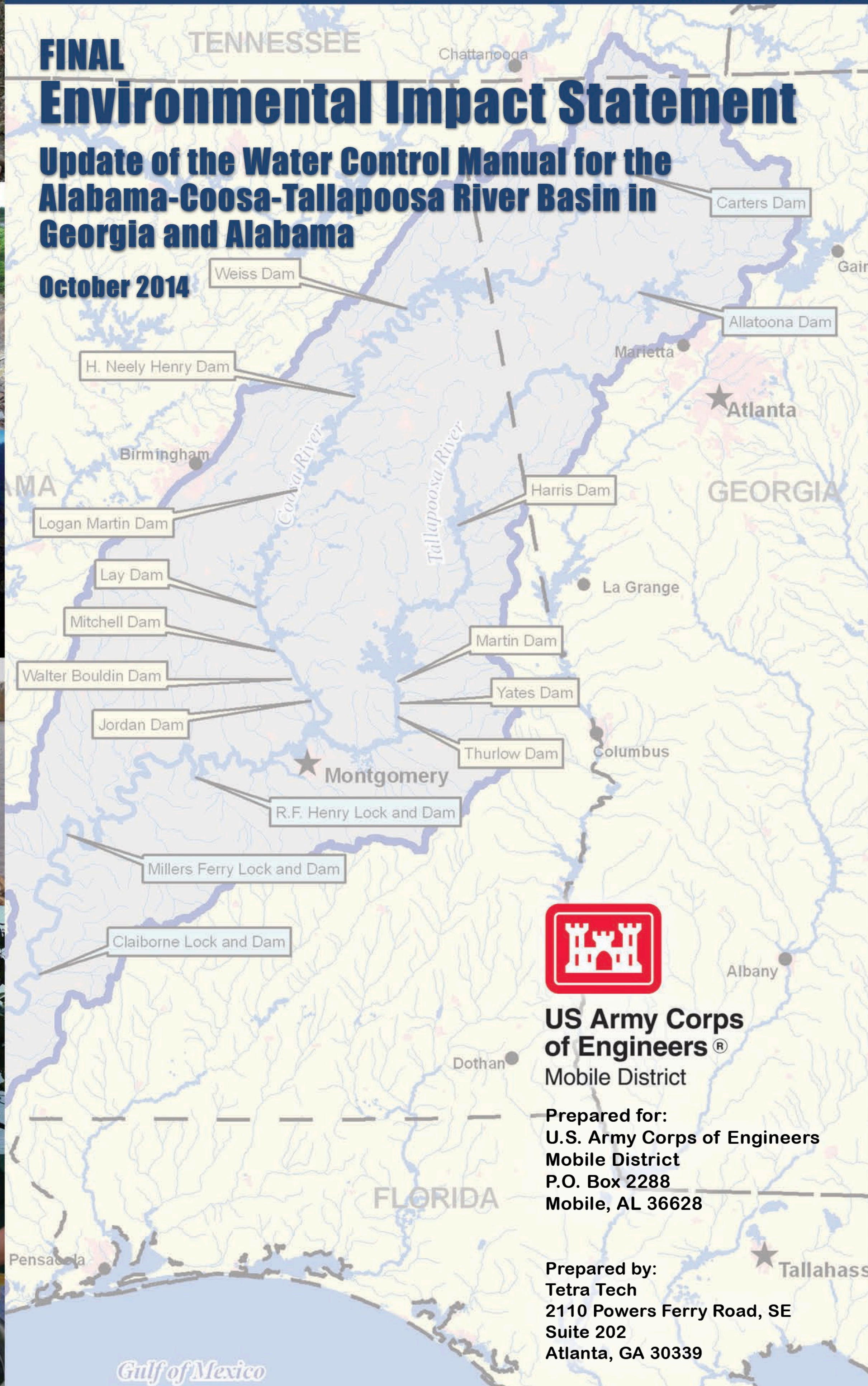
Volume 2: Appendix A (G)

FINAL

Environmental Impact Statement

Update of the Water Control Manual for the Alabama-Coosa-Tallapoosa River Basin in Georgia and Alabama

October 2014



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ALABAMA-COOSA-TALLAPOOSA RIVER BASIN WATER CONTROL MANUAL

APPENDIX G

ROBERT F. HENRY LOCK AND DAM AND R. E. “BOB” WOODRUFF LAKE

ALABAMA RIVER, ALABAMA

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
MOBILE, ALABAMA

SEPTEMBER 1974
REVISED DECEMBER 2014 (scheduled)

Robert F. Henry Lock and Dam
Alabama River, Alabama

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 will 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 Water Management Section, Mobile District Office by phoning (251) 690-2730, during regular duty hours and (251) 509-5368 during non-duty hours. R. F. Henry Project personnel can be reached at (334) 875-4400 or (334) 872-4017.

METRIC CONVERSION

Although values presented in the text are shown in 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 Engineers (herein referred to as USACE or Corps) 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 8A-10D, and the relationship between current and legacy datums are in Exhibit B.

ROBERT F. HENRY LOCK AND DAM

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

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PERTINENT DATA

(see Exhibit A, page E-A-1 for Supplementary Pertinent Data)

GENERAL

Location – Autauga, Lowndes, Montgomery, and Elmore Counties, AL; Alabama River, river mile 236.3

Dam site. Miles above mouth of Alabama River	236.30
Total drainage area above dam site – sq. mi.	16,233

RESERVOIR

Length at elevation 126.0 feet NGVD29 – miles	81.1
Maximum operating pool elevation – feet NGVD29	126
Area at pool elevation 126.0 – acres	13,500
Total conservation volume between elevation 126.0 – 123.0 feet NGVD29 - acre-feet	36,450

GATED SPILLWAY

Total length, including end piers – feet	646
Number of piers, including end piers	12
Elevation of crest – NGVD29	91.0
Type and number of gates	Tainter – 11 gates
Size of gates – feet	50x35
Elevation of top of gates in closed position – NGVD29	126.0

EARTH OVERFLOW DIKES

Right Bank Dike	
Total length – feet	2,661
Top elevation – NGVD29	135.0
Top width – feet	32
Side slopes	1v on 8h
Left Bank Dike	
Total length including lock mound – feet	12,639
Top elevation – NGVD29	143.0
Top width – feet	32
Side slopes	1v on 2.5h

LOCK

Maximum lift – feet	47.0
Chamber size, length by width – feet	600 x 84

POWER PLANT

Number of Units	4
Generator rating, 4 units @ 20,500 each – kW	82,000
Plant output at rated net head	
Installed capacity at rated power factor – kW	82,000
Maximum Static Head (feet)	47

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 Corps reservoirs. This water control manual has been prepared as directed in the Corps' Engineering Regulation (ER) 1110-2-240, *Water Control Management, dated 8 October 1982*. This 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. This manual is also prepared under the format and recommendations described in ER 1110-2-8156, *Preparation of Water Control Manuals, dated 31 August 1995*; and ER 1110-2-1941, *Drought Contingency Plans, dated 15 September 1981*.

1-02. Purpose and Scope. The primary purpose of this manual is to document the water control plan for the Robert F. (R. F.) Henry Lock and Dam Project. Details of the coordinated reservoir regulation plan for R. F. Henry Lock and Dam within the multiple project system of the Alabama River are presented which insure optimum benefits consistent with the physical characteristics and purposes for which the system was authorized. Included are descriptions of physical components of the lock and dam, operating procedures, historical facts, and other pertinent data. Also presented are general characteristics of the area including flood frequencies, meteorology, and a discussion on river forecasting. In conjunction with the ACT Basin master water control manual, this manual provides a general reference source for R. F. Henry 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. The Alabama-Coosa-Tallapoosa River Basin Water Control Manual, of which this is Appendix G, contains general information for the entire basin. Appendices to the basin master water control manual are prepared for all reservoir projects within the basin when one or more project functions are the responsibility of the Corps. Other manuals published for use by project personnel include R. F. Henry Lock and Dam Operation and Maintenance Manual, and CESAM Plan 500-1-4, Emergency Notification Procedures. A list of all the appendices for the Alabama-Coosa-Tallapoosa (ACT) Basin and the master water control manual are listed below.

Alabama-Coosa-Tallapoosa River Basin Master Water Control Manual

- 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)

1-04. Project Owner. The R. F. Henry Lock and Dam Project is a federally-owned project entrusted to the Corps, South Atlantic Division (SAD), Mobile District.

1-05. Operating Agency. The Corps' Mobile District operates the R. F. Henry Lock and Dam Project. Reservoir operation and maintenance are under the supervision of Operations Division. The project falls under the direction of the Operations Project Manager located at Tuscaloosa, Alabama. Maintenance staff duty hours at the R. F. Henry Powerhouse, known primarily as the Jones Bluff Powerhouse, are Monday – Thursday from 6:00 AM to 4:30 PM. The phone number is (334) 875-4400 during duty hours. The powerhouse can be operated at the R. F. Henry site or via remote control from the Millers Ferry Lock and Dam Project. The Millers Ferry Powerhouse can be called at (334) 682-9124. The lock is tended seasonally from 6:00 AM to 4:00 PM on Friday thru Monday during March-September and from Monday thru Thursday during October-February by operators under the direct supervision of a lock supervisor. The lock is closed on all Federal holidays. All commercial traffic must schedule an appointment for lockage. The lock will be made available 24 hours per day, seven days per week for appointments by commercial traffic. Non-commercial traffic may be accommodated during the hours the lock is manned, subject to the availability of lock operators and in conjunction with maintenance activities and as those activities allow. The office phone number of the lock is (334) 872-9525.

1-06. Regulating Agencies. Authority for the water control regulation of the R. F. Henry Project has been delegated to the SAD Commander. Water control regulation activities are the responsibility of the Mobile District, Engineering Division, Water Management Section. When necessary, the Water Management Section instructs the powerhouse operators and lockmaster regarding normal procedures and emergencies for unusual circumstances.

II - DESCRIPTION OF PROJECT

2-01. Location. The R. F. Henry Lock and Dam Project is located in the south central part of the State of Alabama on the Alabama River at a point 236.3 miles above its mouth. It is approximately 15 miles east-southeast of Selma and 35 miles west of Montgomery, Alabama. The dam and the first 32.9 miles of the R. E. “Bob” Woodruff Lake are in Autauga County, which is along the right side of the river, and Lowndes County, which is along the left side of the river. For the next 9.7 miles the right side of the lake is still in Autauga County but the left side is in Montgomery County. The remainder of the lake is in Elmore County on the right side and Montgomery County on the left side. The project is shown on Plate 2-1 and in Figure 2-1.

Figure 2-1. R. F. Henry Lock and Dam

2-02. Purpose. R. F. Henry Lock and Dam is a multiple purpose project. The River and Harbor Act of 1945, Public Law (P. L.) 79-14, authorized flood risk management, navigation, and hydropower. The operating purposes include navigation and hydropower. The minimum pool elevation of 123.0 feet National Geodetic Vertical Datum (NGVD29) provides for navigation to Wetumpka, Alabama 80 miles upstream. There is no flood risk management storage in this project; flood risk management was deleted from the project plan prior to construction. Several other project purposes have been added through general authorizations including water quality, recreation, and fish and wildlife conservation. Access and facilities are provided for recreation, but water is not normally controlled for that purpose.

2-03. Physical Components. The R. F. Henry Project consists of a gravity-type dam with gated spillway supplemented by earth dikes, a navigation lock and control station, and an 82,000 kilowatt (kW) power plant. At full pool elevation 126.0 feet NGVD29, the reservoir formed by the dam extends upstream a maximum distance of approximately 81.1 miles to Wetumpka on the Coosa River. Principal features of the project are described in detail in subsequent paragraphs. Sections, plan, and elevations of the dam and other features are shown on Plates 2-2 and 2-3.

a. Spillway. The spillway is a concrete-gravity structure equipped with 11 tainter gates 50 feet long and 35 feet high. The gate adjacent to the powerhouse is equipped with a trash gate that accommodates the passing of trash accumulations at the powerhouse and spillway. The spillway crest is at elevation 91.0 feet NGVD29. The top of gates in the closed position is elevation 126.0 feet NGVD29. The overall spillway length is 646 feet. The net length is 550 feet. The gates are mounted between 8-feet wide piers and are operated by individual hydraulically operated ratchet gear hoists that are located on top of the piers. A bridge for pedestrian traffic spans the top of the piers. The spillway joins the lock abutment on the left side and the powerhouse on the right side. The spillway stilling basin is a horizontal concrete apron with a 5-feet high sloping end sill. The basin extends downstream a maximum distance of 100 feet from the spillway gate seal, and the apron is stepped in a transverse direction from elevation 73.0 feet NGVD29 down to elevation 63.0 feet NGVD29.

b. Reservoir. The R. F. Henry Dam creates the R. E. “Bob” Woodruff Lake, which covers an area of 13,500 acres at pool elevation 126.0 feet NGVD29. The impounded water at pool elevation 126.0 feet NGVD29 has a total volume of 247,210 acre-feet. The maximum length of the reservoir at elevation 126.0 feet NGVD29 is 81.1 miles which consists of 69.0 miles up the Alabama River to its head at the confluence of the Coosa and Tallapoosa Rivers, then up the Coosa River 12.1 miles to Wetumpka. The lake at elevation 126.0 feet NGVD29 also extends to the tailrace of the Alabama Power Company’s (APC) Walter Bouldin Dam that is located in a canal which runs from Jordan Lake to the Coosa River below Wetumpka. The reservoir also extends approximately 10 miles up the Tallapoosa River. Area and capacity curves are shown on Plate 2-4, and selected area and capacity values are tabulated on Table 2-1.

c. Earth Dikes. The earth dike on the right overbank is 2,661 feet long and connects the powerhouse with high ground to the northwest. A roadway along the dike provides access to the powerhouse. The top of the dike is at elevation 135.0 feet NGVD29 except the portion which slopes upward to the level of the switchyard at elevation 143.0 feet NGVD29. Floods of sufficient magnitude to overtop the dike have a recurrence frequency of once in nine years. Both the upstream and downstream slopes of the dike are protected with grouted riprap against high velocities that occur during overtopping. The dike on the left overbank is a non-overflow section with a top elevation of 143.0 feet NGVD29 and has an access road along its entire length. Considering the distance across the lock esplanade and an adjacent disposal area as part of the dike the total length is 12,639 feet. The top elevation of 143.0 feet NGVD29 is slightly above the computed headwater elevation of the standard project flood series. No riprap is provided on the slopes of this dike since the base is above the maximum pool level, elevation 126.0 feet NGVD29.

d. Lock. The lock is located in the left bank between the spillway and the left overbank earth dike. The lock chamber is 84 feet wide and is 655 feet long between gate pintles. The usable length is slightly over 600 feet. The top of the upper gate blocks and the top of the upstream miter gate are at elevation 143.0 feet NGVD29. The top of all other walls and the downstream miter gate are at elevation 132.0 feet NGVD29. The top of the upper miter sill is at elevation 109.0 feet NGVD29, 17 feet below the full upper pool elevation 126.0 feet NGVD29.

The top of the lower miter sill is at elevation 67.0 feet NGVD29, 13.8 feet below the Millers Ferry full pool elevation 80.8 feet NGVD29. The lock filling and emptying system consists of two intake ports in the riverside face of the upper gate block, a longitudinal culvert in each of the chamber walls, a system of floor culvert in the chamber, and a discharge system that empties outside the lower approach. Reverse-tainter valves control flow in the culverts. The volume of water discharged in acre-feet for each time the lock is emptied can be determined by multiplying the gross head by 1.264.

Table 2-1. R. E. "Bob" Woodruff Lake Area and Capacity

POOL ELEV. (FEET NGVD29)	TOTAL AREA (ACRES)	TOTAL STORAGE (ACRE-FEET)		POOL ELEV. (FEET NGVD29)	TOTAL AREA (ACRES)	TOTAL STORAGE (ACRE-FEET)
64	0	0		122[2]	10,470	200,030
65	10	10		123[3]	10,990	210,760
70	80	200		124	11,700	222,100
75	240	970		125[7]	12,510	234,210
80	600	2,970		126[4,5]	13,500	247,210
85	1,280	7,550		127	14,580	261,250
90	2,150	16,140		128	15,640	276,360
[1]91	2,320	18,370		129	16,650	292,510
95	2,970	28,590		130	17,730	309,700
100	3,900	46,040		131	19,150	328,140
105	5,260	68,880		132	20,550	347,990
110	6,660	98,740		133	22,300	369,410
115	8,110	135,700		134	24,050	392,590
116	8,400	143,950		135[6]	26,380	417,800
117	8,690	152,500		136	28,800	445,390
118	9,000	161,340		137	31,500	475,470
119	9,310	170,500		138	33,700	507,990
120	9,630	179,970		139	36,000	542,840
121	10,010	189,790		140	38,400	580,040

[1] Spillway crest
[2] Emergency drawdown elevation
[3] Minimum operating pool elevation
[4] Maximum full pool operating elevation
[5] Top-of-gates - closed position
[6] Crest of free overflow dike
[7] Normal operating pool elevation

e. Lock Control Station. The control station is located between the spillway and lock adjacent to the upper gate block of the lock. The building is of reinforced concrete construction three stories high. It contains an office and the mechanical and electrical equipment necessary for operation of the lock and spillway. The third floor provides access to the spillway bridge.

f. Powerhouse. The powerhouse at the R. F. Henry Dam retained its original name as the Jones Bluff Powerhouse. It is situated in the right bank of the river adjoining the switchyard and parking area mound to the west. It joins the end of the spillway section to the east or river-side. The building is a reinforced concrete structure, 375 feet long and 160 feet wide. It consists of four generation bays and one erection bay. The generation bays each contain a fixed-blade propeller-type turbine rated at 23,480 horsepower at a head of 28.2 feet. The turbine is connected to a vertical-shaft generator rated at 20,500 kW. The intake is an integral part of the powerhouse structure and is positioned on the axis of the spillway.

g. Switchyard. The switchyard is located on the west side of the powerhouse which is the right bank of the river. It is joined on the west by the right overbank dike. The top elevation of the switchyard mound is 143.0 feet NGVD29. The principle structure in the switchyard is the main takeoff for the outgoing lines. There are other structures for busses, disconnecting switches, and potential transformers.

2-04. Related Control Facilities. The Jones Bluff Powerhouse can be operated remotely from the Millers Ferry Powerhouse and the Millers Ferry Powerhouse from Jones Bluff.

2-05. Real Estate Acquisition. Land acquisition authorization for the R. F. Henry Project was enacted under the River and Harbor Act of 2 March 1945, P.L. 79-14. The acreage acquired for all project purposes totals 19,318.980 acres. Of that total acreage, 5,407.200 acres were acquired in fee and 13,911.780 acres were acquired by perpetual easement.

The acquisition guide lines for flowage easements were based upon backwater computations with the acquisition limits being established at the elevation where the backwater effect with the dam in place is less than one foot. The profiles were developed using flows from 75,000 cfs to 125,400 cfs. The highest flows were for a natural recurrence frequency of once every 1.5 years. The acquisition guide line thus adopted begins at elevation 127.0 feet NGVD29 at the dam, mile 236.3, and continues at that elevation to mile 242.4; then on a uniform slope to elevation 130.5 feet NGVD29 at mile 254.9; then to elevation 131.0 feet NGVD29 at mile 261.9; and then to elevation 139.5 feet NGVD29 at mile 305.3, at the junction of the Coosa and Tallapoosa Rivers. There are a total 12 Real Estate Segment Maps traversing Autauga, Elmore, Lowndes, and Montgomery Counties, which depict the 527 tracts acquired and the final acquisition limits based on the aforementioned elevations. An overview of the real estate acquisition areas are shown on Plates 2-5 and 2-6.

2-06. Public Facilities. R. E. “Bob” Woodruff Lake, impounded by R. F. Henry Lock and Dam, greatly enhances the opportunities for water-oriented recreation. The lake offers such activities as fishing, boating, water skiing, picnicking, camping, swimming, and hiking. The project features 17 primary recreation facilities that are rustic but well facilitated for visitors. Fifteen of the sites are operated by the Corps and have approximately 3,978 total acres. The Fort Toulouse National Historic Park is operated and maintained by the State of Alabama and has approximately 183 total acres. Powder Magazine is operated by the city of Montgomery and has approximately 58 total acres. Conveniences at the parks include beaches, campgrounds, picnic areas, trails, and boat launching ramps. Since the first park was constructed in 1975, annual attendance has risen to over two million. Public facilities at Woodruff Lake are listed in Table 2-2 below and are shown on Plate 2-7. The phone number for the Operations Project Managers Office for the Alabama River Lakes, at the R. F. Henry site is (334) 872-8210.

Table 2-2. R. E. "Bob" Woodruff Lake Public Facilities

	Boat Launch	Marina	Camping	Play Ground	Picnic	Swimming Beach	Trails
Benton	y				y		
Cooters Pond	y						
Damsite East Bank							
Damsite West Bank							
Ft. Toulouse	y		y		y		
Gunter Hill Campground	y		y	y	y		y
Holy Ground Battlefield Park	y				y	y	y
Montgomery Marina		y					
Powder Magazine	y	y					
Prairie Creek	y		y	y	y		y
Swift Creek	y						

III - HISTORY OF PROJECT

3-01. Authorization. The original project for the improvement of the Alabama River was authorized by Congress on 18 June 1878 to provide for a navigation channel four feet deep and 200 feet wide from the mouth to Wetumpka and was modified on 13 July 1892 to provide a 6-feet channel. Subsequent acts approved in 1905 and 1910 provided for a channel 4-foot deep at low water from the mouth to Wetumpka by the use of contracting dikes and dredging. This project was 62 percent complete in 1942, the last year that any new work was performed. The 9-foot navigation channel was authorized by the River and Harbor Act of March 2, 1945 (P. L. 79-14). The authorization refers to House Document 77-414. The House Document recommended the authorization of a general plan for the basin "...in accordance with plans being prepared by the Chief of Engineers." The basin plan at that time contemplated a 9-foot deep navigable channel from the mouth of the Alabama River to Rome, Georgia, to be achieved by open river works and locks and dams.

3-02. Planning and Design

The first comprehensive report on the optimum use of the water resources of the basin was prepared by the Corps in 1934, and was printed as House Document No. 66, 74th Congress, 1st session (308 Report). The plan contemplated five navigation dams on the Alabama River.

A resolution of the Committee on Rivers and Harbors, House of Representatives, passed on 28 April 1936, requested that a review be made to determine if changes in economic conditions might warrant modification of the recommendations in House Document No. 66, 74th Congress, with regard to the Alabama River. A resolution of the Committee on Commerce, U. S. Senate, adopted 18 January 1939, requested a review to determine the advisability of constructing reservoirs on the Alabama-Coosa Rivers and tributaries for development of hydroelectric power and improvement for navigation

The Chief of Engineers in a report submitted on 15 October 1941 and printed as House Document No. 414, 77th Congress, 1st Session recommended a general plan for the development of the basin. Congress authorized in the River and Harbor Act of 2 March 1945 (P. L. 14, 79th Congress) the initial and partial accomplishment of this plan. Planning studies for the initially authorized projects on the Alabama River to provide navigation facilities with the maximum hydroelectric power feasible began in 1945.

A site selection report for the entire Alabama River was submitted on I0 December 1945, which determined that the overall project for the Alabama River should consist of dredging in the lower river, and navigation dams and locks at Claiborne, Millers Ferry and Jones Bluff upstream with power plants added to the latter two projects. The first design memorandum for Jones Bluff presenting "Basic Hydrology" was submitted on 30 April 1963. It was followed by the "General Design" on 16 March 1964 and then by 19 design memoranda for particular features of the project during the next eight years.

3-03. Construction

The first phase of construction placed under contract at the R. F. Henry Project was the lock excavation, which commenced on 7 February 1966, and was completed on 1 October 1966. No other work was contracted because of delays in funding until 1968. The Dravo Corporation was awarded a contract for construction of the lock, nine gate-bays of the spillway, the earth overbank dikes, the access roads, and the lock mound on 17 April 1968. The work under that contract was completed 15 October 1971 at a total cost of $16,417,377.38.

The second-stage cofferdam was completed in October 1970, which closed the river channel. The reservoir was not filled at the time because of reservoir clearing operations under way in the lower reaches. The river flow was passed through the gate bays in the completed portion of the spillway. In November 1971 filling was begun in conjunction with clearing operations in the upper reaches of the reservoir. When clearing was completed in December 1971 the reservoir was filled to pool elevation 125.0 feet NGVD29. The first navigation through the lock was allowed in January 1972 and the facility was officially opened to navigation on 15 April 1972.

A contract for construction of the powerhouse and the last two gate bays of the spillway was awarded on 23 June 1972 to Peter Kiewlt and Sons along with Standard Construction Company as a joint venture. The power units were placed in operation in 1975 at approximately three month intervals for each unit.

Spillway Gate No. 1 was modified in 1990 to include a trash gate which accommodates the passing of trash accumulations at the powerhouse and spillway. As shown in Figure 3-1, hydraulic arms are used to slide the upper portion of the spillway gate down which allows trash and water to spill over the top of the gate.

Figure 3-1. Trash Gate at R. F. Henry Dam

3-04. Related Projects. The R. F. Henry Lock and Dam Project is the third major unit of the navigation system developed on the Alabama River by the Corps. Millers Ferry Lock and Dam, located downstream at river mile 133.0, also has hydropower capability. Claiborne Lock and Dam is located downstream of Millers Ferry at river mile 72.5.

3-05. Modifications to Regulations

P.L. 94-538 [S.2533]; October 18, 1976, designated “the lake formed by the lock and dam referred to as the “Jones Bluff lock and dam” on the Alabama River, Alabama, as ‘R. E. “Bob” Woodruff Lake’.”

P. L. 97-383 [S. 2034]; December 22, 1982, renamed the Jones Bluff Lock and Dam to the “Robert F. Henry Lock and Dam.” The original name of the powerhouse, “Jones Bluff Powerhouse”, was retained.

3-06. Principal Regulation Problems. There have been no significant regulation problems, such as erosion, boils, severe leakage, etc., at the R. F. Henry Project.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Alabama-Coosa-Tallapoosa River System drains a small portion of Tennessee, northwestern Georgia, and northeastern and east-central Alabama. The Alabama River Basin has its source in the Blue Ridge Mountains of northwest Georgia. The main headwater tributaries are the Oostanaula and Etowah Rivers, which join near Rome, Georgia, to form the Coosa River. The Coosa River in turn joins the Tallapoosa River near Wetumpka, Alabama, approximately 14 miles above Montgomery, Alabama, to form the Alabama River. Plate 2-1 shows a map of the ACT River Basin.

The drainage basin is approximately 330 miles in length, and averages 70 miles wide with a maximum width of about 125 miles. The basin has a total drainage area of 22,739 square miles of which 16,233 square miles are above R. F. Henry Lock and Dam. In the early 1990's the Alabama-Coosa River Basin became more widely known as the Alabama-Coosa-Tallapoosa, or ACT River Basin.

4-02. Topography. The ACT River Basin is composed of an unusually wide range of topographic areas. The location of the river basin is within parts of five physiographic provinces: the Blue Ridge Province; the Valley and Ridge Province; the Piedmont Plateau; the Cumberland Plateau; and, the Coastal Plain. Each of these physiographic sub-divisions influences drainage patterns. High rounded mountains and steep narrow valleys characterize the northeastern portion of the basin in the Blue Ridge Province. Overburden is sparse except in the valley flood plains. The topography of the Valley and Ridge Province is alternating valleys and ridges with altitudes varying from approximately 600 to 1,600 feet. The dominant characteristics of the Cumberland Plateau are flat plateaus ranging in altitude from 1,500 to 1,800 feet that bound narrow, northeast-southwest trending valleys. Rolling hills and occasional low mountains topographically characterize the Piedmont Province. Altitudes range from 500 to 1,500 feet. Low hills with gentle slopes and broad shallow valleys that contain slow-moving meandering streams with wide floodplains characterize the topography of the Coastal Plain. The Alabama River flows through a broad lowland valley that varies in width from three to 10 miles throughout the length of the R. F. Henry Lock and Dam Project. To the south the river borders the Black Belt, a prairie land so named for its rich, black soil and flat to gently rolling prairie land developed over the Selma Chalk Formation. The northern side of the river is bounded by stable formations that are more resistant to erosion. Exposed hillsides with a greater relief are characteristic of this northern side. The river strikes a broad, meandering, westerly course through the valley falling at a rate of 0.5-foot per mile. Normal river elevation is below the floodplain. There are numerous tributaries entering the river from both sides and are rather evenly distributed between the upper and lower limits of the lake.

4-03. Geology and Soils.

The ACT River Basin covers an unusually wide range of geologic conditions. The location of the river basin is within parts of five physiographic provinces: the Blue Ridge Province; the Valley and Ridge Province; the Piedmont Plateau; the Cumberland Plateau; and, the Coastal Plain. Each of these physiographic sub-divisions influences drainage patterns. Rugged crystalline rocks characterize the northeastern portion of the basin in the Blue Ridge Province. Folded limestone, shale, and sandstone compose the Valley and Ridge Province. The axes of the folds that trend northeast-southwest influence the course of the streams in that they tend to flow southwestward along the alignment of the geologic structure. Like the Valley and Ridge Province -- folded, faulted, and thrusted rocks form the Cumberland Plateau -- with the deformation being less than the Valley and Ridge rocks. The east-central portions of the basin are in the Piedmont Province, characterized by sequences of metamorphic and igneous rocks. Prominent topographic features generally reflect the erosional and weathering resistance of quartzite, amphibolite, and plutonic rocks. The residual soils are predominately red sandy clays and gray silty sand derived from the weathering of the underlying crystalline rocks. The more recent sedimentary formations of the Coastal Plain underlie the entire southern portion of both river basins. The contact between the Coastal Plain on the south and the previously described physiographic provinces to the north is along a line that crosses the Cahaba River near Centreville, Alabama; the Coosa River near Wetumpka, Alabama; and the Tallapoosa River near Tallassee, Alabama. As the rivers leave the hard rocks above this line and enter the softer formations of the Coastal Plain, the erosion properties change, resulting in the formation of rapids. This line is a geological divide commonly known as the "fall line". The rocks of the Coastal Plain are typically poorly consolidated marine sediments.

Overlying the bedrock at the R. F. Henry Lock and Dam site are layers of fine and coarse grained soils that average 30 feet in thickness. The fine-grained soils consist of silty clay, silty sand and fat clay. The clays were deposited in depressions and range in thickness up to 25 feet. Below the fine grained soils is a layer of poorly graded sand and poorly graded gravel that averages 20 feet in thickness. Underlying the sand and gravel is a soft, residual layer of clay overlying bedrock that generally slopes towards the river channel.

Two geologic formations exist at the project. The Selma Chalk Formation comprises the upper rock section and ranges in thickness from 100 to 135 feet. The Selma Chalk Formation is composed of gray, calcareous chalk, siltstone and claystone with thin layers of green clay. The Eutaw Sand Formation underlies the Selma Formation and ranges in thickness up to 400 feet. The sand is fine to medium grained, green to gray, micaceous and fossiliferous. The Eutaw Formation contains groundwater under artesian pressure.

The geologic structure at the project is a monocline dipping about 35 feet per mile in a southwesterly direction. The Selma Chalk Formation thickens in the downstream direction and includes about 1000 feet of calcareous rocks at full thickness.

4-04. Sediment. Sedimentation ranges were established for the entire reservoir length and the original surveys were made in 1974. The ranges were resurveyed in 1982, 1988, and again in 2009. Key ranges are resurveyed at regular intervals for any appreciable changes in channel geometry. The latest survey was in 2009 and is retained in the Hydraulic Data and Sedimentation Unit at the Mobile District Office. Sedimentation range locations are shown on Plates 4-1.

Based on the 2009 survey data, the R.E. “Bob” Woodruff Lake has heavy deposition and acute right bank erosion on the Tallapoosa River arm at range 16A and slight to moderate erosion on the Coosa River arm at range 17A. The Alabama River ranges appear relatively stable. Shoreline conditions are fairly uniform along the length of the lake with about two-thirds of the shorelines experiencing erosion and the remaining one-third being depositional.

4-05. Climate

a. Temperature. The ACT Basin area has long, warm summers, and relatively short, mild winters. In the southern end of the basin, the average annual temperature is 64 degrees Fahrenheit (°F) with a mean monthly range from 45 °F in January to 80 °F in July and August. In the northern end, the average annual temperature is 60 °F with a mean monthly range from 40 °F in January to 78 °F in July. Extreme temperatures recorded in the basin range from a low of minus 17 °F at Lafayette, Georgia, in January 1940 to a high of 112 °F at Centreville, Alabama, in September 1925. The frost-free season varies from about 200 days in the northern valleys to about 260 days in the southern part of the basin. The maximum, minimum, and mean monthly and annual normal temperatures for locations in or near the R. F. Henry watershed are shown on Table 4-1. Climatologists define a climatic normal as the arithmetic average of a climate element, such as temperature, over a prescribed 30-year time interval. The National Climatic Data Center (NCDC) uses a homogenous and complete dataset with no changes to the collection site or missing values to determine the 30-year normal values. When developing this 30-year normal dataset, the NCDC has standard methods available to them to make adjustments to the dataset for any inhomogeneities or missing data before computing normal values. Extremes and average temperature data at six representative stations throughout the basin are shown on Plate 4-2. The location of the stations is shown on Plate 4-3.

Table 4-1. Normal 30-year Air Temperature for Selected Sites in/near R. F. Henry Basin
(Based on 1981 to 2010 Normals published by National Weather Service)

Normal Temperature Based on 30-Year Period – 1981 Through 2010 (degrees Fahrenheit)														
Station		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**ANNUAL**
Martin Dam (015140)	Max	55.2	59.6	67.5	74.3	81.5	87.9	90.6	89.1	84.6	76.0	66.1	57.4	74.2
	Mean	44.7	47.8	54.5	61.2	69.3	76.4	79.5	78.8	73.8	63.8	54.6	46.6	62.7
	Min	34.2	36.0	41.5	48.1	57.2	64.8	68.4	68.5	63.0	51.5	43.1	35.7	51.1
Montgomery (015553)	Max	57.5	62.1	69.6	76.6	84.2	89.1	91.8	91.3	86.0	77.6	69.0	60.1	76.3
	Mean	46.3	50.5	57.1	63.7	71.8	78.3	80.9	80.6	75.0	64.7	56.2	48.4	64.5
	Min	35.1	38.9	44.7	50.9	59.5	67.4	70.1	70.0	64.0	51.9	43.4	36.6	52.8
Wetumpka (018859)	Max	56.1	60.5	68.7	75.1	82.3	87.7	90.3	89.8	86.1	76.5	67.5	58.2	75.0
	Mean	45.5	49.5	56.5	62.5	71.0	77.6	80.6	80.1	75.7	65.3	55.6	47.8	64.0
	Min	34.9	38.5	44.2	49.8	59.6	67.5	70.8	70.4	65.3	54.0	43.7	37.3	53.1
Selma (017366)	Max	57.4	61.5	69.6	76.4	84.0	89.8	92.0	91.6	86.9	77.7	68.6	59.1	76.3
	Mean	46.4	50.2	57.1	63.7	72.3	79.1	81.7	81.3	76.2	65.9	56.2	48.2	64.9
	Min	35.4	38.9	44.7	51.0	60.5	68.3	71.3	70.9	65.5	54.0	43.7	37.3	53.5
R. F. Henry Basin	Max	56.6	60.9	68.9	75.6	83.0	88.6	91.2	90.5	85.9	77.0	65.3	58.7	75.5
	Mean	45.7	49.5	56.3	62.8	71.1	77.9	80.7	80.2	75.2	64.9	55.7	47.8	64.0
	Min	34.9	38.1	43.8	50.0	59.2	67.0	70.2	70.0	64.5	52.9	43.5	36.7	52.6

b. Precipitation. The ACT Basin lies in a region of heavy annual rainfall which is fairly well distributed throughout the year. The normal annual precipitation for the R. F. Henry Project area is 50.69 inches. Fifty-eight percent of the rainfall occurs during the winter and spring months, 23 percent in the summer, and 19 percent in the fall. The average monthly and annual precipitations for various reporting stations near the R. F. Henry Project are shown on Table 4-2. The locations of the stations are the same as the temperature stations with the exception of Jordan Dam precipitation which is provided due to the lack of precipitation data at the Martin Dam location. Station locations are shown on Plate 4-3. The maximum calendar year rainfall over the ACT Basin was 78 inches in 1929 and the minimum annual was 32 inches in 1954. The highest annual station rainfall recorded in the ACT Basin was 104.03 inches at Flat Top, Georgia, in 1949; the lowest recorded was 22.00 inches at Primrose Farm, Alabama, in 1954.

The light snowfall that occasionally occurs seldom covers the ground for more than a few days and has never affected any major flood in the basin. Precipitation extremes and averages for the basin are shown on Plate 4-4.

Table 4-2. Normal 30-year Precipitation for Selected Sites in/near R. F. Henry Basin
(Based on 1981 to 2010 Normals published by National Weather Service)

Normal Precipitation Based on 30-Year Period – 1981 Through 2010 (inches)														
Station		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**ANNUAL**
Jordan Dam (014306)	Mean	4.11	5.10	4.23	4.02	3.32	3.85	4.72	3.10	3.62	2.94	4.30	4.26	47.57
Montgomery (015553)	Mean	4.62	5.08	5.47	3.97	3.65	4.62	5.27	4.22	3.64	3.05	4.67	4.54	52.80
Wetumpka (018859)	Mean	4.45	5.27	5.66	3.88	3.37	4.22	4.93	4.30	3.37	2.90	4.20	4.74	51.29
Selma (017366)	Mean	4.75	5.03	5.47	3.93	3.26	4.07	4.72	4.42	3.32	2.68	4.55	4.89	51.09
R. F. Henry Basin	Mean	4.48	5.12	5.21	3.95	3.40	4.19	4.91	4.01	3.49	2.89	4.43	4.61	50.69

4-06. Storms and Floods

a. General. Flood-producing storms may occur over the basin anytime but are more frequent during the winter and early spring. These storms are usually of the frontal variety lasting two to four days. Summer storms are the convective type thundershowers with high intensity rainfall over small areas which produce local floods. In the fall, occasional heavy rains may accompany dissipating tropical cyclones.

b. Record Floods. A major storm system in the spring of 1990 produced record floods on the Alabama River. On 16 March 1990, with the river still high from previous rains, the entire basin received very heavy rainfall for two days. For the two-day total, R. F. Henry reported nine inches, Millers Ferry reported 6.75 inches and Claiborne had 9.5 inches. The upper basin received an average of six to seven inches during this period. R. F. Henry discharged a record-breaking 220,000 cfs on 20 March 1990, producing a record tailwater of 135.4 feet NGVD29. The largest known flood for the entire period of record is the historical flood of February-March 1961 with a peak discharge of 283,200 cfs. Another significant flood occurred on 11-16 March 1929, when 10 inches of rainfall over a period of three days was recorded in the vicinity of Auburn, Alabama. A peak discharge was not recorded for the historical flood of April 1886, which is the greatest flood on record for the Millers Ferry Project downstream of R. F. Henry.

4-07. Runoff Characteristics. The tributaries contributing flow to the Alabama River above the R. F. Henry Dam exhibit wide variations in runoff characteristics. They range from very flashy in the mountainous regions of the Coosa Basin above Rome, Georgia, to very slow rising and falling in the lower reaches. The mean annual discharge for the period January 1929 through December 1999 is 23,386 cfs or about 1.3 cfs per square mile.

The average daily discharges shown on Plates 4-5 through 4-11 and the mean monthly and annual flows on Plates 4-12 through 4-13 were developed from data for the USGS gages at

Selma and Montgomery, Alabama, and at the R. F. Henry Project. The data at Selma and Montgomery, Alabama, were adjusted using area ratios to the R. F. Henry site. The data was extended to 1939 to provide the same coverage as was in the previous water control manual. All three gages were needed to provide complete coverage.

4-08. Water Quality. Generally, the surface waters of the Alabama River Basin are of good chemical quality. Overall, the water quality of the R. E. "Bob" Woodruff Lake is adequate. Water quality in Woodruff Lake is influenced by physical dynamics (depth, temperature, flow, etc.) Stratification and turnover are not significant issues due to generally shallow depth. There are also various sources of pollutant loads to the lake including tributaries and upstream contributions, both point and non-point. Upstream sources are dominated by those pollutants entering directly via the Alabama River. Point sources are generally municipal and industrial discharges regulated by the Alabama Department of Environmental Management (ADEM) and agricultural practices contribute the largest percentage of non-point pollutants.

The reservoir has not been identified by ADEM in its 2012 Draft 303(d) list as violating State water quality standards. ADEM has not set a standard for chlorophyl*l a* in the lake. The average chlorophyll *a* measured in mid lake by ADEM during the 2005 wet year was 12.83 µg/L and in the 2000 dry year 18.6 µg/L. The ADEM standard for dissolved oxygen is a minimum 5.0 mg/L. Dissolved oxygen levels generally remain above 6.0 mg/L in mid-lake. The ADEM standard for water temperature is a maximum 90 °F. Temperatures in Woodruff reservoir range generally from 50 °F to 86 °F with occasional peaks of about 90 °F. In shallower embayments there are greater fluctuations in these parameters and occasionally the standards are not met.

4-9. Channel and Floodway Characteristics. The navigation channel from the mouth of the Alabama River to Montgomery, Alabama has an authorized depth of nine feet and a width of 200 feet. There are no major flood damage centers immediately downstream of the R. F. Henry Project.

4-10. Upstream Structures. Above R. F. Henry Lock and Dam are APC hydroelectric projects on the Coosa and Tallapoosa Rivers and two Corps projects, Allatoona and Carters, located above the APC Coosa projects. The Hickory Log Creek Project was constructed in 2007 by the city of Canton, Georgia and Cobb County–Marietta Water Authority (CCMWA), and is located approximately 25 miles northeast of Allatoona Dam. Table 4-3 shows these upstream projects and their drainage areas as well as data for R. F. Henry and downstream projects, Millers Ferry, and Claiborne.

4-11. Downstream Structures. Below R. F. Henry Lock and Dam are two Corps projects, Millers Ferry and Claiborne Locks and Dams. Millers Ferry has a drainage area of 4,404 square miles from R. F. Henry to Millers Ferry. Claiborne has a drainage area of 836 square miles from Millers Ferry to Claiborne.

Table 4-3. COE, APC, and Canton/CCMWA Projects in the ACT

Agency	Alabama River Projects	Drainage Area sq. mi.
COE	**Claiborne	21,473
COE	**Millers Ferry	20,637
COE	RF Henry	16,233
	Coosa River Projects	
APC	*Jordan/Bouldin	10,102
APC	Mitchell	9,778
APC	Lay	9,053
APC	Logan Martin	7,743
APC	Henry	6,596
APC	Weiss	5,270
COE	Allatoona	1,122
COE	Carters	374
Canton/CCMWA	***Hickory Log Creek	8
	Tallapoosa Projects	
APC	Thurlow	3,308
APC	Yates	3,293
APC	Martin	2,984
APC	Harris	1,454

* Jordan Dam is located on the Coosa River at river mile 18.9. Walter Bouldin Dam is located on a by-pass of the Jordan Dam and discharges into a canal which enters the Woodruff Lake at Coosa River mile 4.2.
** Downstream projects
*** Water is pumped directly from the Etowah River to support project, thus such a small drainage area.

4-12. Economic Data. The watershed surrounding the R. F. Henry Project consists of Autauga and Lowndes Counties within Alabama. The watershed includes both developed urban and residential land uses and rural land uses within the watershed.

a. Population. The 2010 population of the two counties bordering the R. F. Henry Project totaled 65,870. The city of Prattville, located in Autauga County, has a population of 33,960. This accounts for more than half the population within the counties. The income data for each county is shown in Table 4-4.

Table 4-4. Income Data per County

County	Population (2010)	Per Capita Income	Persons living below poverty
Autauga County	54,571	24,568	10.6%
Lowndes County	11,299	16,524	27.3%
Total	65,870	41,092	

b. Agriculture. The R. F. Henry watershed and basin below consist of approximately 800 farms averaging 393 acres per farm. In 2005, the agricultural production in the area totaled $148 million in farm products sold and total farm earnings of $17 million. Agriculture in the R. F. Henry watershed consists primarily of livestock, which accounts for 71 percent of the value of farm products sold. Table 4-5 contains agricultural production information and farm earnings for each of the counties within the R. F. Henry watershed and basin below.

