040	1073	1106	1137	1167	1197	1226	1255	1282	1309	1336	1362	1388	1413	1437	1462	1486	1509	1532	1555	1577	1600
24	0.00	1.00	0.20	0.00	742	791	837	880	922	962	1000	1036	1072	1106	1139	1172	1203	1234	1264	1293	1322	1349	1377	1404	1430	1456	1481	1506	1531	1555	1579	1603	1626	1649
25	0.00	1.00	0.25	0.00	775	826	874	920	963	1004	1044	1083	1120	1155	1190	1224	1257	1289	1320	1341	1381	1410	1438	1467	1494	1521	1548	1574	1600	1625	1650	1674	1698	1722
26	0.00	1.00	0.30	0.00	810	863	914	961	1006	1050	1091	1131	1170	1208	1244	1279	1314	1347	1380	1412	1443	1474	1503	1533	1562	1590	1618	1645	1672	1698	1724	1750	1775	1800
27	0.00	1.00	0.35	0.00	813	871	922	970	1016	1059	1101	1142	1181	1219	1255	1291	1326	1360	1393	1425	1456	1487	1517	1547	1576	1605	1633	1660	1687	1714	1740	1766	1792	1817
28	0.00	1.00	0.40	0.00	823	877	928	976	1022	1066	1109	1150	1189	1227	1264	1300	1335	1369	1402	1434	1466	1497	1528	1558	1587	1616	1644	1672	1699	1726	1752	1778	1804	1829
29	0.00	1.00	0.45	0.00	827	882	933	981	1028	1072	1115	1156	1195	1233	1271	1307	1342	1376	1409	1442	1474	1505	1536	1566	1595	1624	1653	1680	1708	1735	1765	1788	1814	1839
30	0.00	1.00	0.50	0.00	902	961	1017	1070	1121	1169	1215	1260	1303	1345	1386	1425	1463	1501	1537	1573	1607	1642	1675	1708	1740	1771	1802	1833	1863	1892	1921	1950	1978	2006
31	0.00	1.00	0.55	0.00	927	989	1046	1101	1153	1202	1250	1296	1341	1384	1425	1466	1505	1544	1581	1618	1654	1689	1723	1757	1790	1822	1854	1885	1916	1946	1976	2006	2035	2063
32	0.00	1.00	0.60	0.00	953	1016	1075	1132	1185	1236	1285	1333	1378	1422	1465	1507	1548	1587	1626	1663	1700	1736	1771	1806	1840	1873	1906	1938	1970	2001	2032	2062	2092	2121
33	0.00	1.00	0.65	0.00	980	1044	1105	1163	1218	1270	1321	1369	1416	1462	1506	1549	1591	1631	1671	1709	1747	1784	1821	1856	1891	1925	1959	1992	2025	2057	2088	2120	2150	2180
34	0.00	1.00	0.70	0.00	997	1063	1125	1183	1239	1293	1344	1394	1442	1488	1533	1576	1619	1660	1701	1740	1779	1816	1853	1889	1925	1960	1994	2028	2061	2094	2126	2158	2189	2219
35	0.00	1.00	0.75	0.00	1010	1077	1140	1199	1256	1310	1362	1412	1461	1508	1553	1598	1641	1683	1723	1763	1802	1841	1878	1915	1951	1986	2021	2055	2089	2122	2154	2187	2218	2249

Table 7-2 (Cont). Carters Reregulation Dam – Spillway Discharge Table

STEP NO.	GATE NUMBER 1	2	3	4	POOL ELEVATION 670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699
	GATE OPENING (FEET)				DISCHARGE (CFS)																													
36	0.00	1.00	0.80	0.00	1028	1096	1160	1220	1278	1333	1386	1438	1487	1535	1581	1626	1670	1712	1754	1795	1834	1873	1912	1949	1986	2022	2057	2092	2126	2160	2193	2226	2258	2289
37	0.00	1.00	0.85	0.00	1048	1118	1183	1245	1304	1360	1415	1467	1517	1566	1613	1659	1704	1747	1790	1831	1872	1912	1950	1989	2026	2063	2099	2134	2169	2204	2238	2271	2304	2336
38	0.00	1.00	0.90	0.00	1118	1192	1261	1327	1390	1450	1508	1564	1617	1669	1720	1769	1816	1863	1908	1952	1996	2038	2080	2120	2160	2199	2238	2276	2313	2350	2386	2421	2456	2491
39	0.00	1.00	0.95	0.00	1140	1215	1286	1353	1418	1479	1538	1595	1649	1702	1754	1804	1852	1900	1946	1991	2035	2078	2121	2162	2203	2243	2282	2321	2359	2396	2433	2469	2505	2540
40	0.00	1.00	1.00	0.00	1161	1238	1310	1379	1444	1507	1567	1625	1681	1735	1787	1838	1888	1936	1983	2029	2074	2118	2161	2204	2245	2286	2326	2365	2404	2442	2480	2516	2553	2589
41	0.25	1.00	1.00	0.00	1271	1356	1435	1510	1582	1651	1717	1780	1842	1901	1958	2014	2069	2122	2173	2224	2273	2322	2369	2415	2461	2506	2550	2593	2635	2677	2718	2759	2799	2838
42	0.25	1.00	1.00	0.25	1428	1523	1613	1697	1778	1856	1930	2001	2070	2137	2202	2265	2326	2386	2444	2501	2556	2611	2664	2716	2767	2818	2867	2916	2964	3011	3057	3103	3148	3192
43	0.50	1.00	1.00	0.25	1532	1634	1731	1822	1909	1992	2072	2149	2223	2295	2365	2432	2498	2562	2625	2686	2746	2804	2862	2918	2973	3027	3080	3132	3184	3234	3284	3333	3382	3429
44	0.50	1.00	1.00	0.50	1727	1843	1952	2056	2154	2248	2338	2425	2509	2590	2669	2746	2820	2893	2963	3032	3100	3166	3231	3294	3356	3418	3478	3537	3595	3652	3708	3764	3818	3872
45	0.75	1.00	1.00	0.50	1806	1928	2042	2150	2254	2352	2447	2538	2626	2711	2794	2871	2952	3028	3102	3174	3245	3314	3382	3449	3514	3578	3641	3703	3764	3823	3882	3940	3998	4054
46	0.75	1.00	1.00	0.75	1925	2055	2177	2293	2403	2509	2610	2707	2801	2892	2980	3066	3149	3230	3309	3387	3462	3536	3609	3680	3749	3818	3885	3951	4016	4080	4143	4205	4266	4326
47	1.00	1.00	1.00	0.75	2142	2288	2424	2554	2677	2794	2907	3016	3121	3222	3321	3416	3509	3600	3688	3774	3858	3941	4022	4101	4179	4255	4330	4404	4476	4548	4618	4687	4755	4822
48	1.00	1.00	1.00	1.00	2328	2486	2635	2776	2910	3038	3161	3279	3393	3504	3611	3715	3816	3915	4011	4105	4197	4287	4375	4461	4546	4629	4710	4791	4869	4947	5024	5099	5173	5246
49	1.25	1.00	1.00	1.00	2469	2637	2796	2946	3088	3225	3355	3481	3603	3720	3834	3945	4052	4157	4259	4359	4646	4552	4646	4828	4828	4916	5003	5088	5172	5254	5336	5416	5494	5572
50	1.25	1.25	1.00	1.00	2610	2783	2956	3115	3266	3411	3549	3683	3812	3936	4057	4174	4288	4399	4507	4613	4917	4818	4917	5109	5109	5203	5295	5385	5474	5561	5647	5732	5816	5898
51	1.25	1.25	1.25	1.00	2750	2939	3116	3284	3444	3597	3743	3884	4020	4152	4279	4403	4523	4641	4755	4867	5187	5083	5187	5391	5391	5489	5587	5682	5776	5868	5959	6048	6137	6224
52	1.25	1.25	1.25	1.25	2890	3089	3276	3453	3621	3782	3936	4085	4228	4367	4501	4632	4758	4882	5002	5120	5458	5348	5458	5672	5672	5776	5878	5979	6077	6175	6270	6365	6457	6549
53	1.50	1.25	1.25	1.25	3029	3238	3435	3621	3798	3967	4129	4285	4436	4582	4723	4860	4993	5123	5249	5373	5728	5612	5728	5953	5953	6062	6169	6275	6379	6481	6581	6680	6778	6874
54	1.50	1.50	1.25	1.25	3168	3387	3594	3789	3975	4152	4322	4486	4644	4796	4944	5088	5228	5364	5496	5626	5998	5876	5998	6233	6233	6348	6461	6571	6680	6787	6892	6996	7098	7199
55	1.50	1.50	1.50	1.25	3306	3536	3752	3956	4151	4336	4514	4685	4851	5010	5165	5315	5462	5604	5743	5878	6267	6140	6267	6514	6514	6634	6751	6867	6981	7093	7203	7311	7413	7524
56	1.50	1.50	1.50	1.50	3443	3684	3910	4123	4326	4520	4706	4885	5057	5224	5386	5543	5695	5844	5989	6131	6537	6404	6537	6794	6794	6919	7042	7163	7281	7698	7513	7627	7738	7848
57	1.75	1.50	1.50	1.50	3581	3832	4167	4290	4502	4704	4898	5084	5264	5438	5606	5770	5929	6084	6235	6382	6806	6668	6806	7074	7074	7204	7332	7458	7582	7704	7823	7942	8058	8173
58	1.75	1.75	1.50	1.50	3717	3979	4224	4456	4676	4887	5089	5283	5470	5651	5826	5997	6162	6323	6481	6634	7075	6931	7075	7354	7354	7489	7622	7753	7882	8009	8133	8256	8377	8497
59	1.75	1.75	1.75	1.50	3853	4125	4381	4622	4851	5070	5279	5481	5676	5864	6046	6223	6395	6563	6726	6885	7343	7194	7343	7633	7633	7774	7912	8048	8182	8314	8443	8571	8696	8820
60	1.75	1.75	1.75	1.75	3989	4272	4537	4787	5025	5252	5470	5679	5881	6076	6266	6449	6628	6801	6971	7136	7611	7456	7611	7912	7912	8058	8202	8343	8482	8618	8753	8885	9015	9144
61	2.00	1.75	1.75	1.75	4124	4417	4692	4952	5199	5434	5660	5877	6086	6289	6485	6675	6860	7040	7216	7387	7879	7719	7879	8191	8191	8342	8491	8637	8781	8923	9062	9199	9334	9467
62	2.00	2.00	1.75	1.75	4259	4562	4847	5116	5372	5616	5849	6074	6291	6500	6703	6900	7092	7278	7460	7638	8147	7981	8147	8470	8470	8626	8780	8932	9080	9227	9371	9513	9353	9790
63	2.00	2.00	2.00	1.75	4393	4707	5002	5280	5545	5797	6039	6271	6495	6712	6922	7125	7324	7516	7704	7888	8414	8243	8414	8748	8748	8910	9069	9226	9379	9531	9680	9826	9971	10113
64	2.00	2.00	2.00	2.00	4526	4851	5156	5444	5717	5978	6227	6468	6699	6923	7140	7350	7555	7754	7948	8138	8682	8504	8682	9026	9026	9193	9358	9519	9678	9834	9988	10140	10289	10436
65	4.00	2.00	2.00	2.00	5575	5987	6373	6436	7081	7410	7725	8027	8318	8600	8873	9137	9394	9645	9889	10127	10809	10587	10809	11241	11241	11451	11658	11860	12059	12255	12488	12638	12825	13010
66	4.00	4.00	2.00	2.00	6590	7091	7559	8000	8418	8816	9197	9563	9915	10255	10584	10904	11214	11516	11810	12097	12920	12651	12920	13440	13440	13693	13941	14185	14425	14661	14893	15122	15347	15569
67	4.00	4.00	4.00	2.00	7569	8162	8716	9236	9728	10197	10645	11075	11489	11888	12275	12649	13013	13367	13712	14048	15012	14698	15012	15622	15622	15928	16209	16494	16775	17051	17323	17590	17854	18113
68	4.00	4.00	4.00	4.00	8511	9200	9841	10442	11010	11551	12067	12563	13039	13499	13943	14375	14792	15199	15595	15981	17088	16727	17088	17787	17787	18127	18460	18788	19109	19426	19737	20044	20346	20643
69	6.00	4.00	4.00	4.00	9417	10204	10934	11618	12265	12879	13465	14026	14566	15087	15590	16077	16550	17010	17458	17895	19145	18738	19145	19935	19935	20319	20695	21065	21428	21785	22137	22483	22823	23159
70	6.00	6.00	4.00	4.00	10284	11172	11995	12765	13490	14179	14836	15465	16069	16652	17245	17759	18288	18802	19302	19790	21185	20730	21185	22066	22066	22494	22914	23326	23731	24129	24521	24906	25286	25660

Table 7-2 (Cont). Carters Reregulation Dam – Spillway Discharge Table

	GATE NUMBER				POOL ELEVATION																													
STEP NO.	1	2	3	4	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699
	GATE OPENING (FEET)				DISCHARGE (CFS)																													
71	6.00	6.00	6.00	4.00	11112	12105	13023	13880	14687	15452	16181	16879	17549	18194	18817	19420	20005	20573	21126	21665	23207	22705	23207	24180	24180	24652	25116	25571	26018	26457	26889	27315	27734	28146
72	6.00	6.00	6.00	6.00	11900	13002	14017	14964	15855	16698	17500	18267	19004	19713	20397	21059	21701	22324	22930	23521	25211	24660	25211	26277	26277	26794	27301	27799	28288	28769	29242	29708	30166	30618
73	8.00	6.00	6.00	6.00		13860	14977	16016	16992	17915	18792	19630	20434	21208	21954	22676	23375	24054	24715	25358	27196	26598	27196	28356	28356	28913	29470	30011	30543	31066	31580	32086	32584	33075
74	8.00	8.00	6.00	6.00		14681	15902	17036	18099	19103	20057	20968	21840	22679	23488	24270	25028	25764	26479	27175	29164	28516	29164	30418	30418	31029	31622	32207	32782	33347	33902	34449	34987	35516
75	8.00	8.00	8.00	6.00		15461	16791	18022	19175	20262	21294	22278	23221	24126	24999	25843	26659	27452	28222	28972	31113	30416	31113	32462	32462	33116	33757	34386	35004	35611	36208	36796	37374	37943
76	8.00	8.00	8.00	8.00		16201	17642	18975	20220	21392	22504	23563	24576	25549	26487	27393	28269	29119	29945	30749	33043	32297	33043	34488	34488	35189	35875	36549	37210	37860	38499	39128	39746	40355
77	10.00	8.00	8.00	8.00				19893	21232	22492	23684	24820	25906	26948	27951	28919	29857	30765	31648	32506	34955	34158	34955	36497	36497	37244	37976	38695	39400	40093	40774	41444	42103	42752
78	10.00	10.00	8.00	8.00				20775	22212	23561	24836	26050	27209	28321	29391	30423	31422	32390	33329	34243	36849	36001	36849	38488	38488	39282	40060	40824	41573	42309	43033	43744	44444	45134
79	10.00	10.00	10.00	8.00				21624	23158	24598	25959	27252	28486	29669	30807	31904	32965	33992	34990	35959	38723	37824	38723	40461	40461	41302	42127	42936	43729	44509	45275	46029	46770	47500
80	10.00	10.00	10.00	10.00				22430	24070	25604	27052	28426	29737	30992	32198	33361	34485	35573	36629	37655	40578	39628	40578	42415	42415	43305	44176	45031	45869	46693	47502	48298	49081	49851
81	12.00	10.00	10.00	10.00						26578	28115	29572	30960	32289	33565	34795	35982	37132	38247	39330	42414	41412	42414	44352	44352	45289	46208	47109	47992	48860	49713	50551	51376	52187
82	12.00	12.00	10.00	10.00						27519	29147	30688	32156	33560	34907	36204	37456	38668	39843	40984	44231	43176	44231	46270	46270	47256	48222	49169	50098	51011	51907	52788	53655	54507
83	12.00	12.00	12.00	10.00						28756	30147	31775	33324	34804	36223	37589	38907	40182	41417	42617	46029	44920	46029	48169	48169	49205	50219	51213	52188	53145	54085	55009	55918	56812
84	12.00	12.00	12.00	12.00						29299	31116	32832	34464	36021	37514	38949	40334	41673	42970	44228	47807	46644	47807	50050	50050	51135	52198	53239	54260	55262	56247	57214	58166	59102
85	14.00	12.00	12.00	12.00								33859	35575	37211	38779	40282	41737	43141	44500	45319	49565	48348	49565	51913	51913	53047	54158	55217	56315	57363	58392	59403	60397	61375
86	14.00	14.00	12.00	12.00								34855	36657	38374	40017	41596	43116	44585	46008	47387	51303	50032	51303	53456	53756	54941	56101	57238	58353	59446	60520	61575	62613	63633
87	14.00	14.00	14.00	12.00								35819	37709	39508	41229	42881	44471	46007	47493	48934	53022	51695	53022	55580	55580	56816	58026	59211	60373	61513	62632	63731	64812	65875
88	14.00	14.00	14.00	14.00								36752	38731	40614	42414	44140	45801	47404	48965	50458	54720	53337	54720	57385	57385	58673	59933	61166	62376	63562	64727	65871	66996	68102
89	16.00	14.00	14.00	14.00										41692	43571	45373	47107	48778	50394	51960	56398	54958	56398	59171	59171	60511	61821	63104	64361	65595	66805	67994	69163	70312
90	16.00	16.00	14.00	14.00										42740	44701	46580	48387	50128	51810	53440	58055	56559	58055	60938	60938	62330	63691	65023	66329	67610	68866	70101	71314	72506
91	16.00	16.00	16.00	14.00										43758	45803	47761	49641	51453	53203	54897	59692	58138	59692	62685	62685	64129	65542	66924	68279	69607	70911	72190	73448	74684
92	16.00	16.00	16.00	16.00										44747	46877	48914	50870	52753	54571	56331	61308	59695	61308	64412	64415	65910	67374	68807	70211	71587	72938	74263	75566	76846
93	18.50	16.00	16.00	16.00													52369	54343	56248	58091	63298	61612	63298	66544	66544	68109	69638	71135	72601	74038	75447	76831	78190	79526
94	18.50	18.50	16.00	16.00													53826	55894	57887	59815	65256	63494	65256	68644	68644	70277	71873	73434	74962	76460	77930	79372	80788	82180
95	18.50	18.50	18.50	16.00													55242	57404	59488	61501	67180	65342	67180	70712	70712	72414	74077	75703	77295	78855	80385	81886	83360	84808
96	18.50	18.50	18.50	18.50													56614	58874	61049	63150	69070	67154	69070	72749	72749	74521	76251	77943	79599	81222	82812	84373	85905	87411

7-04. _Standing Instructions to Damtender. During normal operations, the powerhouse operators will operate the Carters Project in accordance with the daily hydropower schedule. Any deviation from the schedule must come through the Water Management Section. Normally, flood risk management instructions are issued by the Water Management Section in the Mobile District Office. However, if a storm of flood-producing magnitude occurs and all communications are disrupted between the Mobile District and the powerhouse operators, the operators will follow instructions in Exhibit C, Standing Instructions to the Damtender for Water Control.