Table 4-5. Agricultural Production and Income per County

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 Sold From	
						Crops	Livestock
Alabama							
Autauga County	$7,902	373	118	318	$49,871	43.70%	56.30%
Lowndes County	$10,736	420	197	468	$98,862	15.00%	85.00%
Totals	$18,638	793	315	393	$148,733	29.35%	70.65%
Source: U.S. Census Bureau, County and City Data Book: 2007							

c. Industry. The leading industrial sectors that provide non-farm employment are wholesale and retail trade, services, and manufacturing. In 2005, the R. F. Henry Project area counties had 41 manufacturing establishments that provided 3,032 jobs with total earnings of more than $182 million. Table 4-6 shows information on the manufacturing activity for each of the counties in the R. F. Henry Project watershed and basin below.

Table 4-6. Manufacturing Activity per County

County	No. of Manufacturing Establishments	Total Manufacturing Employees	Total Earnings ($1,000)	Value Added by Manufactures ($1,000)
Alabama				
Autauga County	29	1,827	116,715	(D)
Lowndes County	12	1,205	66,046	106,061
Totals	41	3,032	182,761	

(D)-Data withheld to avoid disclosure *Source: U.S. Census Bureau, County and City Data Book: 2007*

d. Flood Damages. Because the dam is considered a run-of-the-river project, with very little storage, there are no quantifiable flooding impacts from the project. A table of water surface elevations at R. F. Henry and associated impacts is shown on Table 4-7.

Table 4-7. Flooding Impacts and Associated R. F. Henry Gage Elevation

R. F. HENRY GAGE HT	Flooding Impacts
(FEET NGVD29)	
122	Flooding of agricultural land begins
127	Widespread flooding of farmlands and of some homes and trailers along the river occurs.
132	Portions of Benton begin to flood. Numerous house trailers along the river become flooded if not moved to higher ground.
134	Portions of Autaugaville begin to flood. In addition sections of the western railway of Alabama Railroad begin to flood at this level. At 135 feet NGVD29 considerable flooding occurs in Benton.
138	There is considerable flooding in Autaugaville. In addition most of Benton is flooded at this level.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

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.

Reservoir project data are obtained through each project's Supervisory Control and Data Acquisition (SCADA) system and provided to the Water Management Section both daily and in real-time.

Figure 5-1. Encoder with Wheel Tape for Measuring 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. Corps personnel also maintain precipitation gages at project locations over the ACT Basin.

All rainfall gages equipped as Data Collection Platforms are capable of being part of the reporting network. Data is received from 22 stations in and around the Alabama River Basin from Montgomery, Alabama, to Millers Ferry Lock and Dam. The data are recorded in 15-minute intervals and these data are reported hourly. The 10 stations listed in Table 5-1 are considered the rainfall reporting network for the R. F. Henry, Millers Ferry, and Claiborne

Projects. The locations of these rainfall stations are shown on Plate 5-1. River conditions above Montgomery, Alabama, are reflected in outflows from Jordan-Bouldin Dam on the Coosa River, and the Thurlow Dam on the Tallapoosa River.

Rainfall and upstream conditions are updated regularly throughout the day. Forecast of runoff are prepared and compared to those prepared by the River Forecast Center.

Table 5-1: Rainfall Reporting Network for the Alabama River Basin

Name	Agency	Agency ID	Latitude	Longitude
Montgomery, AL (at US 31)	USACE	15550	32.41139	-86.4083
Catoma Creek near Montgomery, AL	USACE		32.30722	-86.2994
R.F. Henry L&D near Benton, AL	USACE		32.31667	-86.7833
Selma, AL	USACE	17366	32.40556	-87.0186
Centreville, AL	USACE	11520	32.94500	-87.1392
Suttle, AL	USACE	17963	32.52917	-87.1989
Marion Junction, AL	USACE	15116	32.44389	-87.1803
Below Millers Ferry L&D near Camden, AL	USACE	11301	32.10000	-87.3981
Claiborne L&D near Monroeville, AL	USACE	11690	31.61500	-87.5506

All river stage gages equipped as Data Collection Platforms are capable of being part of the reporting network. Data is available from many stations in and adjacent to the ACT Basin. The river stage gages listed in the section of Table 5-2 titled “River Stage Gages in the Daily Hydrologic Network” are used to plan operations at the R. F. Henry Project. All of these stage gages are not required for daily operations but the information is available when desired. The locations of these and other river stage gages are shown on Plate 5-2. In addition, river stage gages listed in the section of Table 5-2 titled “Other River Stage Gages Within the Alabama River Basin” are available if necessary, but do not report daily.

In addition to the automated reporting stations, stage and flow data at APC projects are furnished to the Corps, Mobile District daily by the APC Birmingham office. The APC also receives Data Collection Platform transmissions directly from gages throughout the ACT Basin.

Data from the river-stage station at R. F. Henry can be received at any time by contacting personnel at the project. Pool and tailwater elevations as well as inflow and outflow at R. F. Henry, Millers Ferry, and Claiborne are reported each morning to the Water Management Section. Most of stations within the basin are maintained by the USGS.

Table 5-2: Reporting Stage Gages Used for Lower Alabama River

USGS Gage	Name	Lat	Long	Drainage Area (sq. miles)	NGVD29 Datum	Flood Stage	Rain Gage
02420000	Alabama River Near Montgomery, AL	32.4114	-86.4083	15,087	97.90	35	No
02421000	Catoma Creek near Montgomery, AL	32.3072	-86.2994	290	151.02	20	No
02421350	Alabama River at R.F. Henry (Head Water)	32.3250	-86.7847	16,233	0.00		Yes
02421351	Alabama River at R.F. Henry (Tail Water)	32.3167	-86.7833	16,233	0.00	122	No
02423000	Alabama River at Selma, AL	32.4056	-87.0186	17,095	61.80	45	No
02424000	Cahaba River at Centreville, AL	32.9450	-87.1392	1,027	180.74	23	No
02424590	Cahaba River at Suttle, AL	32.5292	-87.1989	1,480	97.64	32	No
02425000	Cahaba River at Marion Junction	32.4439	-87.1803	1,766	86.72	36	No
02427505	Alabama River at Millers Ferry (Head Water)	32.1006	-87.3992	20,637	0.00		Yes
02427506	Alabama River at Millers Ferry (Tail Water)	32.1000	-87.3978	20,637	0.00	66	No
02428400	Alabama River at Claiborne (Head Water)	31.6150	-87.5506	21,473	0.00		No
02428401	Alabama River at Claiborne (Tail Water)	31.6134	-87.5506	21,473	0.00	42	No

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.

Data are collected at Corps sites and throughout the ACT Basin through a variety of sources and integrated into one verified and validated central database. The basis for automated data collection at a gage location is the Data Collection Platform. The Data Collection Platform is a computer microprocessor at the gage site. A Data Collection Platform has the capability to interrogate sensors at regular intervals to obtain real-time information (e.g., river stage, reservoir elevation, water and air temperature, precipitation). The Data Collection Platform then saves the information, performs simple analysis of it, and then transmits the information to a fixed geostationary satellite. Data Collection Platforms transmit real-time data at regular intervals to the GOES System operated by the National Oceanic and Atmospheric Administration (NOAA). The GOES Satellite's Data Collection System sends the data directly down to the NOAA Satellite and Information Service in Wallops Island, Virginia. The data are then rebroadcast over a domestic communications satellite (DOMSAT). The Mobile District Water Management Section operates and maintains a Local Readout Ground System (LRGS) that collects the Data Collection Platform-transmitted, real-time data from the DOMSAT. Figure 5-3 depicts a typical schematic of how the system operates.

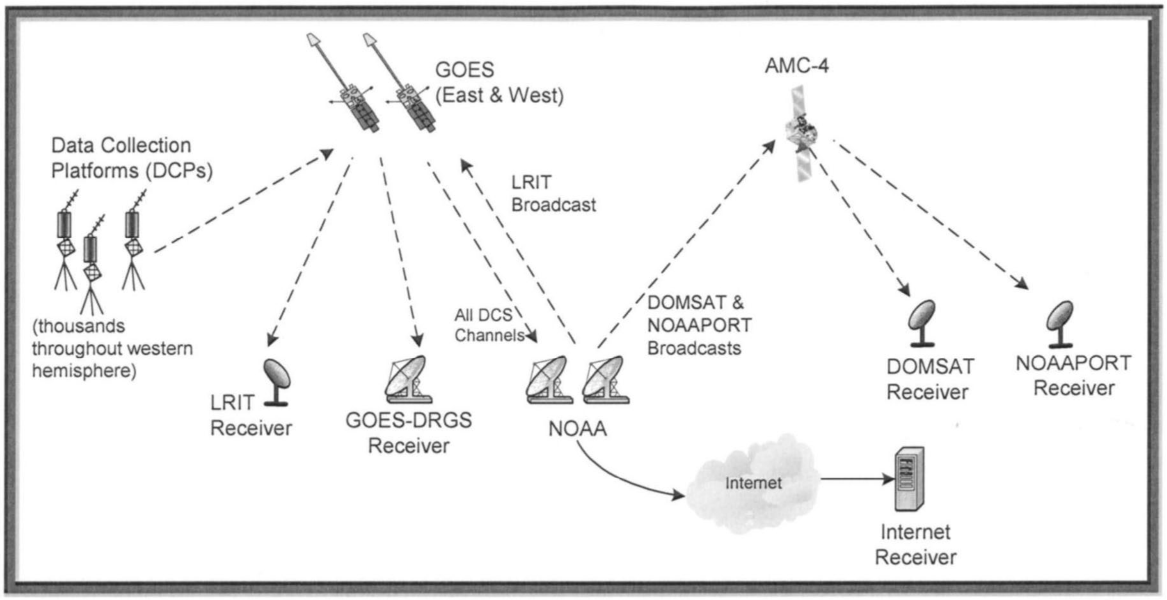


Figure 5-3. Typical configuration of the GOES System

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 Data Collection Platform and GOES antenna are capable of being part of the reporting network.

The power plant at R. F. Henry Project can be operated locally or remotely from the control room at the Millers Ferry Dam powerhouse via a microwave link between the two projects. The remote system also produces visual observations of the project. Data from R. F. Henry Dam are automatically collected at the project and transmitted through the project's SCADA system and the internet to Millers Ferry Dam and the Mobile District. Telephone is an option for other communications. Data for the project and the Data Collection Platforms are downloaded both daily and hourly through the Corps' server network to the Water Management Section.

c. Maintenance. The Corps, Mobile District has a cooperative program with the USGS and their office in Montgomery, Alabama for both maintenance and the exchange of data for the gages identified in the above paragraphs. Maintenance of the gages is accomplished by the USGS according to the program. 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) 690-2730 Web: http://water.sam.usace.army.mil

USGS Alabama Water Science Center, 75 Technacenter Drive, Montgomery, AL 36117
Phone: (334) 395-4120 Web: http://al.water.usgs.gov

5-02. Water Quality Stations. There are no Corps operated or maintained water quality stations in the R. F. Henry Project area. However, there are some real-time water quality parameters collected at several of the stream gages maintained by the USGS for general water quality monitoring purposes. The data for these stations can be obtained from the USGS yearly publication, ***Water Resources Data Alabama***. The Alabama Department of Environmental Management also periodically samples water quality throughout the Alabama portion of the basin on a rotating schedule.

5-03. Sediment Stations. In order to provide an adequate surveillance of sedimentation, a network of sediment ranges were established for R. E. “Bob” Woodruff Lake in 1974. Quantitative computations can be made from these ranges to determine the extent and degree of sedimentation and erosion. General conditions and changes have been measured and recorded using this network. The network of sediment stations is shown on Plate 4-1.

Sediment surveys were conducted in 1982, 1988, and 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 Alabama River Lakes”. 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% change), “Medium” (5 to 15% change), “Light” (0 to 5%), 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% of shorelines showing the greatest bank retreat were classed as “Acute,” the middle 50% in bank retreat were classed as “Moderate,” and the 25% with the least bank retreat were classed as “Slight.” Shorelines in the depositional group were classed as “Deposition.”

R. E. "Bob" Woodruff above R. F. Henry Lock and Dam is the upstream most segment of the Alabama River which is formed at the confluence of the Coosa and Tallapoosa Rivers. The Alabama River portion is represented by 15 sedimentation ranges, and the Coosa and Tallapoosa Rivers are represented by one range each near their mouths. Results are displayed in Table 5-3.

Each of the 2009 range datasets were impacted by discrepancies. Data gaps and misalignment/ mislocation along the stationing were pervasive. Neither the data gaps nor the misalignment/ mislocations could be corrected, thus the quantitative analysis was limited to the historical data, and only five of the seventeen ranges were analyzed qualitatively with the 2009 data.

Table 5-3. Sedimentation Range Results for R.E. "Bob" Woodruff Lake

Rangeline	Location	Qualitative Sedimentation Classification: 1988 to 2009	Sedimentation Classification: 1974 to 1988	Shoreline Erosion Classification: 1974 to 1988	
				Left Bank	Right Bank
1A	Alabama River	Light	Light	Deposition	Deposition
2A	Alabama River		Heavy	Deposition	Deposition
3A	Alabama River		Light	Moderate	Moderate
4A	Alabama River	None/Scour	None	Deposition	Deposition
5A	Alabama River		None	Slight	Acute
6A	Alabama River	None/Scour	None	Acute	Moderate
7A	Alabama River		Medium	Slight	Moderate
8A	Alabama River	None/Scour	None	Slight	Moderate
9A	Alabama River	None/Scour	None	Slight	Acute
10A	Alabama River		None	Acute	Deposition
11A	Alabama River	None/Scour	None	Deposition	Moderate
12A	Alabama River		None	Moderate	Moderate
13A	Alabama River		None	Moderate	Acute
14A	Alabama River		Medium	Deposition	Deposition
15A	Alabama River		None	Deposition	Moderate
16A	Tallapoosa River		Heavy	Deposition	Acute
17A	Coosa River		None	Slight	Moderate

Unclassified range – no analysis

Although the discrepancies in the 2009 data were so great that the ranges could not even be evaluated qualitatively, observations made during the site visit indicated that the trends shown in the analysis from 1974 to 1988 are ongoing with heavy deposition and acute right bank erosion on the Tallapoosa River at 16A and slight to moderate erosion on the Coosa River at range 17A. The Alabama River ranges appear relatively stable in terms of sedimentation. All are classed as "None" or "Light" with the exception of ranges 07A and 14A are each classed as "Medium." Range 14A appears to be located at one of the most active sections of the river, immediately downstream of the Tallapoosa River Lower confluence, thus the degree of sedimentation indicated by the analysis is not unexpected. The more typical ranges show relatively stable beds from 1974 to 1988 with little deposition or scour. Shoreline conditions are fairly uniform along the entire length with about two-thirds of the shorelines classed as erosional and the remaining one-third classed as depositional.

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 the CWMS Oracle database. In the event this database is unavailable, data can alternately be stored in the Hydrologic Engineering Center Data Storage System (HEC-DSS).

To provide stream gage and precipitation data needed to support proper analysis, a DOMSAT Receive Station (DRS) is used to retrieve DCP data from gages throughout the ACF 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. Reservoir data is received through a link with the Supervisory Control and Data Acquisition (SCADA) system which monitors and records reservoir conditions and operations in real time.

Most reservoir data are transmitted in hourly increments for inclusion in daily log sheets that are retained indefinitely. Gage data are transmitted in increments of 15 minutes, 1-hour, or other intervals. Reservoir data are examined and recorded in water control models every morning (or other times when needed). The data are automatically transferred to forecast models.

Automated timed processes also provide provisional real-time data needed for support of real-time operational decisions. Interagency data exchange has been implemented with the USGS and NWS Southeast River Forecast Center (SERFC). A direct link to 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. Likewise, a direct link to USGS gages in the field allows for direct downloading of USGS data to Corps databases.

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 requirement to be available during emergency situations 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.

In the event of a catastrophic incident that causes loss of communication or complete loss of access to the Mobile District Office and the WCDS and CWMS servers located on site, a Continuity of Operations Program (COOP) site is being set up as a backup to these systems. This site will have servers that mirror the WCDS and CWMS servers located at the Mobile District Office allowing Water Managers to continue operating with no interruption or loss of data. It is currently planned that the COOP site will be located at the South Atlantic Division Office in Atlanta, Georgia.

The primary communication network of the R. F. Henry Project is a SCADA system network. The SCADA network includes a microwave link between R. F. Henry and Milllers Ferry Dam. The SCADA network also monitors powerhouse conditions and digitally records real-time project data hourly. The data include physical conditions at the reservoir 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 251-509-5368 (cell)
R. F. Henry Powerhouse*	334-875-4400

5-06. Communication With Project Office

a. Regulating Office with Project Office. Communication between the Water Management Section and R. F. Henry Lock and Dam is by commercial telephone and computer network. The Water Management Section can transfer current data files from the Millers Ferry computer at any time using the Local Data Server (LDS) using the File Transfer Protocol (FTP). During emergencies, a two-way voice radio in the Readiness Branch of Operations Division can be used for communication with Millers Ferry only. For powerhouse and spillway operations, communication is between Water Management Section and powerhouse operating personnel at either Jones Bluff or Millers Ferry. Millers Ferry communicates with R. F. Henry lock tenders by Private Access Exchange (PAX) or Southern Link Radio System. The equipment is located in the powerhouse at both projects.

b. Between Project Office and Others. The Water Management Section communicates daily with the NWS and APC to exchange data and forecasting information. The data exchange is made by computer and is supplemented by telephone and facsimile when necessary. The Water Management Section also has a computer link with the NWS's Advanced Weather Interactive Processing System (AWIPS) communication system via the River Forecast Center in Atlanta, Georgia. The Water Management Section, Millers Ferry, and Claiborne all use a telephone auto-answer recorded message to provide daily information to the public. R. F. Henry data is provided via the Millers Ferry recording. Water resources information is available to the public at the Corps' website, http://water.sam.usace.army.mil. The site contains real-time information, historical data and general information that may be of interest to the public.

In order to warn the public at the start of a hydropower release downstream, a warning horn is activated by the operator from the unit controls. An audio detector or electrical current detector verifies the horn has sounded and allows the unit start-up sequence to continue. The horn will continue to sound for two minutes before the unit starts. The R.F. Henry Spillway has two horns that are initiated from the Millers Ferry/Jones Bluff Powerhouse SCADA system. The horns are activated by powerhouse operators before a gate is raised from its sill. The horns sound for two minutes, and are verified through audio detectors and electrical current detectors.

5-07. Project Reporting Instructions. R. F. Henry and Millers Ferry Powerhouse data is automatically recorded hourly. A file containing the data is sent to the LDS system every four hours. The information includes pool elevations, megawatt loading of the units, turbine and spillway discharges, gate step settings and inflows. At 6:00 AM every morning a water management report is sent to the LDS. It includes rainfall, 24-hour discharges and inflows, projected generation and other pertinent information.

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 R. F. Henry Project, the operator on duty should notify the Water Management Section, Operations Division and the Operations Project Manager at the project. A coordinated effort among those offices and the District's Emergency Management Office will develop notifications to make available to 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 with the constraints of authorized functions. Those plans are presented in water control manuals such as this one. Water control manual preparation and updating is a routine operation of the Water Management Section. In addition, the Water Management 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 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 should be completely familiar with the approved operating plans for the R. F. Henry and Millers Ferry Projects. The Power Project Manager is responsible for implementing actions under the approved water control plans 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. Two forecasts are available for locations along the Alabama River. The NWS's River Forecast Center prepares river forecasts for the general public and for use by the Corps. In addition, the Water Management Section prepares forecasts for internal use. All features of the forecasting procedure are subject to modification and refinement as additional data and operating experience dictate. In general, forecasts are made for Corps projects and control points along the river. Inflows and outflows are estimated for R. F. Henry, Millers Ferry, and Claiborne Projects.

a. Role of 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 ACT Basin and the forecasts issued by the NWS. Whenever possible, the NWS weather and hydrologic forecasts are used. The Water Management Section develops forecasts that are used to meet the regulation objectives of the Corps ACT Reservoirs. In addition, the Water Management Section provides weekly hydropower generation forecasts using current power plant capacity, latest hydrological conditions, and system water availability.

b. Role of Other Agencies. The NWS is responsible for preparing and disseminating all public 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 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 SERFC co-located in Peachtree City, Georgia with the Peachtree City Weather Forecast Office (WFO). SERFC is responsible for the supervision and coordination of streamflow and river-stage forecasting services provided by the NWS WSFOs in Peachtree City, Georgia, and Birmingham, Alabama. SERFC routinely prepares and distributes 5-day streamflow and river-stage forecasts at key gaging stations along the Coosa, Tallapoosa, and Alabama Rivers. Streamflow forecasts are available at additional forecast points during periods above normal rainfall. In addition, SERFC provides a revised regional QPF based on local expertise beyond the NWS Hydrologic Prediction Center QPF. SERFC also provides the Water Management Section with flow forecasts for selected locations upon request. Table 6-1 lists the forecast stations in the Alabama River Basin.

(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 following days, the release decision data are sent to SERFC. Taking release decision data coupled with local inflow forecasts at forecast points along the ACT system, SERFC can provide forecasts of inflow into Corps projects. Having revised inflow forecasts from SERFC, the Corps has up-to-date forecast data to make the following days' release decisions.

(3) Alabama Power Company (APC) provides hourly discharge data from APC's Jordan, Bouldin, and Thurlow projects and provides a 7-day forecast of average daily releases from Jordan, Bouldin, and Thurlow projects.

Table 6-1. Southeast River Forecast Center Forecast Locations for Alabama River Basin

Daily Stage/Elevation Forecasts (Feet NGVD29)				
	Station	**Station ID**	**Action Stage***	**Flood Stage****
	Montgomery	MGMA1	26	35
	R. F. Henry TW	TYLA1	122	122
	Millers Ferry TW	MRFA1	61	66
	Claiborne TW	CLBA1	35	42
Daily 24-hour Inflow in Morning (10 a.m.) State Forecast Discussion				
Reservoir		**Station ID**		
R. F. Henry		TYLA1		
Millers Ferry		MRFA1		
Additional Stage Forecasts Only for Significant Rises				
River/Creek	**Station**	**Station ID**	**Action Stage**	**Flood Stage**
Coosa	Weiss Dam	CREA1		564
Coosa	Gadsden	GAPA1		511
Coosa	Logan Martin Dam	CCSA1		465
Coosa	Childersburg	CHLA1		402
Coosa	Wetumpka	WETA1	40	45
Tallapoosa	Wadley	WDLA1		13
Tallapoosa	Milstead	MILA1	15	40
Tallapoosa	Tallapoosa Wt Pit	MGYA1	15	25
Catoma Creek	Montgomery	CATA1	16	20
Alabama	Selma	SELA1	30	45
Cahaba	Cahaba Hts	CHGA1		14
Cahaba	Centreville	CKLA1	20	23
Cahaba	Suttle	SUTA1	28	32
Cahaba	Marion Junction	MNJA1	15	36

* Action Stage – The stage which some type of mitigation action in preparation for possible significant hydrologic activity occurs.
** Flood Stage – The stage for which a rise in water surface level begins to impact lives, property, or commerce.

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 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 *what if* scenarios. Both water-on-the-ground and predictive QPF forecast are used in making release decisions.

b. Methods. For determining flood conditions at the R. F. Henry Project, the observed hourly discharges out of APC's Jordan, Bouldin, and Thurlow projects along with the APC's daily 7-day forecast for the Coosa and Tallapoosa Rivers are used.

6-03. Conservation Purpose Forecasts. The R. F. Henry Project is essentially a run-of-the-river project and has no practical conservation storage in the reservoir. Therefore, it is unnecessary to forecast for conservation purposes at this project.

6-04. Long-Range Forecasts*.*

a. Requirements. The Alabama River Projects are modified run-of-the-river projects and have no practical conservation storage in the reservoirs. However, the Corps does utilize available information from the NWS and projected release forecast from Alabama Power Company projects on the Coosa and Tallapoosa Rivers to aid in the operation of the system and for planning studies.

b. Methods. In extreme conditions, three-month and six-month forecasts can be produced based on 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 Projects.

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 regional drought indicator. The index is a soil moisture algorithm calibrated for relatively homogeneous regions and may lag emerging droughts by several months. 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 conditions, 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.

c. Reference Documents. The drought contingency plan for the R. F. Henry Project is summarized in Section 7-12 below. The complete ACT Drought Contingency Plan is provided in Exhibit D.

VII - WATER CONTROL PLAN

7-01. General Objectives. The Congressionally authorized purposes for the R. F. Henry Lock and Dam Project as contained in its authorizing legislation were flood risk management (flood control), navigation and hydropower. Flood risk management was deleted from the project prior to construction. The R. F. Henry Dam is operated as part of the Alabama Rivers project to provide navigation depths upstream to Montgomery, Alabama. Several other project purposes have been added through general authorizations including water quality, recreation, and fish and wildlife conservation and mitigation. The regulation plan seeks to balance the needs of all project purposes at the R. F. Henry 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

a. Full Discharge Capacity. The full discharge capacity of the spillway at elevation 125.0 feet NGVD29 is 124,500 cfs, the equivalent of a flood which may be expected to occur once in 1.5 years. Once the spillway capacity is reached a free overflow condition will prevail. There will be little difference in the water surface upstream and downstream of the dam. The river may continue to rise just as it would in the absence of any structure.

b. Head limitation. Design criteria for stability against overturning and sliding of the R. F. Henry structures make it imperative that the head, or difference between headwater and tailwater, does not exceed 47 feet at any time. All operational planning has been based on this strict limitation.

c. Gate Opening Schedule. During construction, eight gates were built by one contractor, and the other three built by another contractor. Since the beginning of operation, gates 1-3 vibrated at low flows. Therefore these gates are not to be used until all the gates can be opened to step 5. This corresponds to a tailwater elevation of 98 feet NGVD29.

7-03. Overall Plan for Water Control. The reservoir elevation will be maintained near the normal pool of 125.0 feet NGVD29 and allowed to fluctuate between the operating range of 123.0 and 126.0 feet NGVD29 by passing the inflow through the power plant and/or the spillway gates until the powerhouse becomes inoperative. When the powerhouse becomes inoperative, additional spillway gates will be opened to maintain the pool between elevations 123.0 and 126.0 feet NGVD29.

Discharges above approximately 112,000 cfs will cause the power plant to be nonproductive because of the high tailwater, so that for higher flows, no outflow will pass through the turbines. With the turbines out of service, spillway gates will be opened to lower and maintain the pool between elevations 123.0 feet NGVD29 and 126.0 feet NGVD29. When the inflow exceeds approximately 125,000 cfs, the spillway capacity will be reached, and there will be no control over the outflow. At such high flow, there will be little difference in the water level above and below the dam, and the flow condition will be that of a natural river in flood. The gates will remain in the full open position until the pool peaks and recedes. As the pool level recedes, spillway gates will be lowered to maintain the elevation between 123.0 feet NGVD29 and 126.0 feet NGVD29. When the tailwater is sufficiently low to restart the powerhouse, the spillway gates will be lowered, and the power plant and spillway gates will be used to maintain the elevation between 123.0 feet NGVD29 and 126.0 feet NGVD29. Gate operating instructions are given in the following paragraph. Any departures from this operating schedule will be made only as directed by the Water Management Section. Plate 7-1 shows total spillway and overbank discharge for pool levels above elevation 125.0 feet NGVD29. The tailwater rating curve is shown on Plate 7-2. In periods when flow is less than powerhouse capability, peaking power releases will be made as described in Paragraph 7-10.b. More detailed instructions for water control operations are given in the following paragraphs.

Operation of Spillway Gates. The spillway gates will be operated as directed by the Power Project Manager in order to maintain the pool between elevations 123.0 feet NGVD29 and 126.0 feet NGVD29 except during floods with inflows in excess of spillway capacity (see Constraints Paragraph 7-02(c) above). When inflow and pool conditions require operation of the spillway, the gates will be operated in the order and increments of openings shown on Plates 7-4 through 7-11. The 11 spillway gates are numbered in sequence beginning at the right bank or west end of the spillway, adjacent to the powerhouse. Gate adjustments will be made as necessary and as specified by the above mentioned plates to maintain the pool between limiting elevations 123.0 feet NGVD29 and 126.0 feet NGVD29. For inflows in excess of spillway capacity the gates will be left in the fully open position until the pool has peaked and recedes to elevation 125.0 feet NGVD29. When this elevation is reached the operator will begin closing gates to pass the inflow, in excess of power plant and lock operation discharge, necessary to keep the pool within the established limits.

7-04. Standing Instructions to Powerhouse Operator. Exhibit C, Standing Instructions to the Powerhouse Operator for Water Control, describes the operator's responsibilities considered necessary for reservoir regulation. These duties include reservoir operating procedures, data collecting, and data reporting.

7-05. Flood Risk Management. There is no flood risk management storage in the R. F. Henry Project. Flowage easements have been obtained encompassing all lands subjected to an increased frequency of flooding from the operation of the project. Paragraph 2-05 describes the real estate acquisition lines.

7-06. Recreation. Most recreational activities at R. E. "Bob" Woodruff Lake occur during the summer months. Because R. F. Henry operates to maintain a generally stable pool, access to recreational areas such as swimming beaches and boat ramps are generally not limited. Other recreational opportunities are hiking trails, picnic areas, a fishing deck, and camping.

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, mark hazards, and perform other necessary tasks to mitigate the effects of low lake levels. Paragraph 2-06 describes the public facilities available at the project. Occasionally, releases may be scheduled for special recreational events such as river float trips.

7-07. Water Quality. Flows from R. F. Henry Dam are used downstream to provide the 7Q10 flow of 6,600 cfs below Claiborne (determined from observed flows between 1929 – 1981 at the USGS gage # 02429500, Alabama River at Claiborne, Alabama). Several industries on the Alabama River have designed effluent discharges and have State discharge permits based on this dilution flow. Whenever flows recede to this level, conditions will be closely monitored so adequate warning can be given if it is necessary to reduce the flows even further. Section 7-10 explains the procedures to be followed should the outflow drop to a level which is not sufficient enough to support the 6,600 cfs flow below Claiborne.

7-08. Fish and Wildlife. The impoundment is favorable for the establishment of a sports fishery. The pool will be maintained at a fairly constant level except during floods when high inflows cause a rise in the reservoir level. This relatively stable pool during the spring spawning season is beneficial to the production of crappie, largemouth and smallmouth bass, shellcracker, warmouth, and sunfishes but is limited by the relatively thin layer of conservation storage and static head limitations of the project.

When Alabama River flow and project conditions allow, the Corps operates the lock from February through May to facilitate downstream/upstream passage of migratory fishes. While there can be slight differences in the locking technique each year, generally two fish locking cycles are performed each day between 8:00 AM and 4:00 PM, depending on facility staffing; one in the morning and one in the afternoon.

7-09. Water Supply. Based upon information provided by the Alabama Office of Water Resource in 2010, there are two major withdrawals that occur from R.E. "Bob" Woodruff Lake; International Paper at Prattville, and the E. B. Harris Southern Company Plant. There are also two minor irrigation withdrawals from the lake by Benton Farms and River Bend Sod. Also, the International Paper (Riverdale Mill) located below the R. F. Henry Project requests a minimum average of six hours of operation from Robert F. Henry.

7-10. Hydroelectric Power. The Jones Bluff Powerhouse is operated as a run-of-river hydropower plant for the production of hydroelectric energy and capacity. Depending upon flow, the plant is either continuously running (high flow) or peaking (low flow) on a seven-day basis. The output from the plant is marketed by the Southeastern Power Administration (SEPA) in accordance with provisions in the Flood Control Act of 1944. The responsibility under this Act for determining the amount of power that can be produced from this project has been delegated to the Mobile District Commander. The District Commander relies on the Water Management Section to make weekly and daily determinations of hydropower that can be generated. The average annual energy produced at R. F. Henry from FY 2000 to 2012 was 284,489 MWH with a high of 417,933 MWH (2003) and a low of 196,178 MWH (2008).

a. Normal Operation. The powerhouse at R. F. Henry Dam is operated to furnish peak energy. The energy is marketed to the government's preference customers under terms of contracts negotiated and administered by SEPA. The generation (and water release) is based on a declaration of energy and capacity available that is prepared weekly by the Mobile District on the basis of the ACT Water Control Manual. The declarations, which are designed to keep the pools within the established seasonal and pondage limits, where practicable, are prepared by the Water Management Section of the Mobile District and furnished to the South Atlantic Division (SAD) office for coordination of the hydropower projects within the Alabama-Georgia-South Carolina power marketing system. Actual daily and hourly scheduling of generation is coordinated by the Water Management Section, SEPA, and the hydropower customers. Local restraints can dictate generation during certain hours. Performance curves which indicate the discharge capacity and power output capability at various operating heads for a single turbogenerator unit are shown on Plate 7-3.

b. High-Flow Operation. During periods when the reservoir inflow is equal to or greater than the capacity of the turbines (about 35,200 cfs), the power plant will be operated at full capacity around the clock. As the flow increases, rising tailwater elevations will reduce the head and the power output. When the head decreases to approximately 15.3 feet, the units will be shut down.

c. Low-Flow Operation. The hydropower operation during extended low-flow or drought periods is slightly different from the normal operation. The maximum allowable drawdown is elevation 123.0 feet NGVD29. Provisions have been made for an emergency drawdown elevation of 122.0 feet NGVD29. During extended low-flow periods the Water Management Section will establish a target tailwater elevation at Claiborne Lock and Dam. The Water Management Section will schedule sufficient daily generation and discharge from R. F. Henry and Millers Ferry to maintain the target tailwater elevation. If the generation schedule causes the pool to drop to elevation 122.5 feet NGVD29, the Project Operator for water control will notify the Water Management Section. In no case will releases be made if the pool falls to elevation 122.0 feet NGVD29 unless specifically directed by the Water Control Manager. Because the upstream APC projects do not normally release as much water on weekends as weekdays, the R. F. Henry pool can be expected to be at its lowest level on Monday and highest level on Friday during the period.

7-11. Navigation.

Navigation is an important use of water resources in the ACT Basin. The Alabama River, from Montgomery, Alabama, downstream to the Mobile, Alabama, area, provides a navigation route for commercial barge traffic, serving as a regional economic resource. A minimum flow is required to ensure usable water depths to support navigation. Congress has authorized continuous navigation on the river, when sufficient water is available. The three Corps locks and dams on the Alabama River and a combination of dredging, river training works, and flow augmentation together support navigation depths on the river. The lack of regular dredging and routine maintenance has led to inadequate depths at times in the Alabama River navigation channel.

When supported by maintenance dredging, ACT Basin reservoir storage, and hydrologic conditions, adequate flows will provide a reliable navigation channel. In so doing, the goal of the water control plan is to ensure a predictable minimum navigable channel in the Alabama River for a continuous period that is sufficient for navigation use. Figure 7-1 shows the effect of dredging on flow requirements for different navigation channel depths using 2004 – 2010 survey data. As shown on Figure 7-1, pre-dredging conditions exist between November and April; dredging occurs between May and August; and post-dredging conditions exist from September through October, until November rainfall causes shoaling to occur somewhere along the navigation channel.

A 9-foot-deep by 200-foot-wide navigation channel is authorized on the Alabama River to Montgomery, Alabama. When a 9.0-foot channel cannot be met, a shallower 7.5-foot channel would still allow for light loaded barges moving through the navigation system. A minimum depth of 7.5 feet can provide a limited amount of navigation. Under low flow conditions, even the 7.5-foot depth has not been available at all times.

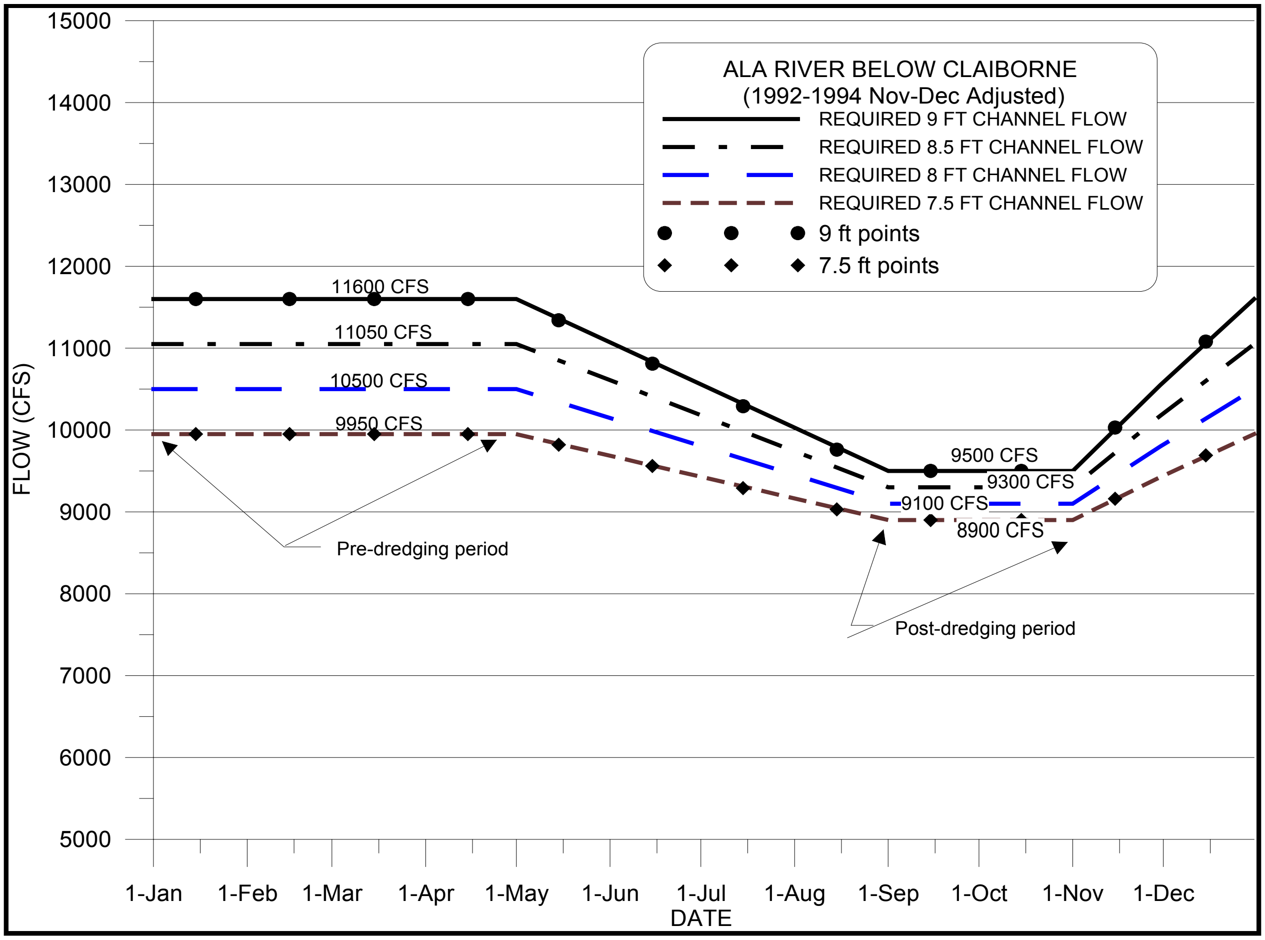


Figure 7-1. Flow-Depth Pattern (Navigation Template) Using 2004 -2010 Survey Data

Flow releases from upstream APC projects have a direct influence on flows needed to support navigation depths on the lower Alabama River. Flows for navigation are most needed in the unregulated part of the lower Alabama River below Claiborne Lock and Dam. When flows are available, R. F. Henry, Millers Ferry, and Claiborne Projects are regulated to maintain stable pool levels, coupled with the necessary channel maintenance dredging, to support sustained use of the authorized navigation channel and to provide the full navigation depth of 9 feet. When river conditions or funding available for dredging of the river indicates that project conditions (9-foot channel) will probably not be attainable in the low water season, the three Alabama River projects are operated to provide flows for a reduced project channel depth as determined by surveys of the river. APC operates its reservoirs on the Coosa and Tallapoosa Rivers (specifically flows from their Jordan, Bouldin, and Thurlow (JBT) projects) to provide a minimum navigation flow target in the Alabama River at Montgomery, Alabama. The monthly minimum navigation flow targets are shown in Table 7-1. However, flows may be reduced if conditions warrant. Additional intervening flow or drawdown discharge from the R. F. Henry and Millers Ferry Projects must be used to provide a usable depth for navigation and/or meet the 7Q10 flow of 6,600 cfs below Claiborne Dam. However, the limited storage afforded in both the R. E. “Bob” Woodruff and William “Bill” Dannelly Lakes can only help meet the 6,600 cfs level at Claiborne Lake for a short period. As local inflows diminish or the storage is exhausted, a lesser amount would be released depending on the amount of local inflows. Table 7-2 and

Figure 7-2 show the required basin inflow for a 9.0-foot channel; Table 7-3 and Figure 7-3 show the required basin inflow for a 7.5-foot channel.

During low-flow periods, it is not always possible to provide the authorized 9-foot deep by 200-foot-wide channel dimensions. In recent years, funding for dredging has been reduced resulting in higher flows being required to provide the design navigation depth. In addition, recent droughts in 2000 and 2007 had a severe impact on the availability of navigation depths in the Alabama River.

Historically, navigation has been supported by releases from storage in the ACT Basin. Therefore, another critical component in the water control plan for navigation involves using an amount of storage from APC storage projects similar to that which has historically been used, but in a more efficient manner.

The ACT Basin navigation regulation plan is based on storage and flow/stage/channel depth analyses using basin inflows and average storage usage by APC (e.g., navigation operations would not be predicated on use of additional storage) during normal hydrologic conditions. Under that concept, the Corps and APC make releases that support navigation when basin inflows meet or exceed seasonal targets for either the 9.0-foot or 7.5-foot channel templates. Triggers are also identified (e.g., when basin inflow are less than required natural flows) to change operational goals between the 9.0-foot and 7.5-foot channels. Similarly, basin inflow triggers are identified when releases for navigation are suspended and only 4,640 cfs releases would occur. During drought operations, releases to support navigation are suspended until system recovery occurs as defined in the ACT Basin Drought Contingency Plan (see Exhibit D).

Table 7-1. Monthly Navigation Flow Target in CFS

Month	9.0-ft target below Claiborne Lake (from Navigation Template) (cfs)	9.0-ft Jordan, Bouldin, Thurlow goal (cfs)	7.5-ft target below Claiborne Lake (from Navigation Template) (cfs)	7.5-ft Jordan, Bouldin, Thurlow goal (cfs)
Jan	11,600	9,280	9,950	7,960
Feb	11,600	9,280	9,950	7,960
Mar	11,600	9,280	9,950	7,960
Apr	11,600	9,280	9,950	7,960
May	11,340	9,072	9.820	7,856
Jun	10,810	8,648	9,560	7,648
Jul	10,290	8,232	9,290	7,432
Aug	9,760	7,808	9,030	7,224
Sep	9,500	7,600	8,900	7,120
Oct	9,500	7,600	8,900	7,120
Nov	10,030	8,024	9,160	7,328
Dec	11,080	8,864	9,690	7,752

Table 7-2. Basin Inflow Above APC Projects Required To Meet A 9.0-Foot Navigation Channel

Month	APC navigation Target (cfs)	Monthly historic storage usage (cfs)	Required basin inflow (cfs)
Jan	9,280	–994	10,274
Feb	9,280	–1,894	11,174
Mar	9,280	–3,028	12,308
Apr	9,280	–3,786	13,066
May	9,072	–499	9,571
Jun	8,648	412	8,236
Jul	8,232	749	7,483
Aug	7,808	1,441	6,367
Sep	7,600	1,025	6,575
Oct	7,600	2,118	5,482
Nov	8,024	2,263	5,761
Dec	8,864	1,789	7,075

Table 7-3. Basin Inflow Above APC Projects Required To Meet A 7.5-Foot Navigation Channel

Month	APC navigation Target (cfs)	Monthly historic storage usage (cfs)	Required basin inflow (cfs)
Jan	7,960	–994	8,954
Feb	7,960	–1,894	9,854
Mar	7,960	–3,028	10,988
Apr	7,960	–3,786	11,746
May	7,856	–499	8,355
Jun	7,648	412	7,236
Jul	7,432	749	6,683
Aug	7,224	1,441	5,783
Sep	7,120	1,025	6,095
Oct	7,120	2,118	5,002
Nov	7,328	2,263	5,065
Dec	7,752	1,789	5,963

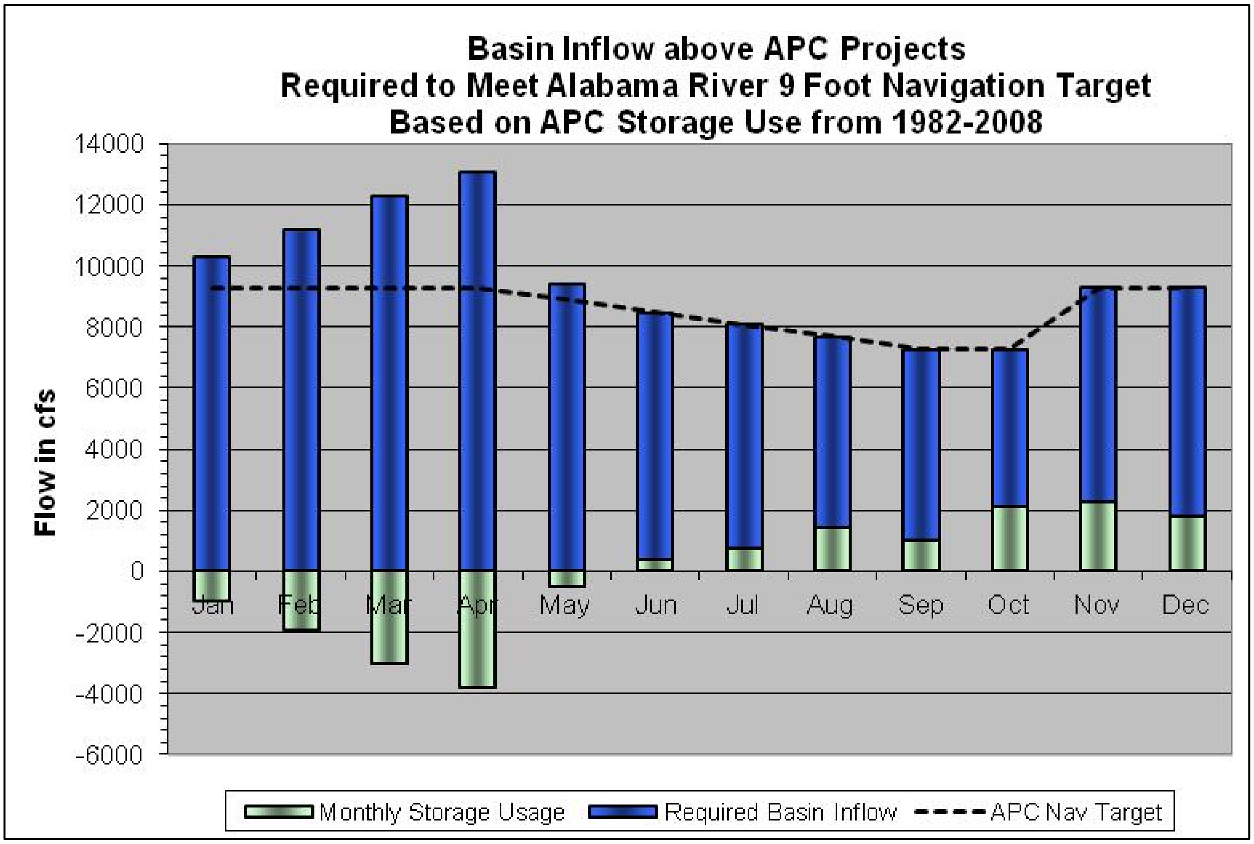


Figure 7-2. Flow Requirements from Rainfall (or Natural Sources) and Reservoir Storage to Achieve the JBT Goal for Navigation Flows for a 9-Foot Channel

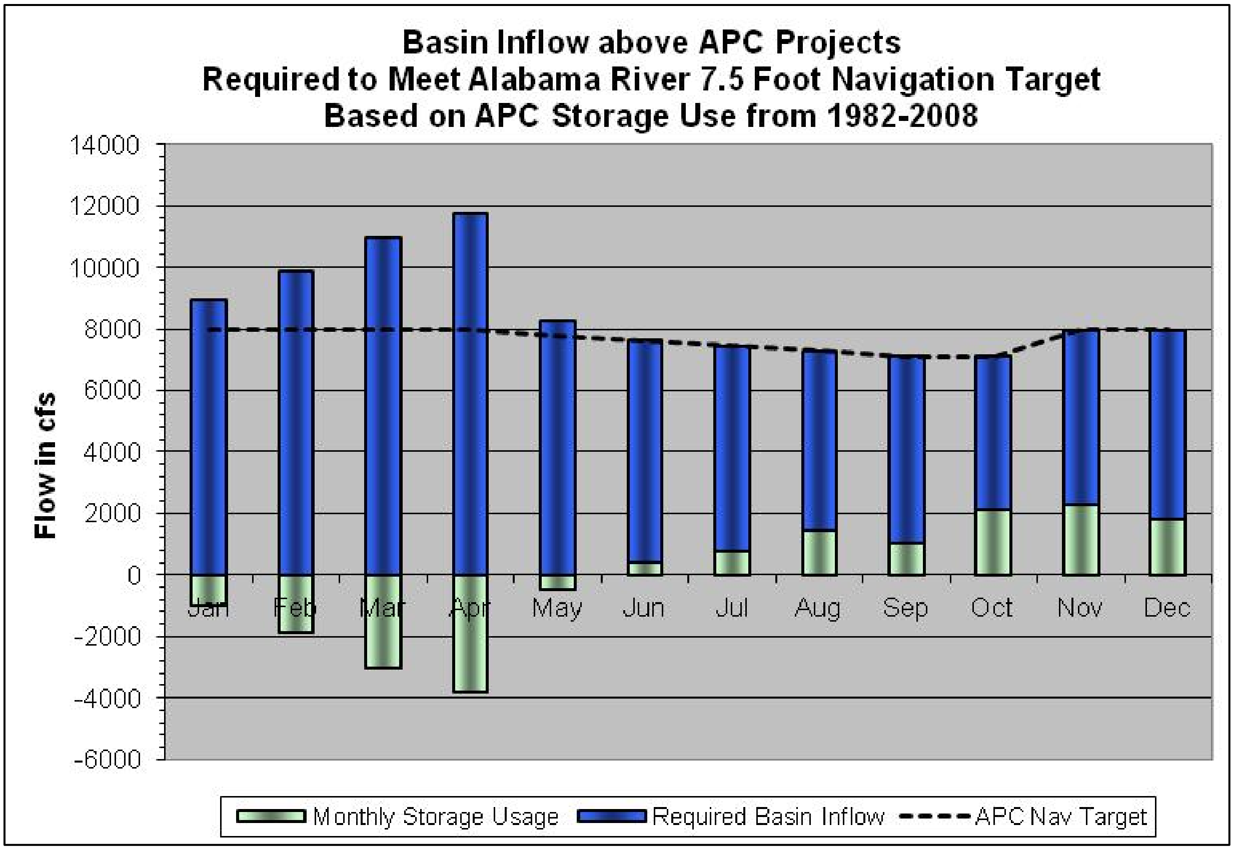


Figure 7-3. Flow Requirements from Rainfall (or Natural Sources) and Reservoir Storage to Achieve the JBT Goal for Navigation Flows for a 7.5-Foot Channel

During normal flow periods, no special water control procedures are required for navigation at the R. F. Henry Project other than maintaining the proper pool level. The normal maximum allowable drawdown at elevation 123.0 feet NGVD29 provides a clearance of 13.0 feet over the upper lock sill and should provide minimum depths for a 9-foot navigation channel at Montgomery and up to Bouldin Dam. Navigable depth is normally available downstream of the project if Millers Ferry is within its normal operating level. However, shoaling between Selma, Alabama, and R. F. Henry may result in the need to make water releases to increase the depth over any shoals. This will be accomplished by regular or specially scheduled hydropower releases when possible.

During high flow periods, navigation will be discontinued through the R. F. Henry Lock during flood periods when the headwater reaches elevation 131.0 feet NGVD29. At this elevation the discharge will be 156,000 cfs which is expected to occur on an average of once every three years and the freeboard will be one-foot on the guide and lock walls.

In the event that the Mobile District Water Management Section (EN-HW) determines upcoming reductions in water releases may impact the available navigation channel depth, they shall contact the Black Warrior/Tombigbee - Alabama/Coosa Project Office (OP-BA), and the Mobile District Navigation Section (OP-TN), to coordinate the impact. EN-HW shall provide the Claiborne tailwater gage forecast to OP-BA and OP-TN. Using this forecast and the latest available project channel surveys, OP-BA and OP-TN will evaluate the potential impact to available navigation depths. Should this evaluation determine that the available channel depth is adversely impacted, OP-BA and OP-TN will work together, providing EN-HW with their determination of the controlling depth. Thereafter, OP-BA and OP-TN will coordinate the issuance of a navigation bulletin. The notices will be issued as expeditiously as possible to give barge owners, and other waterway users, sufficient time to make arrangements to light load or remove their vessels before action is taken at upstream projects to reduce flows. The bulletin will be posted to the Mobile District Navigation website at

http://navigation.sam.usace.army.mil/docs/index.asp?type=nn

Although special releases will not be standard practice, they could occur for a short duration to assist maintenance dredging and commercial navigation for special shipments if basin hydrologic conditions are adequate. The Corps will evaluate such requests on a case by case basis, subject to applicable laws and regulations and the basin conditions.

7-12. Drought Contingency Plan.

Flow in the Alabama River is largely controlled by APC impoundments on the Coosa and Tallapoosa Rivers above R. F. Henry Lock and Dam. Under normal flows the APC impoundments will provide sufficient releases from the Coosa and Tallapoosa Rivers to meet a continuous minimum seven-day average flow of 4,640 cfs (32,480 dsf/7 days). However, additional intervening flow or drawdown discharge from R. F. Henry and Millers Ferry Projects must be used to provide a usable depth for navigation or meet the 7Q10 flow of 6,600 cfs at Claiborne Lock and Dam.

In accordance with ER 1110-2-1941, Drought Contingency Plans, dated 15 September 1981, an ACT Basin Drought Contingency Plan (DCP) has been developed to implement water control regulation drought management actions. Drought operations will be in compliance with the plan for the entire ACT Basin as outlined in Exhibit D. Pertinent requirements of the DCP relative to the R. F. Henry Project are summarized below.

Based upon experience gained during previous droughts, and in particular the 2006 - 2008 drought, a basin-wide DCP was developed and is comprised of three components - headwater operations at Allatoona Lake and Carters Lake in Georgia; operations at APC projects on the Coosa and Tallapoosa Rivers; and downstream operations at Corps projects below Montgomery, Alabama. Drought operations for the APC projects were initially developed as a separate plan by the APC (APCDOP) in cooperation with the State of Alabama and the Corps as a result of the 2006 – 2008 drought. The specifics of the APCDOP, as incorporated into the overall ACT Basin DCP, are shown on Table 7-5.

Operational guidelines have been developed on the basis of a Drought Intensity Level (DIL). The DIL is a drought indicator, ranging from DIL 1 to DIL 3, determined by the combined number of drought triggers that occur. The three drought triggers are: (1) basin inflow; (2) composite conservation storage in APC reservoirs; and (3) state line flow. Additional information on the drought triggers can be found in Exhibit D. Drought management actions would become increasingly more austere when two triggers occur (Drought Level 2) or all three occur (Drought Level 3). Table 7-4 lists the three drought operation intensity levels applicable to APC projects.

Table 7-4. ACT Basin Drought Intensity Levels

Drought Intensity Level (DIL)	Drought Level	No. of Triggers Occurring
DIL 1	Moderate Drought	1
DIL 2	Severe Drought	2
DIL 3	Exceptional Drought	3

Drought management measures for ACT Basin-wide drought regulation consists of three major components:

- Headwater regulation at Allatoona Lake and Carters Lake in Georgia
- Regulation at APC projects on the Coosa and Tallapoosa Rivers
- Regulation at Corps projects downstream of Montgomery on the Alabama River

The headwater regulation component, as described in water control manuals for Allatoona and Carters Projects (Appendices A and H), includes water control actions in accordance with established action zones, minimum releases, and hydropower generation releases. Regulation of APC projects will be in accordance with Table 7-5 in which the drought response will be triggered by one or more of three indicators - state line flows, basin inflow, or composite conservation storage. Corps operation of its Alabama River projects downstream of Montgomery, Alabama, will respond to drought operations of the APC projects upstream.

No storage is provided in the R. E. “Bob” Woodruff pool for regulating releases during periods of low inflow. When drought conditions determine that a change in the operating guidelines is necessary private industries, state agencies and federal agencies with interests in the river system will be notified. Normally the agencies will be advised of any impending reductions well in advance, and their comment will be requested regarding any adverse impacts on the respective agency or industry.

Table 7-5. ACT Basin Drought Management Matrix

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought Level Response[a]	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 1,600 to 2,000 +/-cfs			2,500 +/- cfs		6/15 Linear Ramp down	Jordan 2,000 +/-cfs			Jordan 1,600 to 2,000 +/-cfs		
	Jordan 1,600 +/-cfs			Jordan 1,600 to 2,000 +/-cfs			Jordan 2,000 +/-cfs			Jordan 1,600 to 2,000 +/-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 releases > 350 cfs)				1/2 Yates Inflow					1/2 Yates Inflow		
	Thurlow 350 cfs				1/2 Yates Inflow					Thurlow 350 cfs		
	Maintain 400 cfs at Montgomery WTP (Thurlow release 350 cfs)						Thurlow 350 cfs			Maintain 400 cfs at Montgomery WTP (Thurlow release 350 cfs)		
Alabama River Flow[d]	Normal Operation: Navigation or 4,640 cfs flow											
	4,200 cfs (10% Cut) - Montgomery				4,640 cfs - Montgomery					Reduce: Full – 4,200 cfs		
	3,700 cfs (20% Cut) - Montgomery					4,200 cfs (10% 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% 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 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.

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 include emergency contact information and flood inundation information.

7-14. Other

Passing Drift. In order to pass drift through the gated spillway, it may be necessary to occasionally raise the trash gate located within Gate 1. The time to raise the trash gate to pass the drift should be as short duration as practical to prevent unnecessary scouring of the channel below the spillway. Normal tailwater elevation of 80.0 feet NGVD29 is adequate for short duration passage of debris. At tailwater elevations 103 feet NGVD29 or higher, no time restrictions are necessary. The operation of the trash gate is under the direction of the Powerhouse Operator, who then logs the release in SCADA to estimate the flow adjustments. A discharge-rating curve for the trash gate is shown on Plate 7-12.

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 SAD office as soon as practicable.

b. Declared System Emergency. A Declared System Emergency can occur when there is a sudden loss of power within the electrical grid and there is an immediate need of additional power generation capability to meet the load on the system. In the Mobile District, a system emergency can be declared by the Southern Company or the Southeastern Power Administration’s Operation Center. Once a system emergency has been declared, the requester will contact the project operator and request generation support. The project operator will then lend immediate assistance within the projects operating capabilities. Once support has been given, the project operator should inform the Mobile District Office immediately. The responsibilities and procedures for a Declared System Emergency are discussed in more detail in Division Regulation Number 1130-13-1, *Hydropower Operations and Maintenance Policies*. It is the responsibility of the District Hydropower Section and the Water Management Section to notify South Atlantic Division Operations Branch of the declared emergency. The Division Operations Branch should then coordinate with SEPA, District Water Management, and the District Hydropower section on any further actions needed to meet the needs of the declared emergency.

c. 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.

d. 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 SAD for review and approval.

7-16. Rate of Release Change. There are no restrictions on releases from the R. F. Henry Project during normal operations. During high-flows, it is desirable to uniformly lower discharge downstream as allowable by conditions and equipment to lessen the impacts of the erosive nature of high flows.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. R. F. Henry Lock and Dam is a run-of-the-river project with little storage capacity between the maximum and minimum operating pool elevations of 126.0 feet NGVD29 and 123.0 feet NGVD29. The project has a limited peaking hydropower capacity between elevations 123.0 feet NGVD29 to 126.0 feet NGVD29. The project's minimum reservoir level, elevation 123.0 feet NGVD29, provides navigation depths up to Montgomery, Alabama. Other purposes provided by the project include water quality, public recreation and fish and wildlife conservation and mitigation. While access and some facilities are available at the project for public recreation and fish and wildlife conservation and mitigation, water is typically not specifically managed for these purposes.

The impacts of the *ACT Master Water Control Manual* and its Appendices, including this water control manual have been fully evaluated in an Environmental Impact Statement (EIS) that was published on _____. A Record of Decision (ROD) for the action was signed on _____. 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. R. F. Henry Lock and Dam Project does not contain reservoir flood risk management storage; therefore, the project has no flood risk management capabilities.

a. <u>Spillway Design Flood</u>. The duration of the spillway design flood is approximately 24 days with a peak inflow of 738,000 cfs. Peak outflow is 725,500 cfs. The peak elevation is 148 feet NGVD29. The effects of the spillway design flood are shown on Plate 8-1.

b. <u>Standard Project Flood</u>. The standard project flood would cause a peak pool elevation of 142.3 feet NGVD29 and a maximum discharge of 410,500 cfs. Peak inflow is 421,000 cfs. The effects of the standard project flood are shown on Plate 8-2.

c. <u>Historic Floods</u>. The impacts of the project on hydrographs for the flood of March 1990, and for the flood of record, February 1961, are shown on Plates 8-3 and 8-4.

8-03. Recreation. The R. F. Henry Lock and Dam Project is an important part of the Alabama River Lakes (ARL) recreational resource, providing both economic and social benefits for the region and the Nation. The ARL is composed of the Claiborne, Millers Ferry, and R. F. Henry Projects. The ARL contains 35,632 acres of water plus an additional 12,788 acres of land, most of which are available for public use. Pool elevations of 125 feet NGVD29 at R.F. Henry, 80 feet NGVD29 at Millers Ferry, and 35 feet NGVD29 at Claiborne were used to determine total acres of water. A wide variety of recreational opportunities are provided at the lake including boating, fishing, camping, picnicking, water skiing, 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 ARL receives more than 3,400,000 recreational visitors per year. The local and regional economic benefits of recreation are significant. Annual recreational visitor spending within 30 miles of the project totals $88 million.

8-04. Water Quality. All the ACT Basin projects operate to meet the objective of maintaining water quality. The R. F Henry Project operates essentially as a run-of-the-river project providing a continual discharge of the inflows downstream. These discharges are used downstream to help provide the 7Q10 flow of 6,600 cfs downstream of Claiborne Lock and Dam. Several industries on the Alabama River have designed effluent discharges on the basis of that dilution flow. Whenever flows recede to that level, conditions are closely monitored so that adequate warning can be given if it is necessary to reduce the flows even further in response to extremely dry conditions. Aside from the minimum flow target downstream of Claiborne Lock and Dam, no other water management activities occur to specifically address water quality objectives.

8-05. Fish and Wildlife. The relatively stable pool at R. F. Henry Lock and Dam is beneficial to certain species of fish and wildlife. However, the project also creates a physical barrier to fish and other aquatic organisms' passage. The reservoir is relatively deep and slow moving compared to pre-impounded conditions. This results in a change in physical conditions, such as velocities, temperature, and substrate, as well as feeding and spawning habitat that cannot be tolerated by many species. The dam and reservoir along with other Corps and APC dams and reservoirs in the basin have resulted in declines in many fish and mussel populations. The described lockages in the Claiborne and Millers Ferry Appendices for fish passage are being implemented in order to provide improved opportunities for migration for many species.

8-06. Water Supply. There are no water storage contracts in place at the R. F. Henry Project. However, based on information provided by the Alabama Office of Water Resource in 2010, there are two major withdrawals that occur from R.E. "Bob" Woodruff Lake; International Paper at Prattville, and the E. B. Harris Southern Company Plant. There are also two minor irrigation withdrawals from the lake by Benton Farms and River Bend Sod. Also, the International Paper (Riverdale Mill) located below the R. F. Henry Project requests a minimum average of six hours of operation from Robert F. Henry.

The regulation and permitting of surface water withdrawals for M&I use is a state responsibility. No M&I water supply releases are made from R. F. Henry Dam specifically for downstream M&I water supply purposes. However, water released from R. F. Henry 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 water supply users.

8-07. Hydroelectric Power.

The R. F. Henry Hydropower Project, along with 22 other hydropower dams in the southeastern United States, composes the SEPA service area. SEPA sells hydroelectric power generated by Corps plants 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.

Hydropower is produced as peak energy at R. F. Henry, i.e., power is generated during the hours that the demand for electrical power is highest, causing significant variations in downstream flows. Daily hydropower releases from the dam vary from zero during off-peak periods to as much as 35,000 cfs, which is turbine capacity. Often, the weekend releases are lower than those during the weekdays. The R. F. Henry Project has a limited peaking hydropower capacity between elevations 123.0 feet NGVD29 to 126.0 feet NGVD29. The projects with hydropower capability provide three principal power generation benefits:

1. 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, that 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.

2. Hydropower 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. Between 2001 and 2010, R. F. Henry Project produced an average of 301,580 megawatt hours per fiscal year, with a minimum of 196,178 and a maximum of 417,933 MWH, dependent upon water availability.

3. 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 R. F. Henry 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.

The Alabama River from Montgomery, Alabama, downstream to the Mobile, Alabama, area provides a navigation route for commercial barge traffic, serving as a regional economic resource. A minimum flow is required to ensure usable water depths to support navigation. Congress has authorized continuous navigation on the river, when sufficient water is available. There are three locks and dams on the Alabama River, and a combination of dredging, river training works, and flow augmentation from upstream storage projects, which together support navigation depths on the river.

The Alabama River is a terminus on the inland waterway system. It is accessed by the Black Warrior Tombigbee Waterway and Mobile Harbor and the Gulf Intracoastal Waterway (GIWW). Its major value as a water transportation resource is its ability to carry traffic to and from inland waterway points in Mississippi, Louisiana, and Texas. Traffic on the Alabama River is linked to resources originating along the river, which makes barge transportation essential and convenient for moving these resources.

Because of river bends and shoaling at the bends, typical tow size is a four-barge tow, except during very low water conditions when tow sizes can be reduced to two barges.

Flows for navigation are most needed in the unregulated part of the lower Alabama River below Claiborne Lock and Dam. When flows are available, Claiborne Lock and Dam is operated to provide the full navigation depth of nine feet. When river conditions or funding available for dredging of the river indicates that project conditions (9-foot channel) will probably not be attainable in the low water season, the dam is operated to provide flows for a reduced project channel depth as determined by surveys of the river. In recent years funding for dredging has been cut resulting in higher flows or minimized channel (150 feet wide) being required to provide the design navigation depth. In addition to annual seasonal low flow impacts, droughts have a severe impact on the availability of navigation depths in the Alabama River.

A 9-foot deep by 200-foot wide navigation channel is authorized on the Alabama River to Montgomery, Alabama. A minimum depth of 7.5 feet can provide a limited amount of navigation. Under low-flow conditions, even the 7.5-foot depth has not been available at all times. Over the period from 1976 to 1993, based upon river stage, the 7.5-foot navigation channel was available 79 percent of the time and the 9-foot navigation channel was available 72 percent of the time. Since 1993, the percentage of time that these depths have been available has declined further. Full navigation channel availability on the Alabama River is dependent upon seasonal flow conditions and channel maintenance. The ACT Basin water control plan will provide a 9-foot channel, based upon river stage, approximately 90 percent of the time in January and over 50 percent of the time in September. A 7.5-foot channel, based upon river stage, is expected approximately 90 percent of the time in January and 56 percent of the time in September. Because of higher flows in the winter and spring, channel availability is much higher from December through May.

Figure 8-1 depicts the historic annual channel depth availabilities for the Alabama River below Claiborne Lock and Dam, based upon river stage, computed for 1970 - 2010.

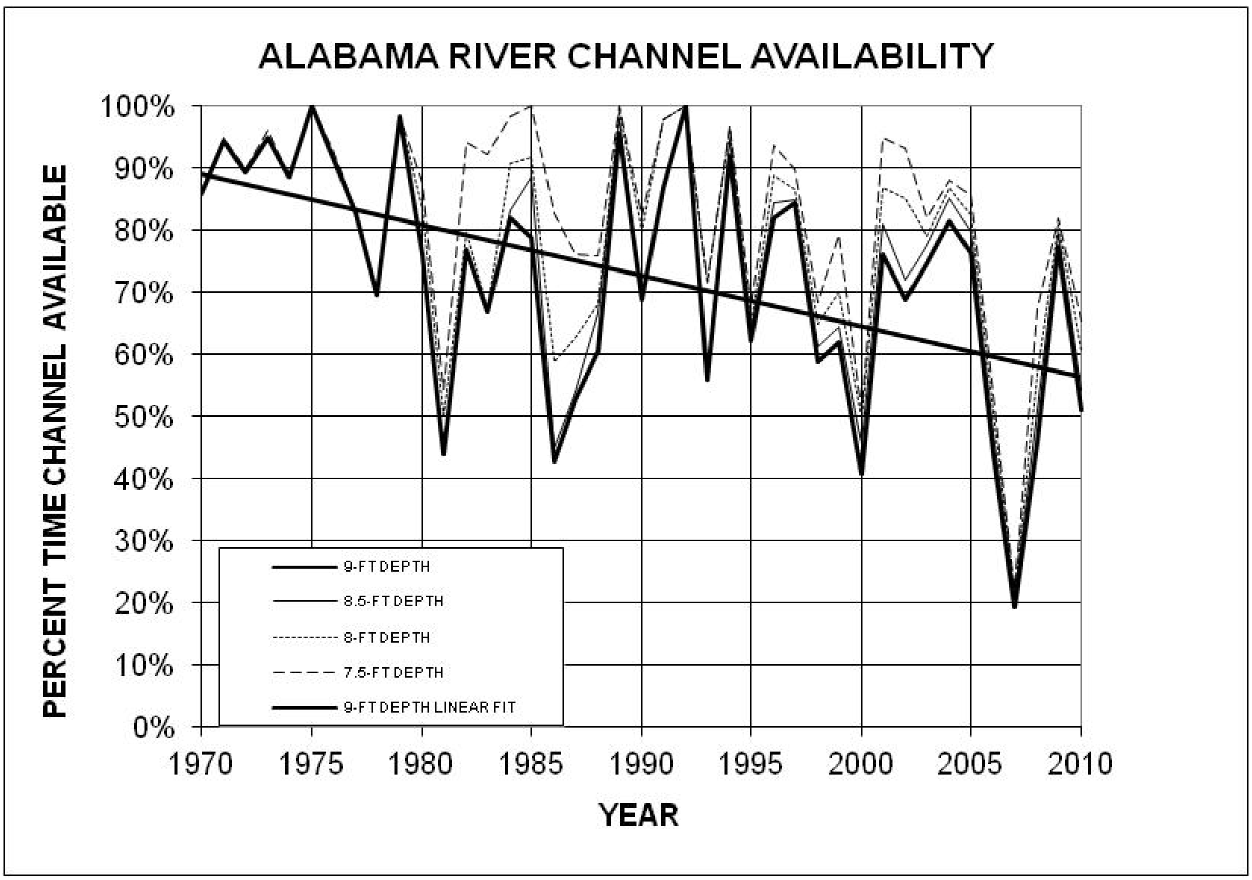


Figure 8-1. **Alabama River Channel Availability Below Claiborne, 1970 to 2010**

Extreme high-flow conditions also limit availability of the project for commercial navigation, principally related to the ability to use the navigation locks at the three locks and dams on the Alabama River. Those conditions are temporary and far more short-term (usually lasting no more than a few days) than low-water limitations resulting from extended periods of drought and low basin inflows. At R. F. Henry Lock and Dam, use of the navigation lock is discontinued when the headwater above the dam reaches elevation 131.0 feet NGVD29. That elevation equates to a flow of about 156,000 cfs, which occurs on average about once every three years. At Millers Ferry Lock and Dam, use of the navigation lock is discontinued when the tailwater below the dam reaches elevation 81.0 feet NGVD29. That tailwater elevation equates to a flow of about 220,000 cfs, which occurs on average about once every 18 years. At Claiborne Lake, use of the navigation lock is temporarily discontinued when the tailwater below the dam reaches elevation 47.0 feet NGVD29. That tailwater elevation equates to a flow of about 130,000 cfs, which occurs on average about once every 1.8 years.

8-09. Drought Contingency Plans. The development of drought plans has become increasingly important as more demands are placed on the water resources of the basin. During low-flow conditions, the system may 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. Response to drought conditions involves all the Corps and APC projects in the basin. Certain flow rates into the Alabama River are prescribed in the water control plan on the basis of available storage in the reservoirs, and other factors. The plan is described in Chapter VII of this appendix.

8-10. Flood Emergency Action Plans. Because the R. F. Henry Dam is not a flood risk management project, no major actions occur that are related to flood risk management. However, flowage easements have been obtained encompassing all lands subjected to an increased frequency of flooding from operation of the project. Normally, all operations are directed by the Mobile District Office. If a storm of flood-producing magnitude event occurs and all communications are disrupted between the district office and project personnel at the R. F. Henry Lock and Dam, emergency operating procedures, as previously described in Chapter VII of this appendix, will begin. If communication is broken after some instructions have been received from the district office, those instructions will be followed for as long as they are applicable.

8-11. Frequencies. The annual peak flow frequency curve at the R. F. Henry Project is plotted on Plate 8-5. The headwater and tailwater stage frequency curve is shown on Plate 8-6.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization. The R. F. Henry Project is a Federal structure operated by the Corps. It is part of the Alabama River Navigation System. Many agencies in Federal and State Governments are responsible for developing and monitoring water resources in the R. F. Henry 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, the State of Alabama is involved through 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 R. F. Henry Project has been delegated to the SAD Commander. The responsibility for water control regulation activities has been entrusted to the Mobile District, Engineering Division, Water Management Section. Water control actions for R. F. Henry are regulated to meet the federally authorized project purposes in coordination with federally authorized ACT Basin-wide System purposes. It is the responsibility of the Water Management Section to develop water control regulation procedures for the R. F. Henry Project, including all foreseeable conditions. 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 seven-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.

The project is tended by operators under direct supervision of the Power Project Manager and the R. F. Henry Site Manager. The Water Management Section communicates directly with the powerhouse operators at the R. F. Henry 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. The Jones Bluff Powerhouse is tended by operators who control both the power generation at Jones Bluff and the spillway gates. They can also remotely control the power generation at Millers Ferry. The Jones Bluff Powerhouse and spillway gates can also be remotely operated from the Millers Ferry Powerhouse. The Millers Ferry spillway gates can only be operated by the lock tender at Millers Ferry. The spillway gates and lock are tended by operators under direct supervision of a lock supervisor who in turn reports to the Project Manager at the Black Warrior Tombigbee/Alabama-Coosa Project Management Office in Tuscaloosa, Alabama.

b. Other Federal Agencies. Other Federal agencies work closely with the Corps to provide their agency support for the various project purposes of R. F. Henry and to meet the Federal requirements for which they might be responsible. The responsibilities and interagency coordination between the Corps and the Federal agencies are discussed in Paragraph 9-02.

c. State Agencies. The 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.

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

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

d. Stakeholders. Many non-Federal stakeholder interest groups are active in the ACT Basin. The groups include lake associations, M&I water users, navigation interests, environmental organizations, and other basin-wide interests groups. Coordinating water management activities with the interest groups, State and Federal agencies, and others is accomplished as required on an ad-hoc basis and on regularly scheduled water management teleconferences when needed to share information regarding water control regulation actions and gather stakeholder feedback. The *ACT Basin Master Water Control 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.

e. Alabama Power Company. The APC owns and operates hydropower projects within the State, and controls most of the storage in the ACT Basin, as shown below in Table 9-1. The R. E. "Bob" Woodruff Lake controls less than two percent of the conservation storage in the ACT Basin.

Table 9-1 ACT Basin Conservation Storage Percent by Acre-Feet

Project	Storage (acre-feet)	Percentage
* Allatoona	284,580	10.8%
* Carters	157,402	6.0%
Weiss	263,417	10.0%
H. Neely Henry	118,210	4.5%
Logan Martin	144,383	5.5%
Lay	92,352	3.5%
Mitchell	51,577	1.9%
Jordan/Bouldin	19,057	0.7%
Harris	207,317	7.9%
Martin	1,202,340	45.7%
Yates	6,928	0.3%
* R. F. Henry (R. E. "Bob" Woodruff)	36,450	1.4%
* Millers Ferry (William "Bill" Dannelly)	46,704	1.8%

* Federal project

R. F. Henry Project receives outflow from the APC dams, Jordan-Bouldin on the Coosa River and Thurlow on the Tallapoosa River, and schedules operation based on these releases and local or intervening flow. The scheduled outflows from these dams primarily determine the operation of R. F. Henry.

9-02. Interagency Coordination

a. Local Press and Corps Bulletins. The local press includes any periodic publications in or near the R. F. Henry Watershed and the ACT Basin. The cities of Montgomery, Prattville, Selma, Clanton, and Greenville, Alabama, are all in or near the R. F. Henry watershed and publish local newspapers. 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 Districts' Water Management homepage http://water.sam.usace.army.mil/.

b. National Weather Service. NWS is the Federal agency in NOAA that is responsible for weather and weather forecasts. The NWS along with its River Forecast Center maintains a network of reporting stations throughout the Nation. It continuously provides current weather conditions and forecasts. It prepares river forecasts for many locations including the ACT Basin. Often, it prepares predictions on the basis of *what if* scenarios. Those include rainfall that is possible but has not occurred. In addition, the NWS provides information on hurricane tracts and other severe weather conditions. It monitors drought conditions and provides the information. Information is available through the Internet, the news, and the Mobile District's direct access.

c. U.S. Geological Survey. 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 R. F. Henry Watershed and ACT Basin. The USGS Water Science Centers in Georgia and Alabama publish real-time reservoir levels, river and tributary stages, and flow data through the USGS NWIS website. The Water Management Section uses the USGS to operate and maintain project water level gaging stations at each Federal reservoir to ensure the accuracy of the reported water levels.

d. Southeastern Power Administration. 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.

1. SEPA's objectives 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.

2. 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.

3. SEPA schedules the hourly generation schedules for the R. F. Henry Hydropower Project at the direction of the Corps on the basis of daily and weekly water volume availability declarations and water release requirements.

e. U.S. Fish and Wildlife Service. The USFWS is an agency of 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 federally designated critical habitat in accordance with the Endangered Species Act of 1973. The USFWS also coordinates with other Federal agencies under the auspices of the Fish and 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.

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 R. F. Henry 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

GENERAL

Other names of project	Jones Bluff
Dam site location	
State	Alabama
Basin	Alabama-Coosa-Tallapoosa
River	Alabama
Miles above mouth of Alabama River	236.30
Total drainage area above dam site	
Square miles	16,233
1 inch of runoff equals - acre-feet	869,333
Type of project	Dam, Reservoir and Power plant
Objectives of regulation	Navigation, Power
Project Owner	United States of America
Operating Agency/ Regulating Agency	U. S. Army Corps of Engineers

STREAM FLOW AT DAM SITE

Period of Total Record	1939-2009
Period of Record (Dam in place)	1975-2009
Average annual flow for period of record (1939-2009) – cfs	24,628
Minimum monthly flow in period of record (1939-2009) - cfs	2,256
Maximum monthly flow in period of record (1939-2009) - cfs	118,061
Minimum daily flow in period of record (1939-2009) - cfs	138
Maximum daily flow in period of record (1939-2009) - cfs	218,355
Peak flow during period of record, (Feb-Mar 1961 flood) - cfs	291,700
Peak stage during period of record, (Feb-Mar 1961 flood) – ft NGVD29	138.6

REGULATED FLOODS

Maximum flood of project record (Mar. 1990)	
Peak inflow - cfs	279,044
Peak outflow - cfs	220,000
Peak pool elevation – feet NGVD29	136.8
Maximum flood of continuous record (Feb. - Mar. 1961)	
Peak inflow - cfs	291,700
Regulated peak outflow - cfs	278,500
Regulated peak pool elevation - feet NGVD29	138.6
Standard project flood series	
Peak inflow - cfs	421,000
Regulated peak outflow - cfs	410,500
Regulated peak pool elevation - feet NGVD29	142.3

REGULATED FLOODS (CONT'D)

Spillway design flood series	
Peak inflow - cfs	738,000
Regulated peak outflow - cfs	725,500
Regulated peak pool elevation – feet NGVD29	148.0

RESERVOIR

Maximum operating pool elevation - feet NGVD29	126.0
Minimum operating pool elevation - feet NGVD29	123.0
Normal operating pool elevation – feet NGVD29	125.0
Total drainage area above R. F. Henry dam site	
Square miles	16,233
1 inch of runoff equals - acre-feet	865,760
Area at pool elevation 126.0 - acres	13,500
Area acquired in fee simple - acres	5,407.2
Area acquired by easement - acres	13,911.78
Area cleared - acres	6,050
Maximum elevation of clearing - feet NGVD29	130.0
Total volume at elevation 126.0 - acre-feet	247,210
Length at elevation 126.0 - miles	81.1
Shoreline distance at elevation 126.0 - miles	397

LOCK

Nominal size of chamber - feet	84 x 600
Distance center to center of gate pintles - feet	655
Maximum lift - feet	47.0
Elevation of upper stop-log sill - feet NGVD29	109.0
Elevation of upper miter sill - feet NGVD29	109.0
Elevation of lower stop-log sill - feet NGVD29	67.0
Elevation of lower miter sill - feet NGVD29	67.0
Elevation of chamber floor - feet NGVD29	66.0
Elevation of top of floor culverts - feet NGVD29	66.0
Elevation of top of upper approach walls - feet NGVD29	132.0
Elevation of top of upper gate blocks - feet NGVD29	143.0
Elevation of top of chamber walls - feet NGVD29	132.0
Elevation of top of lower guide walls - feet NGVD29	132.0
Freeboard on guide walls when lock becomes inoperative - feet	1.0
Percent of time inoperative	0.4
Type of upper gate	horizontally framed miter
Height of upper gate – feet	34
Type of lower gate	horizontally framed miter
Height of lower gate – feet	65
Type of culvert valves	reverse tainter
Dimensions of culverts at valves – feet	10 x 10
Dimensions of culverts at laterals – feet	10 x 15.50
Elevation of culvert ceilings between valves - feet NGVD29	74.0
Minimum submergence of culvert valves - feet	5.0
Type of filling and emptying system	floor culverts
Type of emergency dams	stop logs

LOCK (CONT'D)

Elev. of top of upstream emergency dam (stoplogs) - feet NGVD29	126.7
Elevation of top of downstream emergency dam(stoplogs) - feet NGVD29	97.9
Type of operating machinery	hydraulic oil pressure

SPILLWAY

Type	concrete-gravity
Total length, including end piers - feet	646
Net length - feet	550
Elevation of crest – feet NGVD29	91.0
Number of piers, including end piers	12
Width of piers – feet	8
Type of gates	tainter
Number of gates	11
Length of gates – feet	50
Height of gates – feet	35
Maximum discharge capacity (pool elev. 125.0) - cfs	124,500
Elevation of top of gates in closed position – feet NGVD29	126.0
Elevation of top of gates in open position – feet NGVD29	168.25
Elevation of low steel of gates in fully open position – feet NGVD29	143.6
Elevation of trunnion – feet NGVD29	124.0
Elevation of access bridge – feet NGVD29	158.5
Elevation of stilling basin apron – feet NGVD29	66.0 to 81.0
Length of stilling basin – feet	62 to 72
Height of end sill – feet	5.0

EARTH OVERFLOW DIKES

Right Bank Dike	
Total length – feet	2,661
Top elevation – feet NGVD29	135.0
Top width – feet	32
Side slopes	1 on 8
Thickness of riprap on slopes – inches	24
Thickness of filter blanket – inches	9
Maximum swellhead when dike is overtopped – feet	1.4
Freeboard, top of dike above full upper pool – feet	9
Left Bank Dike	
Total length including lock mound – feet	12,639
Top elevation – feet NGVD29	143.0
Top width – feet	32
Side slopes	1 on 2.5
Freeboard, top of dike above full upper pool – feet	17
Freeboard, top of dike above headwater for Standard Project Flood series – feet	0.7
Recurrence interval of flood which will overtop right bank dike (135 feet NGVD29) using actual peak elevation from 1975- 2009, - yrs	22

POWER PLANT

Maximum power pool elevation – feet NGVD29	126.0
Maximum normal drawdown elevation – feet	123.0
Temporary/Emergency drawdown elevation – feet	122.0
Maximum static head – feet	47
Average operating head without spillway discharge – feet	29
Rated net head – feet	28.2
Operating head with one unit at full gate and pool elevation 126.0 feet	42.5
Minimum head for generation – feet	15.3
Length of powerhouse – feet	375
Width of powerhouse including intake structure – feet	160
Type of powerhouse construction	reinforced concrete
Type of intake gates	tractor
Number of intake gates	3/unit
Height of intake gates – feet	30
Width of intake gates – feet	17
Length of unit bay – feet	73
Number of units	4
Type of turbine	fixed blade
Maximum discharge per unit – cfs	8,800
Capacity of each turbine – hp	23,480
Elevation of centerline of distributor – feet NGVD29	96.0
Total installation – kW	82,000
Dependable plant output during critical period – kW	82,000
Generator rating – kva	20,500
Generator speed – rpm	73.5
Generator, electrical characteristics	3 phase, 60 Hertz 95 p.f.
Elevation of bottom of draft tube – feet NGVD29	39.0
Length of draft tube – feet	87
Type of draft tube gates	vertical slide
Number of draft tube gates	3/unit
Type of draft tube gate operation	positioned by gantry
Elevation of operating deck – feet NGVD29	143.0
Location of switchyard	right bank downstream
Elevation of switchyard and parking area – feet NGVD29	143.0
Transmission voltage – kv	115.0
Number of transformer bays	2
Number of 3-phase type transformers	2
Capacity of each transformer – kva	44,440
Average annual energy from plant (FY 2000-2012) – million kW-hr.	284.5

EXHIBIT B

UNIT CONVERSIONS
AND
VERTICAL DATUM CONVERSION INFORMATION

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	3.86×10^{-7}	2.47×10^{-4}
1 km^2	10^6	1	100	1.55×10^9	1.076×10^7	1.196×10^6	0.3861	247.1
1 ha	10^4	0.01	1	1.55×10^7	1.076×10^7	1.196×10^4	3.86×10^{-3}	2,471
1 in^2	6.45×10^{-4}	6.45×10^{10}	6.45×10^{-8}	1	6.94×10^{-3}	7.7×10^{-4}	2.49×10^{-10}	1.57×10^7
1 ft^2	.0929	9.29×10^{-8}	9.29×10^{-6}	144	1	0.111	3.59×10^{-8}	2.3×10^{-5}
1 yd^2	0.8361	8.36×10^{-7}	8.36×10^{-5}	1296	9	1	3.23×10^{-7}	2.07×10^{-4}
1 mi^2	2.59×10^6	2.59	259	4.01×10^9	2.79×10^7	3.098×10^6	1	640
1 ac	4047	0.004047	0.4047	6.27×10^6	43560	4840	1.56×10^{-3}	1

LENGTH CONVERSION

UNIT	cm	m	km	in.	ft	yd	mi
cm	1	0.01	0.0001	0.3937	0.0328	0.0109	6.21×10^{-6}
m	100	1	0.001	39.37	3.281	1.094	6.21×10^{-4}
km	10^5	1000	1	39,370	3281	1093.6	0.621
in.	2.54	0.0254	2.54×10^{-5}	1	0.0833	0.0278	1.58×10^{-5}
ft	30.48	0.3048	3.05×10^{-4}	12	1	0.33	1.89×10^{-4}
yd	91.44	0.9144	9.14×10^{-4}	36	3	1	5.68×10^{-4}
mi	1.01×10^5	1.61×10^3	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	3.05×10^6	70.05	1.58×10^4	2.28×10^7	22.824
m^3/day	1.16×10^{-5}	1	0.0116	4.09×10^{-4}	35.31	8.1×10^{-4}	0.1835	264.17	2.64×10^{-4}
l/s	0.001	86.4	1	0.0353	3051.2	0.070	15.85	2.28×10^4	2.28×10^{-2}
ft^3/s	0.0283	2446.6	28.32	1	8.64×10^4	1.984	448.8	6.46×10^5	0.646
ft^3/day	3.28×10^{-7}	1233.5	3.28×10^{-4}	1.16×10^{-5}	1	2.3×10^{-5}	5.19×10^{-3}	7.48	7.48×10^{-6}
ac-ft/day	0.0143	5.451	14.276	0.5042	43,560	1	226.28	3.26×10^5	0.3258
gal/min	6.3×10^{-5}	0.00379	0.0631	2.23×10^{-3}	192.5	4.42×10^{-3}	1	1440	1.44×10^{-3}
gal/day	4.3×10^{-8}	3785	4.38×10^{-4}	1.55×10^{-6}	11,337	3.07×10^{-6}	6.94×10^{-4}	1	10^{-6}
mgd	0.0438		43.82	1.55	1.34×10^5	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	8.1×10^{-7}	2.64×10^{-7}
m^3	1000	1	61,023	35.31	264.17	8.1×10^{-4}	2.64×10^{-4}
in^3	1.64×10^{-2}	1.64×10^{-5}	1	5.79×10^{-4}	4.33×10^{-3}	1.218×10^{-8}	4.33×10^{-9}
ft^3	28.317	0.02832	1728	1	7.48	2.296×10^{-5}	7.48×10^6
gal	3.785	3.78×10^{-3}	231	0.134	1	3.07×10^{-6}	10^6
ac-ft	1.23×10^6	1233.5	75.3×10^6	43,560	3.26×10^5	1	0.3260
million gallon	3.785×10^6	3785	2.31×10^8	1.34×10^5	10^6	3.0684	1

COMMON CONVERSIONS

1 million gallons per day (MGD) = 1.55 cfs
1 day-second-ft (DSF) = 1.984 acre-ft = 1 cfs for 24 hours
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 = 0.0737 cubic feet per second for one year

Station	NAVD88 Elevation (feet)	NGVD29 Elevation (feet)	Diff NAVD88 NGVD29 (feet)	Remarks
8A-10D	131.965			Set Corps of Engineers Brass Disk (Elevation obtain from OPUS DB)
8A-10E	143.082			Set Corps of Engineers Brass Disk
US Gauge	147.041			Shot on upstream gauge datum point. Digital readout 125.79, read 25.79 on metal tape. Both readings at 10:52 AM May 26, 2010
DS Gauge	146.968			Shot on downstream gauge datum point. Digital readout 81.13, read 81.23 on metal tape. Both readings at 9:33 AM May 26, 2010
Disk	143.076	143.014	0.062	USGS - RM 2 bronze tablet between pool and tail gages in transmitter room on floor. Elevation 143.014 feet, mean sea level.
RP1 (tail)	146.723	146.644	0.079	USGS - RP 1 [tail gage] penciled arrow on top of metal cover over pipe well, right of float tape indicator. Elevation 146.644 feet, mean sea level.
RP1 (pool)	146.715	146.651	0.064	USGS - RP 1 [pool gage] penciled arrow on top of metal cover over pipe well, right of float tape indicator. Elevation 146.651 feet, mean sea level.
TBM A	132.943			Chiseled "x" in top of bolt on base of light pole. Light pole is on left lock wall 18.20 feet south of hinges on gate leading to metal stair doing down inside of left lock wall
TBM B	159.193			Chiseled "x" in top of bolt of metal handrail base at metal stairs near power house on right side of dam.
TBM C	143.448			Chiseled "x" in base of downstream well pipe in transmitter room of power house.