7-05. Flood Risk Management. Operation of the Carters Project for flood risk management is in accordance with instructions issued by the Water Management Section in the Mobile District Office, and releases depend on the Carters Main Dam and Reregulation Dam pool levels and forecasted inflows. Flood risk management operations at the Carters Project utilize storage in both the main dam and Reregulation Dam. During flood conditions releases from Carters and Allatoona Projects are coordinated to provide flood protection beginning at the two projects and extending to Rome, Georgia.

The top of flood pool for the main dam is 1,099 feet NGVD29. The induced surcharge schedule will be followed once elevation 1,099 feet NGVD29 is reached. In the event that water must be evacuated from the main dam during a flood (such as during induced surcharge operation), the hydropower units will be used first. Discharge through the emergency spillway or emergency sluice should be considered a last resort due to potential erosion and water quality issues that could arise as a result of their use. Therefore it is extremely important that the hydropower units be consistently available during high inflow periods. The reregulation dam pool is also used for temporary flood storage from elevation 677 to 696 feet NGVD29, with elevation 696 feet NGVD29 allowing a two-foot reaction period, in the case of a fast rising pool, before reaching the maximum storage elevation of 698 feet NGVD29. If the Reregulation Dam pool is forecast to reach elevation 696 feet NGVD29, pumping operations may be used to stabilize the Reregulation Dam pool instead of increasing releases through the Reregulation Dam gates. The maximum total discharge thru the pumpback units is 7,530 cfs at a total head of 385 feet.

The gated spillway for the Carters Reregulation Dam was designed to pass the standard project flood (SPF) of peak inflow 90,400 cfs without the headwater overtopping the dam and without exposing the structures to damage from high velocity flow or undesirable current patterns. The earth dikes have their top elevation at 703 feet NGVD29, which would provide a five-foot freeboard above the maximum reregulation pool level of 698 feet NGVD29. The top of the earth dikes would be subject to overtopping only by floods having a peak inflow about 30 percent great than the SPF (reference Carters Dam, Design Memorandum No. 15, Gated Spillway for Reregulation Dam, dated August 1966).

In flood conditions the balance point method of operation will be discontinued. During the early stages of a flood event, the hydropower generation schedule from main dam and outflows from the Reregulation Dam are planned (on the basis of forecasts) to control, or limit, the peak outflow as the flood develops. The inflow and reservoir levels will be monitored continuously along with stages at the USGS streamgage 02387500 at Resaca on the Oostanaula River, and the USGS streamgage 02388500 near Rome on the Oostanaula River. The Carters Reservoir will be operated to minimize flooding at these gages. The Flood Stage (FS) is established by the NWS River Forecast Center and currently for Resaca gage is 18 feet and Rome gage 25 feet. In order to minimize backwater flooding at Tilton on the Conasauga River, normally, evacuation of flood water from the Carters Project will not be made until after the Conasauga River has peaked at Tilton. Releases will also be coordinated with those from Allatoona to minimize flooding in the Rome area. Normally, evacuation of flood storage from Carters will not occur until the stage at the Rome gage is below FS.

Flood evacuation will normally extend over a period of about one to two weeks, until the pools are within one foot of balance. The normal (non-flood) operating plan will then go into effect. When the Main Dam and Reregulation Dam pools approach the balance point daily power declarations from the main dam and discharges from the Reregulation Dam will be reduced slowly.

It is estimated that a downstream flow below the Reregulation Dam of 3,200 cfs can be maintained during the planting and agricultural growing season without causing appreciable damage in the low-lying areas. A 5,000 cfs flow can be maintained during the non-agricultural growing season without causing appreciable damage to these same areas. Bankfull is defined as 3,200 cfs in the dry season, normally summer and fall, and 5,000 cfs in the wet season, normally winter and spring. Normally, the ramp down rate for reregulation flows is 200 cfs every six hours to mitigate erosion along stream banks of farmlands downstream. However, under certain conditions the Water Management Section in the Mobile District Office may depart from this ramp down rate.

a. Induced Surcharge Schedule. If the main dam pool rises above elevation 1,099 feet NGVD the induced surcharge schedule shown in Table 7-3 will be followed. The Water Management Section could issue other instructions if current forecasts indicate a need. The plan is not dependant on downstream stages at Resaca or Rome, Georgia, but has been developed to provide optimum protection for the integrity of the dam.

The required outflow would be discharged through the turbines up to their capacity, and then any additional discharges required would be made through the emergency gated spillway following the schedule in Table 7-3 and Table 7-4. Discharges through the low-level sluice would be used in addition to the gated spillway only as a last resort. The low level sluice discharge rating is shown in Table 7-5. As of the date of this report, neither the low level sluice nor the emergency gated spillway has ever been used.

The surcharge outflow will be adjusted each hour on the basis of the average inflow for the preceding three hours and the current reservoir elevation. Gate settings will not be reduced as long as the pool is rising. The maximum peak outflow will be maintained until the main pool recedes to 1,099.00 feet NGVD29. Outflow will then be reduced to the inflow or 5,000 cfs, whichever is greater. Once the inflow has dropped to 5,000 cfs or lower, surcharge operations will cease.

Carters Reservoir contains 89,191 acre-feet of flood risk management storage space between pool levels 1,074 and 1,099 feet NGVD29 in which flood water is stored and later released in moderate amounts to prevent downstream flooding. Since the beginning of operations, the maximum one-day inflow was 22,498 cfs which occurred on 16 February 1990. The observed maximum pool elevation was 1,099.16 feet NGVD29 on 8 April 1977.

Table 7-3. Surcharge Schedule for Carters Main Dam

INFLOW IN 1000 CFS (AVERAGE FOR PREVIOUS 3 HOURS)

POOL ELEV (FT NGVD 29)	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**120**	**140**	**160**
					SURCHARGE IN 1000 CFS							
1099.0				5.50	8.10	11.20	15.00	19.00	23.30	33.50	44.90	56.00
1099.1				5.90	8.30	11.40	15.30	19.40	23.70	34.20	45.20	56.40
1099.2				6.00	8.50	11.80	15.60	19.80	24.20	34.60	45.80	57.20
1099.3				6.20	8.90	12.00	16.00	20.20	24.40	35.10	46.30	57.80
1099.4				6.30	9.00	12.20	16.20	20.50	25.00	35.50	46.80	58.20
1099.5				6.40	9.10	12.50	16.50	20.80	25.30	36.00	47.20	58.80
1099.6				6.60	9.30	12.80	16.80	21.20	25.80	36.30	47.90	59.50
1099.7				7.00	9.80	13.10	17.20	21.50	26.20	37.00	48.30	60.20
1099.8				7.20	10.00	13.30	17.40	22.00	26.60	37.30	49.00	60.60
1099.9				7.30	10.20	13.60	17.70	22.30	27.10	37.90	49.40	61.20
1100.0				7.50	10.40	14.00	18.00	22.80	27.40	38.30	50.00	61.80
1100.1			0.00	7.70	10.60	14.20	18.30	23.00	28.00	38.80	50.40	62.30
1100.2			5.20	7.90	10.90	14.40	18.70	23.30	28.30	39.30	51.00	62.90
1100.3			5.30	8.00	11.10	14.80	19.00	23.80	28.80	39.90	51.40	63.50
1100.4			5.40	8.10	11.30	15.10	19.30	24.20	29.20	40.30	52.00	64.20
1100.5			5.50	8.30	11.60	15.30	19.80	24.50	29.70	40.80	52.50	64.60
1100.6			5.80	8.50	11.80	15.80	20.20	25.00	30.30	41.30	53.20	65.40
1100.7			6.00	8.90	12.00	16.10	20.30	25.30	30.60	41.80	53.50	66.00
1100.8			6.10	9.00	12.30	16.40	20.80	25.90	31.10	42.30	54.20	66.70
1100.9			6.20	9.10	12.60	16.70	21.10	26.30	31.60	42.90	54.90	67.30
1101.0			6.30	9.30	12.90	17.10	21.50	26.60	32.00	43.40	55.40	68.00
1101.1			6.50	9.80	13.20	17.30	21.90	27.00	32.30	43.90	56.00	68.80
1101.2			6.75	10.00	13.50	17.80	22.30	27.50	33.00	44.30	56.50	69.30
1101.3			6.90	10.30	13.80	18.20	22.60	28.00	33.30	45.00	57.10	70.10
1101.4		0.00	7.10	10.50	14.20	18.40	23.00	28.40	34.00	45.50	57.80	70.80
1101.5		5.00	7.20	10.90	14.40	18.80	23.30	28.90	34.40	46.20	58.30	71.40
1101.6		5.20	7.40	11.20	14.80	19.10	23.90	29.30	35.00	46.80	59.00	72.10
1101.7		5.30	7.75	11.30	15.00	19.50	24.20	30.00	35.40	47.30	59.80	72.90

Table 7-3 (Cont.). Surcharge Schedule for Carters Main Dam

INFLOW IN 1000 CFS (AVERAGE FOR PREVIOUS 3 HOURS)

SURCHARGE IN 1000 CFS

POOL ELEV (FT NGVD 29)	20	30	40	50	60	70	80	90	100	120	140	160
									36.00	47.90	60.20	73.50
1101.9		5.80	8.10	11.90	15.90	20.30	25.20	31.00	36.40	48.40	61.00	74.30
1102.0		5.90	8.30	12.10	16.10	20.70	25.70	31.30	37.00	49.00	61.50	75.10
1102.1		6.00	8.80	12.40	16.40	21.20	26.20	32.00	37.50	49.70	62.30	75.90
1102.2		6.25	9.00	12.80	16.80	21.80	26.50	32.30	38.20	50.30	63.10	76.80
1102.3		6.40	9.20	13.00	17.10	22.10	27.00	33.00	38.80	51.00	63.80	77.40
1102.4		6.75	9.40	13.30	17.60	22.50	27.50	33.50	39.30	51.70	64.30	78.20
1102.5		7.00	9.80	13.80	18.00	23.00	28.00	34.00	39.80	52.20	65.20	79.00
1102.6		7.20	10.00	14.20	18.30	23.50	28.70	34.70	40.40	53.00	66.00	80.00
1102.7		7.30	10.20	14.40	18.80	24.00	29.00	35.20	41.00	53.60	66.80	80.60
1102.8	0.00	7.50	10.30	14.80	19.30	24.30	29.50	36.00	41.60	54.30	67.50	81.50
1102.9	5.00	7.80	10.80	15.00	19.80	25.00	30.20	36.30	42.30	55.20	68.30	82.30
1103.0	5.20	8.00	11.10	15.30	20.20	25.40	30.80	37.10	43.00	55.70	69.20	83.00
1103.1	5.30	8.25	11.30	16.00	20.50	26.10	31.30	37.80	43.70	56.30	70.00	84.00
1103.2	5.50	8.40	11.80	16.20	21.00	26.50	32.00	38.30	44.30	57.20	70.80	84.80
1103.3	5.80	9.00	12.20	16.60	21.50	27.00	32.50	39.20	44.90	58.00	71.70	85.80
1103.4	6.00	9.10	12.40	17.20	22.10	27.50	33.20	39.80	45.70	58.80	72.50	86.50
1103.5	6.25	9.40	12.80	17.50	22.50	28.10	33.80	40.40	46.30	59.80	73.50	87.30
1103.6	6.50	9.80	13.10	18.00	23.10	28.90	34.50	41.00	47.20	60.50	74.30	88.20
1103.7	6.75	10.10	13.30	18.30	23.70	29.40	35.20	41.80	48.00	61.20	75.20	89.10
1103.8	7.00	10.30	14.00	18.80	24.00	30.10	36.00	42.40	48.80	62.20	76.20	90.20
1103.9	7.25	10.75	14.30	19.30	24.70	30.80	36.80	43.30	49.30	63.00	77.20	91.00
1104.0	7.50	11.10	14.60	19.90	25.30	31.40	37.20	44.00	50.30	63.80	78.30	92.20
1104.1	8.00	11.40	15.10	20.20	25.90	32.00	38.20	44.80	51.00	64.90	79.20	93.20
1104.2	8.25	11.80	15.50	20.80	26.50	32.80	39.00	45.40	51.90	65.60	80.20	94.20
1104.3	8.50	12.25	16.20	21.40	27.10	33.20	39.70	46.30	52.80	66.60	81.30	95.20
1104.4	8.80	12.50	16.50	22.00	27.70	34.20	40.50	47.20	53.40	67.50	82.40	96.30
1104.5	9.10	13.00	17.00	22.50	28.50	35.00	41.30	48.00	54.30	68.80	83.30	97.50

Table 7-3 (Cont.). Surcharge Schedule for Carters Main Dam

INFLOW IN 1000 CFS (AVERAGE FOR PREVIOUS 3 HOURS)

SURCHARGE IN 1000 CFS

POOL ELEV (FT NGVD 29)	20	30	40	50	60	70	80	90	100	120	140	160
1104.6	9.25	13.50	17.80	23.20	29.20	35.80	42.30	49.00	55.40	69.90	84.30	98.60
1104.7	10.00	14.00	18.10	24.00	30.10	36.40	43.10	50.00	56.20	71.00	85.50	99.80
1104.8	10.30	14.30	18.60	24.60	31.00	37.30	44.00	50.80	57.20	71.80	86.70	101.20
1104.9	10.70	15.00	19.30	25.30	31.70	38.20	45.00	51.80	58.30	73.20	87.80	102.50
1105.0	11.00	15.40	20.00	26.00	32.50	39.00	46.00	52.70	59.30	74.50	89.00	103.80
1105.1	11.70	16.10	20.90	26.60	33.50	40.00	46.80	54.00	60.30	75.50	90.20	105.20
1105.2	12.30	16.50	21.60	27.60	34.30	41.00	48.00	55.20	61.40	77.00	91.50	106.50
1105.3	13.00	17.25	22.30	28.50	35.50	42.00	49.00	56.30	62.50	78.30	92.60	108.20
1105.4	14.00	17.80	23.00	29.50	36.50	43.00	50.20	57.50	63.80	79.50	94.00	109.50
1105.5	14.60	18.30	24.00	30.50	37.70	44.30	51.50	59.00	65.20	81.00	95.50	111.20
1105.6	15.50	19.30	25.00	31.30	38.80	45.40	52.80	60.50	66.50	82.40	96.80	113.00
1105.7	16.80	20.50	26.00	32.50	40.20	46.50	54.30	62.10	67.90	83.70	98.30	114.50
1105.8	17.80	21.80	27.30	33.60	41.50	48.30	56.00	63.50	69.80	85.30	100.00	116.50
1105.9	20.00	22.50	28.50	35.10	43.00	49.60	57.50	65.30	71.20	86.80	101.40	118.30
1106.0		24.00	30.30	36.50	44.40	51.30	59.50	67.30	73.00	88.50	102.80	120.20
1106.1		26.00	32.00	39.30	46.30	52.80	61.20	69.50	74.50	90.10	104.50	122.30
1106.2		30.00	34.00	40.50	48.00	54.80	63.50	71.50	76.50	92.00	106.30	124.80
1106.3			36.00	43.00	50.20	56.60	66.00	74.00	78.80	93.60	108.20	127.30
1106.4			40.00	46.30	53.20	59.30	68.80	76.50	80.50	95.80	110.70	130.00
1106.5				50.00	56.00	62.50	71.80	78.50	83.30	97.80	113.00	132.50
1106.6					60.00	66.50	74.20	82.00	86.00	100.20	115.60	136.20
1106.7						70.00	79.00	86.00	89.00	103.00	118.50	140.00
1106.8							80.00	90.00	94.00	107.00	121.20	144.00
1106.9									100.00	112.00	127.00	150.50
1107.0										120.00	140.00	160.00

Table 7-4. Emergency Spillway Discharge Rating for Carters Main Dam

EMERGENCY GATED SPILLWAY DISCHARGE RATING IN CFS
(ALL FIVE GATES OPEN TO INDICATED SETTING)

	MAIN POOL ELEVATION IN FEET NGVD 29									
OPEN IN FEET	**1099**	**1100**	**1101**	**1102**	**1103**	**1104**	**1105**	**1106**	**1107**	**1108**
0.5	2780	2830	2870	2920	2960	3010	3050	3100		
1.0	5570	5670	5760	5850	5950	6030	6120	6210		
2.0	11140	11340	11530	11720	11900	12080	12260	12440	12610	
4.0	22260	22660	23060	23450	23830	24200	24570	24940	25300	25650
6.0	33250	33880	34490	35090	35680	36270	36840	37400	37960	38510
8.0	44110	44970	45810	46640	47460	48260	49050	49820	50590	51340
10.0	54730	55840	56930	58000	59050	60080	61100	62100	63080	64050
13.0	70300	71820	73310	74770	76210	77610	79000	80350	81690	83000
16.0	85400	87380	89320	91210	93070	94880	96670	98420	100150	101840
20.0	104290	106950	109550	112090	114570	117000	119380	121710	124000	126250
24.0	121700	125150	128520	131800	135000	138120	141180	144170	147100	149970
28.0	131200	139000	146070	150210	154240	158170	162010	165750	169410	173000
32.0			147000	155100	163500	172000	180500	187170	191700	196120
36.0								189000	197700	206500

Table 7-5. Low Level Sluice Discharge Rating for Carters Main Dam

(FOR BOTH GATES OPEN TO INDICATED SETTING)

MAIN POOL ELEVATION IN FEET NGVD29

DISCHARGE IN CFS

OPEN IN FEET	**800**	**820**	**840**	**860**	**880**	**900**	**920**	**940**	**960**	**980**	**1000**	**1020**	**1040**	**1060**	**1080**	**1100**
0.5	257	288	316	343	367	390	411	431	451	469	487	505	521	538	553	569
1.0	514	577	633	685	734	779	822	862	901	939	974	1009	1042	1075	1106	1137
1.5	770	864	949	1027	1099	1167	1232	1293	1351	1403	1460	1512	1562	1611	1658	1704
2.0	1026	1151	1264	1368	1464	1555	1640	1721	1799	1874	1945	2014	2080	2145	2208	2269
2.5	1288	1446	1588	1719	1840	1954	2062	2163	2261	2354	2444	2531	2615	2696	2775	2852
3.0	1554	1744	1915	2073	2219	2357	2486	2609	2727	2840	2948	3052	3152	3252	3347	3440
3.5	1808	2031	2230	2414	2584	2743	2892	3038	3175	3306	3462	3554	3672	3787	3897	4004
4.0	2062	2315	2541	2752	2945	3128	3300	3464	3620	3770	3914	4053	4187	4317	4443	4566
4.5	2329	2613	2871	3107	3327	3532	3728	3912	4089	4258	4420	4577	4728	4875	5015	5157
5.0	2597	2914	3202	3465	3708	3938	4156	4363	4558	4747	4928	5104	5273	5439	5595	5749
5.5	2882	3238	3553	3846	4115	4372	4615	4843	5062	5272	5473	5666	5854	6037	6213	6385
6.0	3173	3560	3910	4231	4530	4810	5079	5331	5570	5801	6023	6237	6444	6644	6838	7027
6.5	3444	3865	4245	4594	4917	5221	5512	5787	6048	6297	6539	6770	6996	7212	7422	7628
7.0	3714	4170	4578	4953	5304	5633	5947	6242	6523	6794	7053	7303	7544	7779	8007	8228
7.5	4006	4498	4937	5345	5722	6077	6416	6735	7039	7329	7608	7873	8140	8394	8639	8879
8.0	4300	4825	5302	5737	6141	6522	6890	7230	7555	7868	8169	8459	8738	9009	9273	9529
8.5	4592	5156	5667	6129	6562	6968	7361	7723	8075	8406	8728	9038	9337	9626	9907	10181
9.0	4887	5489	6025	6521	6981	7409	7831	8220	8592	8947	9289	9615	9933	10242	10540	10832
9.5	5126	5755	6318	6838	7318	7774	8214	8622	9009	9383	9740	10085	10418	10741	11056	11363
10.0	5360	6016	6606	7150	7653	8125	8571	9016	9421	9810	10186	10544	10895	11232	11562	11884

7-06. Recreation. Recreational activities are best served by maintaining a full conservation pool. Lake levels above top of conservation pool invade the camping and park sites. When the lake recedes several feet below the top of conservation pool access to the water and beaches becomes limited. Water management personnel are aware of recreational effects caused by reservoir fluctuations and attempt to maintain reasonable lake levels, especially during the peak recreational use periods, but there are no specific requirements relative to maintaining recreational levels. Other project functions usually determine releases from the dam and the resulting lake levels.