SURVEY DATASHEET (Version 1.0)

PID: BBBZ02
Designation: 8A-10D
Stamping: 5A-10D
Stability: Monument will probably hold position well
Setting: Massive structures (other than listed below)
Description: LOCATED ON THE ALABAMA RIVER, AT THE ROBERT F. HENRY LOCK AND DAM, IN THE VICINTY OF THE DOWNSTREAM LEFT LOCK GATE AND NEAR THE DOWNSTREAM LEFT LOCK GATE. MONUMENT IS 14.10 FEET NORTHEAST OF A METAL CLEET, 13.00 FEET SOUTHEAST OF THE CONCRETE HANDRAIL, 10.00 FEET EAST OF THE CONCRETE HANDRAIL AND 12.40 FEET WEST OF THE THE CONCRETE HANDRAIL.
MONUMENT IS A STANDARD U.S. ARMY CORPS OF ENGINEERS BRASS DISK SET IN THE LOCK WALL.
Observed: 2010-06-22T13:08:00Z
Source: OPUS - page5 0909.08

Close-up View

REF_FRAME: NAD_83 (CORS96)	EPOCH: 2002.0000	SOURCE: NAVD88 (Computed using GEOID09)	UNITS: m	SET PROFILE	DETAILS

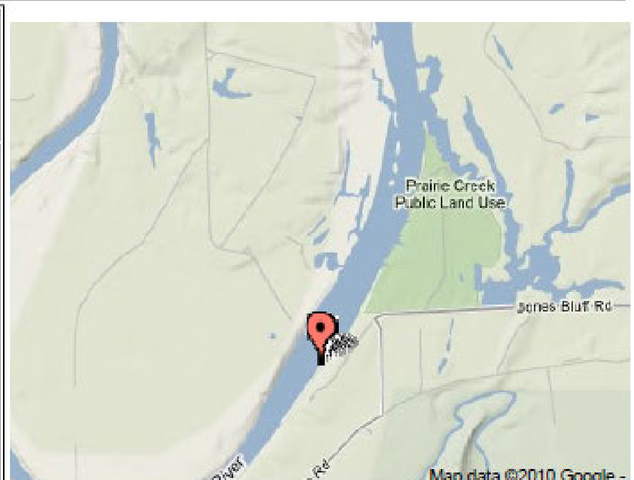
LAT:	32° 19' 19.03351"	± 0.037	m
LON:	-86° 47' 2.29515"	± 0.037	m
ELL HT:	12.413	± 0.029	m
X:	302667.607	± 0.036	m
Y:	-5386568.278	± 0.030	m
Z:	3390661.205	± 0.036	m
ORTHO HT:	40.223	± 0.029	m

	UTM 16	**SPC 102(AL W)**
NORTHING:	3576143.241m	257648.455m
EASTING:	520333.503m	667418.613m
CONVERGENCE:	0.11550603°	0.38285816°
POINT SCALE:	0.99960510	0.99998936
COMBINED FACTOR:	0.99960315	0.99998742

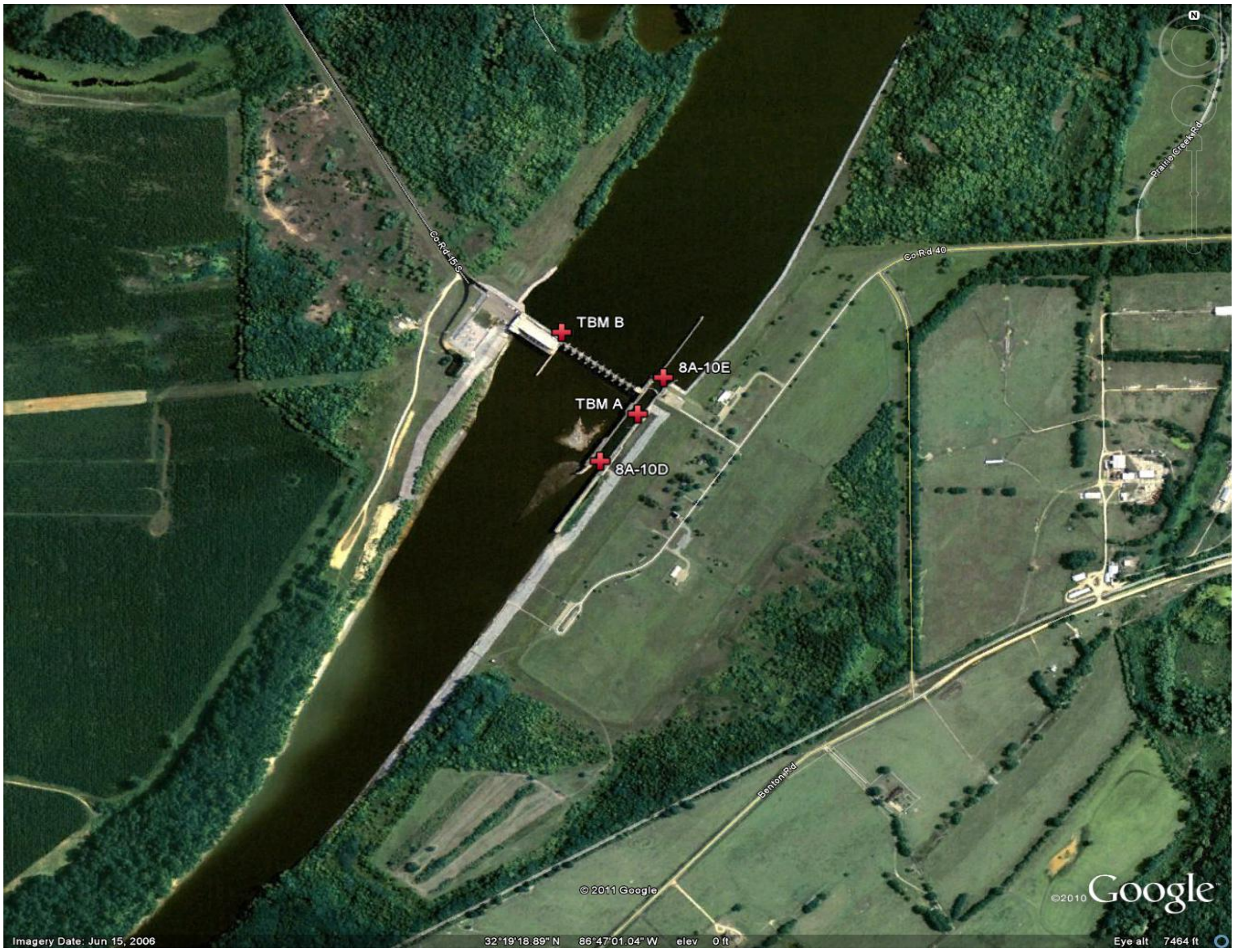
CONTRIBUTED BY

mchaney
Maptech Inc

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.



R. F. Henry Lock and Dam

EXHIBIT C

STANDING INSTRUCTIONS TO THE PROJECT OPERATOR FOR WATER CONTROL

R. F. HENRY LOCK AND DAM

STANDING INSTRUCTIONS TO THE POWERHOUSE OPERATOR FOR WATER CONTROL

ROBERT F. HENRY LOCK AND DAM PROJECT

1. BACKGROUND AND RESPONSIBILITIES

a. General Information. These “Standing Instructions to the Powerhouse 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 R. F. Henry Lock and Dam Project is operated for Hydropower and Navigation.

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

(3) Structure. The R. F. Henry Dam is located at Alabama River mile 236.3, Autauga County, Alabama. The dam is a concrete-gravity structure with a concrete-gravity gated spillway. The Powerhouse is located on the right bank, joined to the spillway on the east or river side. The Lock is located in the left bank between the spillway and the left overbank earth dike.

(4) Operation and Maintenance (O&M). All O&M activities are the responsibility of the Corps.

b. Role of the Powerhouse Operator

(1) Normal Conditions (dependent on day-to-day instruction). The Water Control Manager will coordinate the daily water control actions with SEPA. The Powerhouse Operator will then receive instructions from SEPA. This communication will be increased to an hourly basis if the need develops.

(2) Emergency Conditions (flood, drought, or special operations). During emergency conditions, the Powerhouse 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 Powerhouse Operator will continue to follow the water control plan and contact the Water Management Section as soon as communication is reestablished.

2. DATA COLLECTION AND REPORTING

a. General. R. F. Henry and Millers Ferry Powerhouse data is automatically recorded hourly. A file containing the data is sent to the LDS System every four hours. The information includes pool elevations, megawatt loading of the units, turbine and spillway discharges, gate step settings and inflows.

b. Normal Conditions. At 6:00AM every morning a water management report is sent to the LDS. It includes:

1. Midnight Pool Elevation (feet NGVD29)
2. 6AM Pool Elevation (feet NGVD29)
3. Midnight Tailwater Elevation (feet NGVD29)
4. 6AM Tailwater Elevation (feet NGVD29)
5. 24-Hour Average Inflow (cfs)
6. 1st 4-Hour Average Inflow (cfs)
7. 24-Hour Average Discharge (cfs)
8. 1st 4-Hour Average Discharge (cfs)
9. Gross Generation (mwh)
10. Estimated Generation (mwh)
11. Rainfall (hundredths of an inch)
12. 6AM Gatestep
13. 24-Hour Average Turbine Discharge (cfs)
14. Capacity (mw)
15. Project generation schedule.

c. Regional Hydro-meteorological Conditions. The Powerhouse 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 Powerhouse Operator will follow the R. F. Henry Water Control Manual for normal water control actions and will report directly to the Water Control Manager.

b. Emergency Conditions. During high-flows, the Lock Operator at R. F. Henry will follow the instructions for spillway gate settings given by the Powerhouse Operator and according to the Gate Operating Schedule. The generating units will be shut down when the operating head decreases to approximately 15.3 feet. During low-flow conditions, the Powerhouse Operator will contact the Water Control Manager if the pool elevation reaches 122.5. If unable to reach Water Management Section, generating units will be shut down at elevation 122.0 feet NGVD29, and the Powerhouse Operator will notify Water Management and SEPA as soon as possible. In no case will releases be made when the pool is below elevation 122.0 feet NGVD29 unless specifically directed by the Water Management Section. The Powerhouse Operator will follow the R. F. Henry Water Control Manual for emergency water control actions and will follow the Emergency Action Plan for emergency notification procedures.

c. Inquiries. All significant inquiries received by the Powerhouse 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 Powerhouse 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.

EXHIBIT D

Alabama-Coosa-Tallapoosa (ACT) River Basin, Drought Contingency Plan

DROUGHT CONTINGENCY PLAN

FOR

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

ALLATOONA DAM AND LAKE
CARTERS DAM AND LAKE
ALABAMA POWER COMPANY COOSA RIVER PROJECTS
ALABAMA POWER COMPANY TALLAPOOSA RIVER PROJECTS
ALABAMA RIVER PROJECTS

US Army Corps
of Engineers ®

South Atlantic Division
Mobile District

December 2014

DROUGHT CONTINGENCY PLAN
FOR THE
ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

I – INTRODUCTION

1-01. **Purpose of Document**. The purpose of this Drought Contingency Plan (DCP) is to provide a basic reference for water management decisions and responses to water shortage in the Alabama-Coosa-Tallapoosa (ACT) River Basin induced by climatological droughts. As a water management document it is limited to those drought concerns relating to water control management actions for federal U.S. Army Corps of Engineers (Corps) and Alabama Power Company (APC) dams. This DCP does not prescribe all possible actions that might be taken in a drought situation due to the long-term nature of droughts and unique issues that may arise. The primary value of this DCP is in documenting the overall ACT Basin Drought Management Plan for the system of Corps and APC projects; in documenting the data needed to support water management decisions related to drought regulation; and in defining the coordination needed to manage the ACT project's water resources to ensure that they are used in a manner consistent with the needs which develop during a drought. This DCP addresses the water control regulation of the five Corps impoundments and the APC Coosa and Tallapoosa projects (Table 1) in regard to water control regulation during droughts. Details of the drought management plan as it relates to each project and its water control regulation during droughts are provided in the water control manual within the respective project appendix to the ACT Basin Master Water Control Manual.

II – AUTHORITIES

2-01. **Authorities**. The following list provides the policies and guidance that are pertinent to the development of drought contingency plans and actions directed therein.

A. ER 1110-2-1941, "Drought Contingency Plans", dated 15 Sep 1981. This regulation provides policy and guidance for the preparation of drought contingency plans as part of the Corps of Engineers' overall water management activities.

B. ER 1110-2-8156, "Preparation of Water Control Manuals", dated 31 Aug 1995. This document provides a guide for preparing water control manuals for individual water resource projects and for overall river basins to include drought contingency plans.

C. ER 1110-2-240, "Water Control Management", dated 8 Oct 1982. This regulation prescribes the policies and procedures to be followed in water management activities including special regulations to be conducted during droughts. It also sets the responsibility and approval authority in development of water control plans.

D. EM 1110-2-3600, "Management of Water Control Systems", dated 30 Nov 1987. This guidance memorandum requires that the drought management plan be incorporated into the project water control manuals and master water control manuals. It also provides guidance in formulating strategies for project regulation during droughts.

Table 1. Reservoir impoundments within the ACT River Basin

River/Project Name	Owner/State/ Year Initially Completed	Total storage at Full Pool (acre-feet)	Conservation Storage (acre-feet)	Percentage of ACT Basin Conservation Storage (%)
Coosawattee River				
Carters Dam and Lake	Corps/GA/1974	383,565	141,402	5.9
Carters Reregulation Dam	Corps/GA/1974	17,500	16,000	0.1
Etowah River				
Allatoona Dam and Lake	Corps/GA/1949	367,471	284,580	10.8
Hickory Log Creek Dam	CCMWA/Canton/ 2007	17,702	NA	NA
Coosa River				
Weiss Dam and Lake	APC/AL/1961	306,655	263,417	10.0
H. Neely Henry Dam and Lake	APC/AL/1966	120,853	118,210	4.5
Logan Martin Dam and Lake	APC/AL/1964	273,467	144,383	5.5
Lay Dam and Lake	APC/AL/1914	262,887	92,352	3.5
Mitchell Dam and Lake	APC/AL/1923	170,783	51,577	1.9
Jordan Dam and Lake	APC/AL/1928	236,130	19,057	0.7
Walter Bouldin Dam	APC/AL/1967	236,130	NA	--
Tallapoosa River				
Harris Dam and Lake	APC/AL/1982	425,721	207,317	7.9
Martin Dam and Lake	APC/AL/1926	1,628,303	1,202,340	45.7
Yates Dam and Lake	APC/AL/1928	53,908	6,928	0.3
Thurlow Dam and Lake	APC/AL/1930	17,976	NA	--
Alabama River				
Robert F. Henry Lock and Dam/R.E. “Bob” Woodruff Lake	Corps/AL/1972	247,210	36,450	1.4
Millers Ferry Lock and Dam/William “Bill” Dannelly Lake	Corps/AL/1969	346,254	46,704	1.8
Claiborne Lock and Dam and Lake	Corps/AL/1969	102,480	NA	--

III – DROUGHT IDENTIFICATION

3-01. <u>Definition</u>. Drought can be defined in different ways - meteorological, hydrological, agricultural, and socioeconomic. In this DCP, the definition of drought used in the *National Study of Water Management During Drought* is used:

> “Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or streamflow.”

That definition defines drought in terms of its impact on water control regulation, reservoir levels, and associated conservation storage. Water management actions during droughts are intended to balance the water use and water availability to meet water use needs. Because of hydrologic variability, there cannot be 100 percent reliability that all water demands are met. Droughts occasionally will be declared and mitigation or emergency actions initiated to lessen the stresses placed on the water resources within a river basin. Those responses are tactical measures to conserve the available water resources (USACE 2009).

3-02. Drought Identification. There is no known method of predicting how severe or when a drought will occur. There are, however, indicators that are useful in determining when conditions are favorable: below normal rainfall; lower than average inflows; and low reservoir levels, especially immediately after the spring season when rainfall and runoff conditions are normally the highest. When conditions indicate that a drought is imminent, the Corps Water Management Section (WMS) and APC will increase the monitoring of the conditions and evaluate the impacts on reservoir projects if drought conditions continue or become worse for 30-, 60-, or 90-day periods. Additionally, WMS and APC will determine if a change in operating criteria would aid in the total regulation of the river system and if so, what changes would provide the maximum benefits from any available water.

Various products are used to detect and monitor the extent and severity of basin drought conditions. One key indicator is the U.S. Drought Monitor available through the U.S. Drought Portal, www.drought.gov. The National Weather Service (NWS) Climate Prediction Center (CPC) also develops short-term (6- to 10-day and 8- to 14-day) and long-term (1-month and 3-month) precipitation and temperature outlooks and a U.S. Seasonal Drought Outlook, which are useful products for monitoring dry conditions. The Palmer Drought Severity Index is also used as a drought reference. The Palmer index assesses total moisture by using temperature and precipitation to compute water supply and demand and soil moisture. It is considered most relevant for non-irrigated cropland and primarily reflects long-term drought. However, the index requires detailed data and cannot reflect an operation of a reservoir system. The Alabama Office of the State Climatologist also produces a Lawn and Garden Moisture Index for Alabama, Florida, Georgia, and South Carolina, which gives a basin-wide ability to determine the extent and severity of drought conditions. The runoff forecasts developed for both short- and long-range periods reflect drought conditions when appropriate. There is also a heavy reliance on the latest El Niño Southern Oscillation (ENSO) forecast modeling to represent the potential effects of La Niña on drought conditions and spring inflows. Long-range models are used with greater frequency during drought conditions to forecast potential effects on 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 and reservoir stages on the basis of climatic conditions, 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. For example, models using data of previous droughts or a percent of current to mean monthly flows with several operational schemes have proven helpful in forecasting reservoir levels for water management planning purposes. Other parameters considered during drought management are the ability of the various lakes to meet the demands placed on storage, the probability that lake elevations will return to normal seasonal levels, basin streamflows, basin groundwater table levels, and the total available storage to meet hydropower marketing system demands.

3-03. Historical Droughts. Drought events have occurred in the ACT Basin with varying degrees of severity and duration. Five of the most significant historical basin wide droughts occurred in 1940-1941, 1954-1958, 1984-1989, 1999-2003, and 2006-2009. The 1984 to 1989 drought caused water shortages across the basin in 1986. This resulted in the need for the

Corps to make adjustments in the water management practices. Water shortages occurred again from 1999 through 2002 and during 2007 through 2008. The 2006 to 2009 drought was the most devastating recorded in Alabama and western Georgia. Precipitation declines began in December 2005. These shortfalls continued through winter 2006-07 and spring 2007, exhibiting the driest winter and spring in the recorded period of record. The Corps and APC had water levels that were among the lowest recorded since the impoundments were constructed. North Georgia received less than 75 percent of normal precipitation (30-year average). The drought reached peak intensity in 2007, resulting in a D-4 Exceptional Drought Intensity (the worst measured) throughout the summer of 2007.

3-04. **Severity**. Water shortage problems experienced during droughts are not uniform throughout the ACT River Basin. Even during normal, or average, hydrologic conditions, various portions of the basin experience water supply problems. The severity of the problems are primarily attributed to the pattern of human habitation within the basin; the source of water utilized (surface water vs. ground water); and the characteristics of the water resources available for use. During droughts, these problems can be intensified. A severe drought in the basin develops when a deficiency of rainfall occurs over a long time period and has a typical duration of 18 to 24 months. The number of months of below normal rainfall is more significant in determining the magnitude of a drought in the basin than the severity of the deficiency in specific months. However, the severity of the rainfall deficiency during the normal spring wet season has a significant impact on the ability to refill reservoirs after the fall/winter drawdown period. Another confounding factor which influences droughts in the basin is the variability of rainfall over the basin, both temporarily and spatially.

IV – BASIN AND PROJECT DESCRIPTION

4-01. **Basin Description**. The headwater streams of the Alabama-Coosa-Tallapoosa (ACT) River Basin rise in the Blue Ridge Mountains of Georgia and Tennessee and flow southwest, combining at Rome, Georgia, to form the Coosa River. The confluence of the Coosa and Tallapoosa Rivers in central Alabama forms the Alabama River near Wetumpka, Alabama. The Alabama River flows through Montgomery and Selma and joins with the Tombigbee River at the mouth of the ACT Basin to form the Mobile River about 45 miles above Mobile, Alabama. The Mobile River flows into Mobile Bay at an estuary of the Gulf of Mexico. The total drainage area of the ACT Basin is approximately 22,739 square miles: 17,254 square miles in Alabama; 5,385 square miles in Georgia; and 100 square miles in Tennessee. A detailed description of the ACT River Basin is provided in the ACT Master Water Control Manual, Chapter II – Basin Description and Characteristics.

4-02. **Project Description**. The Corps operates five projects in the ACT Basin: Allatoona Dam and Lake on the Etowah River; Carters Dam and Lake and Reregulation Dam on the Coosawattee River; and Robert F. Henry Lock and Dam, Millers Ferry Lock and Dam, and Claiborne Lock and Dam on the Alabama River. Claiborne is a lock and dam without any appreciable water storage behind it. Robert F. Henry and Millers Ferry are operated as run-of-river projects and only very limited pondage is available to support hydropower peaking and other project purposes. APC owns and operates eleven hydropower dams in the ACT Basin; seven dams on the Coosa River and four dams on the Tallapoosa River. Figure 1 depicts the percentage of conservation storage of each project in the ACT Basin. Figure 2 shows the project locations within the basin. Figure 3 provides a profile of the basin and each project.

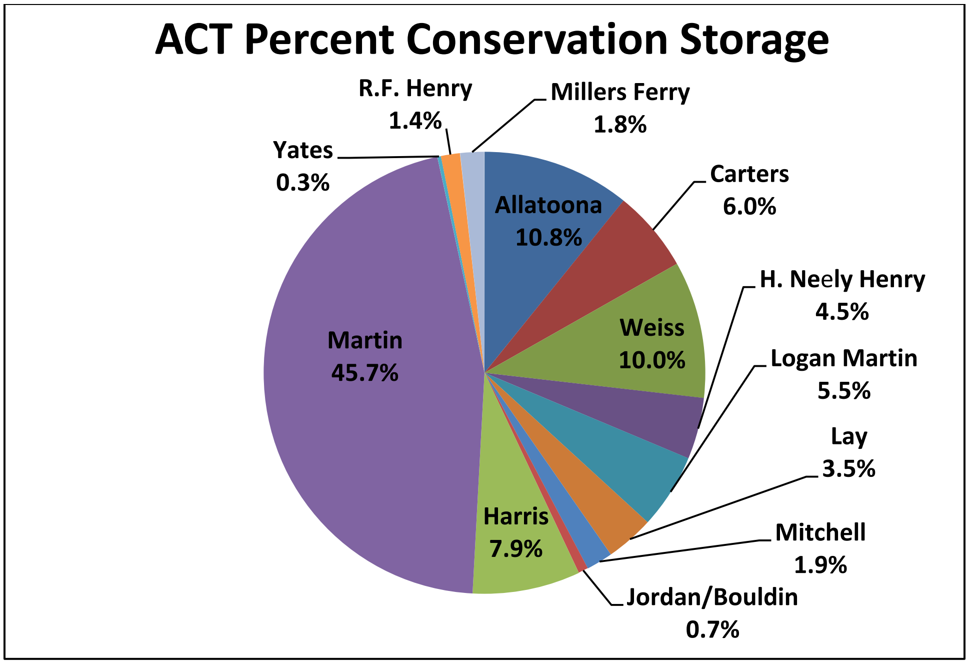


Figure 1. ACT Percent Conservation Storage

A. **General.** Of the 16 reservoirs (considering Jordan Dam and Lake and Bouldin Dam as one reservoir and Carters Lake and Carters Reregulation Dam as one reservoir), Lake Martin on the Tallapoosa River has the greatest amount of storage, containing 45.7 percent of the conservation storage in the ACT Basin. Allatoona Lake, R.L. Harris Lake, Weiss Lake, and Carters Lake are the next four largest reservoirs in terms of storage. APC controls approximately 80 percent of the available conservation storage; Corps projects (Robert F. Henry Lock and Dam, Millers Ferry Lock and Dam, Allatoona Lake, and Carters Lake) control 20 percent. The two most upstream Corps reservoirs, Allatoona Lake and Carters Lake, account for 16.8 percent of the total basin conservation storage.

Figure 2. Alabama-Coosa-Tallapoosa River Basin Project Location Map

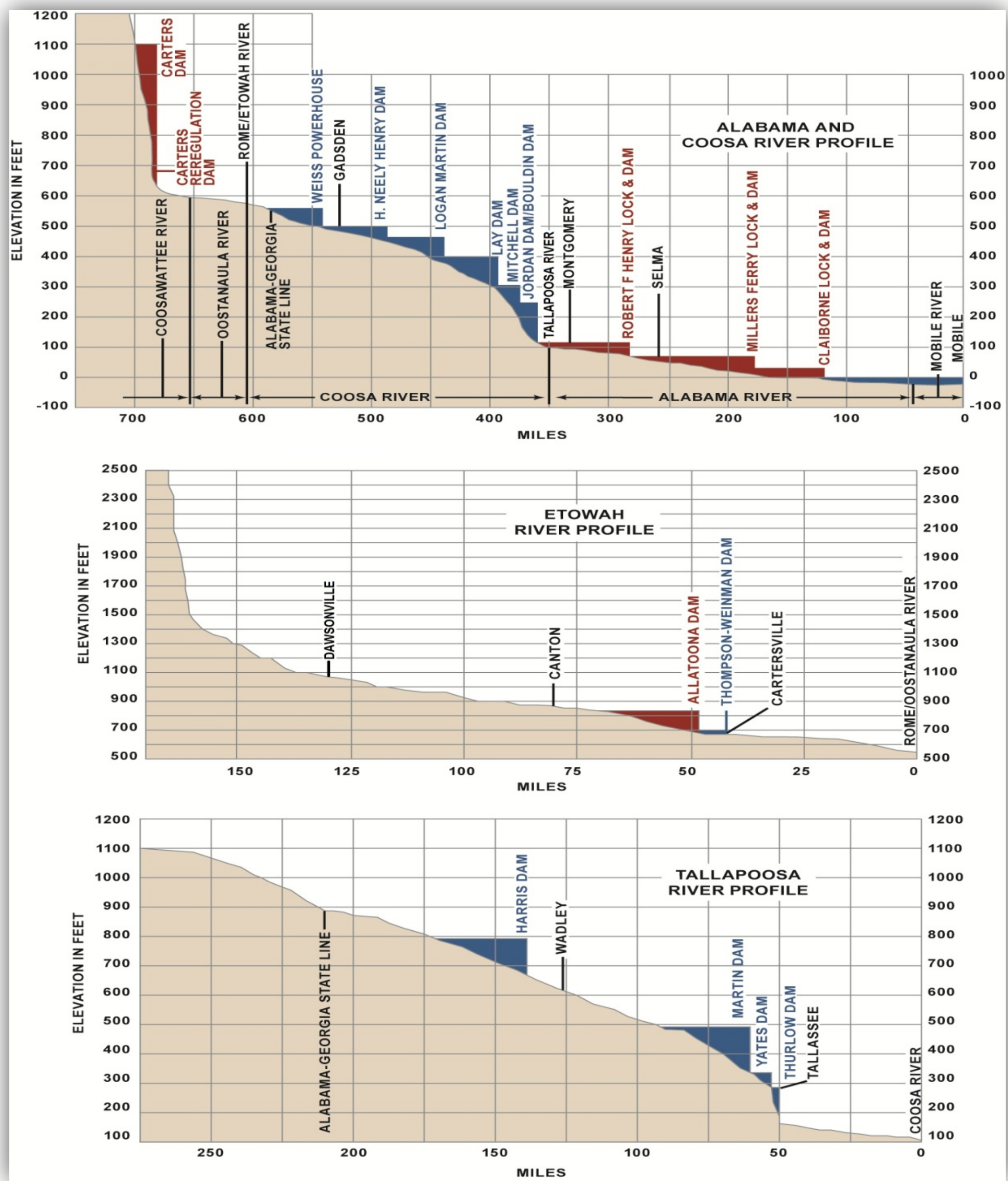


Figure 3. Alabama-Coosa-Tallapoosa River Basin Profile Map

B. **Allatoona Dam and Lake**. The Corps' Allatoona Dam on the Etowah River creates the 11,862 acres Allatoona Lake. The project's authorization, general features, and purposes are described in the Allatoona Dam and Lake Water Control Manual. The Allatoona Lake top of conservation pool is elevation 840 feet NGVD29 during the late spring and summer months (May through August); transitions to elevation 835 feet NGVD29 in the fall (October through mid-November); transitions to a winter drawdown to elevation 823 feet NGVD29 (1-15 January); and refills back to elevation 840 feet NGVD29 during the winter and spring wet season as shown in the water control plan guide curve (Figure 4). However, the lake level may fluctuate significantly from the guide curve over time, dependent primarily upon basin inflows but also influenced by project operations, evaporation, withdrawals, and return flows. A minimum flow of about 240 cfs is continuously released through a small unit, which generates power while providing a constant flow to the Etowah River downstream. Under drier conditions when basin inflows are reduced, project operations are adjusted to conserve storage in Allatoona Lake while continuing to meet project purposes in accordance with four action zones as shown on Figure 4.

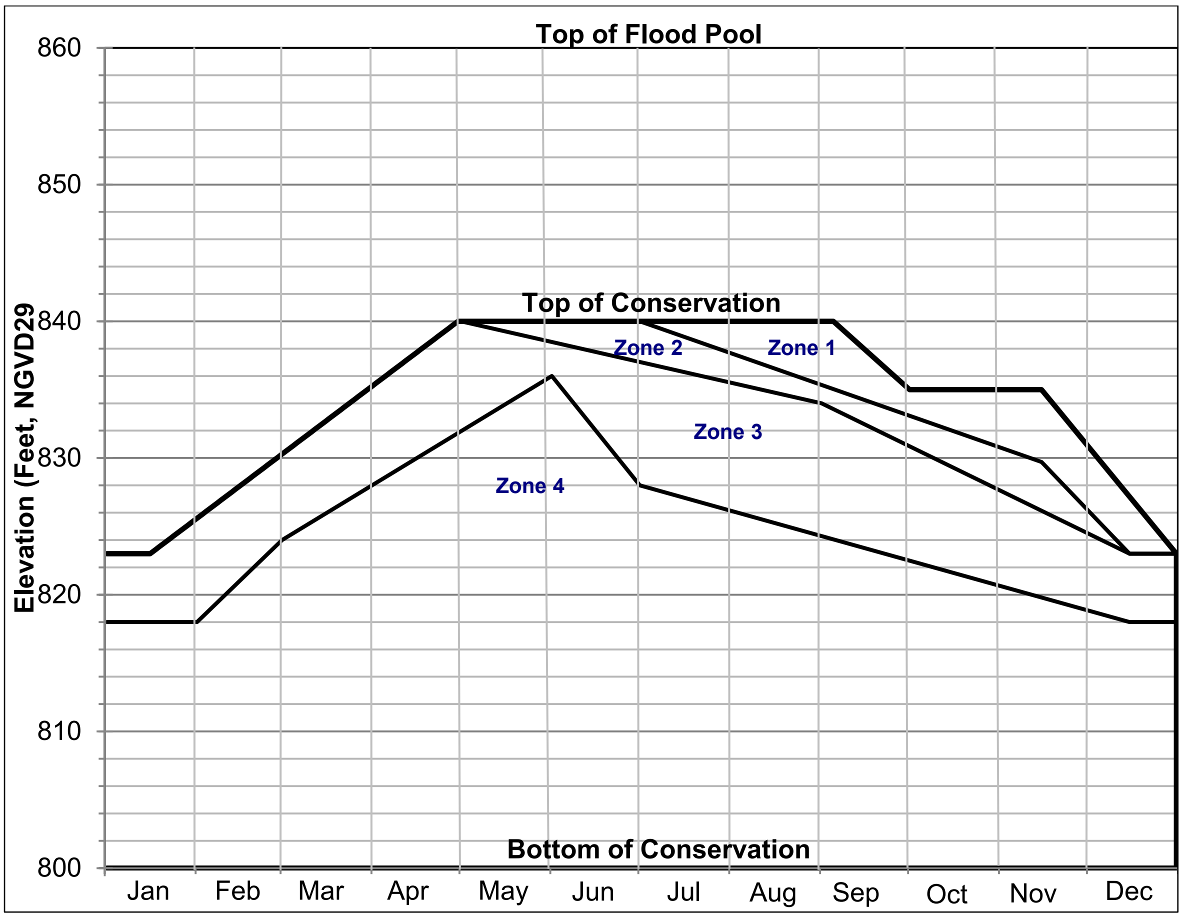


Figure 4. Allatoona Lake Guide Curve and Action Zones

C. **Carters Dam and Lake and Reregulation Dam**. Carters Lake is formed by Carters Dam, a Corps' reservoir on the Coosawattee River in northwest Georgia upstream of Rome, Georgia. The Carters project is a pumped-storage peaking facility that utilizes a Reregulation Dam and storage pool in conjunction with the main dam and lake. The project's authorization, general features, and purposes are described in the Carters Dam and Lake and Regulation Dam water control manual. The Carters Lake top of conservation pool is elevation 1,074 feet NGVD29 from 1 May to 1 November; transitioning to elevation 1,072 feet NGVD29 between 1 November and 1 December; remains at elevation 1,072 feet NGVD 29 from 1 December to April; then transitioning back to 1,074 feet NGVD29 between 1 April and 1 May. This is shown in the water control plan guide curve (Figure 5). As expected with a peaking/pumped storage operation, both Carters Lake and the reregulation pool experience frequent elevation changes. Typically, water levels in Carters Lake vary no more than 1 to 2 feet per day. The reregulation pool will routinely fluctuate by several feet (variable) daily as the pool receives peak hydropower discharges from Carters Lake and serves as the source for pumpback operations into Carters Lake during non-peak hours. The reregulation pool will likely reach both its normal maximum elevation of 696 feet NGVD29 and minimum elevation of 677 feet NGVD29 at least once each week. However, the general trend of the lake level may fluctuate significantly from the guide curve over time, dependent primarily upon basin inflows but also influenced by project operations and evaporation. Carters Regulation Dam provides a seasonal varying minimum release to the Coosawattee River for downstream fish and wildlife conservation. Under drier conditions when basin inflows are reduced, project operations are adjusted to conserve storage in Carters Lake while continuing to meet project purposes in accordance with action zones as shown on Figure 5. In Zone 2, Carters Regulations Dam releases are reduced to 240 cfs.

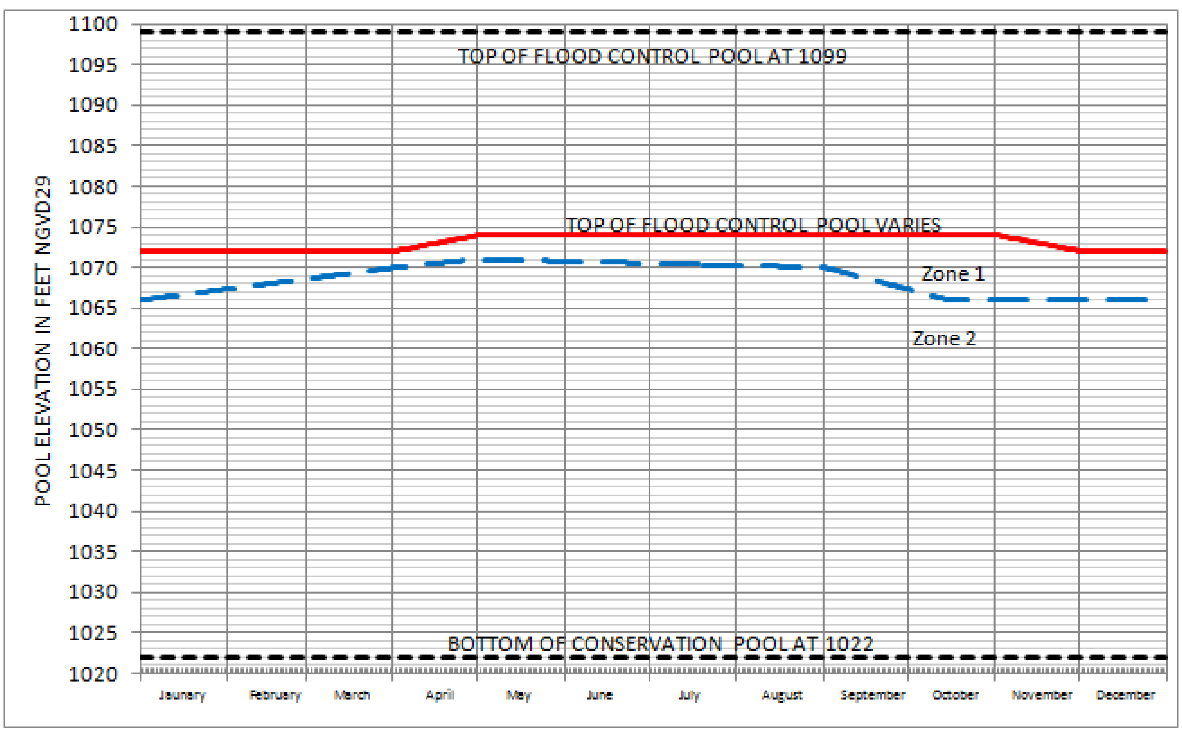


Figure 5. Carters Lake Guide Curve and Action Zones

D. **APC Coosa River Projects**. APC owns and operates the Coosa Hydro system of projects at Weiss Lake, H. Neely Henry Lake, Logan Martin Lake, Lay Lake, Mitchell Lake, and Jordan/Bouldin Dam and Lake on the Coosa River in the ACT Basin. APC Coosa River projects function mainly to generate electricity by hydropower. In addition, the upper three projects (Weiss, H. Neely Henry, and Logan Martin) operate pursuant to Public Law 83-436 regarding the requirement for the projects to be operated for flood risk management and navigation in accordance with reasonable rules and regulations of the Secretary of the Army. The rules and regulations are addressed in a memorandum of understanding between the Corps and APC (Exhibit B of the *Master Water Control Manual, Alabama-Coosa-Tallapoosa (ACT) River Basin, Alabama, Georgia*), in individual water control manuals for the three projects, and in this ACT Basin DCP. The Weiss Lake is on the Coosa River in northeast Alabama, about 80 mi northeast of Birmingham, Alabama, and extends into northwest Georgia for about 13 miles upstream on the Coosa River. The dam impounds a 30,027 acres reservoir (Weiss Lake) at the normal summer elevation of 564 feet NGVD29 as depicted in the regulation guide curve shown in Figure 6 (source APC). The H. Neely Henry Lake is on the Coosa River in northeast Alabama, about 60 miles northeast of Birmingham, Alabama. The dam impounds an 11,200 acres reservoir at the normal summer elevation of 508 feet NGVD29 as depicted in the regulation guide curve shown in Figure 7 (source APC). The Logan Martin Lake is in northeast Alabama on the Coosa River, about 40 miles east of Birmingham, Alabama. The dam impounds a 15,269-acre reservoir at the normal summer elevation of 465 feet NGVD29 as depicted in the regulation guide curve shown in Figure 8 (source APC). The projects' authorizations, general features, and purposes are described in the Weiss, H. Neely Henry, and Logan Martin water control manual appendices to the ACT Basin Master Water Control Manual.

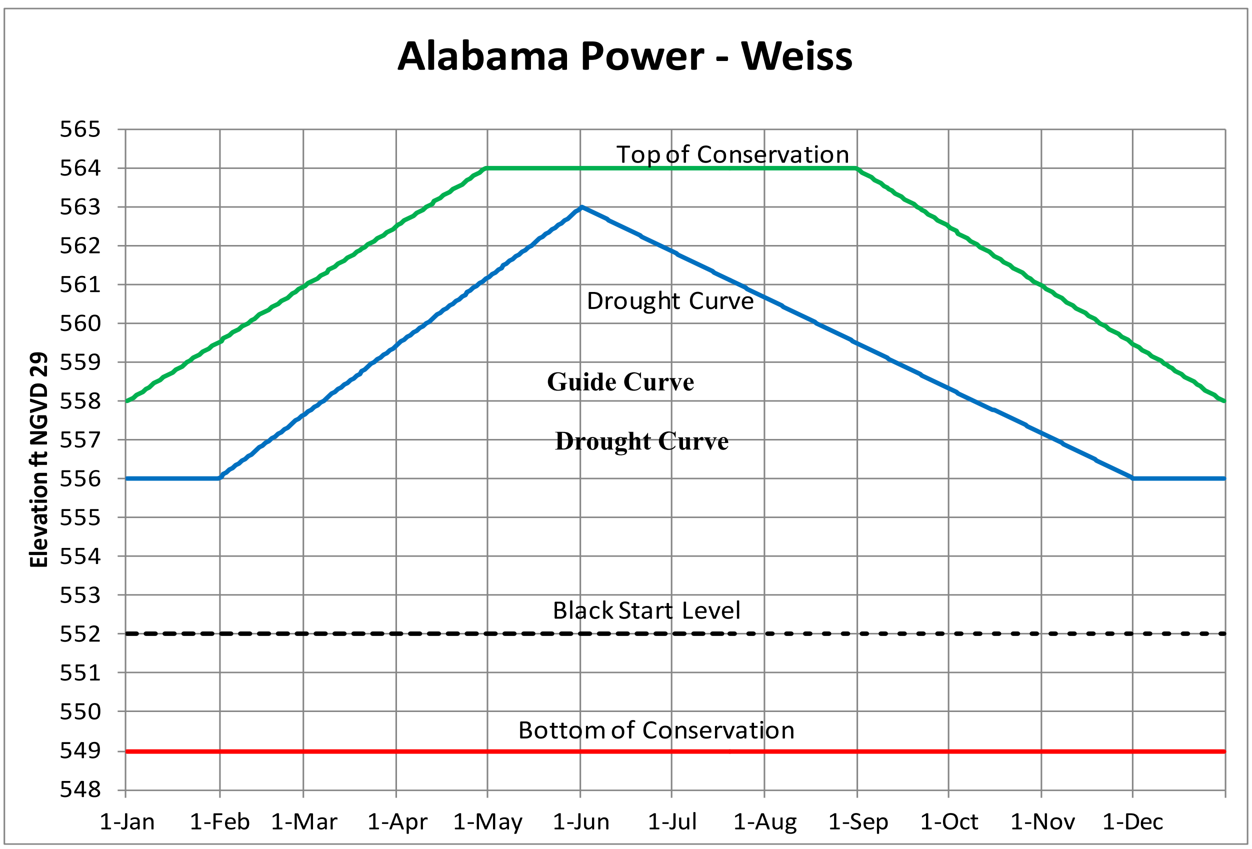


Figure 6. Weiss Lake Guide Curve

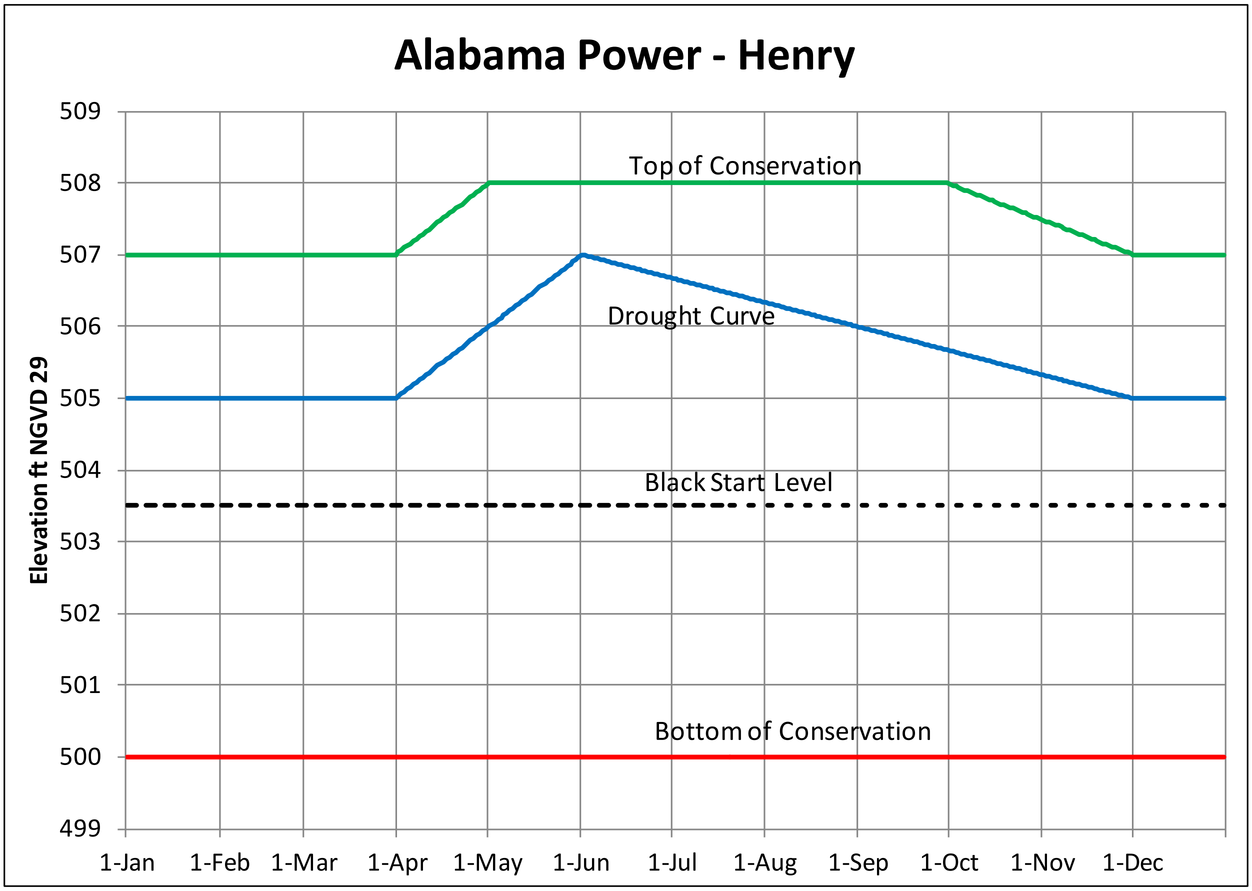


Figure 7. H. Neely Henry Lake Guide Curve

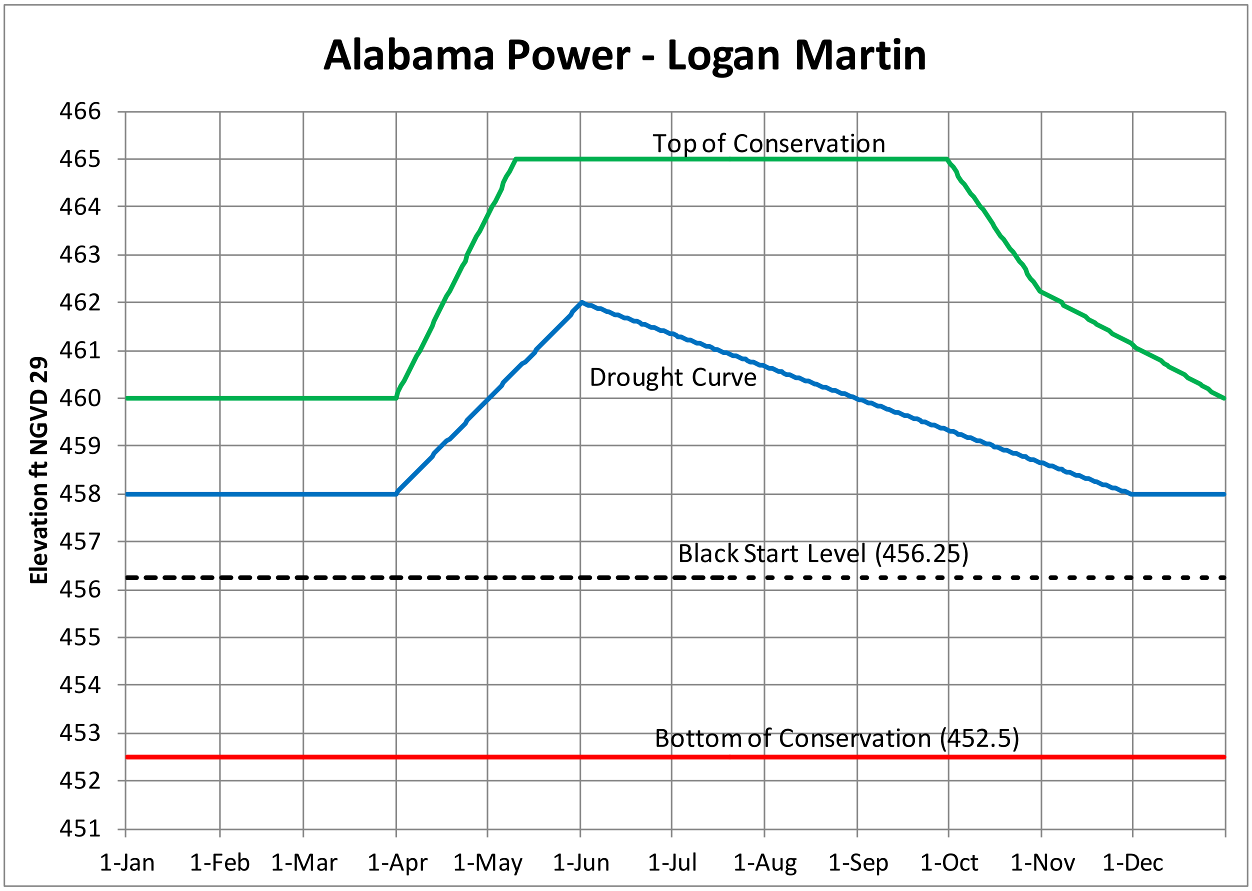


Figure 8. Logan Martin Lake Guide Curve

The downstream Coosa River APC run-of-river hydropower projects (Lay Dam and Lake, Mitchell Dam and Lake, and Jordan/Bouldin Dams and Lake) have no appreciable storage and are operated in conjunction with the upstream Coosa projects to meet downstream flow requirements and targets in support of the ACT Basin Drought Plan and navigation.

E. **APC Tallapoosa River Projects**. APC owns and operates the Tallapoosa River system of projects at Harris Dam and Lake, Martin Dam and Lake, Yates Dam, and Thurlow Dam in the ACT Basin. APC Tallapoosa River projects function mainly to generate electricity by hydropower. In addition, the Robert L. Harris Project operates pursuant to 33 CFR, Chapter II, Part 208, Section 208.65 regarding the requirement for the project to be operated for flood risk management and navigation in accordance with reasonable rules and regulations of the Secretary of the Army. The rules and regulations prescribed are described in a memorandum of understanding between the Corps and APC, individual water control manuals for the APC projects, and this DCP.

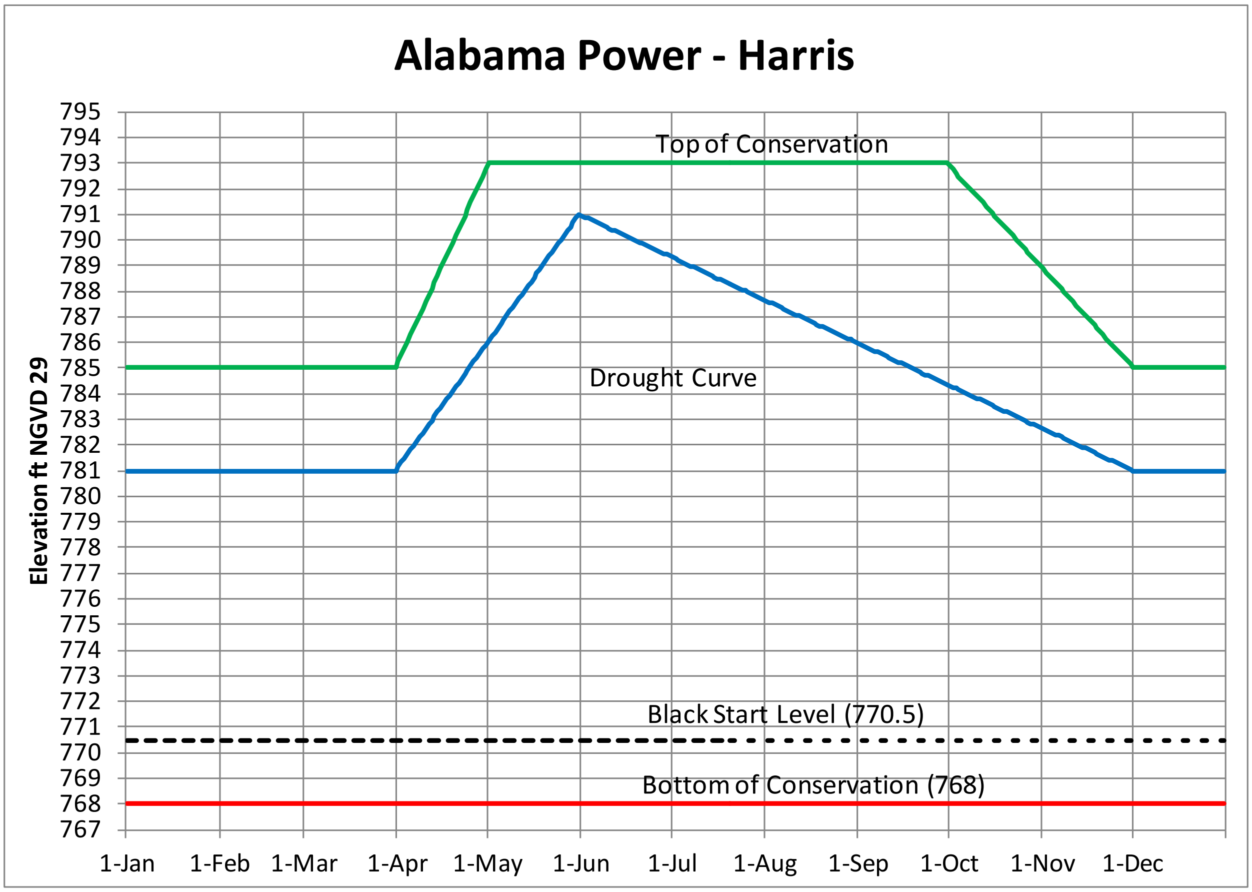


Figure 9. Robert L. Harris Lake Guide Curve

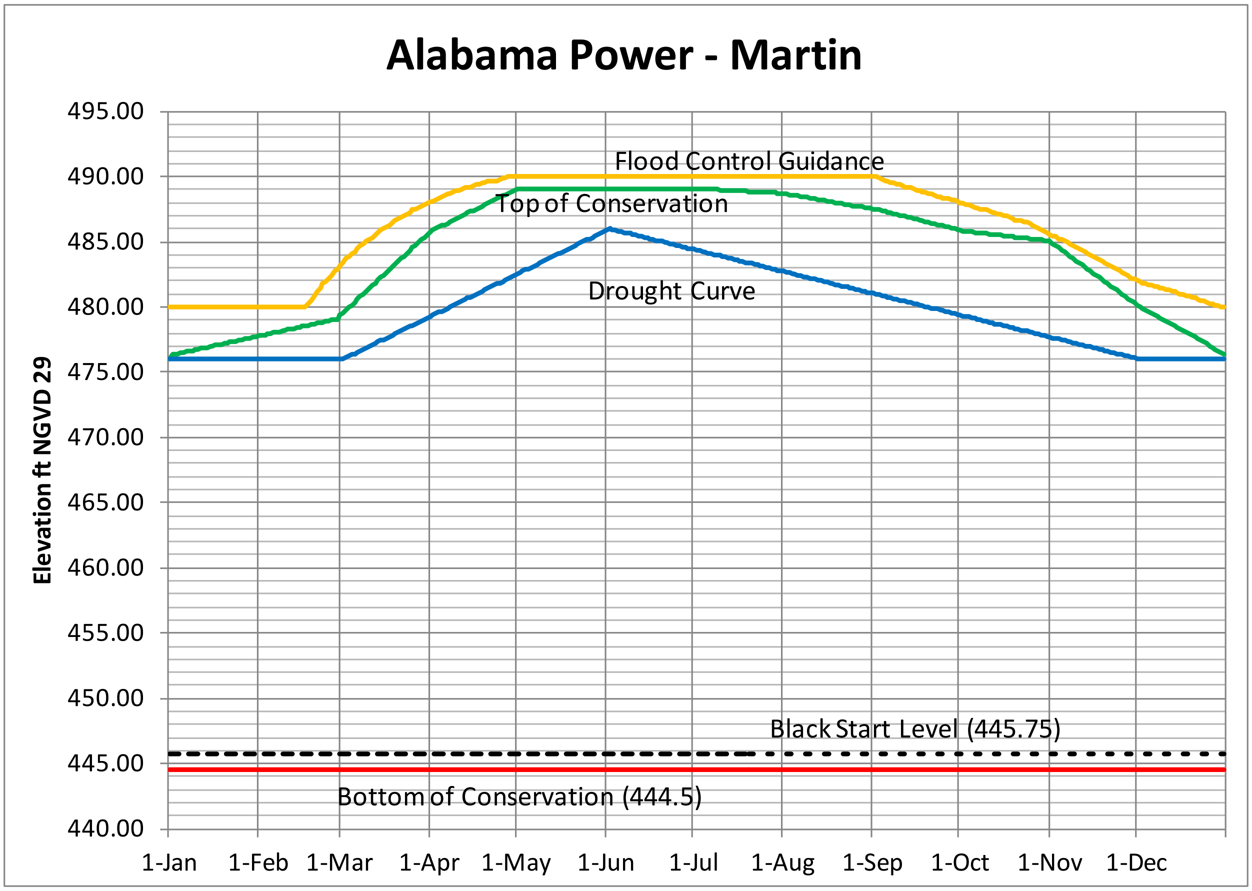


Figure 10. Martin Lake Guide Curve

F. **Corps Alabama River Projects**. The Corps operates three run-of-river lock and dam projects (Robert F. Henry, Millers Ferry, Claiborne) on the Alabama River in the lower ACT Basin to support commercial navigation. Claiborne Lake, together with R.E. “Bob” Woodruff Lake and William “Bill” Dannelly Lake, are collectively referred to as the Alabama River Lakes. The primary location used for communicating the available reliable navigation depth is the Claiborne Lock and Dam tailwater elevation. The water surface elevation is related to the available navigation depth based on the latest hydrographic surveys of the lower Alabama River reach downstream of Claiborne.

(1) Robert F. Henry. The R.E. “Bob” Woodruff Lake is created by the Robert F. Henry Lock and Dam on the Alabama River at river mile 236.3. R.E. “Bob” Woodruff Lake extends from the Robert F. Henry Lock and Dam upstream to the Walter Bouldin Dam. In addition to hydropower and navigation, R.E. “Bob” Woodruff Lake provides recreation and fish and wildlife conservation. R.E. “Bob” Woodruff Lake is 81.1 miles long and averages 1,300 feet wide. It has a surface area of 13,500 acres and a storage capacity of 247,210 acre-feet at a normal pool elevation of 126 feet NGVD29. Lake levels are typically fairly stable with minimal fluctuation between the operating pool elevation limits, 123 feet NGVD29 to 126 feet NGVD29. The emergency drawdown pool elevation is 122 feet NGVD29. An authorized 9-foot-deep by 200-foot-wide navigation channel exists over the entire length of the lake. The Jones Bluff hydropower plant generating capacity is 82 MW (declared value). The lake is a popular recreation destination, receiving up to two million visitors annually.

(2) Millers Ferry. The William “Bill” Dannelly Lake is created by the Millers Ferry Lock and Dam on the Alabama River at river mile 133. William “Bill” Dannelly Lake is 103 miles long and averages almost 1,400 feet wide. The reservoir has a surface area of 18,500 acres and a storage capacity of 346,254 acre-feet at a normal full pool elevation of 80 feet NGVD29. Lake levels remain fairly stable on a day-to-day basis with minimal fluctuation between the operating pool elevation limits, 79 feet NGVD29 to 80 feet NGVD29. It has an authorized 9-foot-deep by 200-foot-wide navigation channel which extends the entire length of the reservoir. The facility is a multipurpose reservoir constructed by the Corps for both navigation and hydropower. The reservoir also provides recreational benefits and has lands managed for wildlife mitigation. The Millers Ferry hydropower plant generating capacity is 90 MW (declared value). The reservoir provides ample recreation opportunities. Recreation visitors number three million annually.

(3) Claiborne. Claiborne Lake is created by the Claiborne Lock and Dam on the Alabama River at river mile 72.5. The lake is similar to a wide river, averaging about 800 feet wide, with a surface area of 5,930 acres. Claiborne Lake extends 60 miles upstream to the Millers Ferry Lock and Dam. Storage capacity in the lake is 96,360 acre-feet at a normal pool elevation of 35 feet NGVD29. The operating pool elevation limits are between 32 feet NGVD29 and 36 feet NGVD29. The lake has an authorized 9-foot-deep, 200-foot-wide navigation channel extending its entire length. The primary purpose of the Corps project is navigation. No hydropower generating capability exists at the project. The lake also provides recreation benefits and lands managed for wildlife mitigation.

G. As other ACT water management objectives are addressed, lake levels might decline during prime recreation periods. Drought conditions will cause further drawdowns in lake levels. While lake levels will be slightly higher than what would naturally occur if no specific drought actions are taken, reservoir levels will decline thus triggering impacts associated with reaching initial recreation and water access limited levels. Large reservoir drawdowns impact recreational use: access to the water for boaters and swimmers is inhibited; submerged hazards (e.g., trees, shoals, boulders) become exposed or nearly exposed, posing safety issues; and exposed banks and lake bottoms become unsightly and diminish the recreation experience. Consequently certain levels are identified in each Corps impoundment at which recreation would be affected. The *Initial Impact level* (IIL) represents the level at which recreation impacts are first observed (i.e., some boat launching ramps are unusable, most beaches are unusable or minimally usable, and navigation hazards begin to surface). The *Recreation Impact level* (RIL) defines the level at which major impacts on concessionaires and recreation are observed (more ramps are not usable, all beaches are unusable, boats begin having problems maneuvering in and out of marina basin areas, loss of retail business occurs). The level at which severe impacts are observed in all aspects of recreational activities is called the *Water Access Limited level* (WAL). At this point, all or almost all boat ramps are out of service, all swimming beaches are unusable, major navigation hazards occur, channels to marinas are impassable and/or wet slips must be relocated, and a majority of private boat docks are unusable. The individual project water control manuals describe the specific impact levels at each project and provide information regarding the effects of the water control plans on recreation.

V – WATER USES AND USERS

5-01. Water Uses and Users.

A. Uses – The ACT Basin rivers and lakes provide for wastewater dilution, M&I water supply, fish and wildlife propagation, hydropower generation, and recreational boating and fishing.

B. Users – The following tables list the surface water uses and water users within Georgia and Alabama in the ACT Basin.

Table 2. Surface water use: ACT Basin (Georgia 2005)

Water use category	Quantity (mgd)	% of total
Total Use	788.98	100%
Public Supply	154.78	19.6%
Domestic and Commercial	0.30	0.0%
Industrial and Mining	32.49	4.1%
Irrigation	11.31	1.4%
Livestock	16.18	2.1%
Thermoelectric Power Generation	573.92	72.8%

Table 3. M&I surface water withdrawal permits in the ACT Basin (Georgia)

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Coosa River Basin (Georgia)—upstream counties to downstream counties						
Coosa	Dalton Utilities, Conasauga R	155-1404-01	Whitfield	Conasauga River	49.400	40.300
Coosa	Dalton Utilities, Mill Creek	155-1404-02	Whitfield	Mill Creek	13.200	7.500
Coosa	Dalton Utilities, Coahulla Cr	155-1404-03	Whitfield	Coahulla Creek	6.000	5.000
Coosa	Dalton Utilities, Freeman Sprngs	155-1404-04	Whitfield	Freeman Springs	2.000	1.500
Coosa	Dalton Utilities - River Road	155-1404-05	Whitfield	Conasauga River	35.000	18.000
Coosa	Chatsworth WW Commission	105-1405-01	Murray	Holly Creek	1.100	1.000
Coosa	Chatsworth WW Commission	105-1405-02	Murray	Eton Springs	1.800	1.800
Coosa	Chatsworth WW Commission	105-1409-01	Murray	Carters Lake	2.550	2.300
Coosa	Chatsworth, City of	105-1493-02	Murray	Coosawattee River	2.200	2.000
Coosa	Ellijay, City of - Ellijay R	061-1407-01	Gilmer	Ellijay River	0.550	0.450
Coosa	Ellijay - Gilmer County W & S Authority	061-1408-01	Gilmer	Cartecay River	4.000	4.000
Coosa	Calhoun, City of	064-1411-03	Gordon	Big Spring	7.000	6.000
Coosa	Calhoun, City of	064-1412-01	Gordon	City Of Calhoun Spring	0.638	0.537
Coosa	Calhoun, City of	064-1492-02	Gordon	Oostanaula River	6.200	3.000

Table 3 (continued). M&I surface water withdrawal permits in the ACT Basin (Georgia)

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Coosa	Calhoun, City of	064-1493-01	Gordon	Coosawattee River	18.000	16.000
Coosa	Jasper, City of	112-1417-02	Pickens	Long Swamp Creek	1.000	1.000
Coosa	Bent Tree Community, Inc.	112-1417-03	Pickens	Chestnut Cove Creek and unnamed creek	0.250	0.230
Coosa	Bent Tree Community, Inc.	112-1417-04	Pickens	Lake Tamarack	0.250	0.230
Coosa	Big Canoe Utilities Company, Inc.	112-1417-05	Pickens	Lake Petit	1.000	1.000
Coosa	Big Canoe Utilities Company, Inc.	112-1417-06	Pickens	Blackwell Creek	2.650	2.650
Coosa	Etowah Water & Sewer Authority	042-1415-01	Dawson	Etowah River	5.500	4.400
Coosa	Cherokee County Water & Sewerage Auth	028-1416-01	Cherokee	Etowah River	43.200	36.000
Coosa	Gold Kist, Inc	028-1491-03	Cherokee	Etowah River	5.000	4.500
Coosa	Canton, City of	028-1491-04	Cherokee	Etowah River	23.000	18.700
Coosa	Canton, City of (Hickory Log Creek)	028-1491-05	Cherokee	Etowah River	39.000	39.000
Coosa	Bartow County Water Department	008-1411-02	Bartow	Bolivar Springs	0.800	0.800
Coosa	Adairsville, City of	008-1412-02	Bartow	Lewis Spring	5.100	4.100
Coosa	New Riverside Ochre Company, Inc.	008-1421-01	Bartow	Etowah River	5.000	5.000
Coosa	New Riverside Ochre Company, Inc.	008-1421-02	Bartow	Etowah River	6.000	6.000
Coosa	Emerson, City of	008-1422-02	Bartow	Moss Springs	0.630	0.500
Coosa	Gerdau AmeriSteel US, Inc. – Cartersville Steel Mill	008-1423-01	Bartow	Pettit Creek	2.000	1.500
Coosa	Baroid Drilling Fluids, Inc.	008-1423-02	Bartow	Etowah River	3.400	2.500
Coosa	Cartersville, City of	008-1423-04	Bartow	Etowah River	26.420	23.000
Coosa	Georgia Power Co. - Plant Bowen	008-1491-01	Bartow	Etowah River	520.000	85.000
Coosa	CCMWA	008-1491-05	Bartow	Allatoona Lake	86.000	78.000
Coosa	Cartersville, City of	008-1491-06	Bartow	Allatoona Lake	21.420	18.000
Coosa	La Fayette, City of Dry Creek	146-1401-01	Walker	Dry Creek	1.000	0.900
Coosa	La Fayette, City of Big Spring	146-1401-02	Walker	Big Spring	1.650	1.310
Coosa	Mount Vernon Mills - Riegel Apparel Div.	027-1401-03	Chattooga	Trion Spring	9.900	6.600
Coosa	Summerville, City of	027-1402-02	Chattooga	Raccoon Creek	3.000	2.500
Coosa	Summerville, City of	027-1402-04	Chattooga	Lowe Spring	0.750	0.500
Coosa	Mohawk Industries, Inc.	027-1402-05	Chattooga	Chattooga R./ Raccoon Cr.	4.500	4.000
Coosa	Oglethorpe Power Corp.	057-1402-03	Floyd	Heath Creek	3,838.000	3,030.000
Coosa	Floyd County - Brighton Plant	057-1414-02	Floyd	Woodward Creek	0.800	0.700

Table 3 (continued). M&I surface water withdrawal permits in the ACT Basin (Georgia)

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Coosa	Cave Spring, City of	057-1428-06	Floyd	Cave Spring	1.500	1.300
Coosa	Floyd County	057-1428-08	Floyd	Old Mill Spring	4.000	3.500
Coosa	Berry Schools, The (Berry College)	057-1429-01	Floyd	Berry (Possum Trot) Reservoir	1.000	0.700
Coosa	Inland-Rome Inc.	057-1490-01	Floyd	Coosa River	34.000	32.000
Coosa	Georgia Power Co. - Plant Hammond	057-1490-02	Floyd	Coosa River	655.000	655.000
Coosa	Rome, City of	057-1492-01	Floyd	Oostanaula & Etowah R	18.000	16.400
Coosa	Rockmart, City of	115-1425-01	Polk	Euharlee Creek	2.000	1.500
Coosa	Vulcan Construction Materials, L.P.	115-1425-03	Polk	Euharlee Creek	0.200	0.200
Coosa	Cedartown, City of	115-1428-04	Polk	Big Spring	3.000	2.600
Coosa	Polk County Water Authority	115-1428-05	Polk	Aragon, Morgan, Mulco Springs	1.600	1.100
Coosa	Polk County Water Authority	115-1428-07	Polk	Deaton Spring	4.000	4.000
Tallapoosa River Basin (Georgia)						
Tallapoosa	Haralson County Water Authority	071-1301-01	Haralson	Tallapoosa River	3.750	3.750
Tallapoosa	Bremen, City of	071-1301-02	Haralson	Beech Creek & Bremen Reservoir (Bush Creek)	0.800	0.580
Tallapoosa	Bowdon, City of Indian	022-1302-01	Carroll	Indian Creek	0.400	0.360
Tallapoosa	Southwire Company	022-1302-02	Carroll	Buffalo Creek	2.000	1.000
Tallapoosa	Villa Rica, City of	022-1302-04	Carroll	Lake Paradise & Cowens Lake	1.500	1.500
Tallapoosa	Carrollton, City of	022-1302-05	Carroll	Little Tallapoosa River	12.000	12.000
Tallapoosa	Bowdon, City of Lake Tysinger	022-1302-06	Carroll	Lake Tysinger	1.000	1.000

Source: GAEPD 2009a

Table 4. M&I surface water withdrawals in the ACT Basin (Georgia)

Basin (subbasin)	Withdrawal by	County	Withdrawal (mgd)
Coosa River Basin (Georgia)			
Coosa (Conasauga)	Dalton Utilities	Whitfield	35.38
Coosa (Conasauga)	City of Chatsworth	Murray	1.26
Coosa (Coosawattee)	Ellijay-Gilmer County Water System	Gilmer	3.12
Coosa (Coosawattee)	City of Fairmount	Gordon	0.06
Coosa (Oostanaula)	City of Calhoun	Gordon	9.10
Coosa (Etowah)	Big Canoe Corporation	Pickens	0.48
Coosa (Etowah)	City of Jasper	Pickens	1.00
Coosa (Etowah)	Bent Tree Community	Pickens	0.07
Coosa (Etowah)	Lexington Components Inc (Rubber)	Pickens	0.01
Coosa (Etowah)	Etowah Water and Sewer Authority	Dawson	1.50
Coosa (Etowah)	Town of Dawsonville	Dawson	0.10
Coosa (Etowah)	City of Canton	Cherokee	2.83
Coosa (Etowah)	Cherokee County Water System	Cherokee	15.81
Coosa (Etowah)a	Gold Kist, Inc.	Cherokee	1.94

Table 4 (continued). M&I surface water withdrawals in the ACT Basin (Georgia)

Basin (subbasin)	Withdrawal by	County	Withdrawal (mgd)
Coosa (Etowah)	City of Cartersville	Bartow	13.26
Coosa (Etowah)	New Riverside Ochre Company, Inc (Chemicals)	Bartow	1.67
Coosa (Etowah)	Gerdau AmeriSteel US, Inc. – Cartersville Steel Mill (Primary metals)	Bartow	0.16
Coosa (Etowah)	Georgia Power Co – Plant Bowen	Bartow	38.92
Coosa (Etowah)	CCMWA	Bartow	44.42
Coosa (Upper Coosa)	City of Lafayette	Walker	1.20
Coosa (Upper Coosa)	City of Summerville	Chattooga	2.05
Coosa (Upper Coosa)	Mount Vernon Mills – Riegel Apparel Division (Textiles)	Chattooga	2.74
Coosa (Oostanaula)	City of Cave Spring (Domestic/Commercial)	Floyd	0.30
Coosa (Etowah / Oostanaula)	City of Rome	Floyd	9.98
Coosa (Upper Coosa)	Floyd County Water System	Floyd	2.57
Coosa (Upper Coosa)	Inland-Rome Inc. (Paper)	Floyd	25.74
Coosa (Upper Coosa)	Georgia Power Co - Plant Hammond	Floyd	535.00
Coosa (Upper Coosa)	Polk County Water Authority	Polk	2.22
Coosa (Etowah)	Vulcan Construction Materials	Polk	0.09
Tallapoosa River Basin (Georgia)			
Tallapoosa (Upper)	City of Bremen	Haralson	0.32
Tallapoosa (Upper)	Haralson County Water Authority	Haralson	2.05
Tallapoosa (Upper)	City of Bowdon	Carroll	0.75
Tallapoosa (Upper)	Southwire Company	Carroll	0.09
Tallapoosa (Upper)	City of Carrollton	Carroll	5.37
Tallapoosa (Upper)	City of Temple	Carroll	0.26
Tallapoosa (Upper)	City of Villa Rica	Carroll	0.58
Tallapoosa (Upper)	Carroll County Water System	Carroll	4.08

Table 5. Surface water use - ACT Basin (Alabama, 2005) (mgd)

ACT subbasin	HUC	Public supply	Industrial	Irrigation	Livestock	Thermo-electric	Total, by Subbasin
Upper Coosa	03150105	2.12	0	3.10	0.40	0	5.62
Middle Coosa	03150106	33.24	65.83	7.91	0.87	142.68	250.53
Lower Coosa	03150107	10.96	0.89	5.10	0.35	812.32	829.62
Upper Tallapoosa	03150108	0.90	0	0.15	0.40	0	1.45
Middle Tallapoosa	03150109	19.09	0	0.52	0.32	0	19.93
Lower Tallapoosa	03150110	38.22	2.23	4.22	0.28	0	44.95
Upper Alabama	03150201	10.40	30.63	3.84	0.84	4.14	49.85
Cahaba	03150202	52.90	0	3.49	0.25	0	56.64
Middle Alabama	03150203	0	21.04	1.73	0.48	0	23.25
Lower Alabama	03150204	0	54.61	0.64	0.02	0	55.27
Total - By Use Category		167.83	175.23	30.70	4.21	959.14	1337.11

Source: Hutson et al. 2009

Table 6. M&I surface water withdrawals in the ACT Basin (Alabama)

Basin (subbasin)	Withdrawal by	County	Withdrawal (mgd)
Coosa River Basin (Alabama)			
Coosa (Upper)	Centre Water Works & Sewer Board	Cherokee	1.19
Coosa (Upper)	Piedmont Water Works & Sewer Board	Calhoun	0.93
Coosa (Middle)	Jacksonville Water Works & Sewer Board	Calhoun	1.34
Coosa (Middle)	Anniston Water Works & Sewer Board	Calhoun	0.08
Coosa (Middle)	Fort Payne Water Works Board	DeKalb	8.10
Coosa (Middle)	Goodyear Tire and Rubber Company	Etowah	9.87
Coosa (Middle)	Gadsden Water Works & Sewer Board	Etowah	14.86
Coosa (Middle)	Alabama Power Co – Gadsden Steam Plant	Etowah	142.68
Coosa (Middle)	SIC 32 – Unnamed Stone, Glass, Clay, and/or Concrete Products	St. Clair	3.49
Coosa (Middle)	Talladega/Shelby Water Treatment Plant	Talladega	6.44
Coosa (Middle)	Talladega County Water Department	Talladega	0.81
Coosa (Middle)	Talladega Water Works & Sewer Board	Talladega	1.62
Coosa (Middle)	Bowater Newsprint, Coosa Pines Operation	Talladega	52.47
Coosa (Lower)	Sylacauga Utilities Board	Talladega	3.25
Coosa (Lower)	SIC 22 – Unnamed Textile	Talladega	0.89
Coosa (Lower)	Goodwater Water Works & Sewer Board	Coosa	0.46
Coosa (Lower)	Alabama Power Co – E.C. Gaston Plant	Shelby	812.32
Coosa (Lower)	Clanton Waterworks & Sewer Board	Chilton	1.79
Coosa (Lower)	Five Star Water Supply	Elmore	5.46
Tallapoosa River Basin (Alabama)			
Tallapoosa (Upper)	Heflin Water Works	Cleburne	0.51
Tallapoosa (Upper)	Wedowee Gas, Water, and Sewer	Randolph	0.39
Tallapoosa (Middle)	Roanoke Utilities Board	Randolph	1.29
Tallapoosa (Middle)	Clay County Water Authority	Clay	1.87
Tallapoosa (Middle)	Lafayette	Chambers	0.53
Tallapoosa (Middle)	Central Elmore Water & Sewer Authority	Elmore	4.83
Basin (subbasin)	**Withdrawal by**	**County**	**Withdrawal (mgd)**
Tallapoosa (Middle)	Alexander City Water Department	Tallapoosa	10.57
Tallapoosa (Lower)	West Point Home, Inc	Lee	2.23
Tallapoosa (Lower)	Opelika Water Works Board	Lee	2.61
Tallapoosa (Lower)	Auburn Water Works Board	Lee	5.75
Tallapoosa (Lower)	Tallassee	Tallapoosa	1.98
Tallapoosa (Lower)	Tuskegee Utilities	Macon	2.71
Tallapoosa (Lower)	Montgomery Water Works & Sewer Board	Montgomery	25.17
Alabama River Basin			
Alabama (Upper)	Montgomery Water Works & Sewer Board	Montgomery	10.40
Alabama (Upper)	International Paper	Autauga	30.63
Alabama (Upper)	Southern Power Co – Plant E. B. Harris	Autauga	4.14
Alabama (Cahaba)	Birmingham Water Works & Sewer Board	Shelby	52.90
Alabama (Middle)	International Paper – Pine Hill	Wilcox	21.04
Alabama (Lower)	Alabama River Pulp Company	Monroe	54.61

Source: Hutson et al. 2009

VI. – CONSTRAINTS

6-01. **General.** The availability of water resources in the ACT Basin is constrained by existing water supply storage contracts, Corps water control manuals, minimum flow requirements from Allatoona and Carters Dams, APC FERC licenses, Corps-APC Memorandum of Understanding, and industrial water quality flow needs. Existing water supply storage contracts do not include the use of the inactive storage pool and would require developing and implementing an emergency storage contract in order to access this water resource. Each Corps project has a water control manual that specifies operational requirements for varying basin conditions and requires a deviation approval to operate outside the parameters established by the manual. The Allatoona Project has a minimum flow release requirement of 240 cfs for downstream purposes. The Carters Project has a seasonally varying minimum flow release requirement that ranges from 250 – 865 cfs during normal conditions and a minimum of 240 cfs during low flow conditions. The APC projects are operated under FERC licenses which define specific operational requirements for each project and require approval from FERC and possibly the Corps and State agencies before any revised operations could be implemented. The Corps and APC projects are also operated under the rules and regulations found in the Corps-APC Memorandum of Understanding, which describes operational requirements for flood conditions and navigation within the ACT Basin. Some industrial NPDES permits within the ACT Basin have water quality discharge limitations which are impacted by the volume of water flow in the river.

VII – DROUGHT MANAGEMENT PLAN

7-01. General. The Drought Contingency Plan (DCP) for the ACT Basin implements drought conservation actions on the basis of composite system storage, state line flows, and basin inflow as triggers to drive drought response actions. The DCP also recognizes that a basin-wide drought plan must incorporate variable hydropower generation requirements from its headwater projects in Georgia (Allatoona Dam and Carters Dam), 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. The Act basin-wide drought plan is composed of three components — Headwater regulation at Allatoona Lake and Carters Lake in Georgia; Regulation at APC projects on the Coosa and Tallapoosa Rivers; and Downstream Alabama River regulation at Corps projects downstream of Montgomery, Alabama.

A. **Headwater Regulation for Drought at Allatoona Lake and Carters Lake**. Drought regulation at Allatoona Lake and Carters Lake consists of progressively reduced hydropower generation as pool levels decline in accordance with the conservation storage action zones established in the projects' water control plans. For instance, when Allatoona Lake is operating in normal conditions (Conservation storage Zone 1); hydropower generation typically ranges from 0 to 4 hours per day. However, as the pool drops to lower action zones during drought conditions, generation could be reduced to 0 to 2 hours per day. As Carters Lake pool level might drop into a conservation storage Zone 2, seasonal varying minimum target flows would be reduced to 240 cfs. The water control manual for each project describes the drought water control regulation plan in more detail.

B. **Drought Regulation at APC Projects on the Coosa, Tallapoosa, and Alabama River**. Regulation guidelines for the Coosa, Tallapoosa, and Alabama Rivers have been defined in a drought regulation matrix (Table 7) on the basis of a Drought Intensity Level (DIL). The DIL is a drought indicator, ranging from one to three. The DIL is determined on the basis of three basin drought criteria (or triggers). 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 drought regulation matrix defines minimum average daily flow requirements on a monthly basis for the Coosa, Tallapoosa, and Alabama Rivers as a function of the DIL and time of year. The combined occurrences of the drought triggers determine the DIL. Three intensity levels for drought operations are applicable to APC projects.

DIL 1 — (moderate drought) 1 of 3 triggers occur
DIL 2 — (severe drought) 2 of 3 triggers occur
DIL 3 — (exceptional drought) all 3 triggers occur

(1) Drought Indicators. The indicators used to determine drought intensity include the following:

1. **Low basin inflow**. The total basin inflow needed is the sum of the total filling volume plus 4,640 cfs. The total filling volume is defined as the volume of water required to return the pool to the top of the conservation guide curve and is calculated using the area-capacity tables for each project. Table 8 lists the monthly low basin inflow criteria. The basin inflow value is computed daily and checked on the first and third Tuesday of the month. If computed basin inflow is less than the value required, the low basin inflow indicator is triggered. The basin inflow is 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 11 illustrates the local inflows to the Coosa and Tallapoosa Basins. 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.