The effects of the Carters Reservoir water control operations on recreation facilities and use at Carters Lake are described as impact lines - Initial Impact Line, Recreation Impact Line, and Water Access Limited Line. The impact lines are defined as pool elevations with associated effects on recreation facilities and exposure to hazards within the lake. The following are general descriptions of each impact line for Low Water Conditions.

a. Initial Impact Line. The Initial Impact Line is defined at lake elevation 1,068 feet NGVD29. At this level impacts are first observed and there is adequate time available to notify the public should the lake level continue to drop. Action is taken to prevent more serious and lasting impacts. Swimming area buoys at Harris Branch Beach are set out at approximately elevation 1,068 feet NGVD29 when the lake is at normal summer pool level of 1,074 feet NGVD29. At the initial impact level, gate attendants issue oral messages and written warnings to the public.

b. Recreation Impact Line. The lake elevation of 1,060 feet NGVD29 is defined as the Recreation Impact Line. At this level action must be taken to prevent significant impacts from occurring. At the level of 1,060 feet NGVD29, the dangers to those participating in water based recreation activities would increase due to hazardous conditions. Steps are taken to alert the marina staff and public of existing dangers. Woodring Campground and Doll Mountain Day Use boat ramps are closed to the public when water level is below 1,060 feet NGVD29. At elevation 1,060 feet NGVD29, the Harris Branch Beach is closed. The designated swimming area buoys are completely out of the water and cannot be moved.

c. Water Access Limited Line. The lake elevation of 1,055 feet NGVD29 is defined as the Water Access Impact line. At this elevation, public access to the water is severely limited. Action is taken to retain this limited access. If navigational hazards appear, they will be temporarily marked with buoys or signs for boater safety. Marina slips are still usable, but dock walkways slope severely from the shoreline. At elevation 1,055 feet NGVD29, Ridgeway boat ramp, Woodring Branch day use area boat ramp and damsite boat ramps are closed.

The Water Control Plan takes the effects on recreation facilities into account in developing action zones for Carters Lake. In dry periods, the lake will often drop to or below the impact levels and Water Management personnel will keep the resource manager informed of projected pool levels through the district's weekly water management meetings. The Operations Project Manager will be responsible for contacting various lakeshore interests and keeping the public informed of lake conditions during drawdown periods. The Operations Project Manager will close beaches and boat ramps as necessary, patrol the lake, and mark hazards and perform other necessary tasks to mitigate the effects of low lake levels.

7-07. Water Quality. The Corps operates the project with the objective of maintaining water quality standards while accepting operational and physical constraints that may limit the ability to do so. Because most water quality concerns occur during periods of low flow, usually during summer and early fall when there is greater stress on biological resources and wastewater discharge assimilation requirements, establishing a continuous minimum release of water is an important consideration. Because of the existence of the reregulation dam and the pump back operation previously discussed, minimum flows are considered from the reregulation dam, rather than from the main dam.

Continuous minimum flows from the Carters Project are provided depending on the Action Zone in which the lake level is in, previously discussed in Section 7-03. When in Action Zone 1, a varying monthly flow ranging from 250-865 cfs is provided as shown in Figure 7-1. When in Action Zone 2, the minimum flow of 240 cfs is provided, regardless of month.

The pump back operation associated with the project allows the flexibility of providing the continuous minimum flow by using the four large turbine-generator units, two of which are capable of pumping. The existence of the reregulation pool allows smoothing of downstream releases and avoids high-pulse flows in many cases.

7-08. Fish and Wildlife. The Carters Lake presents a unique problem to the management of fishery resources within the lake as well as in the tailwaters. Due to the type of project (pump storage), the depth of the reservoir (average depth of about 380 feet, maximum depth of 410 feet), and the makeup of fish populations occurring within the watershed prior to impoundment, a situation exists unlike that anywhere else within the District. Because of the demands and the nature of other project purposes, regulation of the project to enhance fish and wildlife is not possible. However, in consultation with the USFWS the Corps has adopted specific seasonal minimum flow targets, varying monthly over a range from 240 to 865 cfs March and December. Figure 7-1 summarizes the monthly minimum flow targets recommended by the USFWS for the Coosawattee River below Carters Reregulation Dam for each month of the year.

7-09. Water Supply. There is one existing water storage contract (Contract Number DACW01-9-91-481) with the city of Chatsworth, Georgia. The contract has been in place since November 1991 and extends for the life of the project. The contract provides that the city of Chatsworth has the right to utilize an undivided 0.61 percent (estimated to contain 818 acre-feet after adjustment for sediment deposits) of the usable conservation storage space in the project between elevations 1,022 feet NGVD29 and 1,072 feet NGVD29, which usable conservation storage space is estimated to contain 134,900 acre-feet after adjustment for sediment deposits. Other than that, there are no contracts for withdrawals or releases from the Carters Lake for municipal, industrial, irrigation, fish and wildlife, or other uses, except for the minimum continuous low flow release requirement of 240 cfs. Water supply storage accounting is a systematic accounting record to track valid storage users when the lake is in the conservation pool. Users get a proportion of any inflow and any losses as well as measured use. To assure that one contracted water user is not encroaching on the rights of other contracted users. This accounting is especially critical during drought. A component of the accounting is to notify users of the need for conservation measures or the need for additional water supply sources, when available water supply storage drops below 30%. Formula used to calculate water supply storage: Ending Storage – Beginning Storage + Inflow Share – Loss Share – User's Usage. The conservation pool is drawn down as water usage exceeds inflow. The entire pool is drawn down and the individual accounts are also drawn down at different rates based on their usage. Users will be notified on a weekly base once the storage account drops below 30%.

7-10. Hydroelectric Power. The Carters Project is a pumped storage project operated as a peaking plant for producing hydroelectric power.

a. Except in the most unusual circumstances, reservoir releases required for conservation or flood risk management operations will be used to produce hydropower. Such production is normally scheduled during peak energy demand hours throughout the week. The historical Average Monthly Hydroelectric Power Generation is shown in Table 7-6. The typical operations for non-flood conditions are illustrated on Plates 7-4 and 7-5.

b. Each week, the Water Management Section makes a forecast of expected inflows into the Carters Project. On the basis of that forecast, the present pool elevation, downstream requirements, and other pertinent needs, the Water Management Section determines the volume of water to be released and the corresponding hydropower available to be generated. That energy is scheduled by the receiving utility throughout the following week. There could be needs for certain timing of releases, but in general the utility makes the schedule and generation is spread across the week during the peak hours. The Water Management Section constantly monitors climatic conditions and can adjust the volume of hydropower available daily. Energy is marketed to the government's preference customers under terms of contracts negotiated and administered by SEPA. Those declarations, which are designed to keep the pools within the established seasonal and pondage limits, when practicable, are prepared by the Water Management Section of the Mobile District.

c. Typical operation during non-flood conditions are as follows:

1. Generation during the weekdays normally occurs between the hours of 6 a.m. and 10 p.m. In general, little or no generation occurs during the weekend. However, generation can occur on the weekends if warranted by power demands.
2. Pumpback normally occurs between the hours of 10 p.m. and 6 a.m. during both the weekdays and weekends, but can occur outside this time period.
3. The reregulation dam pool will likely reach both the maximum elevation 696 feet NGVD29 and the minimum elevation 677 feet NGVD29 at least once during the course of the week.
4. The reregulation pool is at its peak late on Friday and is at its low-point early Monday a.m. because of the significant pumping over the weekend. The total downward fluctuation of the reregulation pool is up to 20 feet over a weekend.
5. The main pool is at its high point early Monday a.m. and at its low-point mid to late week. The typical fluctuation of the main pool is about four feet.

Power operations, including pumping, can continue throughout a flood event as long as storage space can safely be allocated in the main pool and pumping energy is available to keep the reregulation dam pool at or below 696 feet NGVD29. In addition, pumping will discontinue when the reregulation dam pool falls below 677 feet NGVD29 or to the minimum elevation necessary to maintain the constant discharge downstream to insure an orderly and timely evacuation of stored flood waters.

Table 7-6. Average Daily Hydroelectric Power Generation by Month (Megawatt Hours)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Min	Max
1975								498	527	730	765	779	660	498	779
1976	1413	969	1697	1350	1413	1117	1370	569	391	466	439	789	999	391	1697
1977	830	638	1764	2359	926	572	426	345	493	665	1250	848	926	345	2359
1978	1594	966	1103	851	938	594	394	496	256	170	290	604	688	170	1594
1979	1260	1267	2040	2093	1073	872	766	630	510	444	974	605	1045	444	2093
1980	868	927	2845	1926	1320	769	447	294	340	317	329	275	888	275	2845
1981	204	804	531	628	513	624	247	195	220	196	274	525	413	195	804
1982	1718	1986	1284	968	748	482	569	541	351	544	659	1635	957	351	1986
1983	861	1153	960	1432	1314	845	846	361	403	256	690	1380	875	256	1432
1984	1008	1033	1582	1385	1666	706	825	631	315	314	300	445	851	300	1666
1985	476	978	515	510	455	380	371	403	230	323	334	434	451	230	978
1986	346	514	527	331	248	127	41	100	148	306	665	634	332	41	665
1987	906	980	1098	731	481	418	254	87	64	75	124	197	451	64	1098
1988	587	401	374	525	269	63	82	114	195	143	412	263	286	63	587
1989	840	905	1330	1215	896	1564	1058	543	768	1036	990	964	1009	543	1564
1990	1699	3652	3120	1344	1029	615	749	397	382	448	341	1164	1245	341	3652
1991	951	1317	1532	1284	1429	832	625	593	414	297	464	956	891	297	1532
1992	876	1109	1375	1011	598	675	665	485	453	424	1037	1600	859	424	1600
1993	1531	1023	1277	1136	743	407	221	213	109	94	236	443	619	94	1531
1994	639	888	1505	1824	774	752	768	580	390	641	475	683	827	390	1824
1995	849	1463	1362	784	536	467	237	238	247	778	968	553	707	237	1463
1996	1747	1353	1712	1247	997	625	380	328	404	258	527	861	870	258	1747
1997	957	1089	1587	1414	1501	1024	607	400	366	732	785	779	937	366	1587
1998	959	1483	1061	1383	842	744	717	1064	911	881	804	1079	994	717	1483
1999	913	883	1028	1002	1132	1198	1382	1178	1209	1343	1264	1217	1146	883	1382
2000	1305	973	810	848	1161	1047	1107	1323	1174	1144	1103	901	1075	810	1323
2001	834	1172	1217	1060	1085	1156	1073	1067	955	1035	1020	1030	1059	834	1217
2002	1033	1168	958	1199	1099	968	1126	1028	1033	996	812	964	1032	812	1199
2003	1080	982	928	576	1383	1061	1255	1277	1163	1184	1412	1240	1128	576	1412
2004	1503	1418	1232	1236	1143	1226	1358	1535	1420	1111	930	1405	1293	930	1535
2005	1062	889	1136	1191	1119	1505	1286	1429	1197	1000	1047	1005	1156	889	1505
2006	1165	1197	1266	1161	1295	1406	1385	1246	1098	1032	914	908	1173	908	1406
2007	1114	1132	1218	1105	1267	1292	1834	2084	2014	1728	1343	1343	1456	1105	2084
2008	1630	1416	1128	1070	1481	1544	961	2063	1861	1618	1450	1459	1473	961	2063
2009	1524	1505	1385	1345	1371	1624	2033	1861	1804	1399	1235	1402	1541	1235	2033
2010	1156	1775	1631	2103	1541	1659	2448	1827	1986	1606	1135	1262	1677	1135	2448
2011	1387	1350	1597	1084	1656	1467	1383	2133	1817	1432	1111	1187	1467	1084	2133
Avg	1078	1188	1325	1186	1040	901	869	824	753	734	782	918	967	734	1325
Min	204	401	374	331	248	63	41	87	64	75	124	197	184	41	401
Max	1747	3652	3120	2359	1666	1659	2448	2133	2014	1728	1450	1635	2134	1450	3652

Performance curves for the pump back operation are shown on Plate 7-6. Performance curves for the conventional unit are shown on Plate 7-7. Performance curves for the pump-turbine unit are shown on Plate 7-8.

The Main Dam Discharge Rate-Tailwater relationship for Various Reregulation Pool elevations is shown on Plate 7-9. The Pumping Rate-Tailwater relationship for various reregulation pools is shown on Plate 7-10.

7-11. Navigation. Allatoona Dam and Carters Dam, while originally authorized to support downstream navigation, are not regulated for navigation purposes because they are distant from the navigation channel, and any releases for that purpose would be captured and reregulated by APC reservoirs downstream. Downstream navigation in the Alabama River benefits indirectly from the operation of the Allatoona and Carters Projects for the other authorized purposes.

7-12. Drought Contingency Plans. ER1110-2-1941, *Drought Contingency Plans*, dated 15 September 1981, called for developing drought contingency plans for Corps' reservoirs. For the Carters Project, the Corps will coordinate water management during drought with other federal agencies, private power companies, navigation interests, the states, and other interested state and local parties as necessary. Drought operations will be in compliance with the plan for the entire ACT Basin as outlined in the *ACT Master Water Control Manual, Exhibit C,* and summarized below. The plan includes operating guidelines for drought conditions and normal conditions.

In response to the 2006 - 2008 drought, Alabama Power Company (APC) worked closely with the State of Alabama to develop the APC draft *Alabama Drought Operations Plan (ADROP)* that specified operations at APC projects on the Coosa and Tallapoosa Rivers. The plan included the use of composite system storage, state line flows, and basin inflow as triggers to drive drought response actions. Similarly, in response to the 2006 - 2008 drought, the Corps recognized that a basin-wide drought plan must incorporate variable hydropower generation requirements from its headwater projects in Georgia (Allatoona and Carters), a reduction in the level of navigation service provided on the Alabama River as storage across the basin declines, and that environmental flow requirements must still be met to the maximum extent practicable.

Based upon experience gained during previous droughts, and in particular the 2006 - 2008 drought, a basin-wide drought plan composed of three components - headwater operations at Allatoona and Carters Projects in Georgia; operations at APC projects on the Coosa and Tallapoosa Rivers; and downstream operations at Corps projects below Montgomery, has been developed. The concept is graphically depicted in Figure 7-2 with the specifics shown on Table 7-7.

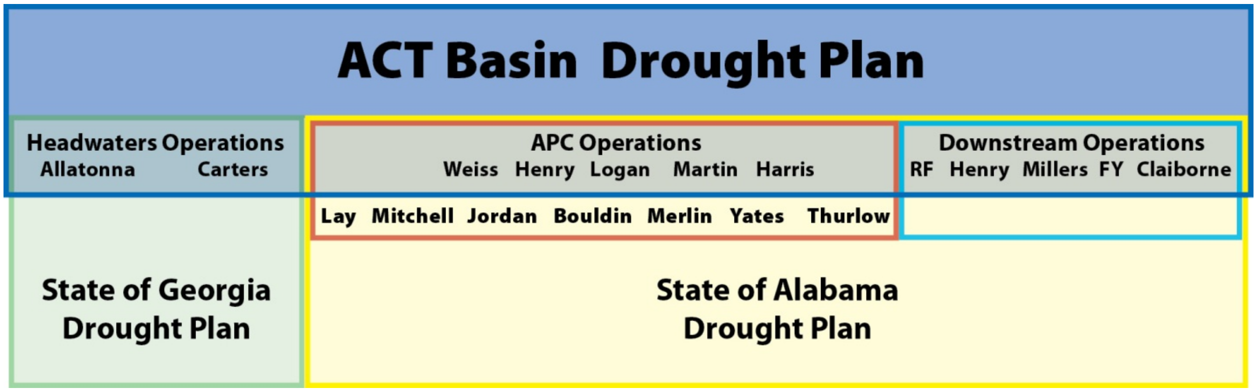


Figure 7-2. Schematic of the ACT Basin Drought Plan

Table 7-7. APC Drought Operations Plan

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought Level Response[a]	DIL 0 - Normal Operations											
	DIL 1: Low Basin Inflows or Low Composite or Low State Line Flow											
	DIL 2: DIL 1 criteria + (Low Basin Inflows or Low Composite or Low State Line Flow)											
	DIL 3: Low Basin Inflows + Low Composite + Low State Line Flow											
Coosa River Flow[b]	Normal Operation: 2,000 cfs			4,000 (8,000)		4,000 – 2,000	Normal Operation: 2,000 cfs					
	Jordan 2,000 +/-cfs			4,000 +/- cfs		6/15 Linear Ramp down	Jordan 2,000 +/-cfs			Jordan 2,000 +/-cfs		
	Jordan 1,800 +/-cfs			2,500 +/- cfs		6/15 Linear Ramp down	Jordan 2,000 +/-cfs			Jordan 1,800 +/-cfs		
	Jordan 1,600 +/-cfs			Jordan 1,800 +/-cfs			Jordan 2,000 +/-cfs			Jordan 1,800 +/-cfs		Jordan 1,600 +/-cfs
Tallapoosa River Flow[c]	Normal Operations: 1200 cfs											
	Greater of: 1/2 Yates Inflow or 2 x Heflin Gage(Thurlow Lake releases > 350 cfs)				1/2 Yates Inflow					1/2 Yates Inflow		
	Thurlow Lake 350 cfs				1/2 Yates Inflow					Thurlow Lake 350 cfs		
	Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)						Thurlow Lake 350 cfs			Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)		
Alabama River Flow[d]	Normal Operation: Navigation or 7Q10 flow											
	4,200 cfs (10% 7Q10 Cut) - Montgomery				7Q10 - Montgomery (4,640 cfs)					Reduce: Full – 4,200 cfs		
	3,700 cfs (20% 7Q10 Cut) – Montgomery					4,200 cfs (10% 7Q10 Cut) - Montgomery				Reduce: 4,200 cfs-> 3,700 cfs Montgomery (1 week ramp)		
	2,000 cfs Montgomery				3,700 cfs Montgomery		4,200 cfs (10% 7Q10 Cut) - Montgomery			Reduce: 4,200 cfs -> 2,000 cfs Montgomery (1 month ramp)		
Guide Curve Elevation	Normal Operations: Elevations follow Guide Curves as prescribed in License (Measured in Feet)											
	Corps Variances: As Needed; FERC Variance for Lake Martin											
	Corps Variances: As Needed; FERC Variance for Lake Martin											
	Corps Variances: As Needed; FERC Variance for Lake Martin											

a. Note these are base flows that will be exceeded when possible.
b. Jordan flows are based on a continuous +/- 5% of target flow.
c. Thurlow Lake flows are based on continuous +/- 5% of target flow: flows are reset on noon each Tuesday based on the prior day's daily average at Heflin or Yates. d. Alabama River flows are 7-Day Average Flow.

a. Headwater Operations for Drought at Carters and Allatoona Projects. Drought operations at Carters and Allatoona Projects consist of progressively reduced discharges as pool levels decline. For instance, as Carters Lake pool level drops into Zone 2, minimum target flows would be reduced from seasonal varying values to 240 cfs. When Allatoona Lake is operating in normal conditions (Zone 1 operations), hydropower generation would be zero to four hours per day. However, as the pool level drops to lower action zones during drought conditions, generation would be reduced to zero to two hours per day.

b. Operations at APC Projects on the Coosa, Tallapoosa, and Alabama Rivers. Under current operations, APC provides a minimum flow at Montgomery, Alabama, of 4,640 cfs (seven-day average) based on the combined flows from the Tallapoosa and Coosa Rivers. The minimum flow target of 4,640 cfs was originally derived from the 7Q10 flow at Claiborne Lake of 6,600 cfs. Those flows were established with the understanding that if APC provided 4,640 cfs, the Corps and intervening basin inflow would be able to provide the remaining water to meet 6,600 cfs at Claiborne Lake. However, as dry conditions continued in 2007, water managers realized that, if the basin inflows from rainfall were insufficient, the minimum flow target would not likely be achievable. Therefore, in coordination with APC, drought operations for the middle reaches of the ACT Basin have been revised and are described below.

The ADROP served as the initial template for developing proposed drought operations for the APC Drought Operation Plan (APCDOP) and ACT Basin. APCDOP operational guidelines for the Coosa, Tallapoosa, and Alabama Rivers have been defined in a matrix, on the basis of a Drought Intensity Level (DIL). The DIL is a drought indicator, ranging from zero to three. The DIL is determined on the basis of three basin drought criteria (or triggers). A DIL=0 indicates normal operations, while a DIL from 1 to 3 indicates some level of drought conditions. The DIL increases as more of the drought indicator thresholds (or triggers) occur. The APCDOP matrix defines monthly minimum flow requirements for the Coosa, Tallapoosa, and Alabama Rivers as a function of DIL and time of year. Such flow requirements are modeled as daily averages.

The combined occurrences of the drought triggers determine the DIL. Three intensity levels for drought operations are applicable to APC projects.

- DIL0 - (normal operation) no triggers occur
- DIL1 - (moderate drought) one of three triggers occur
- DIL2 - (severe drought) two of three triggers occur
- DIL3 - (exceptional drought) all three triggers occur

The indicators used in the APCDOP to determine drought intensity include the following:

- Low basin inflow
- Low state line flow
- Low composite conservation storage

Each of the indicators is described in detail below.

The DIL is computed on the 1st and 15th of each month. Once a drought operation is triggered, the DIL can only recover from drought condition at a rate of one level per period. For example, as the system begins to recover from an exceptional drought with DIL=3, the DIL must be stepped incrementally back to zero to resume normal operations. In that case, even if the system triggers return to normal quickly, it will still take at least a month before normal operations can resume - conditions can improve only to DIL=2 for the next 15 days, then DIL=1 for the next 15 days, before finally returning to DIL=0.

For DIL=0, the matrix shows a Coosa River flow between 2,000 cfs and 4,000 cfs with peaking periods up to 8,000 cfs occurring. The required flow on the Tallapoosa River is a constant 1,200 cfs throughout the year. The navigation flows on the Alabama River are applied to the APC projects. The required navigation depth on the Alabama River is subject to the basin inflow.

For DIL=1, the Coosa River flow varies from 2,000 cfs to 4,000 cfs. On the Tallapoosa River, part of the year, the required flow is the greater of one-half of the inflow into Yates Lake and twice the Heflin USGS gage. For the remainder of the year, the required flow is one-half of Yates Lake inflow. The required flows on the Alabama River are reduced from the amounts when DIL=0.

For DIL=2, the Coosa River flow varies from 1,800 cfs to 2,500 cfs. On the Tallapoosa River, the minimum is 350 cfs for part of the year and one-half of Yates Lake inflow for the remainder of the year. The requirement on the Alabama River is between 3,700 cfs and 4,200 cfs.

For DIL=3, the flows on the Coosa River range from 1,600 cfs to 2,000 cfs. A constant flow of 350 cfs on the Tallapoosa River is required. It is assumed an additional 50 cfs will occur between Thurlow Lake and the city of Montgomery’s water supply intake. Required flows on the Alabama River range from 2,000 cfs to 4,200 cfs

In addition to the APCDOP, the DIL affects the navigation operations. When the DIL is equal to zero, APC projects are operated to meet the navigation flow target or the 7Q10 flow. Once DIL is greater than zero, drought operations will occur, and navigation operations are suspended.

c. Low Basin Inflow Trigger. The total basin inflow needed for navigation is the sum of the total filling volume plus the 7Q10 flow (4,640 cfs). Table 7-8 lists the monthly low basin inflow criteria. All numbers are in cfs-days. The basin inflow value is computed daily and checked on the 1st and 15th of the month. If computed basin inflow is less than the value required, the low basin inflow indicator is triggered.

The basin inflow is the total flow above the APC projects excluding Allatoona Lake and Carters Lake. It is the sum of local flows, minus lake evaporation and diversions. Figure 7-3 illustrates the local inflows to the Coosa and Tallapoosa River Basin. The basin inflow computation differs from the navigation basin inflow, because it does not include releases from Allatoona Lake and Carters Lake. The intent is to capture the hydrologic condition across APC projects in the Coosa and Tallapoosa Basins.

d. Low State Line Flow Trigger. A low state line flow trigger occurs when the Mayo’s Bar USGS gage measures a flow below the monthly historical 7Q10 flow. The 7Q10 flow is defined as the lowest flow over a seven-day period that would occur once in 10 years. Table 7-9 lists the Mayo’s Bar 7Q10 value for each month. The lowest seven-day average flow over the past 14 days is computed and checked at the 1st and 15th of the month. If the lowest seven-day average value is less than the Mayo’s Bar 7Q10 value, the low state line flow indicator is triggered. If the result is greater than or equal to the trigger value from Table 7-9, the flow is considered normal, and the state line flow indicator is not triggered.

The term *state line flow* is used in developing the drought management plan because of the proximity of the Mayo’s Bar gage to the Alabama-Georgia state line and because it relates to flow data upstream of the Alabama-based APC reservoirs. State line flow is used only as a source of observed data for one of the three triggers and does not imply that *targets* exist at that geographic location. The APCDOP does not include or imply any Corps operation that would result in water management decisions at Carters Lake or Allatoona Lake.

Table 7-8. Low Basin Inflow Guide (in cfs-days)

Month	Coosa Filling Volume	Tallapoosa Filling Volume	Total Filling Volume	7Q10 flow	Required Basin Inflow
Jan	629	0	629	4,640	5,269
Feb	647	1,968	2,615	4,640	7,255
Mar	603	2,900	3,503	4,640	8,143
Apr	1,683	2,585	4,268	4,640	8,908
May	242	0	242	4,640	4,882
Jun			0	4,640	4,640
Jul			0	4,640	4,640
Aug			0	4,640	4,640
Sep	–602	–1,304	–1,906	4,640	2,734
Oct	–1,331	–2,073	–3,404	4,640	1,236
Nov	–888	–2,659	–3,547	4,640	1,093
Dec	–810	–1,053	–1,863	4,640	2,777

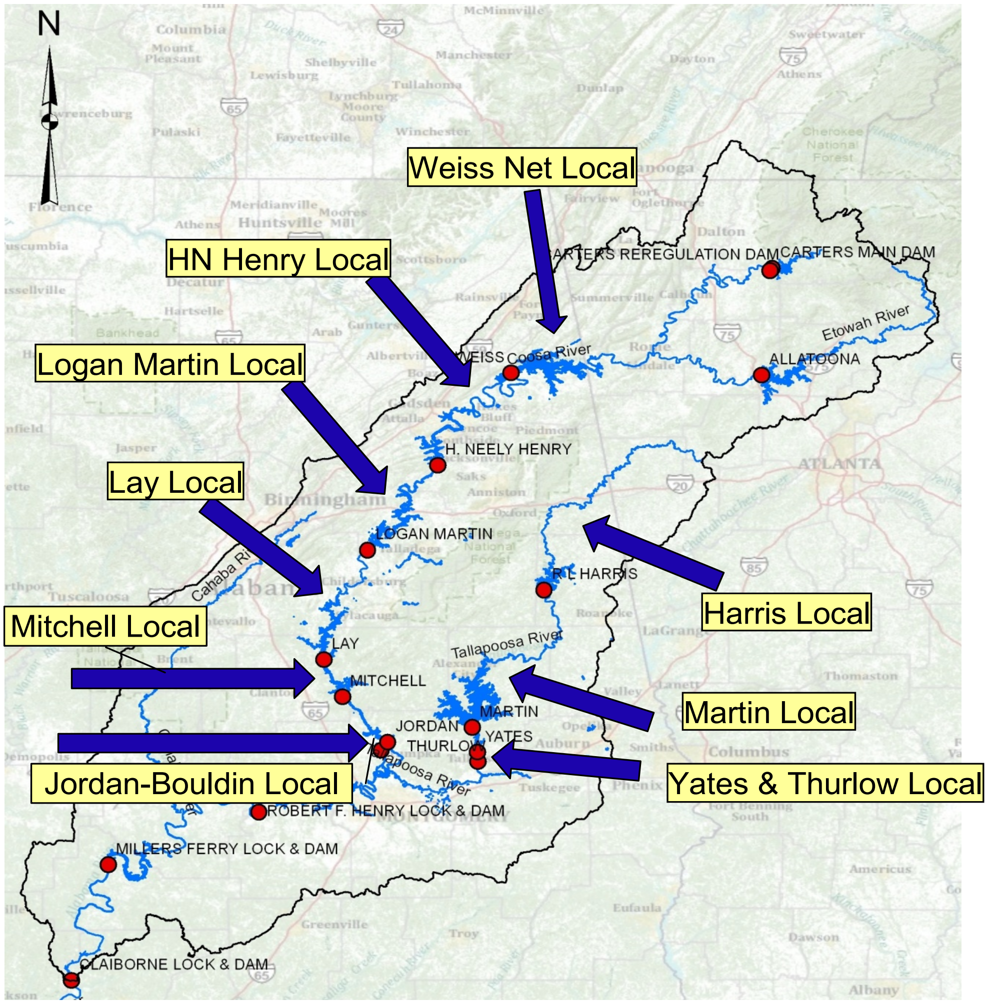


Figure 7-3. ACT Basin Inflows

Table 7-9. APC Drought Operations Plan State Line Flow Trigger

Month	Mayo's Bar (7Q10 in cfs)
Jan	2,544
Feb	2,982
Mar	3,258
Apr	2,911
May	2,497
Jun	2,153
Jul	1,693
Aug	1,601
Sep	1,406
Oct	1,325
Nov	1,608
Dec	2,043

Note: Based on USGS Coosa River at Rome Gage
(Mayo's Bar, USGS 02397000) observed flow from 1949 to 2006

e. Low Composite Conservation Storage in APC Projects Trigger. Low composite conservation storage occurs when the APC projects' composite conservation storage is less than or equal to the storage available within the drought contingency curves for the APC reservoirs. Composite conservation storage is the sum of the amounts of storage available at the current elevation for each reservoir down to the drought contingency curve at each APC major storage project. The reservoirs considered for the trigger are R. L. Harris Lake, H. Neely Henry Lake, Logan Martin Lake, Lake Martin, and Weiss Lake projects. Figure 7-4 plots the APC composite zones. Figure 7-5 plots the APC low composite conservation storage trigger.

If the actual active composite conservation storage is less than or equal to the active composite drought zone storage, the low composite conservation storage indicator is triggered. The computation is performed on the 1st and 15th of each month, and is compared to the low state line flow trigger and basin inflow trigger.

f. Operations for Corps Projects Downstream of Montgomery. Drought operations of the Corps' Alabama River projects (R. E. "Bob" Woodruff Lake [Robert F. Henry Lock and Dam], and William "Bill" Dannelly Lake [Millers Ferry Lock and Dam]) will respond to drought operation of the APC projects. When combined releases from the APC projects are reduced to the 7Q10 flow of 4,640 cfs, the Corps' Alabama River projects will operate to maintain a minimum flow of 6,600 cfs below Claiborne Lake. When the APCDOP requires flows less than 4,640 cfs, the minimum flow at Claiborne Lake is equal to the inflow into Millers Ferry Lock and Dam. There is inadequate storage in the Alabama River projects to sustain 6,600 cfs, when combined releases from the APC projects are less than 4,640 cfs.

g. Summary of Potential Drought Management Measures. Management measures developed for ACT Basin-wide drought operations consist of three major components:

- Headwater operations at Allatoona Lake and Carters Lake in Georgia
- Operations at APC projects on the Coosa and Tallapoosa Rivers
- Operations at Corps projects downstream of Montgomery

7-13. Flood Emergency Action Plans. The Corps is responsible for developing Flood Emergency Action Plans for the ACT System. The plans are included in the Operations and Maintenance Manuals for each system project. Example data available are emergency contact information, flood inundation information, and such.

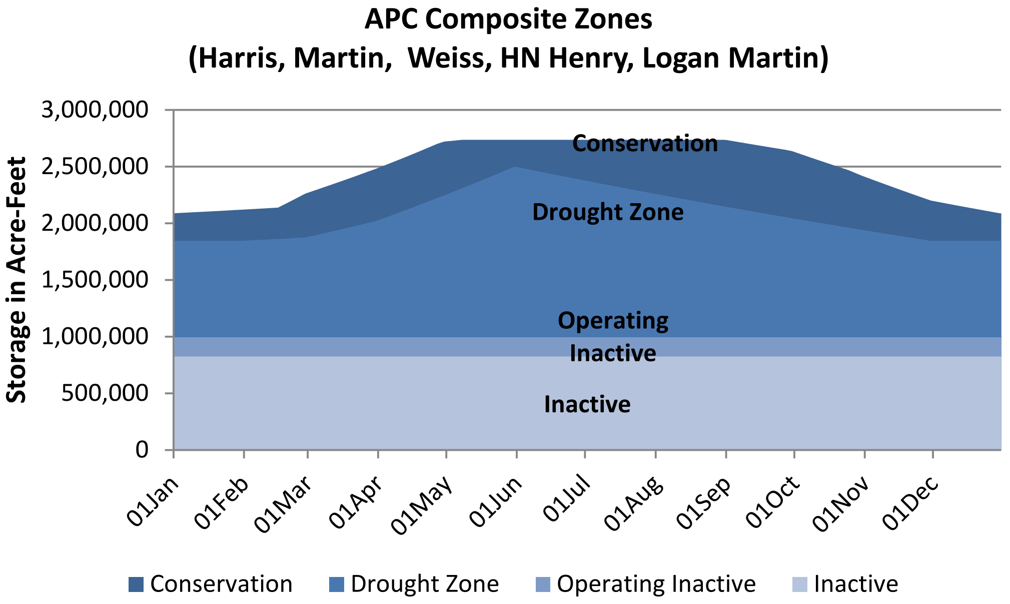


Figure 7-4. APC Composite Zones

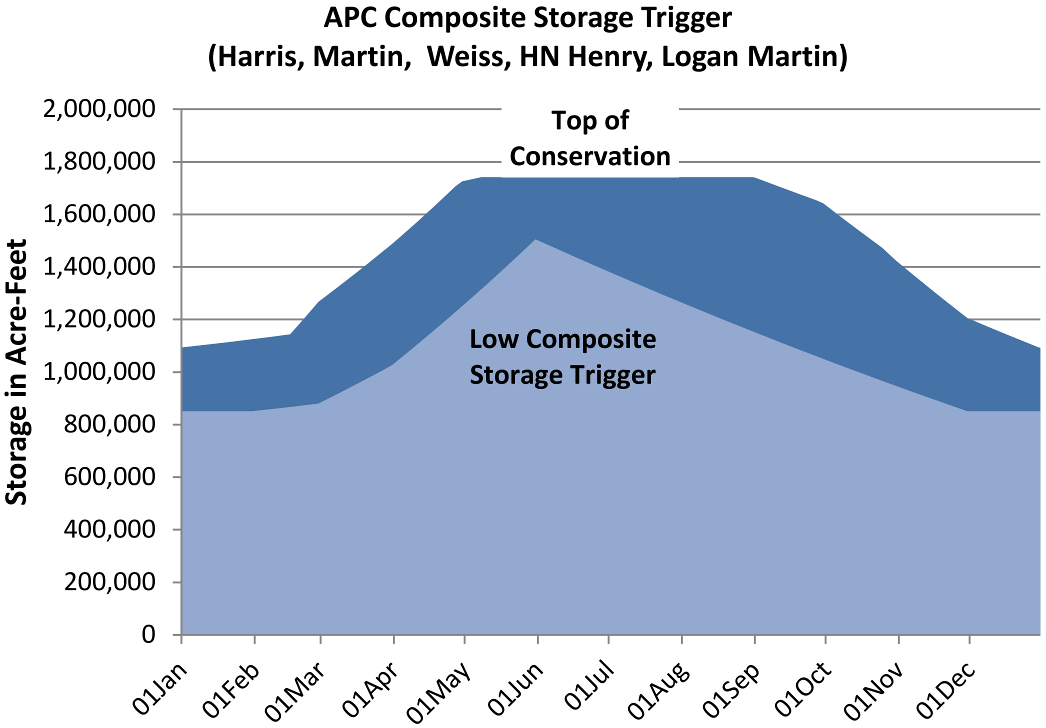


Figure 7-5. APC Low Composite Conservation Storage Drought Trigger

7-14. Other.

a. Mosquito Control Operations. Water level management is not a part of the mosquito control program of Carters Lake. The large storage volume per foot elevation would require the discharge of large quantities of storage to affect the water levels enough to have direct and specific effective control of the mosquito population. In addition, the lost water would adversely affect the many purposes during the period of most need (summer). During normal operations, the pool level fluctuates during the year which tends to reduce aquatic vegetation associated with mosquito habitat.

b. Correlation with Other Projects. Flood operations at Carters will be coordinated with Allatoona Dam to provide maximum flood protection at Rome, Georgia downstream. Flood releases from Carters will also be coordinated with the APC projects downstream. During lower flows and droughts the Carters Project releases will follow the basin-wide drought plan.

7-15. Deviation from Normal Regulation. The District Commander is occasionally requested to deviate from normal regulation. Prior approval for a deviation is required from the Division Engineer except as noted in subparagraph a below.