Table 7. ACT Basin Drought Regulation Plan Matrix

<table>
<tr><th></th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th colspan="2">Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="4">Drought Level Response[a]</td><td colspan="13">Normal Operations</td></tr>
<tr><td colspan="13">DIL 1: Low Basin Inflows or Low Composite or Low State Line Flow</td></tr>
<tr><td colspan="13">DIL 2: DIL 1 criteria + (Low Basin Inflows or Low Composite or Low State Line Flow)</td></tr>
<tr><td colspan="13">DIL 3: Low Basin Inflows + Low Composite + Low State Line Flow</td></tr>
<tr><td rowspan="4">Coosa River Flow[b]</td><td colspan="3">Normal Operation: 2,000 cfs</td><td colspan="2">4,000 (8,000)</td><td colspan="2">4,000 – 2,000</td><td colspan="6">Normal Operation: 2,000 cfs</td></tr>
<tr><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="3">4,000 +/- cfs</td><td>6/15 Linear Ramp down</td><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="3">Jordan 2,000 +/-cfs</td></tr>
<tr><td colspan="3">Jordan 1,600 to 2,000 +/-cfs</td><td colspan="3">2,500 +/- cfs</td><td>6/15 Linear Ramp down</td><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="3">Jordan 1,600 to 2,000 +/-cfs</td></tr>
<tr><td colspan="3">Jordan 1,600 +/-cfs</td><td colspan="4">Jordan 1,600 to 2,000 +/-cfs</td><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="2">Jordan 1,600 to 2,000 +/-cfs</td><td>Jordan 1,600 +/- cfs</td></tr>
<tr><td rowspan="4">Tallapoosa River Flow[c]</td><td colspan="13">Normal Operations: 1200 cfs</td></tr>
<tr><td colspan="4">Greater of: 1/2 Yates Inflow or 2 x Heflin Gage(Thurlow Lake releases > 350 cfs)</td><td colspan="6">1/2 Yates Inflow</td><td colspan="3">1/2 Yates Inflow</td></tr>
<tr><td colspan="4">Thurlow Lake 350 cfs</td><td colspan="6">1/2 Yates Inflow</td><td colspan="3">Thurlow Lake 350 cfs</td></tr>
<tr><td colspan="7">Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)</td><td colspan="3">Thurlow Lake 350 cfs</td><td colspan="3">Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)</td></tr>
<tr><td rowspan="4">Alabama River Flow[d]</td><td colspan="13">Normal Operation: Navigation or 4,640 cfs flow</td></tr>
<tr><td colspan="4">4,200 cfs (10% Cut) - Montgomery</td><td colspan="6">4,640 cfs - Montgomery</td><td colspan="3">Reduce: Full – 4,200 cfs</td></tr>
<tr><td colspan="5">3,700 cfs (20% Cut) - Montgomery</td><td colspan="5">4,200 cfs (10% Cut) - Montgomery</td><td colspan="3">Reduce: 4,200 cfs-> 3,700 cfs Montgomery (1 week ramp)</td></tr>
<tr><td colspan="4">2,000 cfs Montgomery</td><td colspan="3">3,700 cfs Montgomery</td><td colspan="3">4,200 cfs (10% Cut) - Montgomery</td><td colspan="3">Reduce: 4,200 cfs -> 2,000 cfs Montgomery (1 month ramp)</td></tr>
<tr><td rowspan="4">Guide Curve Elevation</td><td colspan="13">Normal Operations: Elevations follow Guide Curves as prescribed in License (Measured in Feet)</td></tr>
<tr><td colspan="13">Corps Variances: As Needed; FERC Variance for Lake Martin</td></tr>
<tr><td colspan="13">Corps Variances: As Needed; FERC Variance for Lake Martin</td></tr>
<tr><td colspan="13">Corps Variances: As Needed; FERC Variance for Lake Martin</td></tr>
</table>

a. Note these are based on 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.

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

Month	Coosa Filling Volume	Tallapoosa Filling Volume	Total Filling Volume	Minimum JBT Target Flow	Required Basin Inflow
Jan	628	0	628	4,640	5,268
Feb	626	1,968	2,594	4,640	7,234
Mar	603	2,900	3,503	4,640	8,143
Apr	1,683	2,585	4,269	4,640	8,909
May	248	0	248	4,640	4,888
Jun			0	4,640	4,640
Jul			0	4,640	4,640
Aug			0	4,640	4,640
Sep	–612	–1,304	–1,916	4,640	2,724
Oct	–1,371	–2,132	–3,503	4,640	1,137
Nov	–920	–2,748	–3,667	4,640	973
Dec	–821	–1,126	–1,946	4,640	2,694

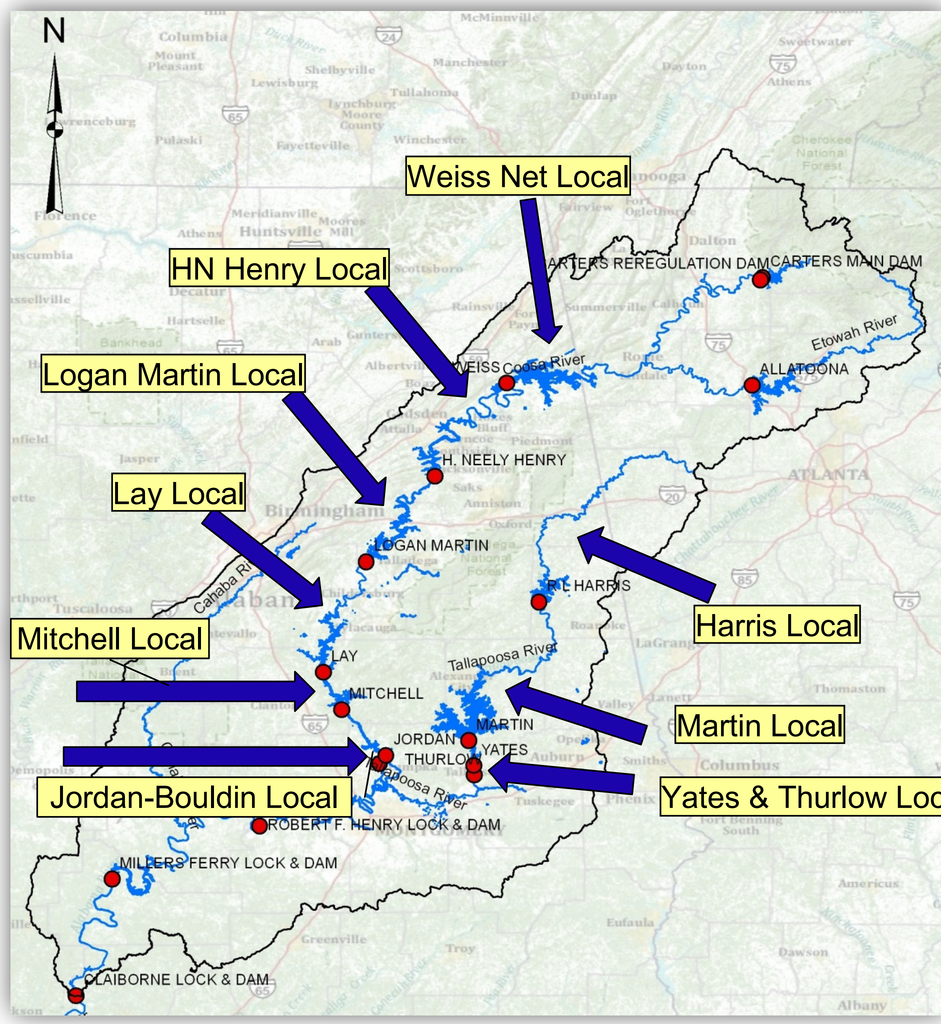


Figure 11. ACT Basin Inflows

2. **Low composite conservation storage**. 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. Figure 12 plots the APC composite zones. Figure 13 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. That computation is performed on the first and third Tuesday of each month, and is considered along with the low state line flow trigger and basin inflow trigger.

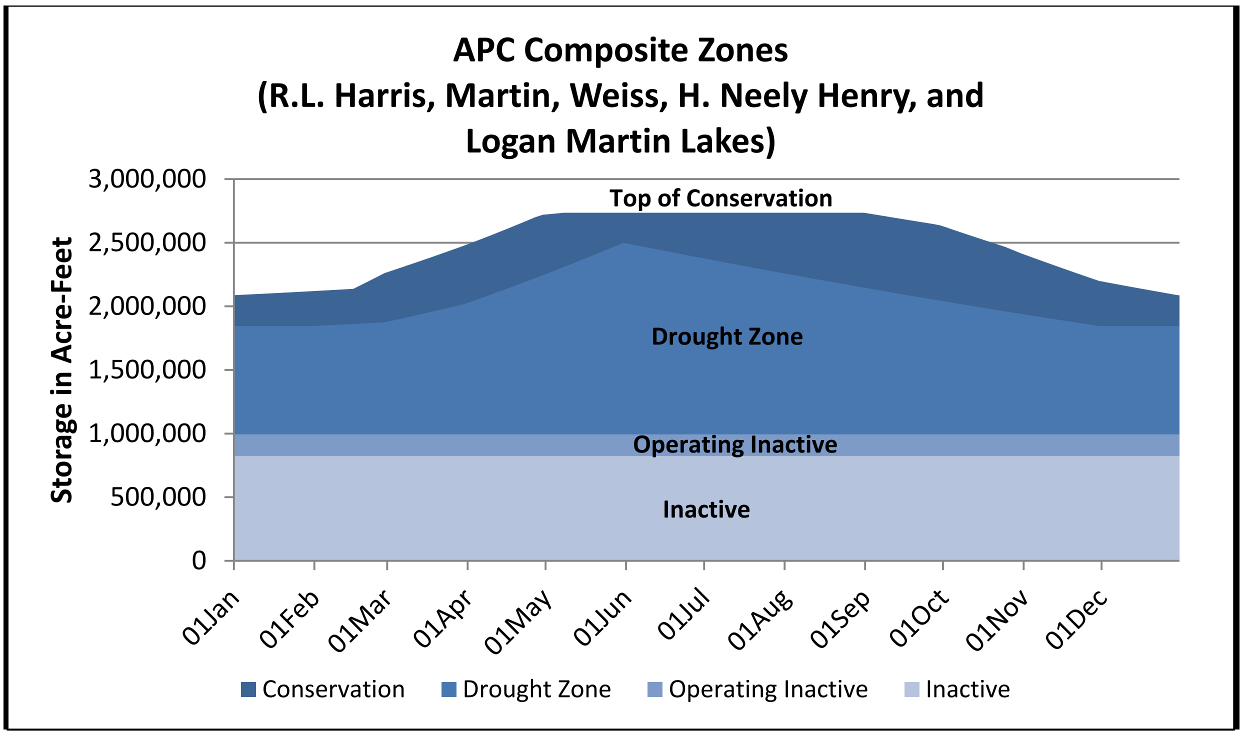


Figure 12. APC Composite Zones

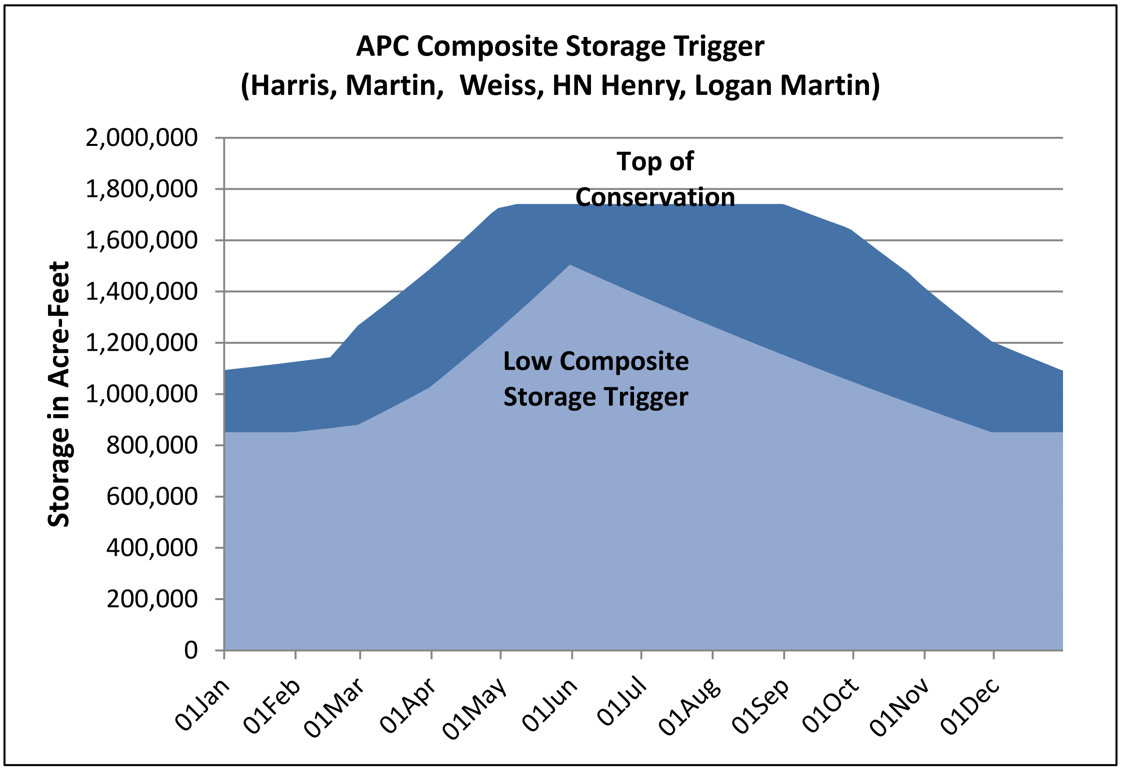


Figure 13. APC Low Composite Conservation Storage Drought Trigger

3. **Low state line flow**. 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 7-day period that would occur once in 10 years. Table 9 lists the Mayo's Bar 7Q10 value for each month (determined from observed flows from 1949 – 2006). The lowest 7-day average flow over the past 14 days is computed and checked at the first and third Tuesday of the month. If the lowest 7-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 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 flow targets exist at that geographic location. The ACT Basin drought matrix does not include or imply any Corps regulation that would result in water management decisions at Carters Lake or Allatoona Lake.

Table 9. State Line Flow Triggers

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

(2) Drought Regulation. The DIL is computed on the first and third Tuesday 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 normal operating conditions.

For normal operations, 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, the required flow is the greater of one-half of the inflow into Yates Lake or twice the Heflin USGS gage from January thru April. 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 required for 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 water supply intake. Required flows on the Alabama River range from 2,000 cfs to 4,200 cfs

In addition to the flow regulation for drought conditions, the DIL affects the flow regulation to support navigation operations. Under normal operations, the APC projects are operated to meet the needed navigation flow target or 4,640 cfs flow as defined in the navigation measure section. Once drought operations begin, flow regulation to support navigation operations is suspended.

7-02. Extreme Drought Conditions. An extreme drought condition exists when the remaining composite conservation storage is depleted, and additional emergency actions may be necessary. When conditions have worsened to this extent, utilization of the inactive storage must be considered. Such an occurrence would typically be contemplated in the second or third year of a drought. Inactive storage capacities have been identified for the two federal projects with significant storage (Figures 14 and 15). The operational concept established for the extreme drought impact level and to be implemented when instituting the use of inactive storage is based on the following actions:

(1) Inactive storage availability is identified to meet specific critical water use needs within existing project authorizations.

(2) Emergency uses and users will be identified in accordance with emergency authorizations and through stakeholder coordination. Typical critical water use needs within the basin are associated with public health and safety.

(3) Weekly projections of the inactive storage water availability to meet the critical water uses in the ACT Basin will be utilized when making water control decisions regarding withdrawals and water releases from the federal reservoirs.

(4) The inactive storage action zones will be developed and instituted as triggers to meet the identified priority water uses (releases will be restricted as storage decreases).

(5) Dam safety considerations will always remain the highest priority. The structural integrity of the dams due to static head limitations will be maintained.

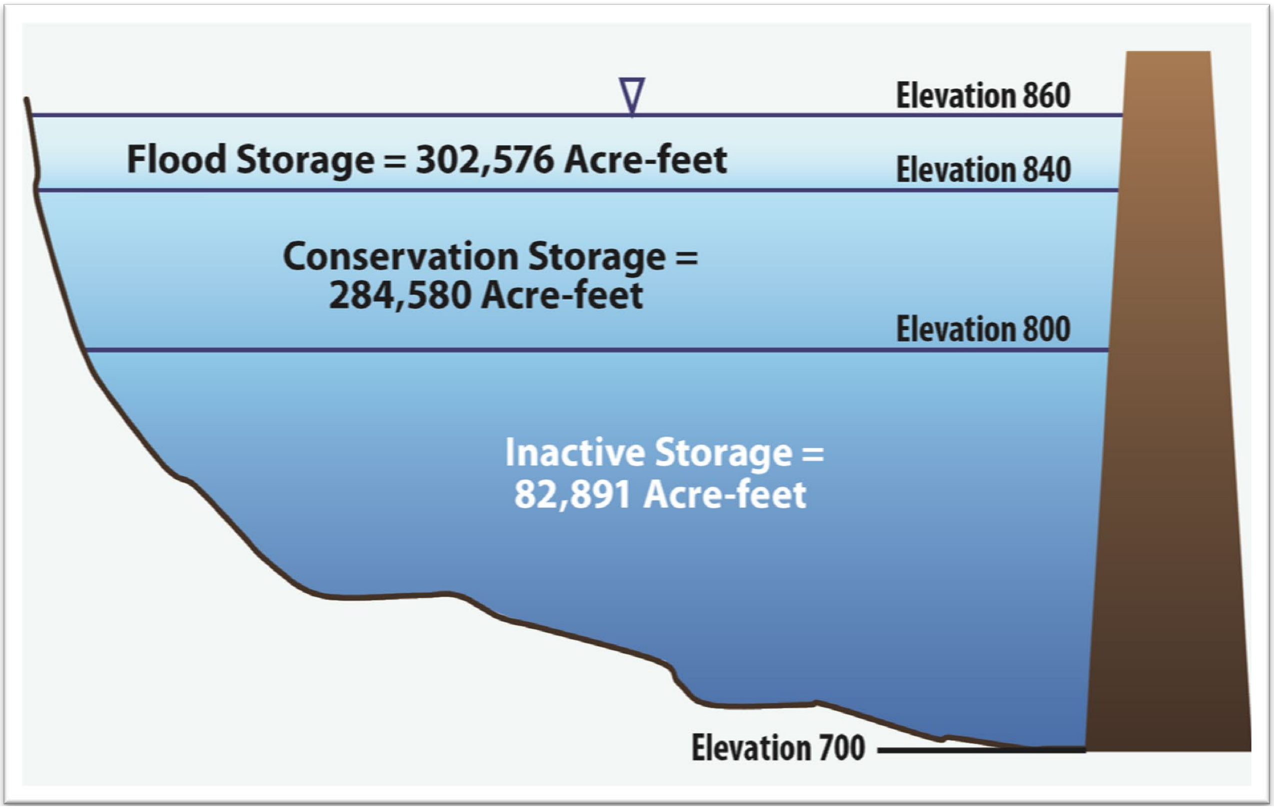


Figure 14. Storage in Allatoona Lake

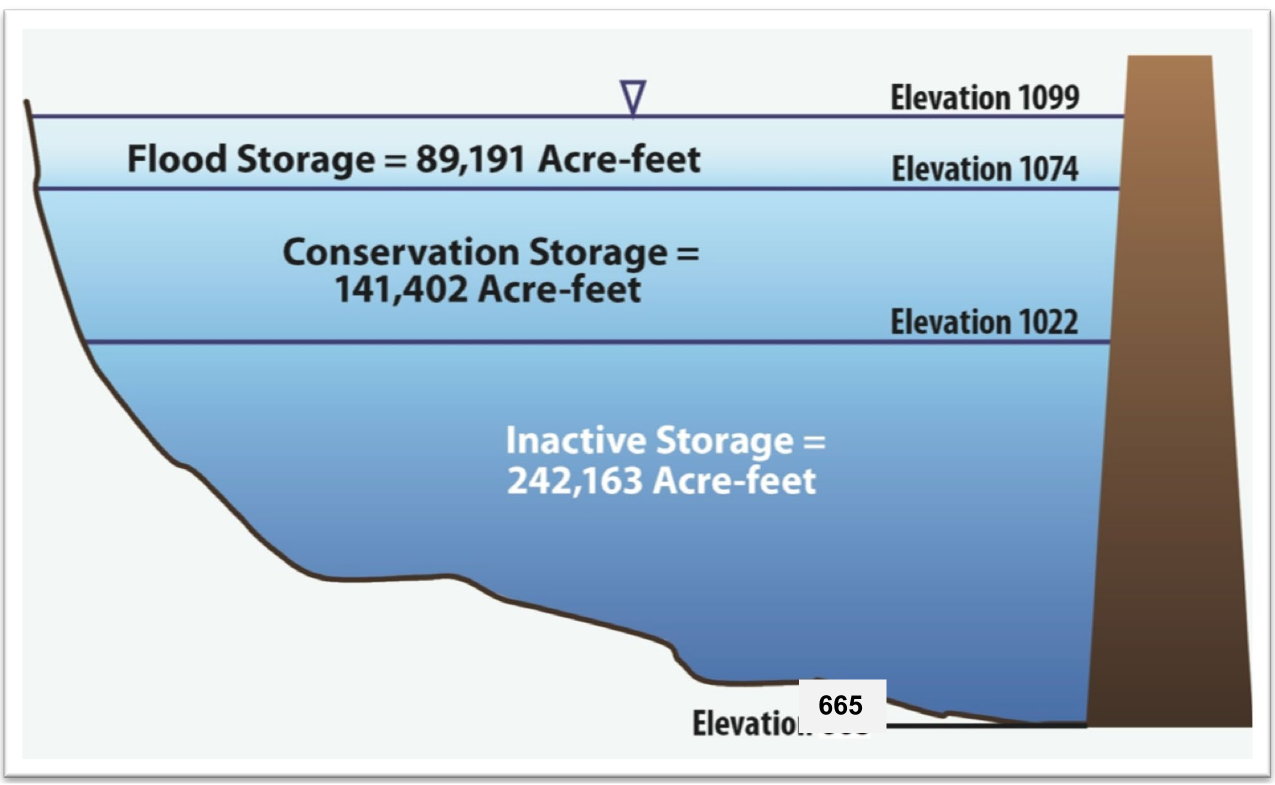


Figure 15. Storage in Carters Lake (excluding reregulation pool)

VIII – DROUGHT MANAGEMENT COORDINATION AND PROCEDURES

8-01. <u>USACE Coordination</u>. It is the responsibility of the Mobile District Water Management Section and APC to monitor climatological and hydrometeorological conditions at all times to make prudent water management decisions. The Water Management Section makes daily decisions and coordinates with APC every two weeks or more often if conditions warrant and with other district representatives from the various areas for which the river systems are operated -- hydropower, recreation, navigation, environmental, and others to exchange information concerning the operation of the river system. This coordination includes conducting weekly meetings with these other district elements. Daily water management decisions regarding water availability, lake level forecasts, and storage forecasts are determined using the information obtained along with current project and basin hydrometeorological data. A weekly District River System Status report is prepared that summarizes the conditions in each of the river basins. When conditions become evident that normal low flow conditions are worsening, the Water Management Section will elevate the district coordination to a heightened awareness. When drought conditions are imminent, Emergency Management representatives will be notified of the conditions and will be included in the regular coordination activities.

8-02. <u>Interagency Coordination</u>. The Water Management Section will support the environmental team regarding actions that require coordination with the U.S. Fish and Wildlife Service (USFWS) for monitoring threatened and endangered species and with the Environmental Protection Agency (EPA), Georgia Environmental Protection Division (GAEPD), and Alabama Department of Environmental Management (ADEM) regarding requests to lower minimum flow targets below Claiborne Dam.

8-03. <u>Public Information and Coordination</u>. When conditions determine that a change in the water control actions from normal regulation to drought regulation is imminent, it is important that various users of the system are notified so that any environmental or operational preparations can be completed prior to any impending reduction in reservoir discharges, river levels, and reservoir pool levels. In periods of severe drought within the ACT Basin it will be within the discretion of the Division Commander to approve the enactment of ACT Basin Water Management conference calls. The purposes of the calls are to share ongoing water management decisions with basin stakeholders and to receive stakeholder input regarding needs and potential impacts to users within the basin. Depending upon the severity of the drought conditions, the calls will be conducted at regular monthly or bi-weekly intervals. Should issues arise, more frequent calls would be implemented.

a. Local Press and Corps Bulletins. The local press consists of periodic publications in or near the ACT Basin. Montgomery, Columbus, and Atlanta 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 for the latest project information. 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>. The Mobile District Public Affairs Office issues press releases as necessary to provide the public with information regarding Water Management issues and activities and also provides information via the Mobile District web site.

IX – REFERENCES

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U.S. Army Corps of Engineers, (USACE). January 2009. Western States Watershed Study: Drought.

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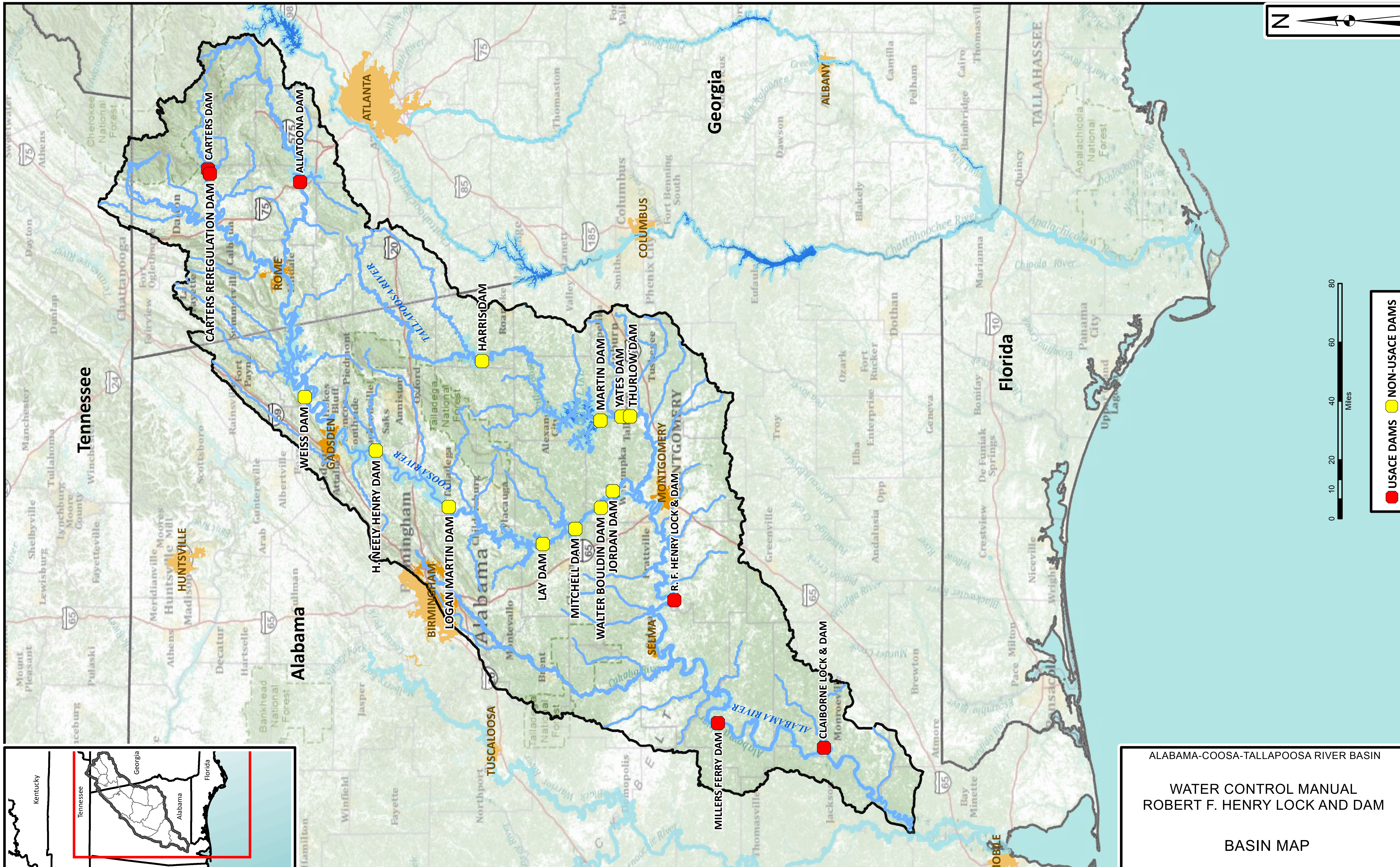
PLATES

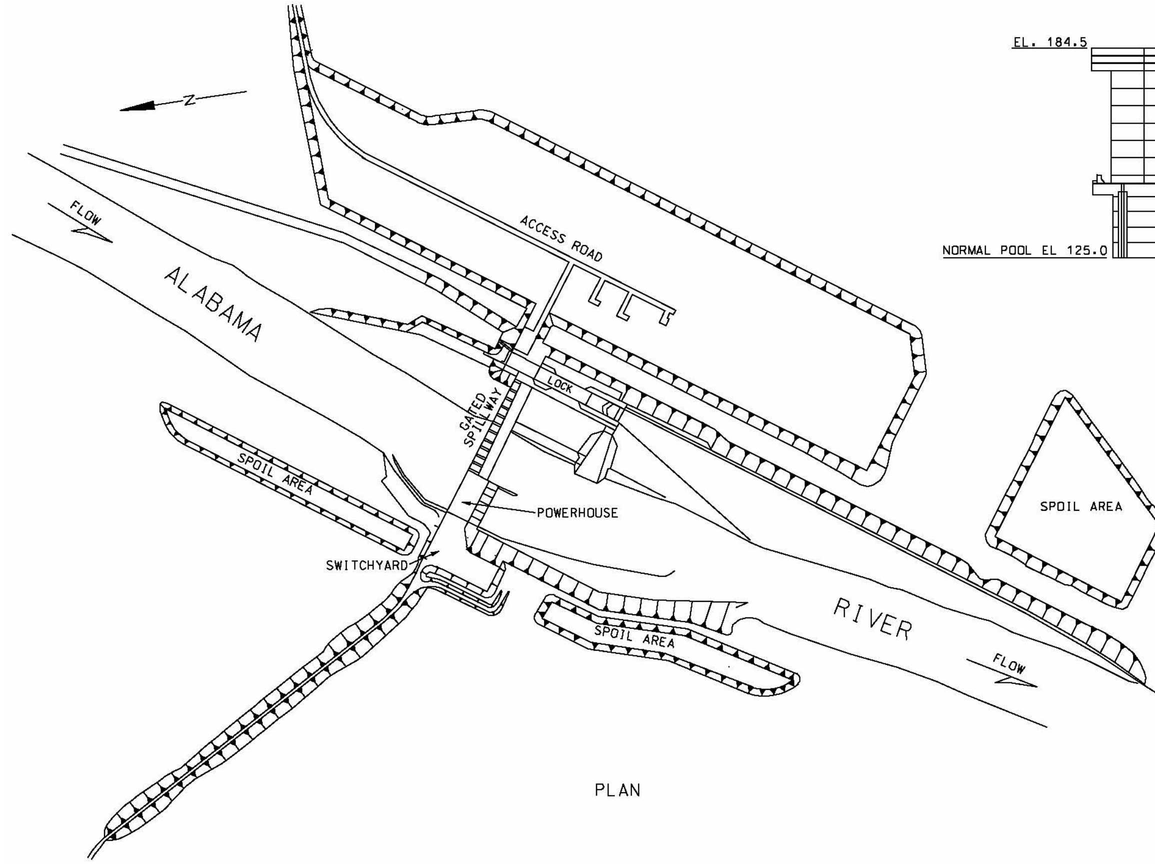


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

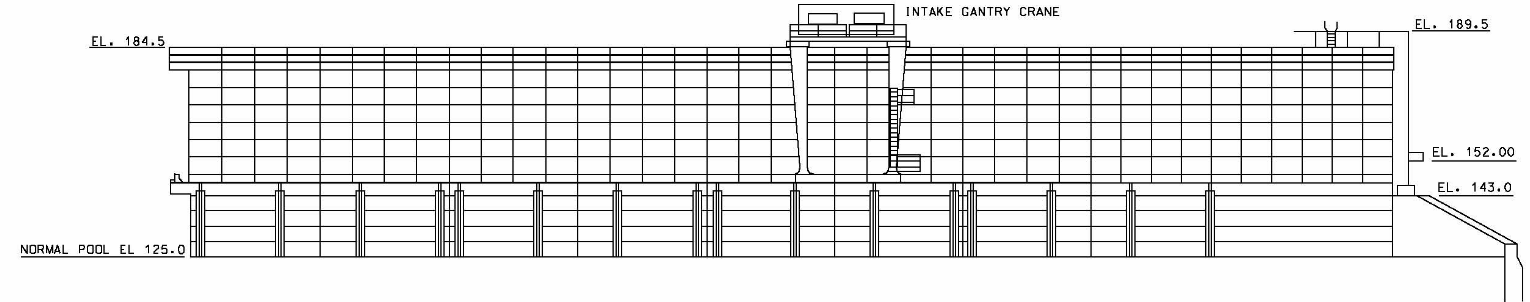
WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM

BASIN MAP

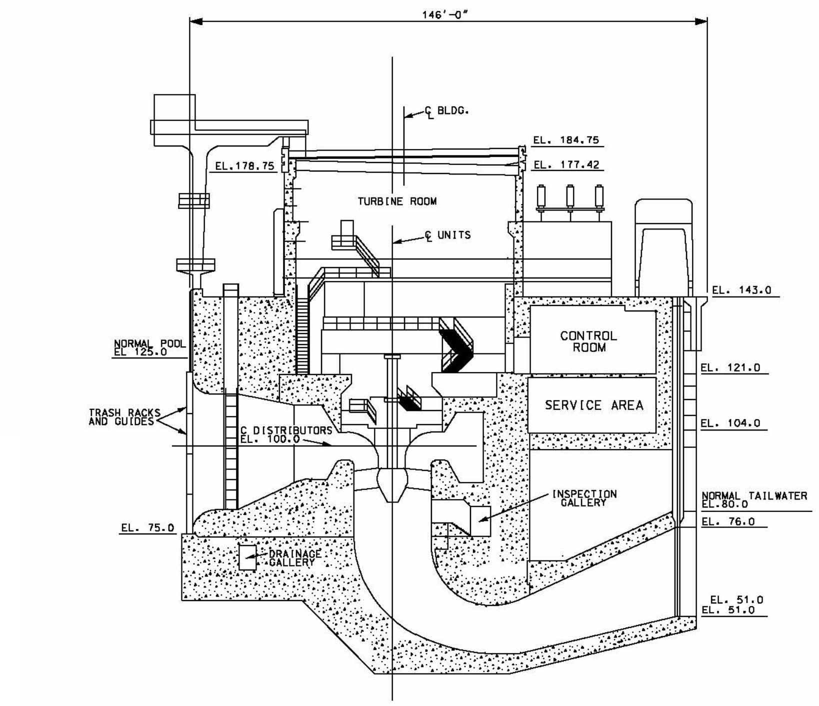
R005_19MAY11_BASIN_MAP_11X17.mxd



PLAN



POWERHOUSE



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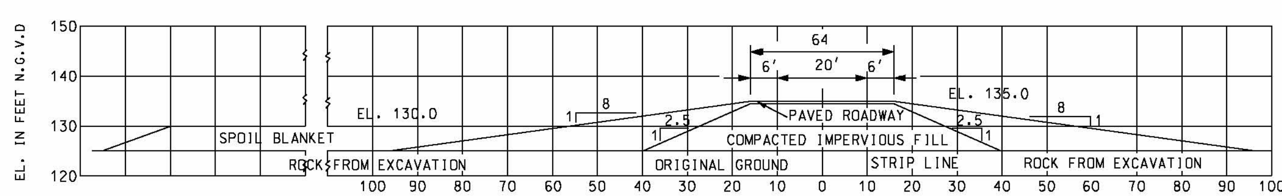
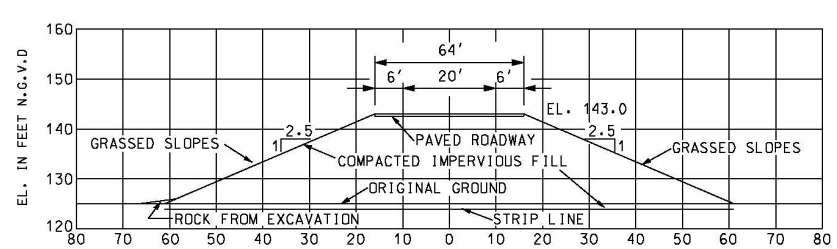


TYPICAL SECTION - RIGHT BANK OVERFLOW EARTH DIKE



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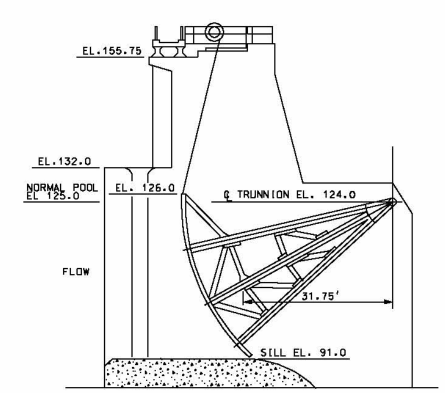
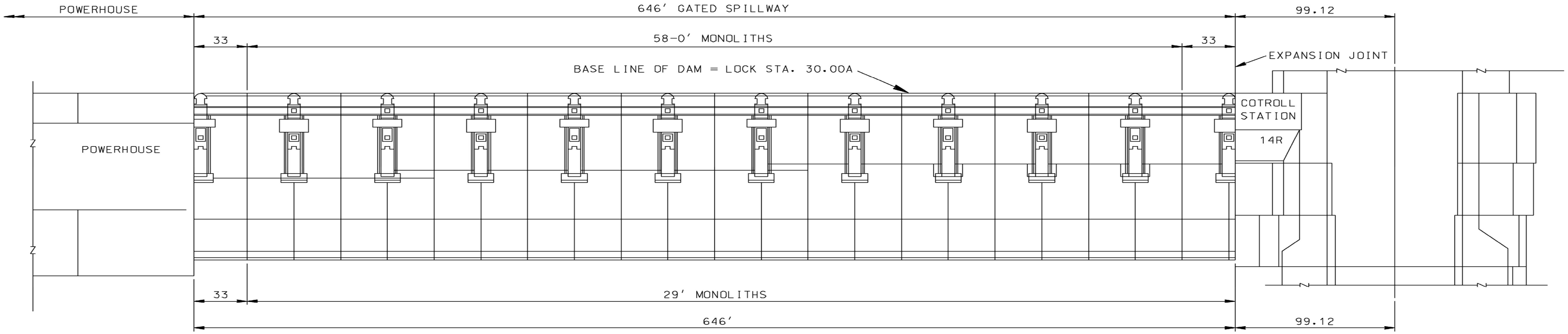


GATED SPILLWAY

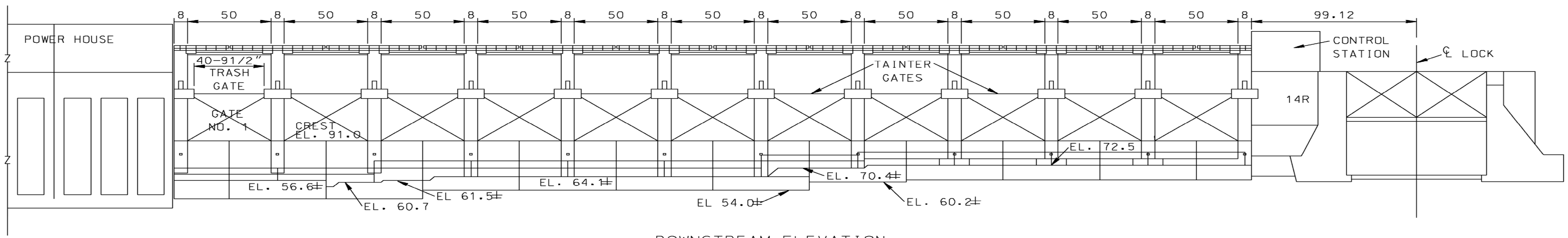
ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

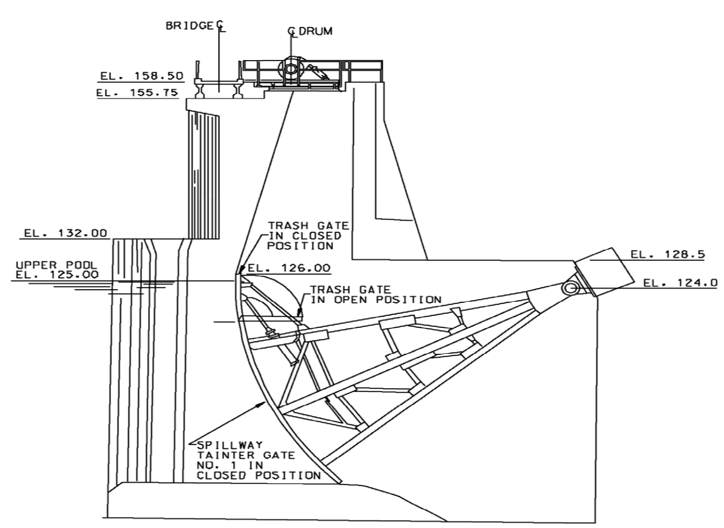
PLAN AND SECTIONS



PLAN



DOWNSTREAM ELEVATION



SPILLWAY GATE NO. 1 W/TRASHGATE

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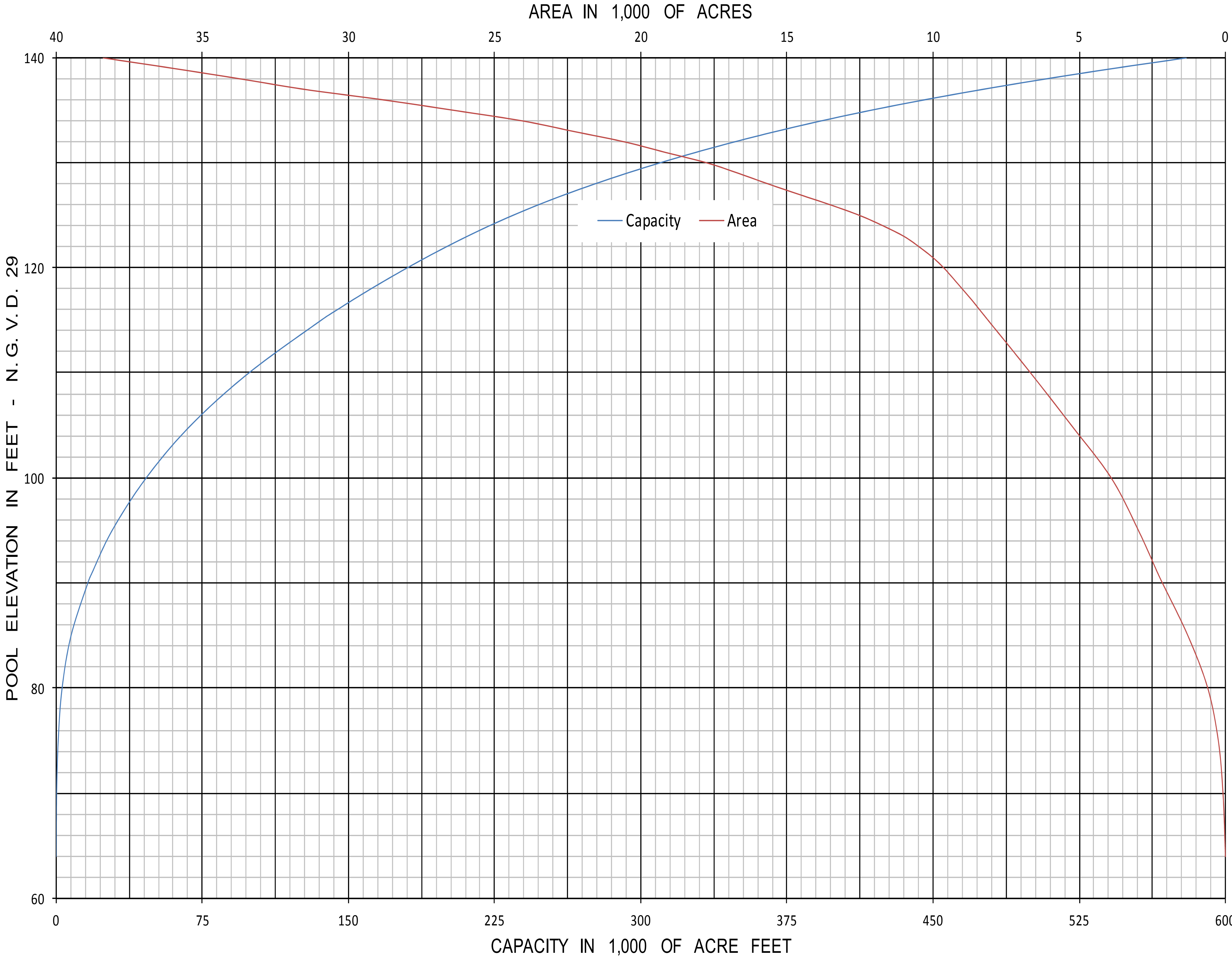
SPILLWAY ELEVATION AND SECTIONS