Deviation requests usually fall into the following categories:

a. Emergencies. Examples of some emergencies that can be expected to occur at a project are drowning and other accidents, failure of the operation facilities, chemical spills, treatment plant failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. The Mobile District will notify the division office as soon as practicable.

b. Unplanned Deviations. Unplanned instances can create a temporary need for deviations from the normal regulation plan. Unplanned deviations may be classified as either major or minor but do not fall into the category of emergency deviations. Construction accounts for many of the minor deviations and typical examples include utility stream crossings, bridge work, and major construction contracts. Minor deviations can also be necessary to carry out maintenance and inspection of facilities. The possibility of the need for a major deviation mostly occurs during extreme flood events. Requests for changes in release rates generally involve periods ranging from a few hours to a few days, with each request being analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to impacts on project and system purposes, upstream watershed conditions, potential flood threat, project condition, and alternative measures that can be taken. Approval for unplanned deviations, either major or minor, will be obtained from the Division Office by telephone or electronic mail prior to implementation.

c. Planned Deviations. Each condition should be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or electronic mail to the South Atlantic Division for review and approval.

7-16. Rate of Release Change. Normally, the ramp down rate for Reregulation Dam flows is 200 cfs every six hours to mitigate erosion along stream banks of farmlands downstream. However, under certain conditions the Water Management Section in the Mobile District Office may adjust this ramp down rate.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. The Carters Dam and Reregulation Dam is a multi-purpose project authorized for flood risk management, hydropower, recreation, fish and wildlife, navigation, water quality, and water supply.

Authority for development of a dam on the Coosawattee River near Carters, Georgia, is contained in Section 2 of the River and Harbor Act adopted 2 March 1945 (Public Law 12, 79th Congress, 1st Session). This Act approved the initial and ultimate development of the Alabama-Coosa River and Tributaries for flood risk management, power generation, navigation and other purposes as outlined in House Document 414, 77th Congress. House Document No. 414, 77th Congress, 1st Session, did not prescribe a specific plan for the development of the Coosawattee River. At that time the comprehensive plan for the basin provided for an upper and lower dam on the Coosawattee River with an impounding dam on the Cartecay River. As a result of subsequent studies, a more complete development of the river by a single high dam at the lower site was found to be warranted. Modification of the two-dam plan was therefore authorized.

To provide for the authorized purposes, Carters Reservoir has a total storage capacity of 472,756 acre-feet at elevation 1,099 feet NGVD29. Of that, 141,402 acre-feet are usable for conservation purposes, 89,191 acre-feet are reserved for flood damage reduction, and 242,163 acre-feet are inactive storage. The top of conservation pool is at elevation 1,074 feet NGVD29 from May through September, transitioning to 1,072 feet NGVD29 from mid-October through mid-April. The benefits and effects of the project are described in the Sections below.

The impacts of the *ACT Master Water Control Manual* and its Appendices, including this water control plan have been fully evaluated in an Environmental Impact Statement (EIS) that was published on (date). A Record of Decision (ROD) for the action was signed on (date). During the preparation of the EIS, a review of all direct, secondary and cumulative impacts was made. As detailed in the EIS, the decision to prepare the Water Control Manual and the potential impacts was coordinated with Federal and State agencies, environmental organizations, Indian tribes, and other stakeholder groups and individuals having an interest in the basin. The ROD and EIS are public documents and references to their accessible locations are available upon request.

8-02. Flood Risk Management. One of the major benefits of the water control operations of Carters is flood damage reduction. Carters Lake contains 95,683 acre-feet of flood risk management storage space between 1,099 and 1,072 feet NGVD29, in which flood water is stored and later released in moderate amounts to prevent downstream flooding. During most years, one or more flood events occur in the ACT Basin. While most of those events are of minor significance, on occasion, major storms produce widespread flooding or unusually high river stages. The main benefits of the flood risk management operations of the Carters Project are at the Towns of Resaca and Rome, Georgia.

a. Spillway Design Flood. A spillway design flood series was adopted as the criteria in establishing the top of dam. The flood of January 1947, one of the largest volume floods of record, was assumed to precede the spillway design flood with its peak occurring five days before the peak of the spillway design flood. When routed through the five-gate spillway, this series reached a peak pool elevation of 1107.3 feet NGVD29 with a maximum discharge of

197,800 cfs. Inflow-outflow-pool stage relationships for the routing of this flood using the five-gate emergency spillway are shown on Plate 8-1.

b. Standard Project Flood. Routing of the standard project flood required use of the spillway gate regulation schedule, when the pool exceeded elevation 1,099 feet NGVD29, but it was not necessary to utilize the spillway to its full capacity for this flood. When routed, the flood reached a peak pool elevation of 1,106.5 feet NGVD29 with a maximum discharge of 54,000 cfs. Inflow-outflow-pool stage relationship for this flood is shown on Plate 8-2.

c. Other Floods. The pre-record flood of March 1886 was the greatest known on the Oostanaula River and, in all probability, was equally severe in that portion of the basin above Carters Dam site. Other major floods of record resulted from the storms of April 1938, January 1947, March 1951 and April 1977. The flood of April 1938 is remarkable because of the even distribution of rainfall over the area. It produced the maximum stage of record at Ellijay and near record stages throughout the Oostanaula River Basin. The storm of January 1947, while not producing as large a peak discharge as some of the other storms, lasted for several days and would have caused a larger volume of water to be held in storage at Carters Dam during flood risk management operations. The storm of March 1951 resulted in record stages at Pine Chapel and Resaca below the Carters site and was of considerable severity in the basin above Carters Dam site. All floods of record would be confined to full power plant discharge (approximately 21,000 cfs). Typical inflow-outflow-pool stage relationships for the January 1947 and March 1951 floods, two of the larger floods volume and peak-wise, are shown on Plates 8-3 and 8-4. The flood of April 1977, the largest since the completion of the project, produced a peak pool of 1098.8 feet NGVD29 as shown on Plate 8-5.

8-03. Recreation. Carters Lake is an important recreational resource, providing significant economic and social benefits for the region and the Nation. A wide variety of recreational opportunities are provided at the lake including boating, fishing, camping, picnicking, water skiing, hunting and sightseeing. Mobile District park rangers and other project personnel conduct numerous environmental and historical education tours and presentations, as well as water safety instructional sessions each year for the benefit of area students and project visitors.

The effects of the Carters Project water control operations on recreation facilities and use at Carters Lake are described as impact lines - Initial Impact Line, Recreation Impact Line, and Water Access Limited Line. The impact lines are defined as pool elevations with associated effects on recreation facilities and exposure to hazards within the lake. The following are general descriptions of each impact line:

a. Initial Impact Line. The Initial Impact Line is defined at lake elevation 1,068 feet NGVD29. At this level impacts are first observed and there is adequate time available to notify the public should the lake level continue to drop. Action is taken to prevent more serious and lasting impacts. Swimming area buoys at Harris Branch Beach are set out at approximately elevation 1,068 feet NGVD29 when the lake is at normal summer pool level of 1,074 feet NGVD29. At the initial impact level, gate attendants issue oral messages and written warnings to the public.

b. Recreation Impact Line. The lake elevation of 1,060 feet NGVD29 is defined as the Recreation Impact Line. At this level action must be taken to prevent significant impacts from occurring. At the level of 1,060 feet NGVD29, the dangers to those participating in water based recreation activities would increase due to hazardous conditions. Steps are taken to alert the marina staff and public of existing dangers. Woodring Campground and Doll Mountain Day Use boat ramps are closed to the public when water level is below elevation 1,060 feet NGVD29.

c. Water Access Limited Line. The lake elevation of 1,055 feet NGVD29 is defined as the Water Access Impact line. At this elevation, public access to the water is severely limited. Action is taken to retain this limited access. If navigational hazards appear, they will be temporarily marked with buoys or signs for boater safety. Marina slips are still usable, but dock walkways slope severely from the shoreline. At elevation 1,055 feet NGVD29, Ridgeway boat ramp, Woodring Branch day use area boat ramp and Damsite boat ramps are closed. At elevation 1,060 feet NGVD29, the Harris Branch Beach is closed. The designated swimming area buoys are completely out of the water and cannot be moved.

Table 8-1 shows the lake elevation for each impact line and the percent of time over a 70-year simulation of the proposed operation that each impact line would be reached at Carters Lake.

Table 8-1. Carters Lake Recreational Impact Levels

	Number of Triggered Events Over Period of Record	% of time pool level falls below level
Initial Impact level	679	2.7%
Recreation Impact level	58	0.2%
Water Access Limited level	0	0.0%

High water also has a recreational impact. The facilities affected from high lake levels are described in Table 8-2.

Table 8-2. High Water Impacts on Recreation Facilities

Elevation	Facilities Information
1074.0	Full Pool
1076.0	Harris Beach – Sand on lower beach covered
1078.0	Doll Day Use – water above concrete wall in lower picnic area
1083.0	Woodring Campground - Site 15 water on power pedestal – turn off power to sites 9, 11, 13, 15
1087.0	Woodring Camping – road to sites 16 - 42 OK Sites 9,11,13,15 power turned off – at 1083 Sites 15, 30, 40, 42 flooded
1087.7	Woodring Camping – road to sites 16 – 42, water 2-3” deep Harris Br. & Doll Mtn. Campgrounds all campsites OK Woodring Day Use Ramp – 2-3” water in lower parking lot near picnic tables ramp still OK Woodring Day Use Picnic Shelter – water on access trail 6” deep
1088.5	Woodring Day Use Area ramp closed
1088.7	Damsite Ramp – water covering low spot near fee vault – upper parking lot access covered by 1-3” water Doll Day Use Ramp – turn around to launch OK – Woodring Day Use Ramp – lower parking lot covered with water 2-6” deep – ramp OK, upper parking lot OK

1089	Damsite Park is Closed
1090.0	Doll Day Use Ramp – Turn around covered, launching still possible by backing in from upper parking lot Woodring Day Use Ramp – Launching area covered, lower parking lot under water Doll Mountain Campground - Site 20 water on tent pad Damsite - Call GA Power and have them turn power off before water covers road at 1090.0 or boat will be needed to access transformer
1093.8	Damsite Georgia Power Transformer – water at base of transformer box

8-04. Water Quality. In the main reservoir, water quality is typically better in the middle of the reservoir than in the more enclosed inlets and upper arms. Sediment and nutrient concentrations are greatest in the upper tributaries and decrease towards the main body of the pool. As with other reservoirs, Carters Lake acts as a sink removing sediments and nutrients from downstream reaches. During the summer, thermal and dissolved oxygen stratification occurs. Both are greatest in the upper levels of the water column and colder, oxygen depleted water occurs at lower levels. Chlorophyll *a* concentrations tend to be greatest during the warm summer months. Because of the nature of the lake and its associated stratification, hydropower generation can release cold, oxygen depleted water to downstream reaches of the river. In addition, drought conditions can result in reduced hydropower generation and lowered downstream flows at a time when such flows are critically needed by downstream organisms.

The proposed operational procedures are designed to help reduce water quality impacts. By varying the minimum flow releases throughout the year water quality will be improved due to greater aeration in the water column and changes in water temperature. Aeration is needed because it increases dissolved oxygen levels which have a direct impact on flora and fauna. The variable month to month minimum flow releases would provide adequate flow for water quality and aquatic ecosystems while allowing water conservation during critical periods. Those improved flows would provide both improved water quality and additional spawning and migration habitat during spring and early summer when many organisms are most active.

8-05. Fish and Wildlife. Because of the type of project and the depth of the reservoir (average depth of about 380 feet, maximum depth of 410 feet), and the makeup of fish populations occurring within the watershed prior to impoundment, regulation of the project to enhance fish and wildlife within the main lake is not possible. The daily fluctuations of the main reservoir can be up to four feet which are not conducive for fish and wildlife.

However, project operations do enhance the aquatic ecosystem in the Coosawattee River downstream of the Carters Reregulation Dam. In 2000, 2003, and in the Planning Aid Letter for the Environmental Impact Statement (EIS) prepared for the update to the ACT Water Control Manuals, the U.S. Fish and Wildlife Service (USFWS) identified a seasonal varying minimum flow from the Reregulation Dam. As a result seasonal minimum releases shown on Figure 7-1 were incorporated into the operation and two Action Zones added to the conservation storage. In action Zone 1, minimum flow releases at Carters Reregulation Dam would be equal to the seasonal minimum shown on Figure 7-1. If Carters Lake were in action Zone 2, minimum flow releases from the Carters Reregulation Dam would be 240 cfs. The project is operated to comply with the Endangered Species Act of 1973 and related Biological Opinions produced by the USFWS including the Biological Opinion prepared by them during the preparation of this Water Control Manual. Such compliance will include all Terms and Conditions and Reasonable and Prudent Alternatives that would minimize impacts to specific species and avoid jeopardy to their continued existence.

8-06. Water Supply. In Carters Lake, the Corps authorized the city of Chatsworth the right to utilize 818 acre-feet of the usable conservation storage space between elevations 1,022 and 1,072 feet NGVD29. The storage space allocated under this contract is based on the need of the city of Chatsworth to have a dependable source of water to supply an average daily quantity of water per annum of 2.0 million gallons per day (MGD) during the occurrence of a once in a fifty year drought. During periods of normal or greater stream flow, the storage will yield greater quantities than the 2.0 MGD which will be available to the city. Less would be available in the storage space during more severe drought periods.

During droughts there is serious concern about protecting water supplies. The use of contracted water supply storage space will be carefully monitored to ensure contracted storage volumes are not exhausted. The Chatsworth intake structure is shown in Figure 8-1.

Water Supply storage accounting is a systematic accounting record to track valid storage users when the lake is in the conservation pool. Users get a proportion of any inflow and any losses as well as measured use. To assure that one contracted water user is not encroaching on the rights of other contracted users. This accounting is especially critical during drought. A component of the accounting is to notify users of the need for conservation measures or the need for additional water supply sources, when available drops below 30%. Formula: End Storage = Beg Storage + inflow share – loss share – user’s usage. The conservation pool is drawn down as water usage exceeds inflow. The entire pool is drawdown and the individual accounts are also drawn at different rates based on their usage. Users will be notified continually on weekly bases once the storage account drops below 30%.

Figure 8-1. The city of Chatsworth Water Intake Structure

No M&I water supply releases are made from Carters Dam specifically for downstream M&I water supply purposes. However, water released from the Reregulation Dam for its authorized project purposes, particularly during dry periods, help to ensure a reasonably stable and reliable water flow in the river to the benefit of downstream M&I water supply users. The most significant water use within the Georgia portion of the ACT Basin is for thermoelectric power generation (72.8 percent), while public water supply represents about 20 percent of the surface water withdrawals.

8-07. Hydroelectric Power. The Carters Dam Hydropower Project, along with 9 other hydropower dams located in Georgia, Alabama, and South Carolina comprise the GA-AL-SC System, one of SEPA's four power systems providing energy throughout the Southeastern United States. Other projects within the GA-AL-SC system include Allatoona, Buford, West Point, WF George, RF Henry, Millers Ferry, Hartwell, Russell, and Thurmond. SEPA sells hydroelectric power generated at Carters Dam to a number of cooperatives and municipal power providers, referred to as preference customers. Hydroelectric power is one of the cheaper forms of electrical energy, and it can be generated and supplied quickly as needed in response to changing demand.

From FY 2000-2011, the Carters Project has provided generation of 5,650,244 megawatt-hours (MWh) of the total generation in the Georgia-Alabama-South Carolina System of 37,720,506 MWh, or approximately 15 percent of the System generation.

The projects with hydropower capability provide three principal power generation benefits:

a. Hydropower helps to ensure the reliability of the electrical power system in the SEPA service area by providing dependable capacity to meet annual peak power demands. For most plants, this condition occurs when the reservoir is at its maximum elevation. Dependable capacity at hydropower plants reduces the need for additional coal, gas, oil, or nuclear generating capacity.

b. The projects provide a substantial amount of energy at a small cost relative to thermal electric generating stations, reducing the overall cost of electricity. Hydropower facilities reduce the burning of fossil fuels, thereby reducing air pollution. The value of the energy produced at Carters Project is approximately $9.5 million a year.

c. Hydropower has several valuable operating characteristics that improve the reliability and efficiency of the electric power supply system, including efficient peaking, a rapid rate of unit unloading, and rapid power availability for emergencies on the power grid.

Hydropower generation by the Carters Dam Hydropower Plant, in combination with the other hydropower power projects in the ACT Basin, helps to provide direct benefits to a large segment of the basin's population in the form of relatively low-cost power and the annual return of revenues to the Treasury of the United States. Hydropower plays an important role in meeting the electrical power demands of the region.

8-08. Navigation. Specific releases from the Carters Project to meet navigation flows are not part of the routine regulation plan. The seasonal variation in reservoir storage does redistribute downstream flows providing benefits to navigation.

8-09. Drought Contingency Plans. The importance of drought contingency plans has become increasingly obvious as more demands are placed on the water resources of the basin. During low-flow conditions, the system might not be able to fully support all project purposes. The purpose of drought planning is to minimize the effect of drought, to develop methods for identifying drought conditions, and to develop both long- and short-term measures to be used to respond to and mitigate the effects of drought conditions. For the Carters Project, the Corps will coordinate water management during drought with other federal agencies, private power companies, navigation interests, the states, and other interested state and local parties as necessary. Drought operations will be in compliance with the plan for the entire ACT Basin as outlined in the *ACT Master Water Control Manual*. The plan includes operating guidelines for drought conditions and normal conditions. It is important to recognize that Carters Dam would be operated as an element of the total water control plan for the basin. Outflows from the project would be determined by total basin-wide needs, both upstream and downstream.

Drought operations at Carters would consist of progressively reduced hydropower generation as pool levels decline. As the pool drops to the lower action Zone 2 during minimum target flows from the Reregulation Dam would be reduced from seasonal varying values to 240 cfs.

8-10. Flood Emergency Action Plans. Normally, all flood control operations are directed by the Water Management Section. If, however, a storm of flood-producing magnitude occurs and all communications are disrupted between the Water Management Section and project personnel at the Carters Dam Powerhouse, emergency operating procedures, as described in Exhibit C, Standing Instructions to the Damtenders, will begin. If communication is broken after some instructions have been received from the Water Management Section, those instructions will be followed for as long as they are applicable.

8-11. Frequencies and Probabilities. The Carters Main Pool Peak Pool Frequency and Peak Inflow Frequency for the operation plan are shown on Figure 8-2, and 8-3. Figure 8-4 shows the Carters Pool Elevation Annual Duration Curve.

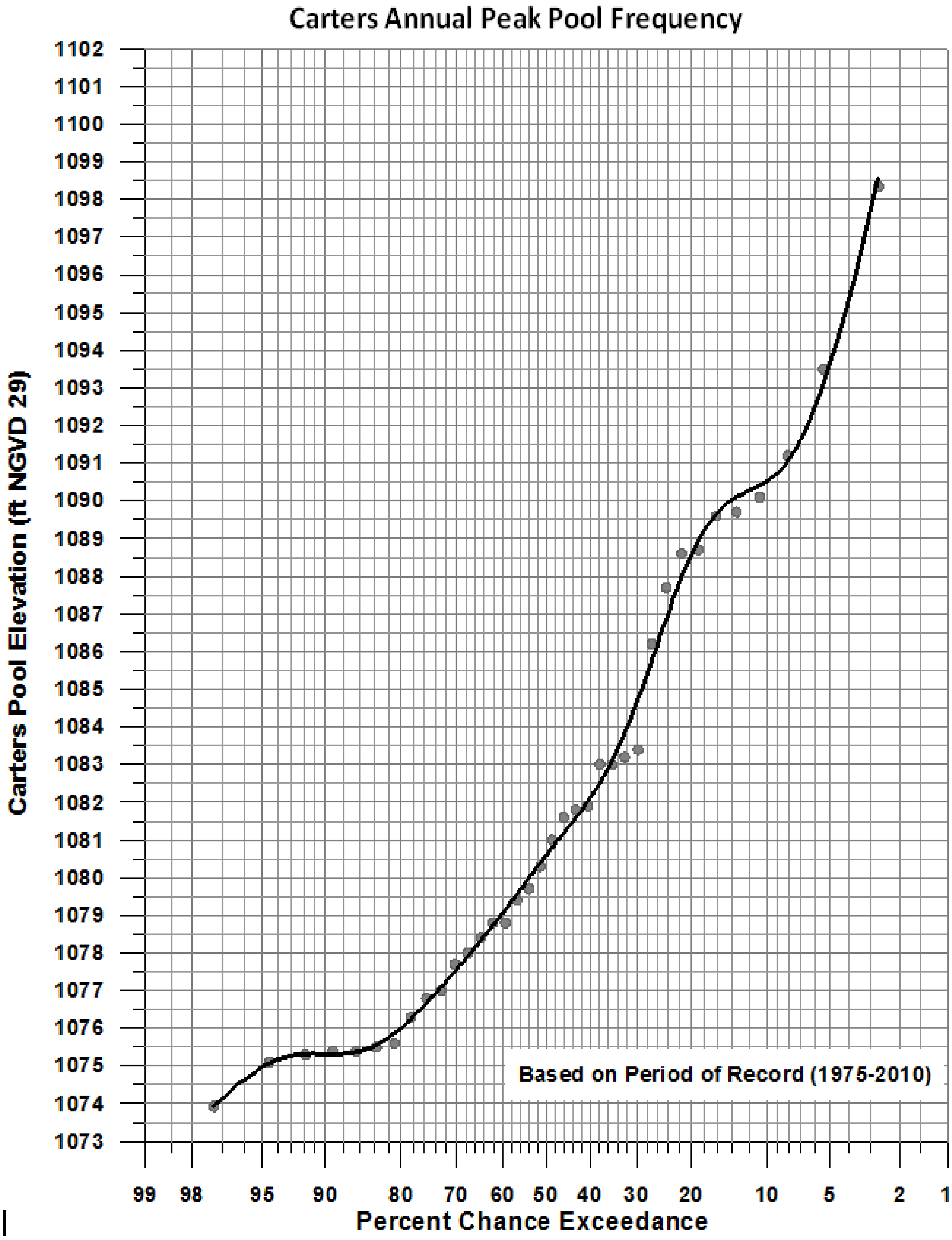


Figure 8-2. Carters Annual Peak Pool Frequency

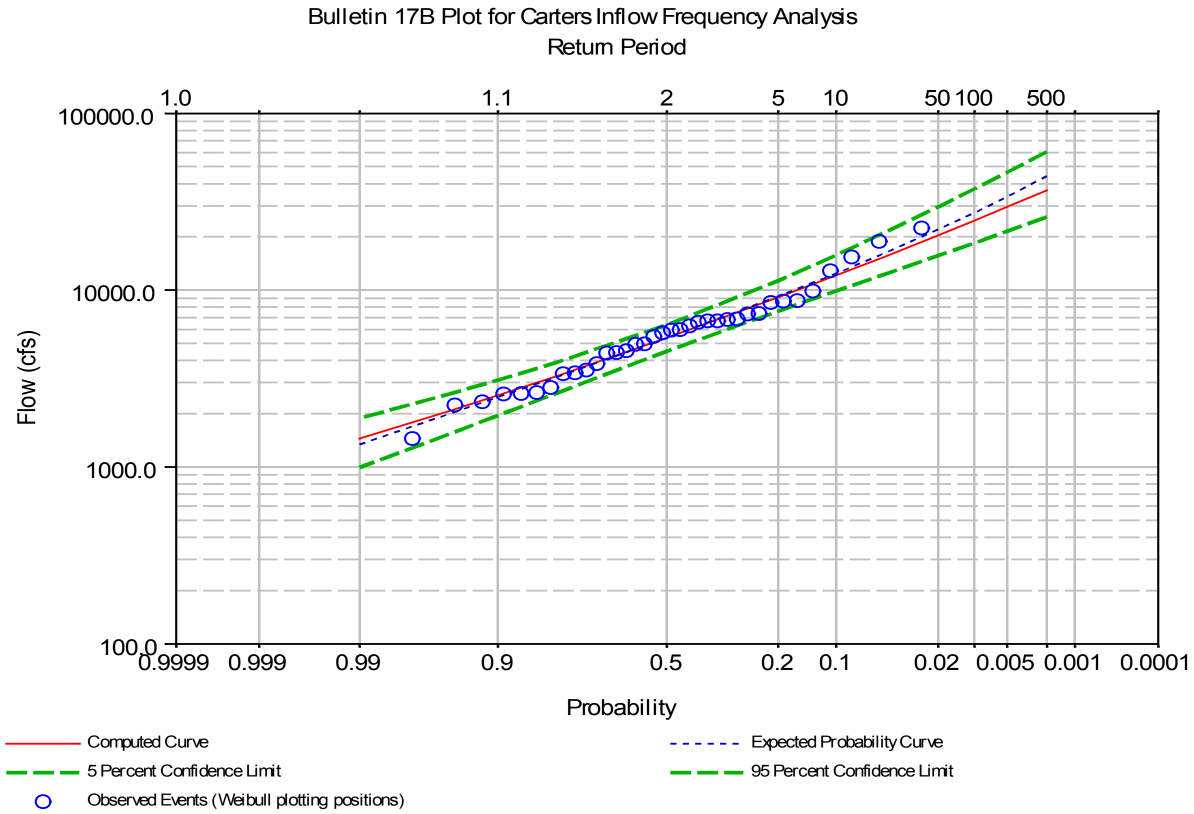


Figure 8-3. Carters Inflow Frequency

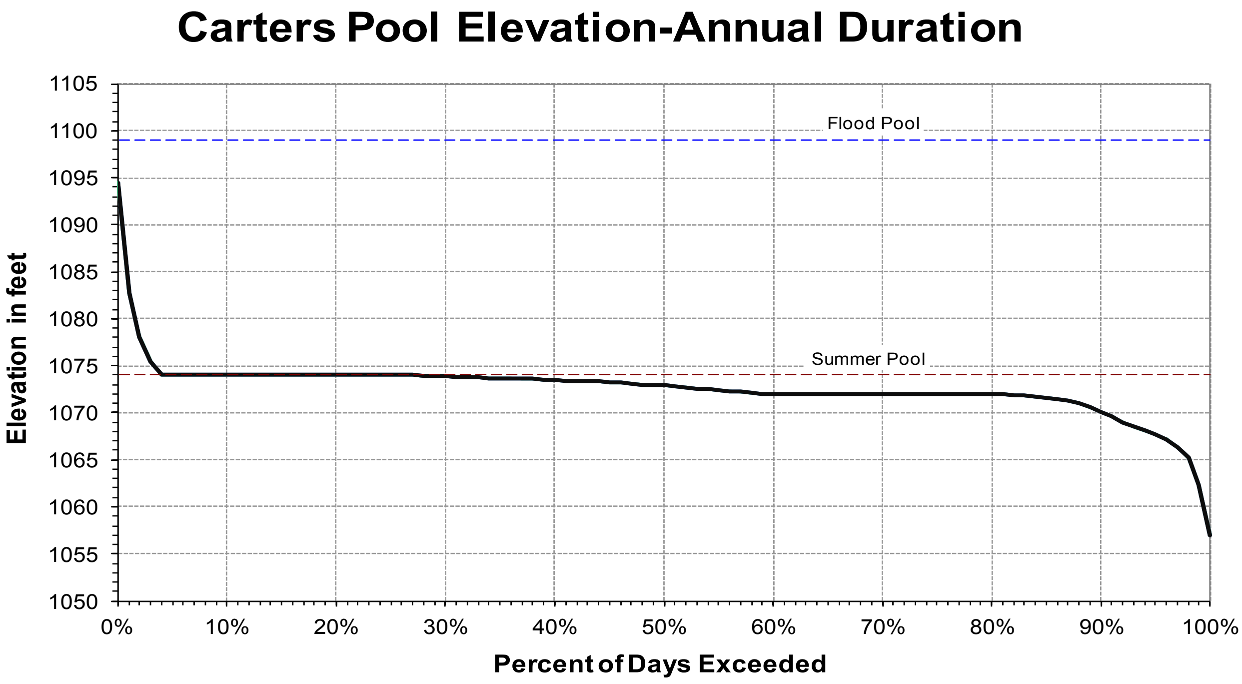


Figure 8-4. Carters Pool Elevation Annual Duration

The influence of the Reregulation Dam is shown in the Headwater and Tailwater rating curves for the Reregulation Dam area shown in Plate 8-6.

The estimated frequencies of peak flow at Pine Chapel, and Resaca with the Carters regulation plan are shown on Plates 8-7 and Plate 8-8. Frequencies of peak flow at Rome (Oostanaula River) and Rome (Coosa River at Mayo's Bar) are shown on Plate 8-9 and Plate 8-10. Annual maximum and minimum pool elevations and pool frequencies for the Carters Main Dam are shown on Plates 8-11 thru Plate 8-13.

8-12. Other Studies. In early 2010 the Corps, Mobile District, developed updated critical yields for the Allatoona and Carters Projects in the ACT Basin in response to the following language in the FY 2010 Energy & Water Development Appropriations Bill, 111th Congress, 1st Session:

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

Robert F. Henry Lock and Dam, Millers Ferry Lock and Dam and Claiborne Lock and Dam are federal projects in the ACT Basin that were excluded from the critical yield analyses because they are *run-of-river* impoundments with little or no usable water storage and cannot significantly contribute to critical yield.

Critical yield provides the basis from which water stored in a reservoir is allocated to various project purposes. The volume of water stored in a reservoir can be allocated to a specific project purpose (e.g., hydropower or water supply) based on a percent of critical yield. A change in critical yield may result in modification of the allocations for a project purpose.

The impacts of the river withdrawals on the critical yield can be quantified by computing the critical yield with and without diversions. Withdrawals for the year 2006 was used in the analyses and showed that river withdrawals had a measurable impact, reducing critical yield as much as five percent at Allatoona Dam but only 0.8 percent at Carters Dam. The critical yield for Carters was determined to be 390 cfs without diversions and 387 cfs with diversions. The critical drought for the period of record occurred in 2007.

In 2000, 2003, and in the Planning Aid Letter for the EIS (USFWS 2010a), the U.S. Fish and Wildlife Service identified the need for a seasonal varying minimum flow from the Reregulation Dam. As a result seasonal minimum releases were incorporated into the operation and two Action Zones added to the conservation storage and are shown on Figure 7-1.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization. Many agencies in federal and state governments are responsible for developing and monitoring water resources in the ACT Basin. Some of the federal agencies are the Corps, U.S. Environmental Protection Agency, National Parks Service, U.S. Coast Guard, USGS, U.S. Department of Energy, U.S. Department of Agriculture, U.S. Fish and Wildlife, and NOAA. In addition to the federal agencies, each state has agencies involved: GAEPD, the Coosa-North Georgia Regional Water Planning Council, and the Alabama Department of Environmental Management, Alabama Office of Water Resources.

a. U.S. Army Corps of Engineers. Authority for water control regulation of the Carters Project has been delegated to the SAD Commander. The responsibility for water control regulation activities has been entrusted to the Mobile District. Water control actions for the Carters Project are regulated to meet the federally authorized project purposes at Carters in coordination with other authorized projects in the ACT Basin. It is Mobile District's responsibility to develop water control regulation procedures for the Carters Project. The Water Management Section monitors the project for compliance with the approved water control plan. In accordance with the water control plan, the Water Management Section performs water control regulation activities that include determination of project water releases, daily declarations of water availability for hydropower generation and other purposes; daily and weekly reservoir pool elevation and release projections; weekly river basin status reports; tracking basin composite conservation storage and projections; determining and monitoring daily and 7-day basin inflow; managing high-flow operations and regulation; and coordination with other District elements and basin stakeholders. When necessary, the Water Management Section instructs the project operator regarding normal water control regulation procedures and emergencies, such as flood events. Personnel at Carters Dam are under the direct supervision of a power plant manager and operations project manager. The Water Management Section communicates directly with the powerhouse operators at the Carters Dam Powerhouse and with other project personnel as necessary. The Water Management Section is also responsible for collecting historical project data and disseminating water control information, such as historical data, lake level and flow forecasts, and weekly basin reports within the agency; to other federal, state, and local agencies; and to the general public.

b. Other Federal Agencies.

1) National Weather Service (NWS). The NWS is the federal agency in NOAA that is responsible for weather warnings and weather forecasts. With support from the Corps NWS Cooperative Gaging program, the NWS forecast offices, along with SERFC, maintain a network of rainfall and flood reporting stations throughout the Carters Watershed and the ACT Basin. It continuously provides weather conditions and forecasts. The SERFC prepares river forecasts and provides the official flood stage forecasts along the ACF Rivers. Often, it prepares predictions on the basis of what if scenarios, such as QPF - a prediction of the spatial precipitation across the United States and the region. The Corps, NWS, and SERFC share information regarding rainfall, project data, and streamflow forecasts. In addition, the NWS provides information on hurricane forecasts and other severe weather conditions. It monitors drought conditions and provides the information to the public.

2) U.S. Geological Survey (USGS). The USGS is an unbiased, multidisciplinary science organization that focuses on biology, geography, geology, geospatial information, and water.

The agency is responsible for the timely, relevant, and impartial study of the landscape, natural resources, and natural hazards. Through the Corps USGS Cooperative Gaging program, the USGS maintains a comprehensive network of gages in the ACT Basin.

3) Southeastern Power Administration (SEPA). SEPA was created in 1950 by the Secretary of the Interior to carry out the functions assigned to the secretary by the Flood Control Act of 1944. In 1977, SEPA was transferred to the newly created U.S. Department of Energy. SEPA, headquartered in Elberton, Georgia, is responsible for marketing electric power and energy generated at reservoirs operated by the Corps. The power is marketed to more than 491 preference customers in Georgia, Florida, Alabama, Mississippi, southern Illinois, Virginia, Tennessee, Kentucky, North Carolina, and South Carolina.

a. The objectives of SEPA are to market electricity generated by the federal reservoir projects, while encouraging its widespread use at the lowest possible cost to consumers. Power rates are formulated using sound financial principles. Preference in the sale of power is given to public bodies and cooperatives, referred to as preference customers. SEPA does not own transmission facilities and must contract with other utilities to provide transmission, or *wheeling* services, for the federal power.

b. SEPA's responsibilities include the negotiation, preparation, execution, and administration of contracts for the sale of electric power; preparation of repayment studies to set wholesale rates; the provision, by construction, contract or otherwise, of transmission and related facilities to interconnect reservoir projects and to serve contractual loads; and activities pertaining to the operation of power facilities to ensure and maintain continuity of electric service to its customer.

c. SEPA schedules the hourly generation for the Carters power project at the direction of the Corps on the basis of daily and weekly water volume availability declarations and water release requirements.

4) U.S. Fish and Wildlife Service (USFWS). The USFWS is an agency within the Department of the Interior whose mission is working with others to conserve, protect and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The USFWS is the responsible agency for the protection of federally listed threatened and endangered species and their federally designated critical habitat in accordance with the Endangered Species Act of 1973. The Corps also coordinates with the USFWS on water resource actions under the auspices of the Fish & Wildlife Coordination Act. The Corps, Mobile District, with support from the Water Management Section, coordinates water control actions and management with USFWS in accordance with both laws.

c. State Agencies.

1) Georgia. Georgia Environmental Protection Division (GAEPD) conducts water resource assessments to determine a sound scientific understanding of the condition of the water resources, in terms of the quantity of surface water and groundwater available to support current and future in-stream and off-stream uses and the capacity of the surface water resources to assimilate pollution. Regional water planning councils in Georgia prepare recommended Water Development and Conservation Plans. Those regional plans promote the sustainable use of Georgia's waters through the selection of an array of management practices, to support the state's economy, to protect public health and natural systems, and to enhance the quality of life for all citizens.

2) Alabama. Alabama Office of Water Resources (OWR) administers programs for river basin management, river assessment, water supply assistance, water conservation, flood mapping, the National Flood Insurance Program and water resources development. Further, OWR serves as the state liaison with federal agencies on major water resources related projects, conducts any special studies on instream flow needs, and administers environmental education and outreach programs to increase awareness of Alabama's water resources.

a. The Alabama Department of Environmental Management (ADEM) Drinking Water Branch works closely with the more than 700 water systems in Alabama that provide safe drinking water to four million citizens.

b. The Alabama Chapter of the Soils and Water Conservation Society fosters the science and the art of soil, water, and related natural resource management to achieve sustainability.

d. <u>Private Organizations</u>. The Alabama Power Company (APC) owns and operates hydropower projects downstream of Carters Project throughout the Coosa Basin. These projects are discussed in the ACT Master Water Control Manual.

e. <u>Stakeholders</u>. Many nonfederal stakeholder interest groups are active in the ACT Basin. These groups include lake associations, M&I water users, navigation interests, environmental organizations, and other basin-wide interests groups. Coordinating water management activities with these interest groups, state and federal agencies, and others is accomplished as required on an ad-hoc basis and on regularly scheduled water management teleconferences that occur during unusual flood or drought conditions to share information regarding water control regulation actions and gather stakeholder feedback. The Master Manual includes a list of state and federal agencies and active stakeholders in the ACT Basin that have participated in the ACT Basin water management teleconferences and meetings.

9-02. Interagency Coordination.

a. <u>Local Press and Corps Bulletins</u>. The local press consists of periodic publications in or near the Carters watershed and the ACT Basin. Montgomery, Gadsden, Anniston and Birmingham, Alabama, and Rome and Atlanta, Georgia, have some of the larger daily papers. The papers often publish articles related to the rivers and streams. Their representatives have direct contact with the Corps through the Public Affairs Office. In addition, they can access the Corps Web pages. The Corps and the Mobile District publish e-newsletters regularly which are made available to the general public via email and postings on various websites. Complete, real-time information is available at the Mobile District's Water Management homepage <u>http://water.sam.usace.army.mil/</u>. During the hurricane season, the Water Management Section posts tropical updates to District and Division elements. The Mobile District Public Affairs Office issues press releases as necessary to provide the public with information regarding Water Management issues and activities. During floods, the Water Management Section prepares daily flood notices in cooperation with the Emergency Management Branch of Operations Division of the Mobile District Office.