AREA CAPACITY TABLE

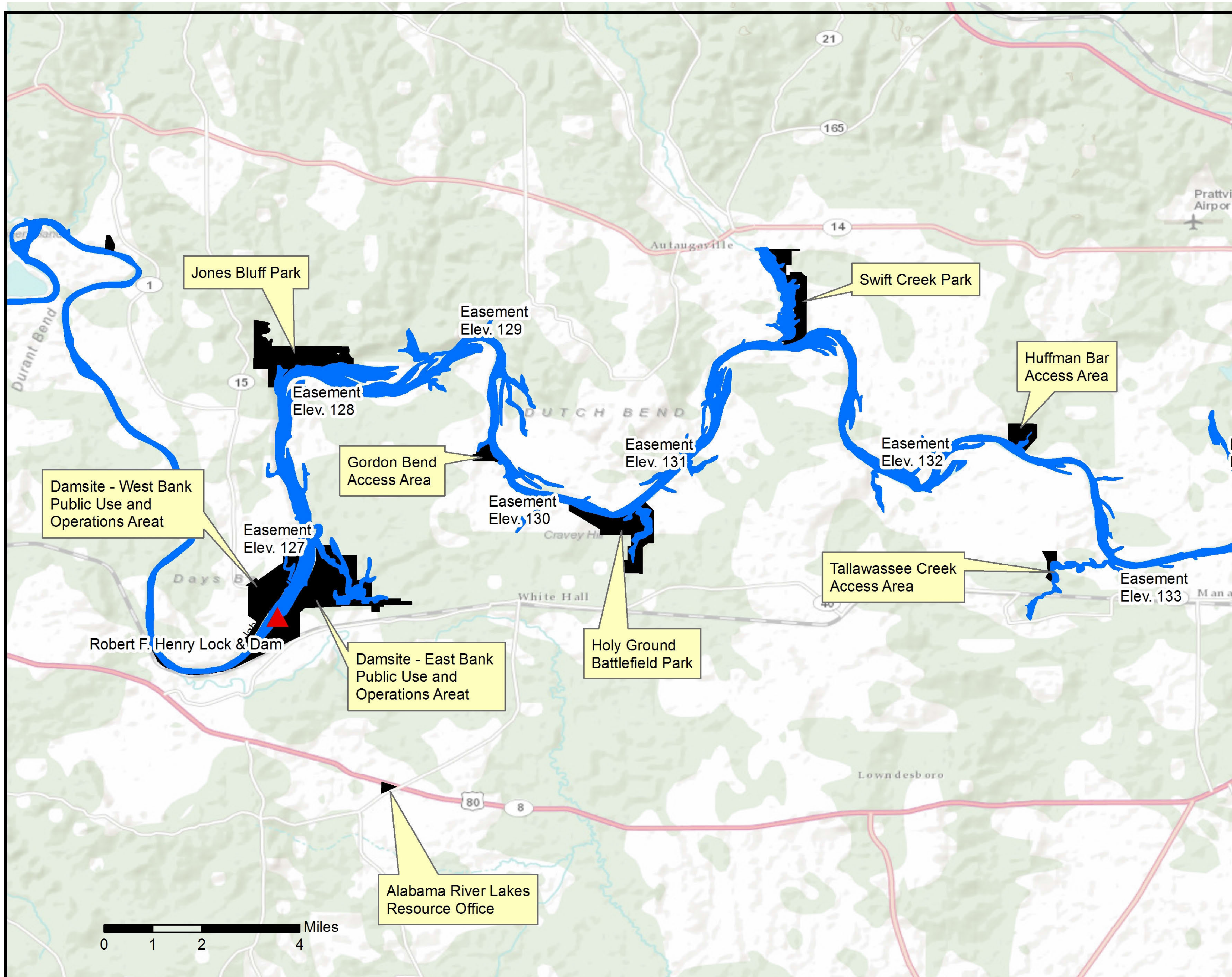
Pool Elevation (Feet)	Total Area (Acres)	Total Storage (Acre-Feet)	Pool Elevation (Feet)	Total Area (Acres)	Total Storage (Acre-Feet)
64	0	0	122	10470	200030
65	10	10	(2)123	10990	210760
70	80	200	124	11700	222100
75	240	970	125	12510	234210
80	600	2970	(1,4)126	13500	247210
85	1280	7550	127	14580	261250
90	2150	16140	128	15640	276360
(3)91	2320	18370	129	16650	292510
95	2970	28590	130	17730	309700
100	3900	46040	131	19150	328140
105	5260	68880	132	20550	347990
110	6660	98740	133	22300	369410
115	8110	135700	134	24050	392590
116	8400	143950	135	26380	417800
117	8690	152500	136	28800	445390
118	9000	161340	137	31500	475470
119	9310	170500	138	33700	507990
120	9630	179970	139	36000	542840
121	10010	189790	140	38400	580040

(2) Top of conservation
(3) Minimum conservation
(4) Spillw ay crest elevation
(5) Top of gates – closed position

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

AREA-CAPACITY CURVE



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WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
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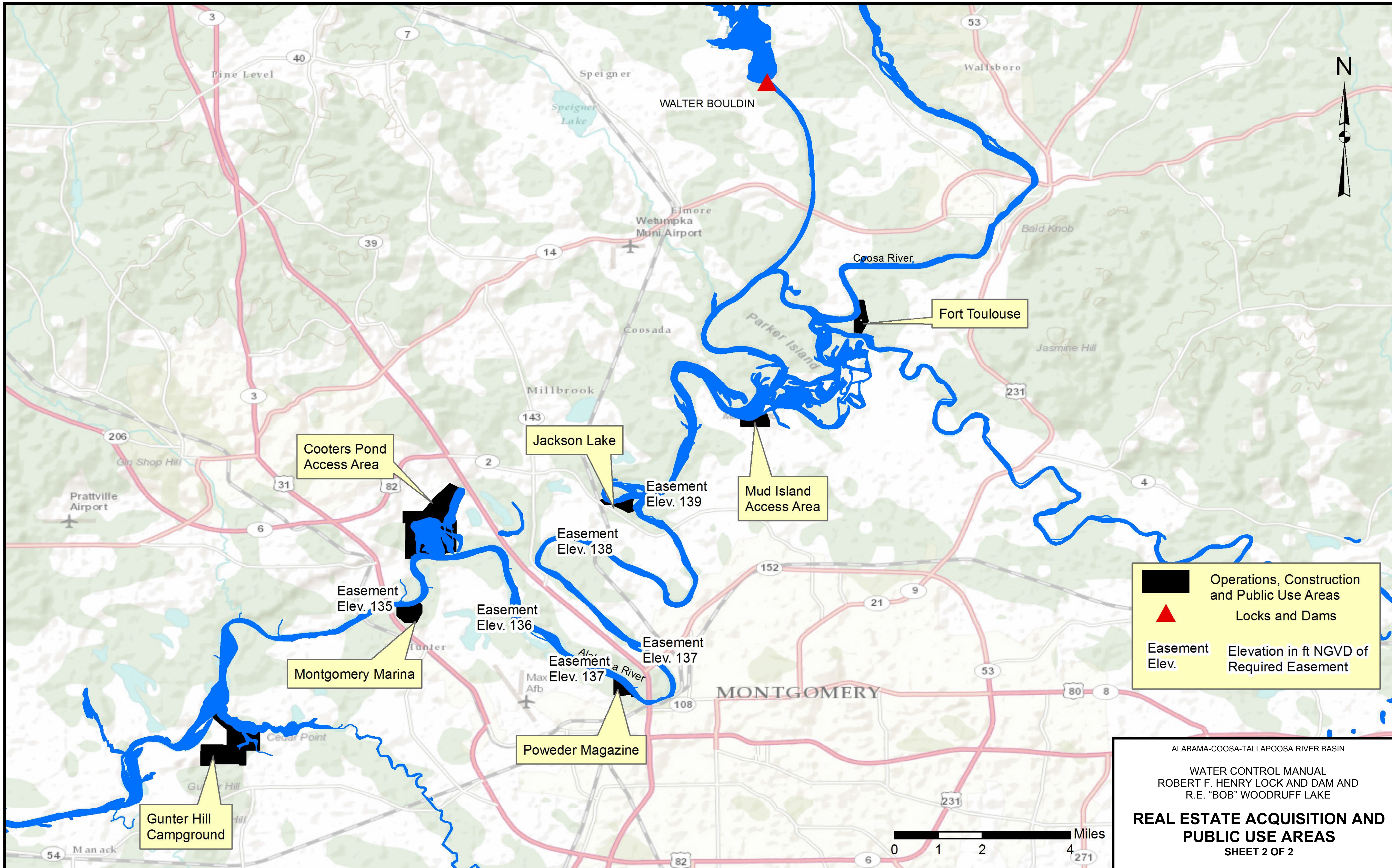
REAL ESTATE ACQUISITION AND PUBLIC USE AREAS
SHEET 1 OF 2


N
WALTER BOULDIN
Coosa River
Fort Toulouse
Parker Island
Mud Island Access Area
Jackson Lake
Easement Elev. 139
Easement Elev. 138
Cooters Pond Access Area
Easement Elev. 135
Easement Elev. 136
Easement Elev. 137
Easement Elev. 137
Montgomery Marina
Poweder Magazine
Gunter Hill Campground
MONTGOMERY
Pine Level
Speigner
Speigner Lake
Wallsboro
Elmore
Wetumpka Muni Airport
Coosada
Millbrook
Prattville Airport
Gin Shop Hill
Bald Knob
Jasmine Hill
Max Afb
Hunter
Cedar Point
Manack
Operations, Construction and Public Use Areas
Locks and Dams
Easement Elev.
Elevation in ft NGVD of Required Easement
Miles
0 1 2 4
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WATER CONTROL MANUAL
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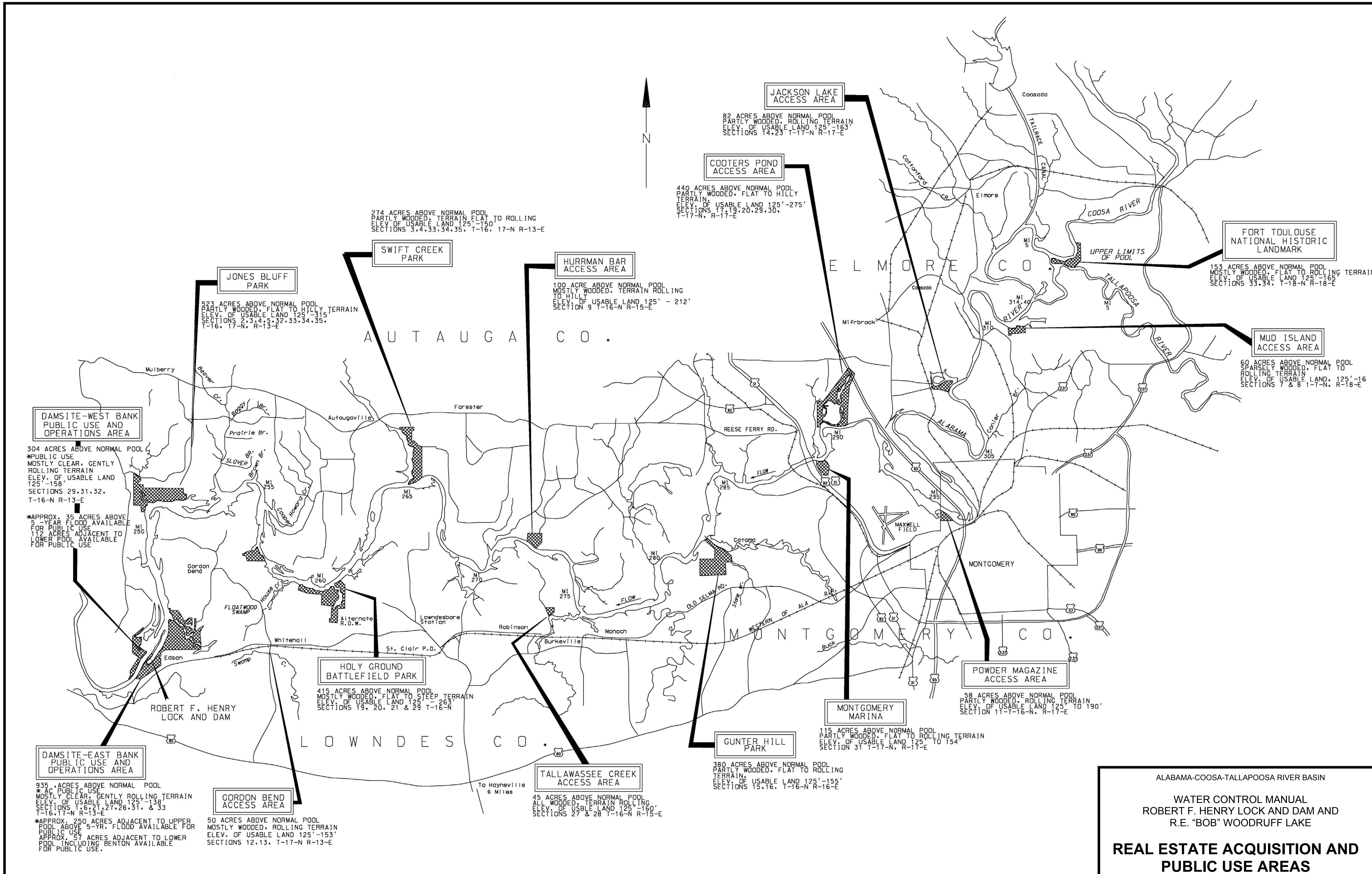
REAL ESTATE ACQUISITION AND PUBLIC USE AREAS
SHEET 2 OF 2



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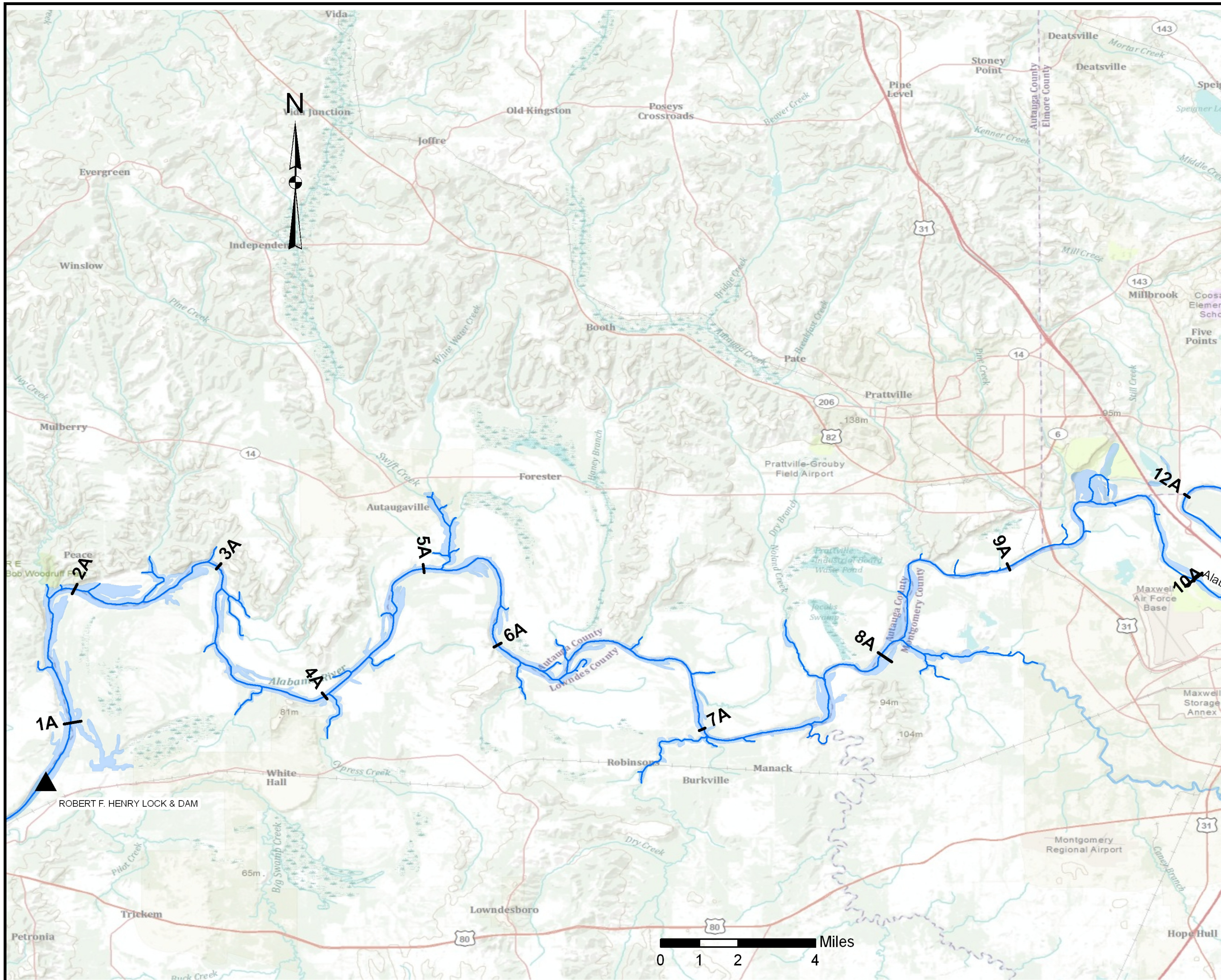


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

SEDIMENTATION RANGES

Station:((097600) ROME,GA From Year=1893 To Year=2009

Temperature Averages and Daily Extremes

	Monthly Averages			Daily Extremes			
	Max. (F)	Min. (F)	Mean (F)	High (F)	Date	Low (F)	Date
January	52.5	31.7	42.1	84	1/1/1917	-9	1/21/1985
February	56.4	33.3	44.9	85	2/25/1930	-5	2/13/1899
March	65.2	40.1	52.7	92	3/22/1907	8	3/07/1899
April	74.1	47.7	60.9	95	4/24/1925	23	4/1/1987
May	81.4	56.1	68.8	103	5/30/1914	33	5/2/1963
June	87.7	64.2	75.9	107	6/28/1931	42	6/1/1930
July	90.1	67.9	79	109	7/20/1913	51	7/1/1923
August	89.5	67.2	78.3	105	8/16/2007	51	8/31/1946
September	84.7	61.1	72.9	107	9/5/1925	32	9/30/1967
October	75.2	48.6	62		10/31/1905	23	10/30/1910
November	63.2	38.8	51	87	11/2/1961	4	11/25/1950
December	54	33	43.6	80	12/7/1951	-2	12/25/1983
Annual	72.8	49.1	61	95.8	10/31/1905	-9	1/21/1985

Station:(017020) ROCKFORD 3 ESE From Year=1954 To Year=2009

Temperature Averages and Daily Extremes

	Monthly Averages			Daily Extremes			
	Max. (F)	Min. (F)	Mean (F)	High (F)	Date	Low (F)	Date
January	54.2	31.8	43.1	80	1/30/1957	-6	1/21/1985
February	58.7	34.3	46.5	82	2/14/1962	6	2/17/1958
March	67.2	41	54.1	87	3/14/1955	11	3/3/1980
April	75.7	48.7	62.2	90	4/18/1955	24	4/1/1987
May	81.9	56.3	69.1	98	5/20/1962	33	5/13/1960
June	87.7	63.2	75.4	102	6/6/1985	37	6/3/1956
July	89.6	66.8	78.2	103	7/13/1980	50	7/6/1972
August	89.3	66.1	77.7	107	8/7/1956	49	8/30/1968
September	84.9	61.4	73.1	101	9/4/1954	37	9/29/1967
October	75.7	49.9	62.8	98	10/5/1954	23	10/31/1954
November	65.8	40.8	53.3	87	11/1/1961	12	11/30/1976
December	57.2	34.2	45.7	79	12/13/1971	-4	12/13/1962
Annual	74	49.5	61.8	107	8/7/1956	-6	1/21/1985

Station:(015439) MILSTEAD From Year=1902 To Year=2009

Temperature Averages and Daily Extremes

	Monthly Averages			Daily Extremes			
	Max. (F)	Min. (F)	Mean (F)	High (F)	Date	Low (F)	Date
January	57.2	34	45.6	80	1/22/1999	-3	1/21/1985
February	61.3	36.7	49	83	2/16/1989	9	2/5/1996
March	69.1	42.8	56	87	3/21/1982	15	3/3/1980
April	75.7	49.1	62.4	91	4/22/1987	27	4/1/1987
May	83.2	58.5	70.9	97	5/24/1996	41	5/1/1996
June	89	66.7	77.8	102	6/7/1985	45	6/1/1984
July	91.4	70.3	80.8	106	7/30/1986	57	7/2/2008
August	91.1	69.3	80.2	107	8/18/2007	56	8/29/1992
September	86.4	63.4	75.1	101	9/17/1980	38	9/22/1983
October	77.1	51.2	64.2	93	10/8/1990	28	10/29/2001
November	68.6	42.6	55.6	88	11/1/1984	21	11/30/1979
December	59.1	35.9	47.5	81	12/3/1982	7	12/24/1989
Annual	75.8	51.7	63.8	107	8/18/2007	-3	1/21/1985

Station:(091640) CARROLLTON From Year=1904 To Year=2009

Temperature Averages and Daily Extremes

	Monthly Averages			Daily Extremes			
	Max. (F)	Min. (F)	Mean (F)	High (F)	Date	Low (F)	Date
January	53.3	31.7	42.6	81	1/12/1949	-9	1/21/1985
February	57.2	33.7	45.5	80	2/16/1954	2	2/14/1905
March	65.5	39.9	52.7	93	3/12/1955	8	3/4/1943
April	74.1	47.3	60.7	92	4/24/1965	24	4/1/1987
May	81.1	55.6	68.3	97	5/21/1941	30	5/9/1984
June	86.7	63	74.9	101	6/19/1944	36	6/6/1974
July	88.8	66.8	77.8	103	7/13/1980	49	7/19/1999
August	88.1	65.9	77	102	8/21/1983	48	8/29/1968
September	82.9	60.2	71.6	100	9/1/1951	32	9/30/1967
October	73.8	48.2	61	97	10/5/1954	23	10/31/1954
November	64.1	38.9	51.4	86	11/2/1974	2	11/25/1950
December	55.3	33.2	44.2	81	12/21/1971	0	12/13/1962
Annual	72.6	48.7	60.6	103	7/13/1980	-9	1/21/1985

Station:(015121) MARION JUNCTION 2 NE From Year=1950 To Year=2009

Temperature Averages and Daily Extremes

	Monthly Averages			Daily Extremes			
	Max. (F)	Min. (F)	Mean (F)	High (F)	Date	Low (F)	Date
January	55.9	33.8	44.8	88	1/4/1965	-1	1/21/1985
February	60.2	36.7	48.5	85	2/13/1962	7	2/3/1951
March	67.9	43.5	55.7	87	3/25/1954	14	3/3/1980
April	75.9	50.8	63.3	92	4/19/2006	30	4/7/1950
May	83.1	59.4	71.3	97	5/31/1951	39	5/4/1971
June	89	66.6	77.8	104	6/28/1954	40	6/1/1984
July	91.4	69.7	80.5	108	7/25/1952	52	7/16/1967
August	90.9	69	79.9	106	8/28/1954	56	8/22/1956
September	86.2	63.4	74.8	102	9/5/1954	36	9/30/1967
October	76.9	51.2	64.1	99	10/5/1954	23	10/30/1952
November	67	41.3	54.1	89	11/2/1961	11	11/25/1950
December	58.4	35.4	46.9	83	12/9/1978	0	12/26/1983
Annual	75.2	51.7	63.5	108	7/25/1952	-1	1/21/1985

Station:(013154) GADSDEN STEAM PLANT From Year=1953 To Year=2009

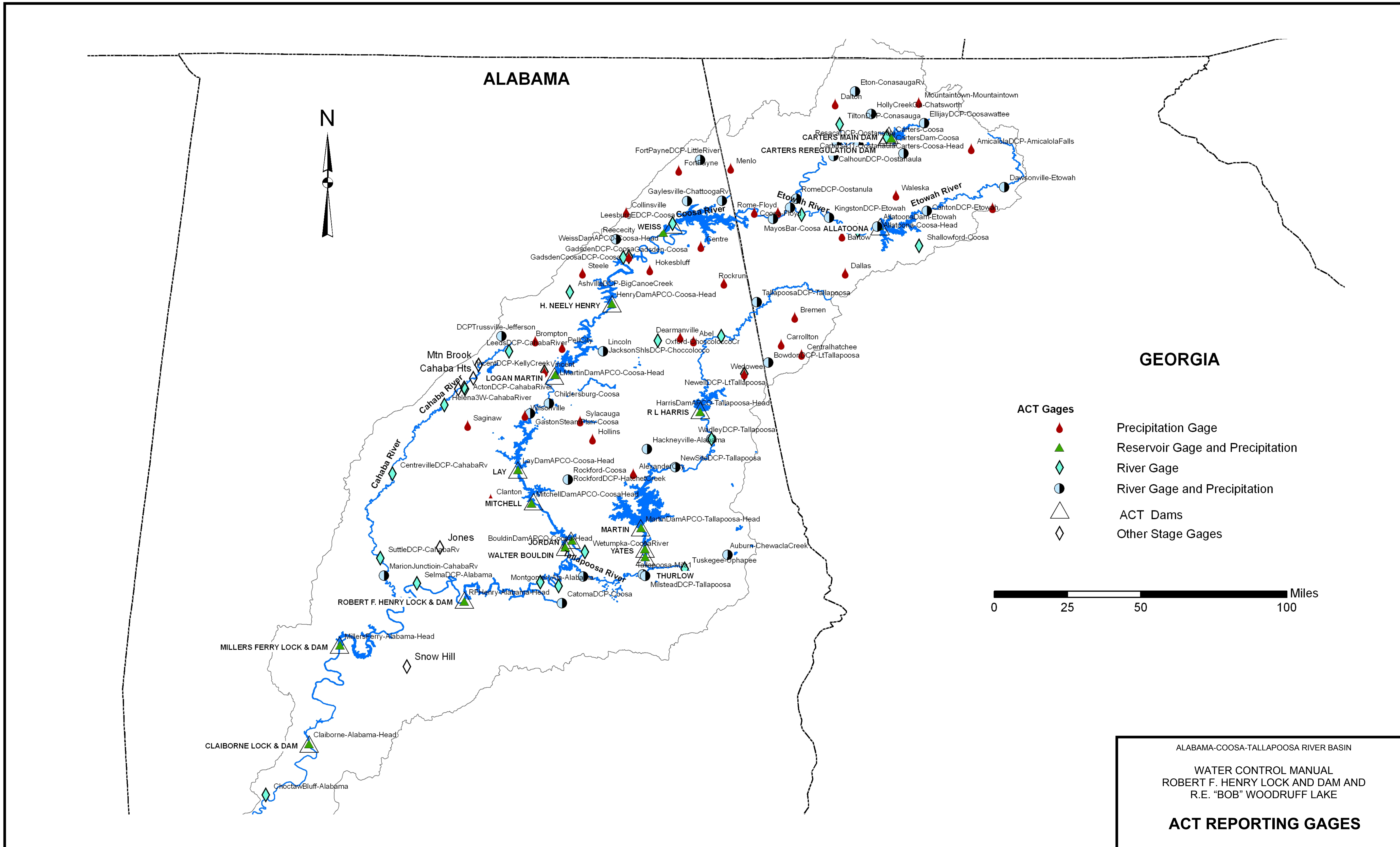
Temperature Averages and Daily Extremes

	Monthly Averages			Daily Extremes			
	Max. (F)	Min. (F)	Mean (F)	High (F)	Date	Low (F)	Date
January	51.1	30.7	40.9	76	1/29/1975	-6	1/20/1985
February	56.1	33.7	44.9	82	2/13/1962	1	2/1/1966
March	65	40.6	52.8	88	3/11/1974	11	3/5/1960
April	74.4	48.9	61.7	91	4/18/1955	22	4/4/1987
May	81.3	57.3	69.3	99	5/24/1970	33	5/13/1960
June	87.4	65.1	76.2	102	6/27/1954	42	6/3/1956
July	90.3	69.1	79.7	103	7/1/1954	52	7/11/1963
August	90.1	68.1	79.1	105	8/16/1954	52	8/31/1954
September	84.5	62	73.2	102	9/3/1954	33	9/30/1967
October	74.5	49.6	62.1	96	10/5/1954	23	10/30/1954
November	63.6	40	51.8	87	11/1/2000	14	11/24/1970
December	54.7	33.4	44	78	12/3/1982	1	12/13/1962
Annual	72.7	49.9	61.3	105	8/16/1954	-6	1/20/1985

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

BASIN TEMPERATURE AVERAGES AND EXTREMES



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

ACT REPORTING GAGES

Station:(097600) ROME — From Year=1893 To Year=2009

Precipitation Averages and Daily Extremes

	Monthly Averages					1 Day Maximum	
	Mean	High	Year	Low	Year		Date
	(in.)	(in.)		(in.)		(in.)	
January	4.99	12.42	1947	0.85	1981	4.65	1/16/1954
February	5.09	13.45	1903	0.74	1906	5.3	2//1921
March	5.97	17.98	1980	1.07	1918	6.22	3/26/1901
April	4.54	13.6	1979	0.3	1915	4.3	4/5/1957
May	3.98	11.33	2003	0.22	2007	2.99	5/3/1964
June	4.31	10.85	1989	0.23	1988	3.31	6/6/1930
July	4.84	14.76	1916	0.87	1960	4.05	7/12/1999
August	4.19	14.54	1992	0.49	1987	4.92	8/22/1992
September	3.51	11.33	1957	0	1897	4.95	9/25/1997
October	2.96	10.37	1995	0	1938	6.67	10/26/1997
November	3.74	16.26	1948	0.36	1924	5.58	11/19/1906
December	4.82	16.47	1932	0.58	1980	5.96	12/12/1961
Annual	52.93	77.65	1932	28.71	2007	6.67	10/26/1997

Station:(017020) ROCKFORD 3 ESE — From Year=1904 To Year=2009

Precipitation Averages and Daily Extremes

	Monthly Averages					1 Day Maximum	
	Mean	High	Year	Low	Year		Date
	(in.)	(in.)		(in.)		(in.)	
January	5.3	13.8	1972	0.27	1986	4.7	1/26/1976
February	5.59	13.9	1961	1.73	1968	4.23	2/10/1981
March	6.62	13.81	1980	0.73	2007	7.04	3/16/1990
April	5.15	14.49	1964	0.26	1986	6	4/5/1957
May	4.31	10.38	1973	0.15	1965	3.68	5/8/1973
June	4.02	10.4	1989	0.1	1988	3.84	6/19/1989
July	5.98	12.85	1975	2.02	1983	4.45	7/29/2009
August	4.21	10.57	2008	0.42	1988	4.3	8/2/1984
September	4.1	14.78	1988	0.22	1987	6.36	9/16/1988
October	2.88	8.93	1970	0	1963	3.48	10/10/1970
November	4.12	10.37	1986	0.91	1969	4.7	11/15/2006
December	5.01	17.05	1961	1.05	1980	5.9	12/10/1961
Annual	57.3	86.01	1975	31.14	2007	7.04	3/16/1990

Station:(015439) MILSTEAD — From Year=1902 To Year=2009

Precipitation Averages and Daily Extremes

	Monthly Averages					1 Day Maximum	
	Mean	High	Year	Low	Year		Date
	(in.)	(in.)		(in.)		(in.)	
January	4.82	14.36	1936	0.48	1927	4.4	1/16/1925
February	5.11	18.39	1961	1.43	1938	9.27	2/25/1961
March	6.04	16.41	1929	0.51	2004	5.78	3/17/1990
April	4.62	18.4	1964	0.24	1986	5.54	4/8/1964
May	3.84	14.85	1978	0.12	1965	4.9	5/4/1978
June	3.85	14.37	1989	0.58	1925	4.34	6/5/1928
July	5.1	14.98	1916	1.43	1976	4.75	7/8/1996
August	4.12	17.13	1961	0.36	1980	10.98	8/31/1961
September	3.57	9.78	1998	0.2	1908	5.7	9/25/1956
October	2.6	13.16	1995	0	1904	6.6	10/5/1995
November	3.74	20.71	1948	0.18	1924	9.33	11/27/1948
December	4.92	12.81	1953	1.08	1955	5.58	12/4/1953
Annual	52.32	83.6	1919	29.76	1954	10.98	8/31/1961

Station:(091640) CARROLLTON — From Year=1904 To Year=2009

Precipitation Averages and Daily Extremes

	Monthly Averages					1 Day Maximum	
	Mean	High	Year	Low	Year		Date
	(in.)	(in.)		(in.)		(in.)	
January	4.75	13.11	1972	0.84	1981	3.96	5/27/1996
February	4.91	11.85	1961	0.73	1978	5.65	2/3/1982
March	5.82	14	1976	0.6	1907	5.34	3/16/1956
April	4.43	13.71	1979	0.14	1986	4.55	4/5/1957
May	4.11	11.37	2003	0.58	1941	6.23	5/27/1981
June	3.94	10.13	2003	0.24	2009	4.65	6/1/1979
July	4.88	13.66	2005	0.18	1952	4.8	7/21/1958
August	3.5	10.28	1960	0.26	1968	4.5	8/17/1939
September	3.53	12.47	2002	0	1904	5.58	9/22/2002
October	2.86	11.04	1995	0	1904	4.52	10/5/1995
November	3.98	18.41	1948	0.48	1939	4.72	11/15/2006
December	4.57	13.28	1961	0.8	1979	3.47	12/31/1973
Annual	51.28	67.8	1982	30.48	207	6.23	5/27/1981

Station:(015121) MARION JUNCTION 2 NE — From Year=1950 To Year=2009

Precipitation Averages and Daily Extremes

	Monthly Averages					1 Day Maximum	
	Mean	High	Year	Low	Year		Date
	(in.)	(in.)		(in.)		(in.)	
January	5.04	12.4	1972	1.44	1954	4.55	1/25/1990
February	4.83	14.54	1961	0.88	1950	4.4	2/25/2001
March	5.98	12.98	1976	0.9	2004	6.4	3/16/1990
April	4.87	13.21	1964	0.24	1986	7.63	4/6/1964
May	3.78	8.54	1978	0.11	2007	4	5/28/1997
June	4.28	12.47	1997	0.72	1986	4.68	6/30/1997
July	4.93	13.27	2005	0.37	1951	4.37	7/12/2005
August	3.76	10.42	2008	0.19	1957	3.79	8/2/2009
September	3.66	9.12	2002	0.17	2008	4.9	9/14/1963
October	2.84	9.1	1959	0	1963	4.32	10/5/1995
November	3.93	13.15	1986	0.69	1950	5.15	11/15/2006
December	5.14	17.15	1961	0.98	1980	4.82	12/10/1961
Annual	53.04	76.31	61	27.43	54	7.63	4/6/1964

Station:(013154) GADSDEN STEAM PLANT — From Year=1953 To Year=2009

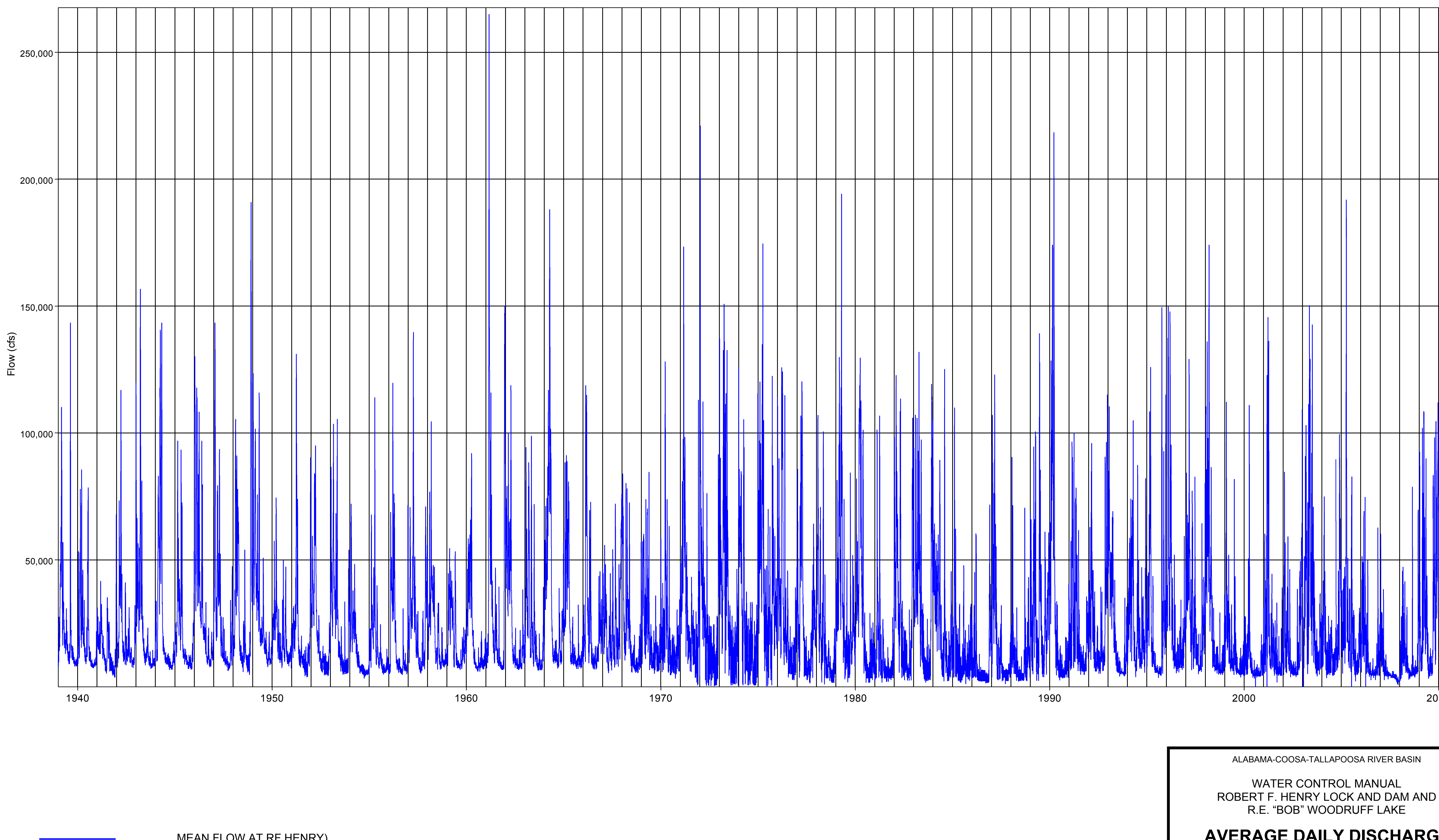
Precipitation Averages and Daily Extremes

	Monthly Averages					1 Day Maximum	
	Mean	High	Year	Low	Year		Date
	(in.)	(in.)		(in.)		(in.)	
January	5.26	9.01	1996	1.14	2005	5.2	1/6/2009
February	4.83	13.54	1961	0.62	1968	4.75	2/21/1961
March	5.84	17.41	1980	0.93	2006	4.98	3/4/1979
April	5.13	12.65	1979	0.57	1986	4.6	4/13/1979
May	4.62	11.11	2009	0.48	2007	3.5	5/1/2009
June	4.12	10.3	1994	0.13	1988	3.1	6/25/1999
July	4.88	14.73	2005	1.01	1960	3.36	7/9/1958
August	3.58	9.52	1992	0.1	1983	3.63	8/26/2008
September	3.6	9.55	1957	0.02	1954	5.1	9/16/2004
October	3.03	9	1995	0	1963	4.98	10/26/1997
November	4.42	14.38	2004	1.3	1981	5.6	11/24/2004
December	4.73	13.05	1961	0.43	1980	5.85	12/12/1961
Annual	54.04	69.71	1979	36.56	1954	5.85	12/12/1961

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

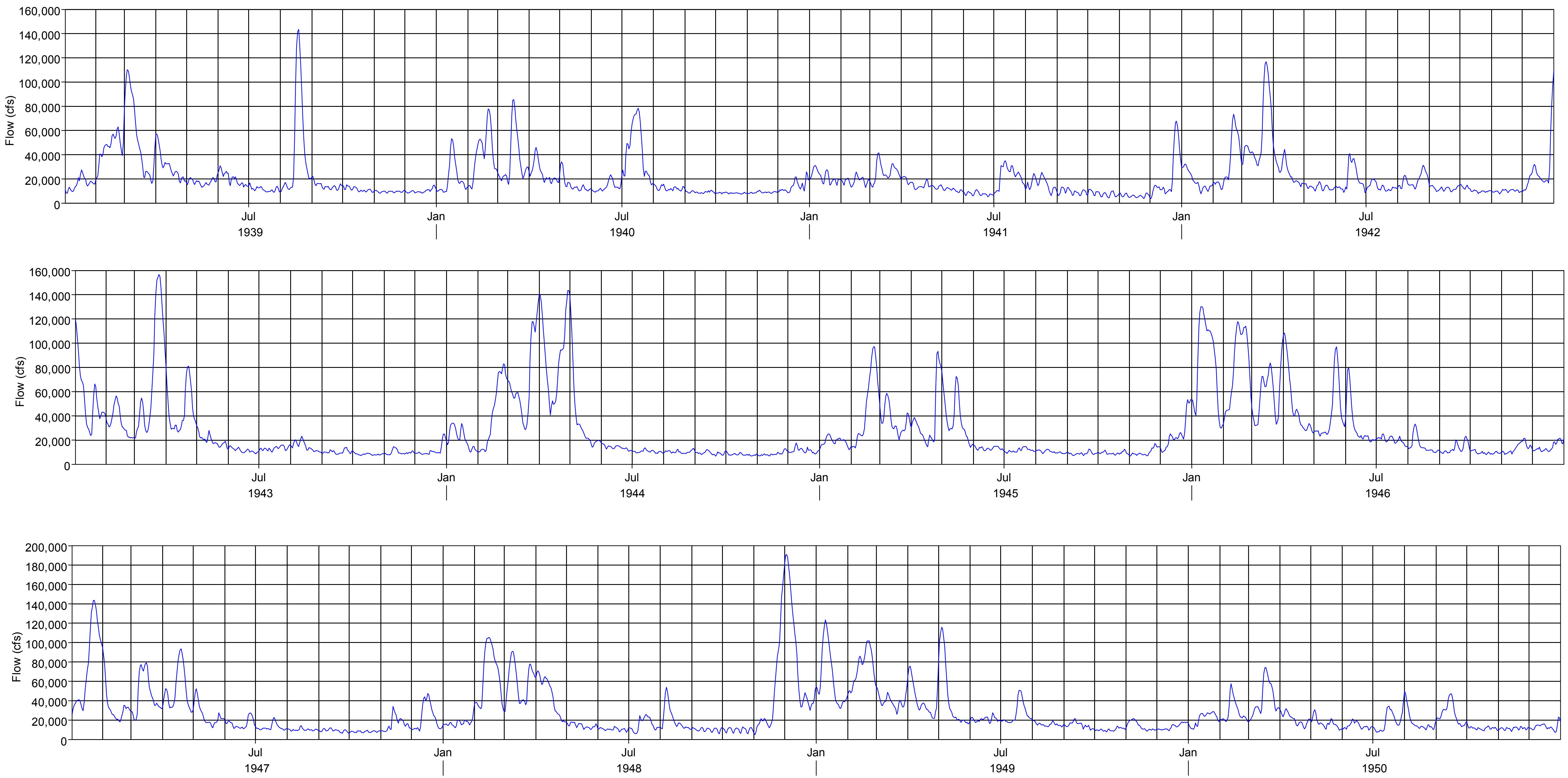
ACT BASIN PRECIPITATION EXTREMES



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

AVERAGE DAILY DISCHARGE HYDROGRAPH
1939 THROUGH 2009

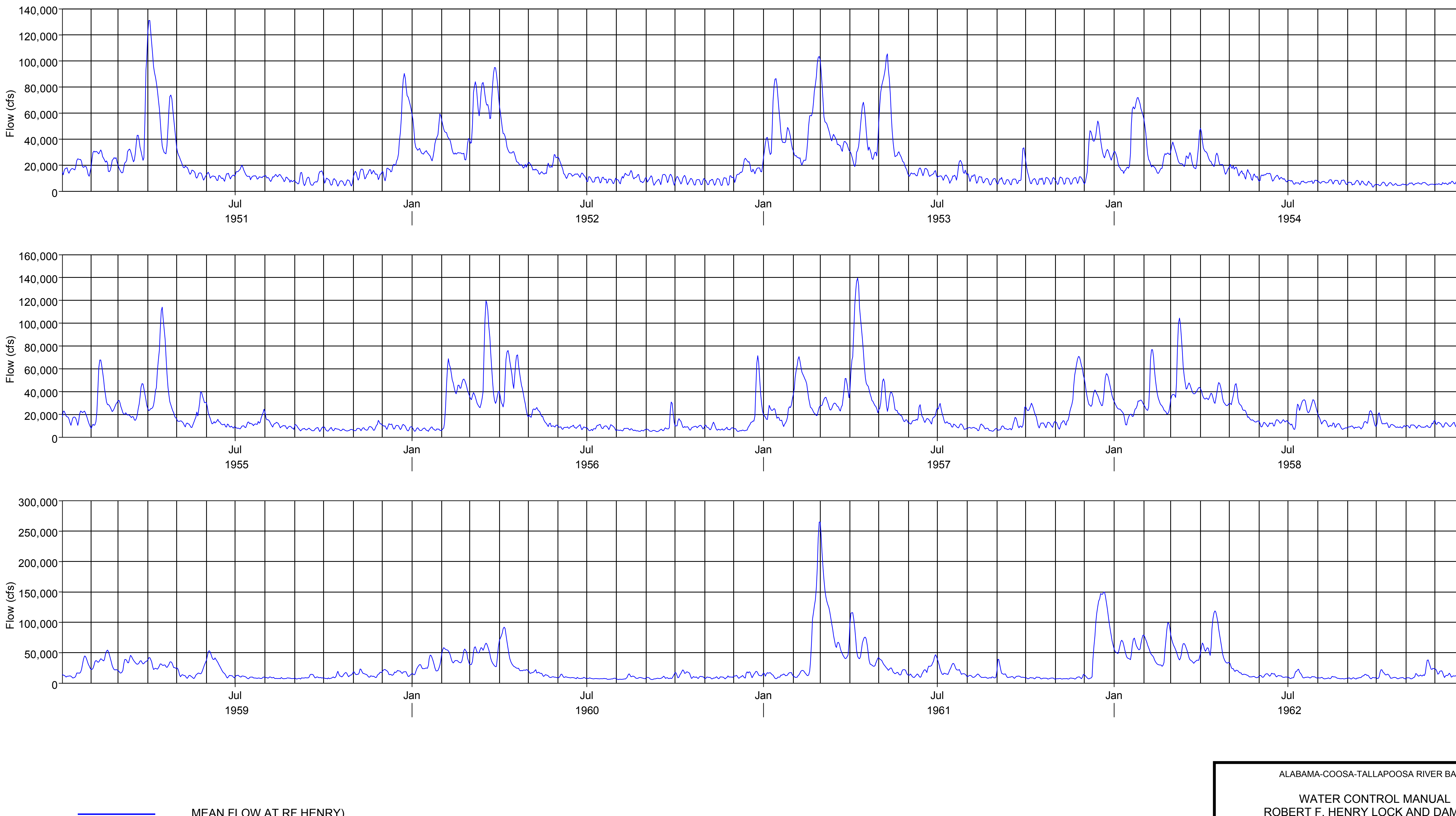


MEAN FLOW AT RF HENRY)