9-03. Framework for Water Management Changes. Special interest groups often request modifications of the basin water control plan or project specific water control plan. The Carters Project and other ACT Basin projects were constructed to meet specific, authorized purposes, and major changes in the water control plans would require modifying, either the project itself or the purposes for which the projects were built. However, continued increases in the use of water resources demand constant monitoring and evaluating reservoir regulations and reservoir systems to insure their most efficient use. Within the constraints of congressional authorizations and engineering regulations, the water control plan and operating techniques are often reviewed to see if improvements are possible without violating authorized project functions. When deemed appropriate, temporary variances to the water control plan approved by SAD can be implemented to provide the most efficient regulation while balancing the multiple purposes of the ACT Basin-wide System.

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

EXHIBIT A
SUPPLEMENTARY PERTINENT DATA

LOCATION AND PURPOSE

Location. The project site is located on the Coosawattee River in Gordon County, Georgia. The Main Dam is located at mile 26.8 and the downstream Reregulation Dam is located at mile 25.3. Carters Project is designed primarily for flood risk management and hydroelectric power. Flow regulation, recreation, fish and wildlife conservation, and, water quality control are additional benefits of the project.

GENERAL

Main Dam Drainage Area, sq. mi.	374
Reregulation Dam Drainage Area, sq. mi.	521
Talking Rock Creek Drainage Area, sq. mi.	148
Primary flood risk mgt. pool elevation, ft. above NGVD29	1,099
Max. power pool elev.(wet season), ft. above NGVD29	1,072
Max. power pool elev.(dry season), ft. above NGVD29	1,074
Min. power pool elev., ft. above NGVD 29	1,022
Max. drawdown, feet	52
Area of primary flood risk management pool, acres	3,880
Area of maximum power pool, acres	3,275
Area of minimum power pool, acres	2,196
Flood storage volume, acre-feet (1,099 – 1072 ft NGVD29)	95,683
Power storage volume, acre-feet (1074 – 1022 ft NGVD29)	141,402
Inactive storage volume, acre-feet	242,163
Maximum elevation of clearing, ft. above NGVD29	1075

SPILLWAY DESIGN FLOOD

Natural peak discharge at dam site, cfs	194,200
Peak inflow to full reservoir, cfs	203,100
Regulated peak outflow, cfs	197,800
Regulated peak headwater, ft. above NGVD 29	1107.2

STANDARD PROJECT FLOOD

Natural peak discharge at dam site, cfs	97,600
Natural peak stage at dam site, ft. above NGVD29	716.8
Peak inflow to full reservoir, cfs	102,000
Peak inflow to reregulation pool, cfs	90,400
Regulated peak outflow, cfs	54,000
Regulated peak headwater, ft. above NGVD29	1,106.5
Regulated peak tailwater, ft. above NGVD29	707.0

MAIN DAM AND DIKES

ROCKFILL DAM

Top elevation, feet above NGVD29	1,112.3
Top width, feet	40
Length, feet	2,053
Maximum height, feet above foundation	445
Upstream slope	1 on 1.9
Downstream slope	1 on 1.8
Freeboard, top of dam above Spillway Design Flood, ft.	5.1

EARTHFILL SADDLE DIKES

Top elevation, feet above NGVD29	1,112.3
Top width, feet	30
Number of dikes	3
Total length, feet	700
Maximum height, feet	40
Side slopes	1 on 2.5
Upstream slope protection	dumped rock
Freeboard, top of dikes above Spillway Design Flood, ft.	5.1

EMERGENCY GATED SPILLWAY

GENERAL

Total length, including end piers, ft.	262
Net length, ft.	210
Elevation of crest, ft. above NGVD29	1,070.0
Type of gates	tainter
Number of gates	5
Length of Gates	42
Height of Gates	36.5
Top of Gates, Closed	1106.0

DIVERSION TUNNEL

GENERAL

Length, ft.	2,407
Shape	horseshoe
Lining	none
Bottom width, ft.	23

Maximum height, ft.	23

EMERGENCY LOW LEVEL SLUICE

GENERAL

Number of sluices	1
Total length of tunnel, ft.	2,712

TUNNEL UPSTREAM OF GATE STRUCTURE

Length of tunnel, ft.	1,198
Shape	circular
Lining	concrete
Nominal diameter of excavated tunnel, ft.	19.5
Diameter of lined tunnel, ft.	16.5
Invert elevation at upstream portal, ft. above NGVD29	725

GATE STRUCTURE

Length of structure, ft.	62
Number of water passages	2
Invert elevation of water passages, ft. above NGVD29	723
Number of gates per passage	2
Total number of gates	4
Type of gates	slide
Height of gates, ft.	10
Width of gates, ft.	5
Type of operating machinery	hydraulic
Nominal diameter of excavated shaft for combined emergency access and air vent, ft.	10

TUNNEL DOWNSTREAM OF GATE STRUCTURE

Length of tunnel, feet	1,452
Shape	horseshoe
Lining	none
Bottom width, ft.	22
Maximum height, ft.	22
Length of concrete splash apron, ft.200	200
Invert elevation at downstream portal, ft. above NGVD29	710

DOWNSTREAM CHANNEL

Length, ft.	640
Maximum bottom width, ft.	50
Side slopes:	
Sound rock	4 on 1
Weathered rock	1 on 1
Overburden	1 on 2
Bottom elevation at downstream end of channel, ft. above NGVD29	700

POWER INTAKE

GENERAL

Number of intake structures	2

HEADRACE

Length (approximate), ft.	1,600
Width (minimum section), ft.	200
Side slopes	4 on 1
Bottom elevation, ft. above NGVD29	979.0

INTAKE STRUCTURES

Top elevation, ft. above NGVD29	1,112.5
Width of each structure, ft.	94
Length of base, ft. (excluding transition)	51
Maximum height, ft.	138.5
Type of head gate	tractor
Number of head gates, each structure	2
Height of gate, ft.	20.5
Width of gate, ft.	14
Type of operation	fixed hoist
Elevation of operating deck, ft. above NGVD29	1,112.5

PENSTOCKS

Number	4
Length of conventional unit penstocks, ft.	835
Length of pump-turbine unit penstocks, ft.	838
Nominal diameter of excavated tunnel, ft.	23
Inside diameter of steel-lined penstock, ft.	18
Minimum thickness of concrete liner, inches	30

POWER DATA

GENERAL

Number of units	4
Capacity: 2 @ 140,000 and 2 @ 160,000 kw (declared values)	600,000
Capacity: 4 @ 144,000 kw (nameplate values)	575,000
Dependable plant output during critical period, kw	500,000
Operating head at maximum power pool, ft.	396
Minimum head at full drawdown, ft.	324
Maximum head loss at 115% generator rating, ft.	4.8
Maximum discharge per unit at 115% generator rating (conventional unit), cfs	5,400
Maximum discharge per unit at 115% generator rating (pump-turbine unit), cfs	5,400
Discharge each pump-turbine unit at 385 feet total head, cfs	3,765
Maximum discharge at minimum power pool, elev. 1022, (estimated for 4 units), cfs	20,900

GENERATING UNITS 1 AND 2 ONLY

Speed-RPM	163.6
Spacing of units, center to center, ft.	63
Turbines	
Type	Francis, clockwise rotation
Capacity, guaranteed at 345.0 ft. net head, HP, each	172,000
Capacity, guaranteed at 393.0 ft. net head, HP, each	199,000
Spiral cases	Plate steel
Draft tubes	Concrete elbow, three discharge/intake passages
Generators	
Type – Vertical shaft, with combined thrust and guide bearing below rotor and with air enclosure for self-ventilation.	
Ratings	
Continuous at 60^{o}C. rise	125,000 kw; 131,579 kVA
Continuous capability at 1.15 rating	143,750 kw; 151,516 kVA
Power factor	0.95
Voltage, 60 hertz, 3-phase	13,800
Short circuit ratio, not less than	1.175
Fly wheel effect (WK^2 LBS-FT^2)	95,700,000
Ratio, Xq”/Xd”’ not more than	1.35

GENERATOR/MOTOR UNITS 3 AND 4 ONLY

Speed-RPM	150
Spacing of units, center to center, ft.	63
Pump/Turbines	
Type – Francis, clockwise rotation as turbine; counter-clockwise rotation as pump	
Capacity, guaranteed at 345.0 ft. net head, HP, each, as a turbine	173,000
Capacity, guaranteed at 376.0 ft. net head, HP, each, as a turbine	209,000
Capacity, guaranteed at 347 ft. total head, eff	87.6%
Capacity, guaranteed at 383 ft. total head, eff	87.2%
Spiral cases	plate steel
Draft tubes	Concrete elbow, three discharge/intake passages
Generator/Motors	
Type – Vertical shaft, with thrust-bearing above and below rotor, and with air enclosure for self-ventilation.	
Ratings	
As Generator	
Continuous at 60^{o}C. rise	125,000 kw; 131,576 kVA
Continuous capability at 1.15 rating	143,750 kw; 151,316 kVA
Power factor	0.95
Voltage, 60 hertz, 3-phase	13,800
Short circuit ratio, not less than	1.175
Fly wheel effect (WK^2 LBS-FT^2)	90,000,000
As Motor	

Output, rated, horsepower	185,000
Power factor	0.95
Voltage, 60 hertz, 3-phase	13,800
Speed rpm	150

POWERHOUSE

GENERAL

Location right bank about 200 feet below the downstream toe of the main dam and 700 feet northward from the river channel

Size of Building

Length, feet (including unloading bay)	361.5
Width, feet (including draft tube deck)	114.25
Entrance wing	"L" shaped

ELEVATIONS, FEET NGVD29

Bottom of Structure	603.2
Low point of draft tube (Units 1 & 2)	620.0
(Units 3 & 4)	615.67
Centerline of distributor (Units 1 & 2)	658.0
(Units 3 & 4)	649.0
Turbine room floor (Units 1 & 2)	676.0
Generator room floor (Units 1 & 2)	691.0
(Units 3 & 4)	676.0
Control room	691.0
Erection floor	708.0
Unloading floor	708.0
Draft tube deck	708.0
Crane runway rail	737.5
Roof, high point	758.08
Top of parapet	761.92

DRAFT TUBE GATES

Type	Vertical Life, Slide
Number	3
Size, Ft (Approx.)	13' 9-1/2" X 20' 1-1/2"
Method of Handling	Gantry Crane

DRAFT TUBE TRASH RACKS (Units 3 & 4 Only)

Type	Vertical Life, Slide
Number	6
Size, Ft (Approx.)	13' 9-1/2" X 21' 8-1/2"
Method of Handling	Gantry Crane

MAIN POWER TRANSFORMERS

Units 1 and 2	
Location	On draft tube deck
Number	2
Type	3-phase, FOA
Rating	140/156.8 mVA, 55/60°C. temp. rise
Low voltage delta connected	13.2 kV
High voltage, wye connected, grounded	230 kV
Taps, Full capacity, above normal	1-2 1/2 % & 1-5%
below normal	1-2 1/2 % & 1-5%
Fire Protection, permanent Installation	water, fog
Units 3 and 4	
Location	On draft tube deck
Number	2
Rating	158/176.96 mVA, 55/65°C. temp. rise
Low voltage delta connected	13.2 kV
High voltage, wye connected, grounded	230 kV
Taps, Full capacity, above normal	1-2 1/2 % & 1-5%
below normal	1-2 1/2 % & 1-5%
Fire Protection, permanent Installation	water, fog

STATION DRAINAGE

Unwatering Sumps, for unwatering draft tubes and spiral cases

Location	Erection Bay and Unloading Bay
Number of Sumps	2
Pumps	
Number	6
Capacity, each	2 @ 300GPM and 4@1,500 GPM
Control	water level automatic

STATION DRAINAGE SUMPS

Location	Erection Bay and Unloading Bay
Number of Sumps	2
Pumps	
Number	4
Capacity, each	300GPM
Control	water level automatic

STATION SERVICE SYSTEM

Normal Supply	From generator step-up transformer leads through two 1000/1333 kVA, 3- phase, self-cooled, forced air ventilated, dry type (Class AA/FA) transformers, 13,800-480 volts, delta- delta connected, with two 2.5% full capacity taps above and below 13,800 volts.
Emergency Supply	Diesel engine driven generator
Main 480 Volt Distribution	Metal-enclosed low voltage power circuit breaker switchgear, with 2-section bus and bus tie circuit breaker. Circuit breakers withdrawal type, those in mains and bus ties electrically operated, those in branches manually operated.
Subsidiary Centers	Metal-enclosed power distribution and motor control centers and panel boards, with molded case circuit breakers.

DIRECT CURRENT SYSTEM

Station Battery	125 volt, 58 cell, valve regulated lead acid, 1400 ampere- hours capacity at 8-hour discharge rate.
Battery Chargers for 125-Volt Station Battery	Two static chargers, AC Inputs: 416-506 volts; 60 amperes, 3- phase, 60 HZ. DC Output: 120-147 volts; 250 amperes.
Switchyard Battery	125 volt, 60 cell, valve regulated lead acid, 150 ampere-hours capacity at 8 hour discharge rate
Battery Chargers for 125-Volt Switchyard Battery	Static type, rack mounted, 125 volt battery charger; AC Input 208 volts 29 amperes, single phase, 60 Hz. DC output 130 volts, 25 amperes.

CRANES

Type	Powerhouse, traveling, with two trolleys and lifting beam
Number	1
Capacity of each main hoist, tons	180
Capacity of each auxiliary hoist, tons	25
Capacity, main hoist and lifting beam, tons	360
Span, ft	61’-6”

RAW WATER

Cooling Water

Units 1 and 2

Pumps

Number	3
Type	Horizontal, centrifugal, single stage, single suction
Capacity	1435 GPM
Motor	50 HP, 1750 RPM

Units 3 and 4	
Pumps; Number	3
Type	Horizontal, centrifugal, single stage, single suction
Capacity	1800 GPM
Motor	60 HP, 1750 RPM
Station Service	
Standby Pump; Number	1
Type	Horizontal, centrifugal, single stage, single suction
Capacity	335 GPM
Motor	25 HP, 3500 RPM

COMPRESSED AIR

Service Air

Compressors; Number	2
Type	Gardner-Denver, screw type
Capacity	100 SCFM at 100 PSIG
Motor	25 HP, 1750 RPM
Main Receiver; Number	1
Capacity	96 CF
Air Brake Receiver; Number	4
Capacity	19 CF

GOVERNOR AIR

Compressors; Number 1	
Type	Air cooled, vertical, two stage
Capacity	22.3 SCFM at 350 PSIG
Motor	10 HP, 1750 RPM

TAILWATER DEPRESSION

Compressors; Number	2
Type	Sullair, screw type
Capacity	683 SCFM at 125 PSIG
Motor	150 HP
Receiver Tanks	6 at 651 CF each

REREGULATION DAM

GENERAL

Dam site, miles above mouth of Coosawattee River	25
Drainage area above dam site, square miles	521
Drainage area of reregulation dam only, square miles	148

RESERVOIR

Maximum storage pool elevation, ft. above NGVD29	698
Maximum normal operating pool elevation, ft. above NGVD29	696
Minimum pool elevation, ft. above NGVD29	662.5
Minimum normal operating pool elevation, ft. above NGVD29	677
Area at maximum storage pool, acres	870
Area at minimum pool, acres	50
Usable storage, acre-feet (elevation 698 ft NGVD29)	17,460
Inactive storage, acre-feet	290
Area acquired, acres	1,373
Maximum elevation of clearing, ft. above NGVD29	700
Area cleared, acres	320

SPILLWAY

Total length, including end piers, ft.	208
Net length, ft.	168
Elevation of crest, ft. above NGVD29	662.5
Number of piers, including end piers	5
Width of piers, ft.	8
Type of gates	tainter
Number of gates	4
Length of gates, ft.	42
Height of gates, ft.	36.5
Elevation of top of gates in closed position, ft. above NGVD29	699.0
Elevation of low steel of gates in fully open position, ft. above NGVD29	699.0
Elevation of trunnion, ft. above NGVD29	675.0
Elevation of access bridge, ft. above NGVD29	717.0
Elevation of stilling basin apron, ft. above NGVD29	647.5
Length of stilling basin, ft.	40
Height of end sill, ft.	4

EARTH DIKES

Top elevation, ft. above NGVD29	703.0
Length, ft.	2,855
Top width of right dike, ft.	32
Top width of left dike, ft.	12
Side slopes	1 on 3
Thickness of riprap, inches	24
Thickness of filter material, inches	9
Thickness of dumped rock, inches	60

EXHIBIT B

UNIT CONVERSIONS

AREA CONVERSION

UNIT	m^2	km^2	ha	in^2	ft^2	yd^2	mi^2	ac
1 m^2	1	10^{-6}	10^{-4}	1550	10.76	1.196	3.86 X 10^{-7}	2.47 X 10^{-4}
1 km^2	10^6	1	100	1.55 X 10^9	1.076 X 10^7	1.196 X 10^6	0.3861	247.1
1 ha	10^4	0.01	1	1.55 X 10^7	1.076 X 10^7	1.196 X 10^4	3.86 X 10^{-3}	2,471
1 in^2	6.45 X 10^{-4}	6.45 X 10^{10}	6.45 X 10^{-8}	1	6.94 X 10^{-3}	7.7 X 10^{-4}	2.49 X 10^{-10}	1.57 X 10^7
1 ft^2	.0929	9.29 X 10^{-8}	9.29 X 10^{-6}	144	1	0.111	3.59 X 10^{-8}	2.3 X 10^{-5}
1 yd^2	0.8361	8.36 X 10^{-7}	8.36 X 10^{-5}	1296	9	1	3.23 X 10^{-7}	2.07 X 10^{-4}
1 mi^2	2.59 X 10^6	2.59	259	4.01 X 10^9	2.79 X 10^7	3.098 X 10^6	1	640
1 ac	4047	0.004047	0.4047	6. 27 X 10^6	43560	4840	1.56 X 10^{-3}	1

LENGTH CONVERSION

UNIT	cm	m	km	in.	ft	yd	mi
cm	1	0.01	0.0001	0.3937	0.0328	0.0109	6.21 X 10^{-6}
m	100	1	0.001	39.37	3.281	1.094	6.21 X 10^{-4}
km	10^5	1000	1	39,370	3281	1093.6	0.621
in.	2.54	0.0254	2.54 X 10^{-5}	1	0.0833	0.0278	1.58 X 10^{-5}
ft	30.48	0.3048	3.05 X 10^{-4}	12	1	0.33	1.89 X 10^{-4}
yd	91.44	0.9144	9.14 X 10^{-4}	36	3	1	5.68 X 10^{-4}
mi	1.01 X 10^5	1.61 X 10^3	1.6093	63,360	5280	1760	1

FLOW CONVERSION

UNIT	m^3/s	m^3/day	l/s	ft^3/s	ft^3/day	ac-ft/day	gal/min	gal/day	mgd
m^3/s	1	86,400	1000	35.31	3.05 X 10^6	70.05	1.58 X 10^4	2.28 X 10^7	22.824
m^3/day	1.16 X 10^{-5}	1	0.0116	4.09 X 10^{-4}	35.31	8.1 X 10^{-4}	0.1835	264.17	2.64 X 10^{-4}
l/s	0.001	86.4	1	0.0353	3051.2	0.070	15.85	2.28 X 10^4	2.28 X 10^{-2}
ft^3/s	0.0283	2446.6	28.32	1	8.64 X 10^4	1.984	448.8	6.46 X 10^5	0.646
ft^3/day	3.28 X 10^{-7}	1233.5	3.28 X 10^{-4}	1.16 X 10^{-5}	1	2.3 X 10^{-5}	5.19 X 10^{-3}	7.48	7.48 X 10^{-6}
ac-ft/day	0.0143	5.451	14.276	0.5042	43,560	1	226.28	3.26 X 10^5	0.3258
gal/min	6.3 X 10^{-5}	0.00379	0.0631	2.23 X 10^{-3}	192.5	4.42 X 10^{-3}	1	1440	1.44 X 10^{-3}
gal/day	4.3 X 10^{-8}	3785	4.38 X10^{-4}	1.55 X 10^{-6}	11,337	3.07 X 10^{-6}	6.94 X 10^{-4}	1	10^{-6}
mgd	0.0438		43.82	1.55	1.34 X 10^5	3.07	694	10^6	1

VOLUME CONVERSION

UNIT	liters	m^3	in^3	ft^3	gal	ac-ft	million gal
liters	1	0.001	61.02	0.0353	0.264	8.1 X 10^{-7}	2.64 X 10^{-7}
m^3	1000	1	61,023	35.31	264.17	8.1 X 10^{-4}	2.64 X 10^{-4}
in^3	1.64 X 10^{-2}	1.64 X 10^{-5}	1	5.79 X 10^{-4}	4.33 X 10^{-3}	1.218 X 10^{-8}	4.33 X 10^{-9}
ft^3	28.317	0.02832	1728	1	7.48	2.296 X 10^{-5}	7.48 X 10^6
gal	3.785	3.78 X 10^{-3}	231	0.134	1	3.07 X 10^{-6}	10^6
ac-ft	1.23 X 10^6	1233.5	75.3 X 10^6	43,560	3.26 X 10^5	1	0.3260
million gallon	3.785 X 10^6	3785	2.31 X 10^8	1.34 X 10^5	10^6	3.0684	1

COMMON CONVERSIONS

1 million gallons per day (mgd) = 1.55 cfs
1 day-second-ft (DSF) = 1.9835 acre-ft
1 cubic foot per second of water falling 8.81 feet = 1 horsepower
1 cubic foot per second of water falling 11.0 feet at 80% efficiency = 1 horsepower
1 inch of depth over one square mile = 2,323,200 cubic feet
1 inch of depth over one square mile = 0.737 cubic feet per second for one year.

VERTICAL DATUM CONVERSION INFORMATION

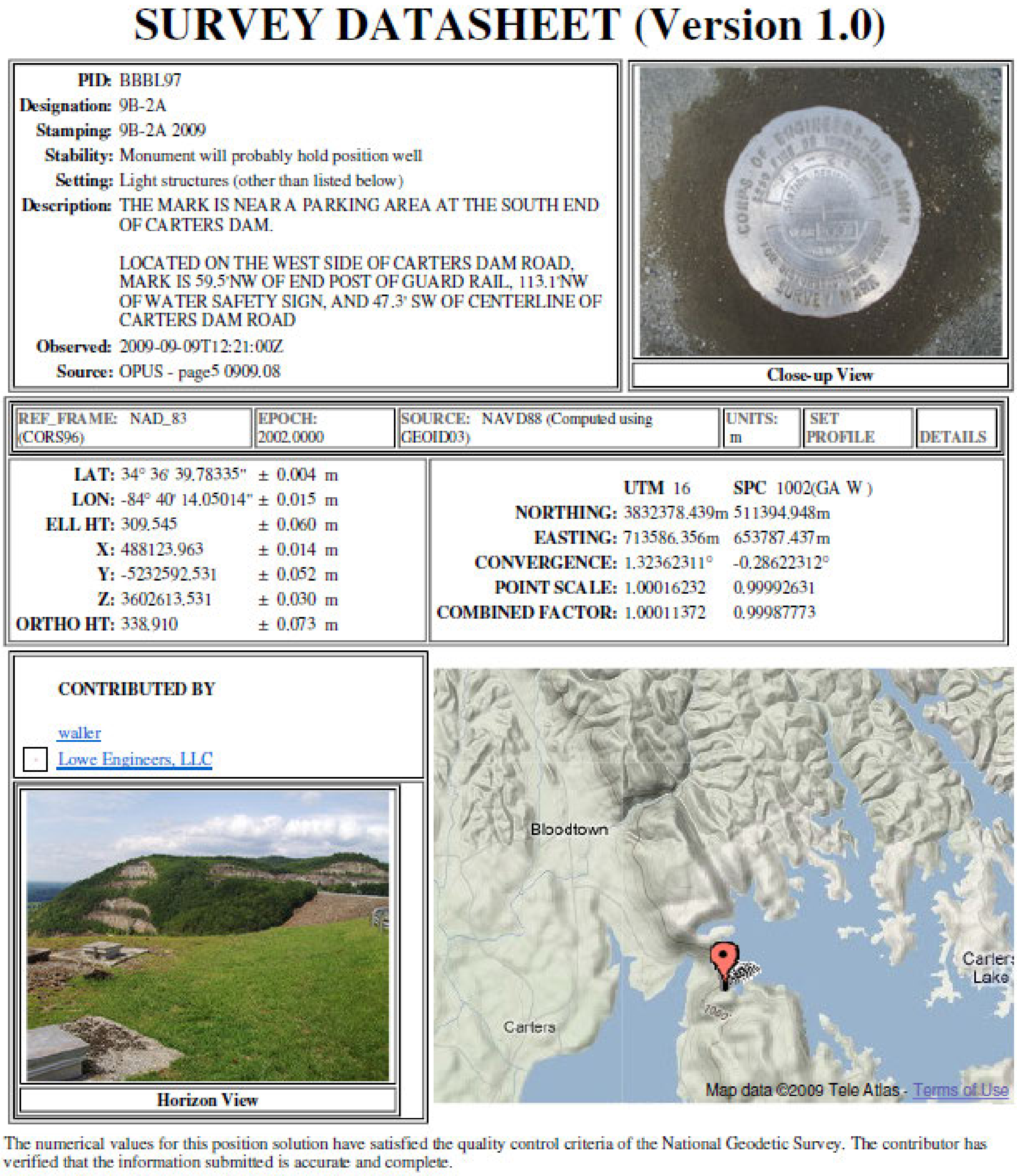
LEVEL ABSTRACT

SURVEY OF CARTERS LAKE
ORDER 3rd
DATE
9/1/2009

ABSTRACTED BY SCN
ADJUSTED BY SCN
CHECK BY SCN
RUN BY TRD

VERTICAL DATUM NAVD88

STATION	# OF	F OR B	SUM OF ROD READINGS		DIFF OF	ELEVATIONS					
	TURNS		BS	FS	ELEV	UNADJUSTED	CORRECTION	ADJUSTED	MEAN	REMARKS	
CARTERS DAM HEADWATER											
LOOP 1									MEAN F & B		
9B-2A						1111.907	0.000	1111.907	1111.907	Elevation Held OPUS DB	New Aluminium CORPS Monument (Right Side Dam)
	1	B	6.309	4.825	1.484				MEAN F & B		
TP-7				MEAN	1.484	1113.391	0.000	1113.391	1113.391		Turning Point
	1	B	5.627	4.371	1.256				MEAN F & B		
TP-6				MEAN	1.256	1114.647	-0.001	1114.646	1114.647		Turning Point
	1	B	4.724	4.702	0.022				MEAN F & B		
TP-5				MEAN	0.022	1114.669	-0.001	1114.668	1114.668		Turning Point
	1	B	4.961	4.479	0.482				MEAN F & B		
TP-4				MEAN	0.482	1115.151	-0.002	1115.149	1115.151		Turning Point
	1	B	4.571	5.002	-0.431				MEAN F & B		
TP-3				MEAN	-0.431	1114.720	-0.002	1114.718	1114.719		Turning Point
	1	B	4.432	3.255	1.177				MEAN F & B		
9B-2B				MEAN	1.177	1115.897	-0.003	1115.894	1115.894273		New Aluminium CORPS Monument (Right Side Dam)
	1	F	3.431	4.604	-1.173						
TP-3				MEAN	-1.173	1114.724	-0.003	1114.721			Turning Point
	1	F	5.032	4.6	0.432						
TP-4				MEAN	0.432	1115.156	-0.004	1115.152			Turning Point
	1	F	4.561	5.044	-0.483						
TP-5				MEAN	-0.483	1114.673	-0.004	1114.669			Turning Point
	1	F	4.726	4.746	-0.02						
TP-6				MEAN	-0.020	1114.653	-0.005	1114.648			Turning Point
	1	F	4.488	5.745	-1.257						
TP-7				MEAN	-1.257	1113.396	-0.005	1113.391			Turning Point
	1	F	5.106	6.59	-1.484						
9B-2A				MEAN	-1.484	1111.912	-0.005	1111.907		Elevation Held OPUS DB	New Aluminium CORPS Monument (Right Side Dam)
	11	Sum Turns									



SURVEY DATASHEET (Version 1.0)

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Designation: 9B-2A
Stamping: 9B-2A 2009
Stability: Monument will probably hold position well
Setting: Light structures (other than listed below)
Description: THE MARK IS NEAR A PARKING AREA AT THE SOUTH END OF CARTERS DAM.

LOCATED ON THE WEST SIDE OF CARTERS DAM ROAD, MARK IS 59.5'NW OF END POST OF GUARD RAIL, 113.1'NW OF WATER SAFETY SIGN, AND 47.3' SW OF CENTERLINE OF CARTERS DAM ROAD

Observed: 2009-09-09T12:21:00Z
Source: OPUS - page5 0909.08

Close-up View

REF_FRAME: NAD_83 (CORS96)	EPOCH: 2002.0000	SOURCE: NAVD88 (Computed using GEOID03)	UNITS: m	SET PROFILE	DETAILS

LAT:	34° 36' 39.78335"	± 0.004	m
LON:	-84° 40' 14.05014"	± 0.015	m
ELL HT:	309.545	± 0.060	m
X:	488123.963	± 0.014	m
Y:	-5232592.531	± 0.052	m
Z:	3602613.531	± 0.030	m
ORTHO HT:	338.910	± 0.073	m

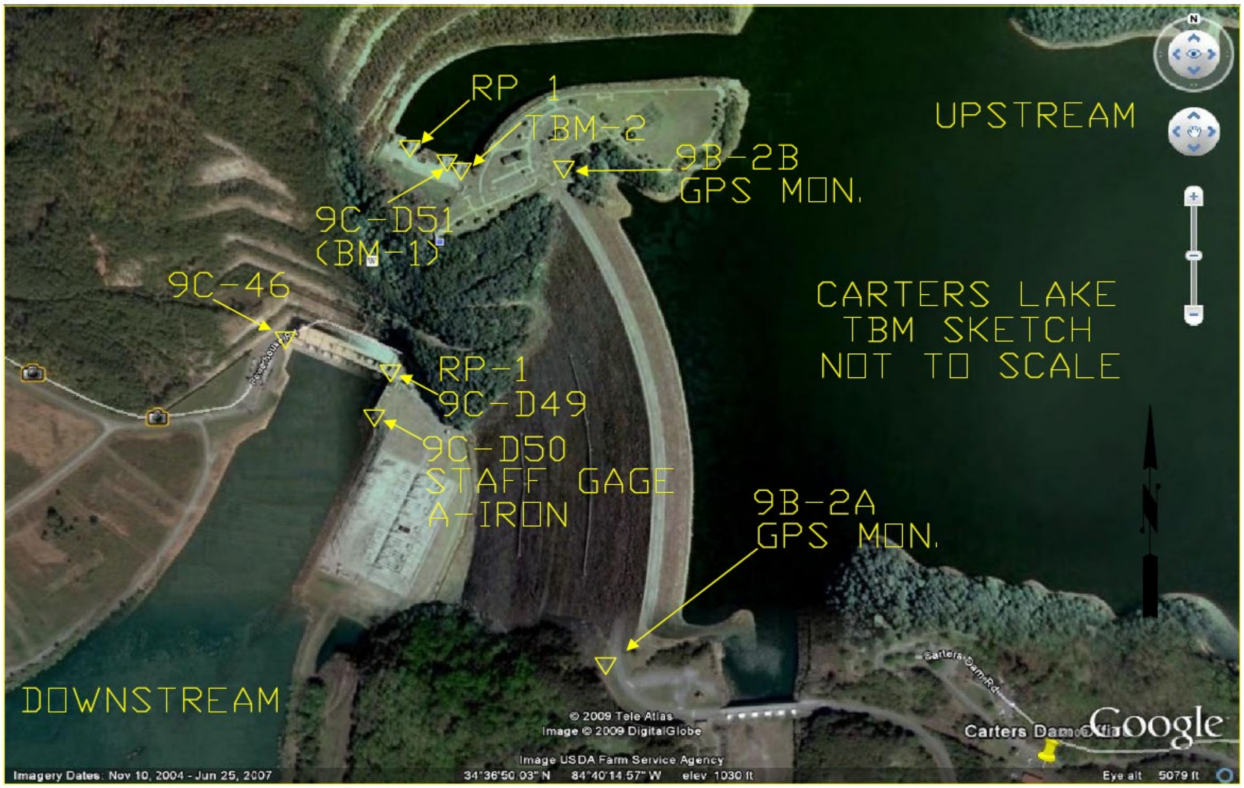
	UTM 16	**SPC** 1002(GA W)
NORTHING:	3832378.439m	511394.948m
EASTING:	713586.356m	653787.437m
CONVERGENCE:	1.32362311°	-0.28622312°
POINT SCALE:	1.00016232	0.99992631
COMBINED FACTOR:	1.00011372	0.99987773

CONTRIBUTED BY

waller
☐ Lowe Engineers, LLC

Horizon View

The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.



Carters Lake Main Dam

Carters Lake Reregulatory Dam

EXHIBIT C

STANDING INSTRUCTIONS TO THE DAMTENDERS FOR WATER CONTROL

EXHIBIT C

STANDING INSTRUCTIONS TO THE DAMTENDERS FOR WATER CONTROL

1. BACKGROUND AND RESPONSIBILITIES

a. <u>General Information</u>. These Standing Instructions to the Project Operator for Water Control are written in compliance with Paragraph 9-2 of EM-1110-2-3600 (Engineering and Design, *Management of Water Control Systems*, 30 November 1987) and with ER-1110-2-240 (Engineering and Design, *Water Control Management*, 8 October 1982). A copy of these Standing Instructions must be kept on hand at the project site at all times. Any deviation from the Standing Instructions will require approval of the District Commander.

(1) **Project Purposes**. The Carters Project is operated for flood risk management, navigation, hydropower, recreation, water quality and water supply. Water Control actions are in support of these project purposes and for purposes of the ACT River System.

(2) **Chain of Command**. The Project Operator is responsible to the Water Control Manager for all water control actions.

(3) **Structure**. The Project Site is located on the Coosawattee River in Gordon County, Georgia. The Main Dam is located at mile 26.8 and the downstream Reregulation Dam is located at mile 25.3. The drainage area above Carters Main Dam is 374 square miles and the drainage area above the Carters Reregulation Dam 521 square miles.

(4) **Operation and Maintenance (O&M)**. All O&M activities are the responsibility of the U.S. Army Corps of Engineers under the supervision of the Mobile District, Operations Division, and the direction of the Carters Operations Project Manager.

b. <u>Role of the Project Operator</u>. The term Project Operator refers to both the Carters Powerhouse operator and to the Carters Powerhouse personnel. Operation of the hydropower units and data reporting is the responsibility of the Carters Powerhouse operator.

(1) **Normal Conditions (dependent on day-to-day instruction)**. The Water Control Manager will coordinate the daily water control actions regarding hydropower releases with the Southeastern Power Administration (SEPA), and will notify the Project Operator of these changes. The Project Operator will then receive instructions from SEPA via hourly generation schedule updates. This daily communication will be increased to an hourly basis if the need develops. Daily generation schedules and updates are provided to the Water Management Section. The Water Control Manager will coordinate the daily water control actions regarding reregulation dam releases with the Carters powerhouse personnel. The required releases will be based on flows and stage as measured at USGS 02382500 Coosawattee River at Carters, Georgia.

(2) **Emergency Conditions (flood, drought, or special operations)**. During emergency conditions, the Project Operator will be instructed by the Water Control Manager on a daily or hourly basis for all water control actions. In the event that communications with Water Management Section are cut off, the Project Operator will continue to follow the Water Control Plan as outlined in Section 7-05 and contact the Water Management Section as soon as communication is reestablished.

2. DATA COLLECTION AND REPORTING

a. General. Report hourly the pool elevation, tailwater elevation, turbine discharge, spillway discharge, capacity, and general project status on the computer and have it accessible to the Water Control Manager by computer network.

b. Daily Reporting. The Project Operator will record the following items daily and will report them by 6:30 AM (0630) Central Time to the Water Management Section either by computer network, by fax machine (251-694-4058), or by telephone conversation (690-690-2737):

(1) Pool elevation in feet above mean sea level at 4 am and 12 midnight (0400 and 2400) for the period since the last report.

(2) Precipitation in hundredths of an inch.

(3) Average plant discharge in cubic feet per second for the first 4 hours of each day and for the 24 hours of the previous day.

(4) Average turbine discharge for the 24 hours of the previous day.

(5) Inflow to the lake in cubic feet per second for the first 4 hours of each day and for the 24 hours of the previous day.

(6) Average pumpback in cubic feet per second and megawatt-hours for the first 4 hours of each day and for the 24 hours of the previous day.

(7) Current day's generation schedule and previous day's actual generation in megawatt-hours. Include the schedule for the current day's generation.

(8) Total current generating capacity of the plant in megawatts.

c. Gage Verification. In accordance with the USACE Guidance Memorandum for Critical Gage Instrumentation dated 15 Dec 2006, the Carters powerhouse personnel will perform gage reading verifications by providing the pool level automated instrumentation gage reading and staff gage readings. In the event that the automated gage equipment malfunctions or if the difference in stage readings is greater than 0.1 ft, the Project Operator will report readings from the staff gage until the automated gage is rectified.

d. Regional Hydro-meteorological Conditions. The Project Operator will be informed by the Water Control Manager of any regional hydro-meteorological conditions that may impact water control actions.

3. WATER CONTROL ACTION AND REPORTING

a. Normal Conditions. During normal conditions, all releases will be made through the turbine units. The Project Operator will follow the Carters Dam Water Control Manual for normal water control actions and will report directly to the Water Control Manager.

b. Emergency Conditions. During high flows, the Project Operator will follow the instructions from the Water Control Manager and SEPA generation schedule updates regarding the suspension of releases during flood events and for resuming releases. . If needed, the Project Operator will follow the instructions for sluice gate settings to achieve the desired release rate.

c. Inquiries. All significant inquiries received by the Project Operator from citizens, constituents, or interest groups regarding water control procedures or actions must be referred directly to the Water Control Manager.

d. Water Control Problems. The Project Operator must immediately notify the Water Control Manager, by the most rapid means available, in the event that an operational malfunction, erosion, or other incident occurs that could impact project integrity in general or water control capability in particular.