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. “BOB” WOODRUFF LAKE

AVERAGE DAILY DISCHARGE HYDROGRAPHS



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

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ROBERT F. HENRY LOCK AND DAM AND
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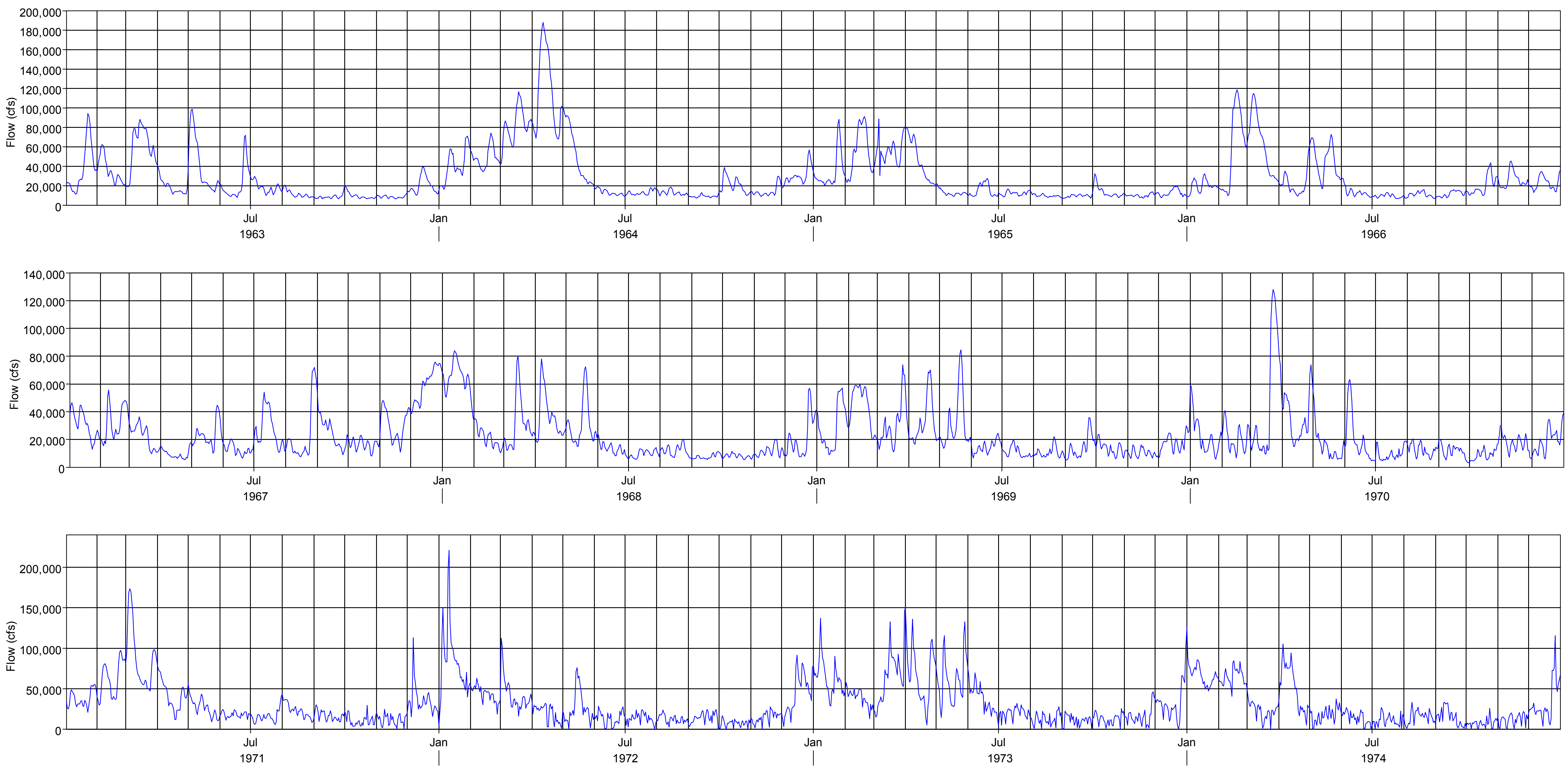
AVERAGE DAILY DISCHARGE HYDROGRAPHS



MEAN FLOW AT RF HENRY)

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

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ROBERT F. HENRY LOCK AND DAM AND
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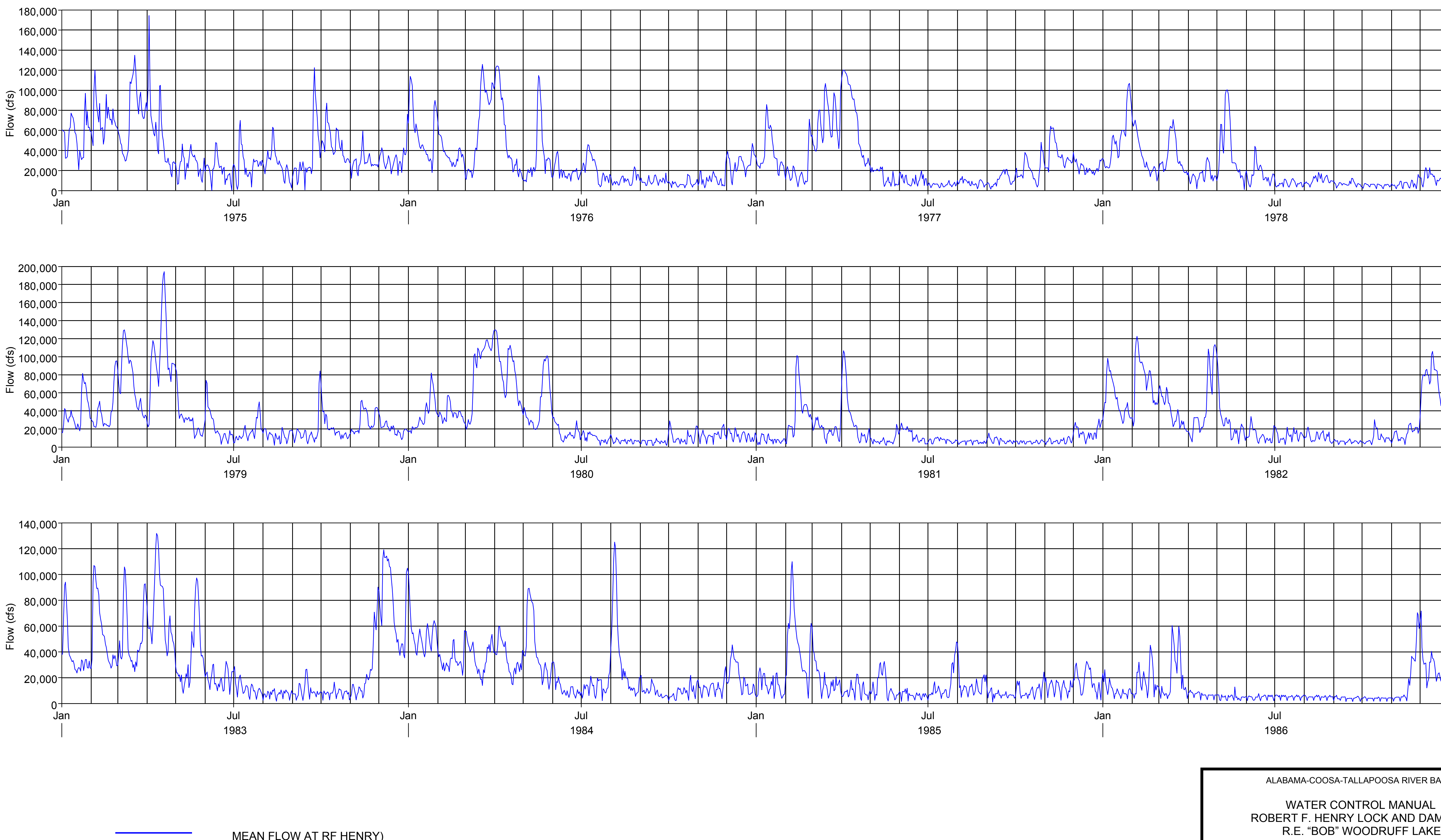
AVERAGE DAILY DISCHARGE HYDROGRAPHS



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

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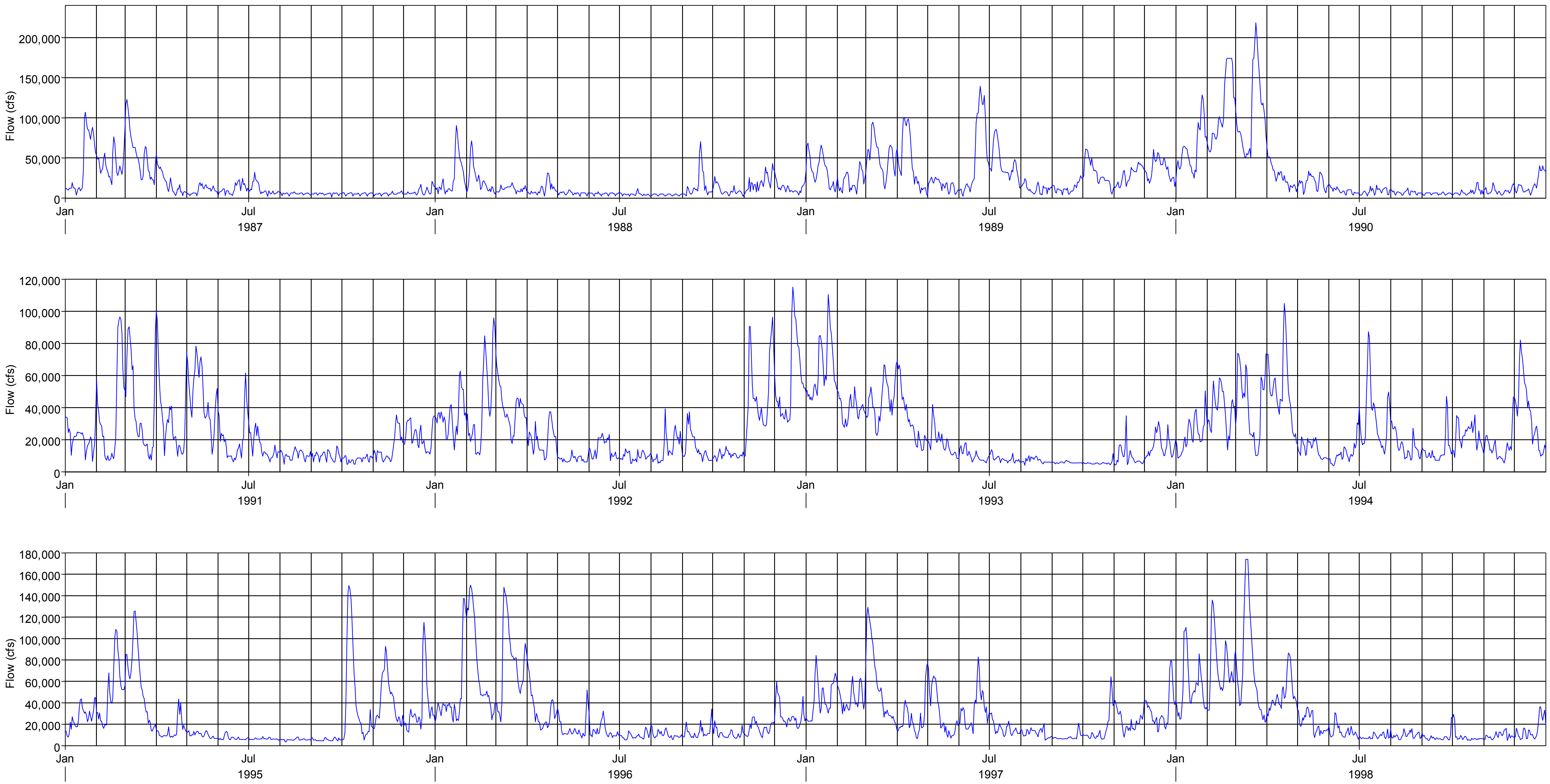
AVERAGE DAILY DISCHARGE HYDROGRAPHS



MEAN FLOW AT RF HENRY)

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

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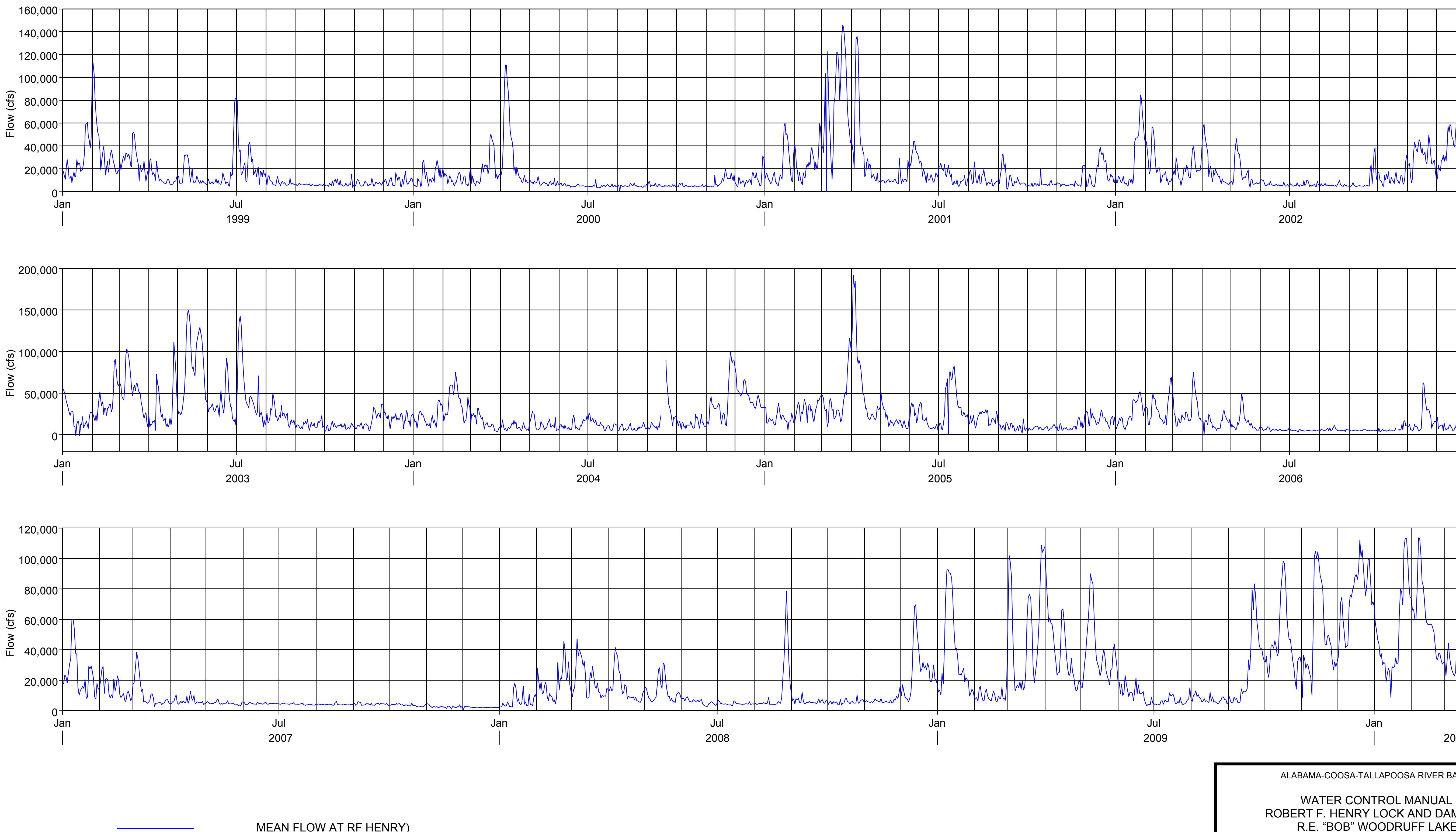


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

AVERAGE DAILY DISCHARGE HYDROGRAPHS

RF Henry Damsite Flow Summary Data

Year	Mean Monthly Discharge (cfs) Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave Mean Monthly	Min Mean Monthly	Max Mean Monthly	Min Daily	Max Daily
1939	15996	47499	54840	29244	17739	19868	11401	45770	14174	11385	9513	10099	23961	9513	54840	7967	143386
1940	20608	41559	36191	24838	15190	13851	43677	12246	9080	8270	8893	14095	20708	8270	43677	7407	85462
1941	21963	18571	25562	15874	11676	7726	22868	15980	9396	7847	6043	22813	15526	6043	25562	3741	67800
1942	18489	33934	58923	25597	13208	19968	13545	19004	12133	10864	9959	28794	22035	9959	58923	7540	116798
1943	55155	34161	76395	43867	19280	11483	13251	14488	10281	8249	9863	11658	25678	8249	76395	7131	156680
1944	21123	44499	71583	90837	33713	13775	10497	10366	9225	7996	8670	11360	27804	7996	90837	6723	143386
1945	18869	48510	35851	38698	36378	13098	11561	10288	8950	9271	10239	26273	22332	8950	48510	6856	96857
1946	83618	82325	60197	47267	42452	31912	19963	15549	13458	9629	13679	14498	36212	9629	83618	7834	130092
1947	77360	33523	47405	51954	24854	16418	12681	10113	9145	8148	16270	23067	27578	8148	77360	6324	143386
1948	17867	66902	60418	44155	14124	10586	15419	20970	10133	9883	52001	82641	33758	9883	82641	4795	190865
1949	64198	74610	40329	41167	42379	20793	26888	15558	14718	10281	13954	13480	31530	10281	74610	7815	123445
1950	21442	28901	41447	20853	16841	14174	20112	17365	26351	11538	11333	13338	20308	11333	41447	7321	74447
1951	18002	25164	35260	67692	16280	11273	12893	9967	9056	7194	13504	40859	22262	7194	67692	3912	131041
1952	35995	34735	71665	29889	18639	13723	8819	10555	9038	8283	8060	17189	22216	8060	71665	4435	94958
1953	47819	49788	44213	36866	50358	14013	12953	9109	11094	8853	8470	33386	27243	8470	50358	4862	105403
1954	39800	24435	26888	24009	13860	10818	7107	7221	6078	5301	5712	6609	14820	5301	39800	3333	71978
1955	17064	32984	25917	48802	18757	12552	12157	10738	7309	6573	8350	9065	17522	6573	48802	4938	113949
1956	6790	43232	51541	48406	16215	8668	8336	6344	9258	9720	7915	19099	19627	6344	51541	4767	119647
1957	20444	41235	32053	66730	27228	16801	13044	7662	10624	15928	33626	37870	26937	7662	66730	5261	139588
1958	23562	36566	52024	35207	24521	12444	22838	11031	11901	11212	9955	10992	21854	9955	52024	6837	104453
1959	19916	34877	33183	29456	15822	26507	9692	8268	9411	11914	14612	17157	19235	8268	34877	6837	54506
1960	27945	44070	48603	41984	14036	9345	7395	8824	8734	12835	9291	13414	17578	7395	48603	6039	91919
1961	13451	69730	95206	57693	22481	21658	20315	10761	13918	8150	8330	82638	23487	8340	58660	6704	264932
1962	58252	53800	47963	65790	15568	12236	11650	8325	9475	11192	16921	14934	23466	8287	58833	6751	118697
1963	38008	35507	60381	18827	40504	22425	18201	11375	8889	9366	8660	20572	23591	8287	59522	6476	98756
1964	41619	48942	82543	118061	50036	13177	13028	12692	9300	20679	14416	30757	23958	8389	61066	7293	188016
1965	34393	55974	55982	44763	12738	15357	12268	9749	9547	13774	10015	12711	24045	8318	61163	7093	91159
1966	19928	58728	62035	22326	45270	13475	9427	10741	11811	20376	25882	22897	23971	8321	60471	6884	118697
1967	30677	32855	21678	9437	23409	12830	27369	24607	24097	16426	30931	60234	23797	8336	59090	5489	75776
1968	63419	20953	31508	37280	31256	12868	9973	11840	7712	8127	11648	22546	23863	8308	59571	5479	83848
1969	28519	44118	31183	32624	32188	14672	10765	10606	14905	13374	10121	19372	23302	8248	58478	5242	84512
1970	21989	21010	49052	36157	14658	20426	9910	12711	11079	11153	16016	20180	23108	8252	57620	3297	128040
1971	37674	63166	89526	41872	26159	18130	16700	22192	16973	10777	11798	34607	22624	8178	56483	661	173363
1972	85636	43374	43127	19767	26522	13469	13244	12416	14028	7860	15079	46045	22219	8083	55659	349	220953
1973	63859	38574	67474	67703	61114	36338	20472	12267	11246	13046	16702	35188	22306	7935	56305	637	150702
1974	66290	64493	22681	51655	17723	13785	11104	15141	15086	7945	12258	34589	22308	7969	55787	663	115576
1975	54531	72490	74956	54457	25711	20762	25701	26152	35419	46344	28376	32785	22312	7965	55066	289	174497

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

MONTHLY AND DAILY FLOW DATA

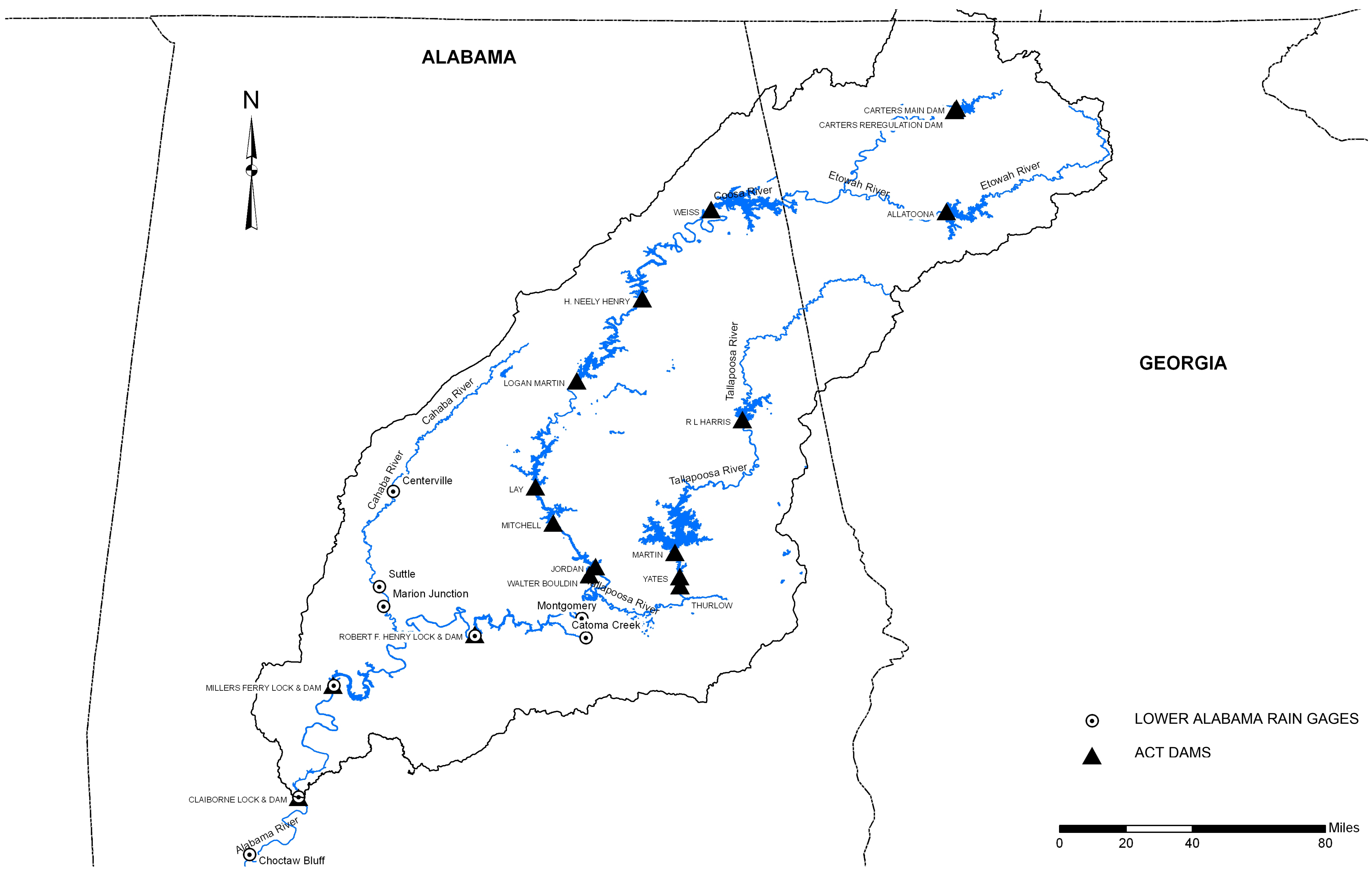
RF Henry Damsite Flow Summary Data

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave Mean Monthly	Min Mean Monthly	Max Mean Monthly	Min Daily	Max Daily
	Mean Monthly Discharge (cfs)																
	58293	35275	68404	52736	35726	19082	21712	10607	9613	7004	11619	27206	22088	7942	55280	2741	125748
1977	36989	21521	69638	71182	13832	10227	5883	7856	11073	21145	36866	23021	22418	8062	55983	1483	120205
1978	52948	33102	34425	15270	40289	16100	6986	10430	6558	5241	6732	13638	22641	8129	56310	1038	106931
1979	38811	41191	71396	103079	28555	21948	17679	12885	18590	19857	29914	19451	22778	8210	56526	1871	194130
1980	36332	36718	89236	81159	48553	15985	10340	6507	6036	11043	12756	12467	22589	8235	56063	1657	129580
1981	7681	41646	20453	32986	8016	13010	7415	5588	7192	5515	6911	17071	22622	8157	56246	1735	106698
1982	52573	75315	37471	49540	24771	13266	12152	11153	5914	9749	15714	68886	22776	8152	57217	2507	122696
1983	38652	55013	53233	70686	37742	19129	11385	7487	9811	7929	26912	77552	23012	8187	57609	1737	131798
1984	52054	33839	36742	35253	42568	11380	13749	35672	8965	9351	12366	19530	22991	8180	57561	2227	125081
1985	14207	48176	17244	9993	13224	6398	15312	13054	6698	10184	12501	17711	22969	8175	57504	1152	109878
1986	10075	17984	20810	6801	4926	4822	5256	4832	4122	3917	20637	27080	22941	8170	57412	1463	71673
1987	41534	42313	54395	17211	9998	11779	10743	5550	5349	5359	5506	8590	22894	8160	57246	1162	122946
1988	25926	22480	11406	11201	6134	5418	4778	4303	15513	9553	19826	12859	22842	8152	57068	2174	90417
1989	35099	21243	52866	42791	16500	53837	42356	11983	12958	30674	28717	35812	22791	8145	56913	2383	139177
1990	62514	112455	105496	25815	19881	8942	8667	6966	5558	7767	9222	17860	22745	8136	56814	2578	218355
1991	22135	36677	39848	32001	46882	19873	15268	10525	10049	7957	15242	22437	22694	8128	56689	4831	99896
1992	34864	42235	38781	19557	8226	14396	9850	14631	15355	10682	49969	56644	22667	8123	56607	5207	115000
1993	64255	38953	45453	31262	17909	10209	8054	7130	5826	5529	9487	16642	22647	8117	56561	4128	110372
1994	23501	38913	43434	49563	13840	12484	33684	16110	13349	22569	16341	36159	22648	8114	56565	3933	104870
1995	26391	50453	57594	14764	9992	7083	6251	5665	5536	45455	42056	36176	22667	8115	56606	3618	149436
1996	48461	73305	79036	31918	16347	13348	9449	10127	12887	10999	16556	28403	22684	8124	56620	5430	149710
1997	44750	44983	55965	26215	29400	34240	15870	11614	8107	16505	23190	34119	22701	8131	56657	5026	129025
1998	54817	76183	72976	48214	20521	12981	8761	9674	8252	7923	9333	15078	22718	8138	56730	4758	174000
1999	28494	37478	26651	12309	13595	17585	23588	7847	5992	6758	7168	9322	22747	8147	56796	3785	112159
2000	13229	10978	19443	35139	7640	5251	4897	4976	5349	5026	9075	11022	22762	8151	56833	0	110870
2001	21227	24861	80284	37996	11543	21005	12758	10761	11161	6728	8382	16557	22767	8152	56856	0	145514
2002	27692	21809	20108	18891	15655	6315	6165	5706	9666	12287	30381	49321	22767	8149	56871	3825	109126
2003	21678	40584	52227	32452	83665	36683	50806	22111	11755	9775	17282	19984	22775	8146	56908	0	150164
2004	20677	38791	14717	9303	12147	11708	11946	8062	22044	12891	42047	45017	22782	8145	56938	3474	99396
2005	19119	31589	42299	61901	18106	19128	38283	19872	8811	7969	10392	18520	22782	8145	56926	0	191817
2006	26043	31657	27392	14415	14740	6061	4801	5885	4994	6860	18538	12546	22772	8143	56895	0	74680
2007	23836	14346	10732	6284	4939	4741	4341	4109	4370	3643	2666	2256	22762	8141	56864	841	60201
2008	6349	17758	20028	15068	12789	5828	4652	13571	6192	5746	6855	26446	22752	8140	56835	2429	78649
2009	37223	11519	51445	38709	38897	11028	6602	7453	28527	45787	50634	75853	22744	8138	56809	3307	111975

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. “BOB” WOODRUFF LAKE

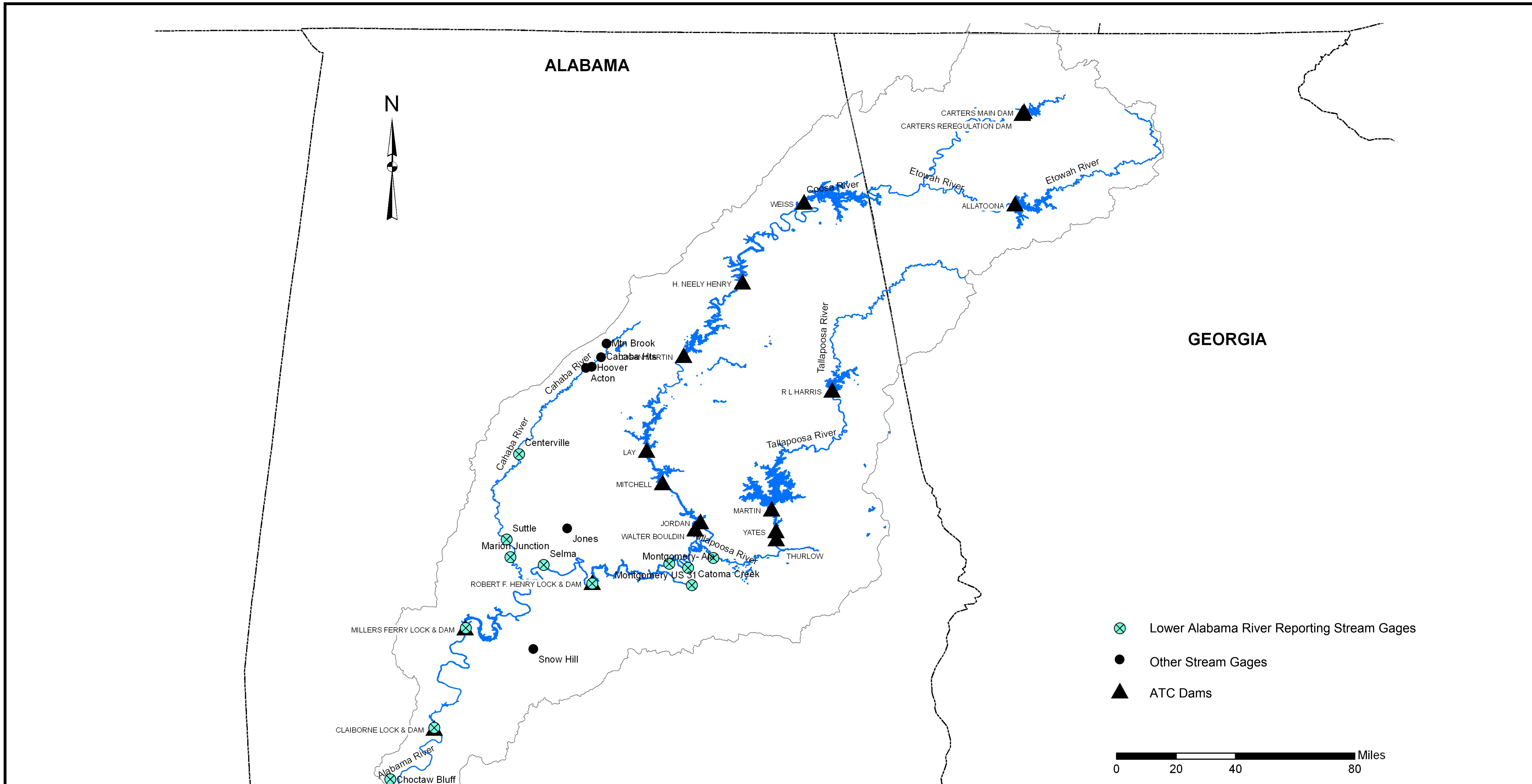
MONTHLY AND DAILY FLOW DATA



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

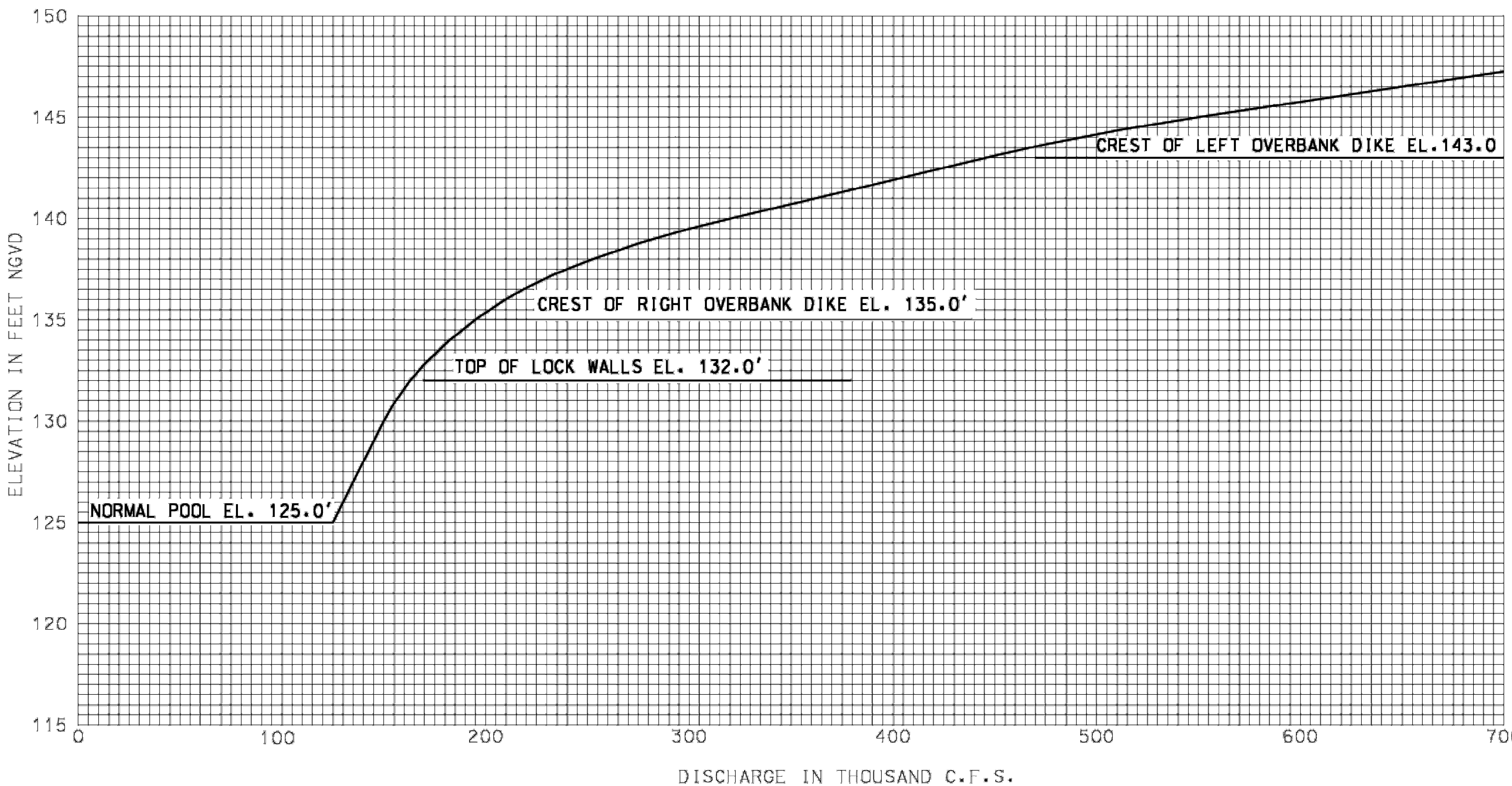
LOWER ALABAMA RIVER REPORTING RAIN GAGES



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

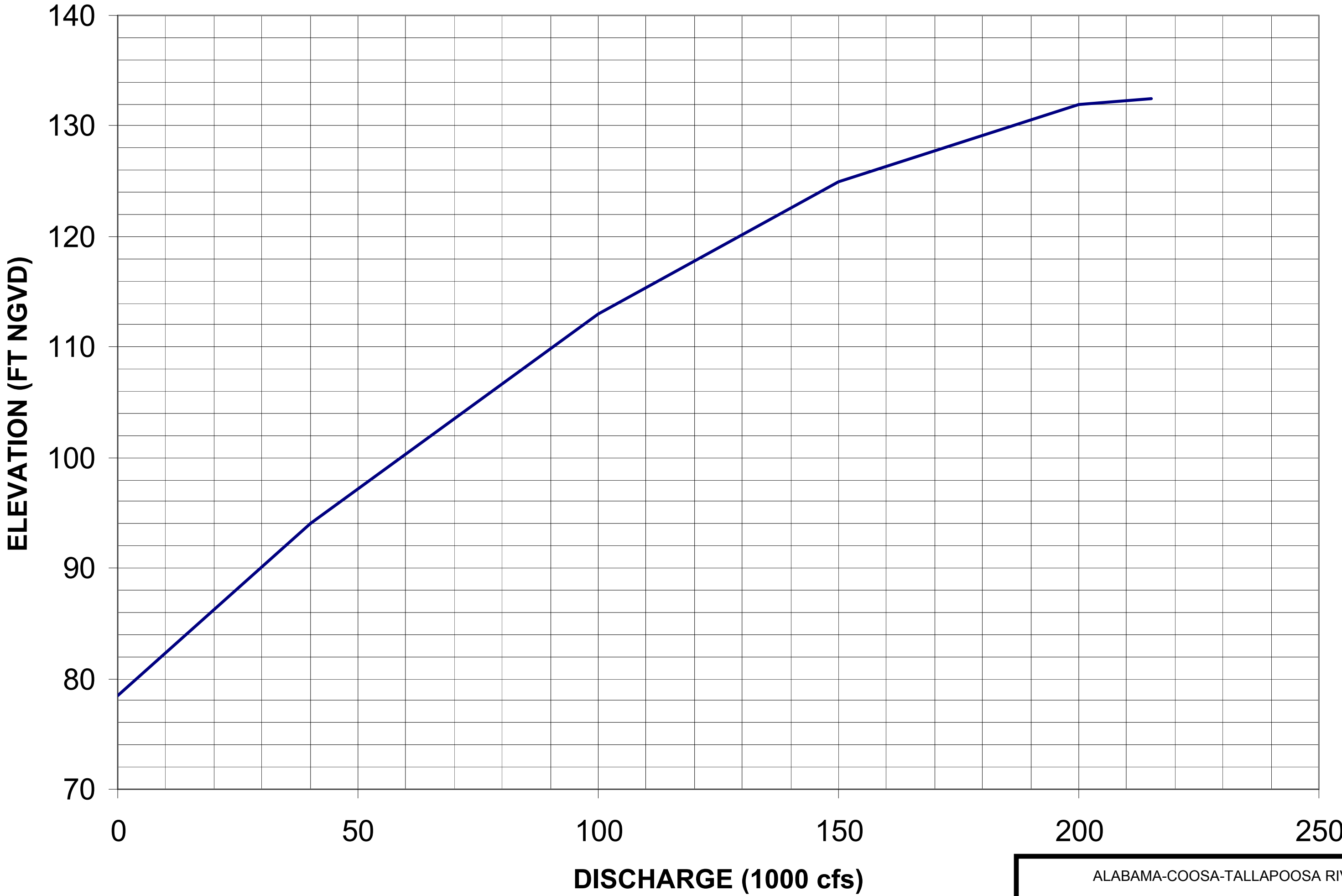
LOWER ALABAMA RIVER REPORTING RIVER AND STREAM GAGES



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

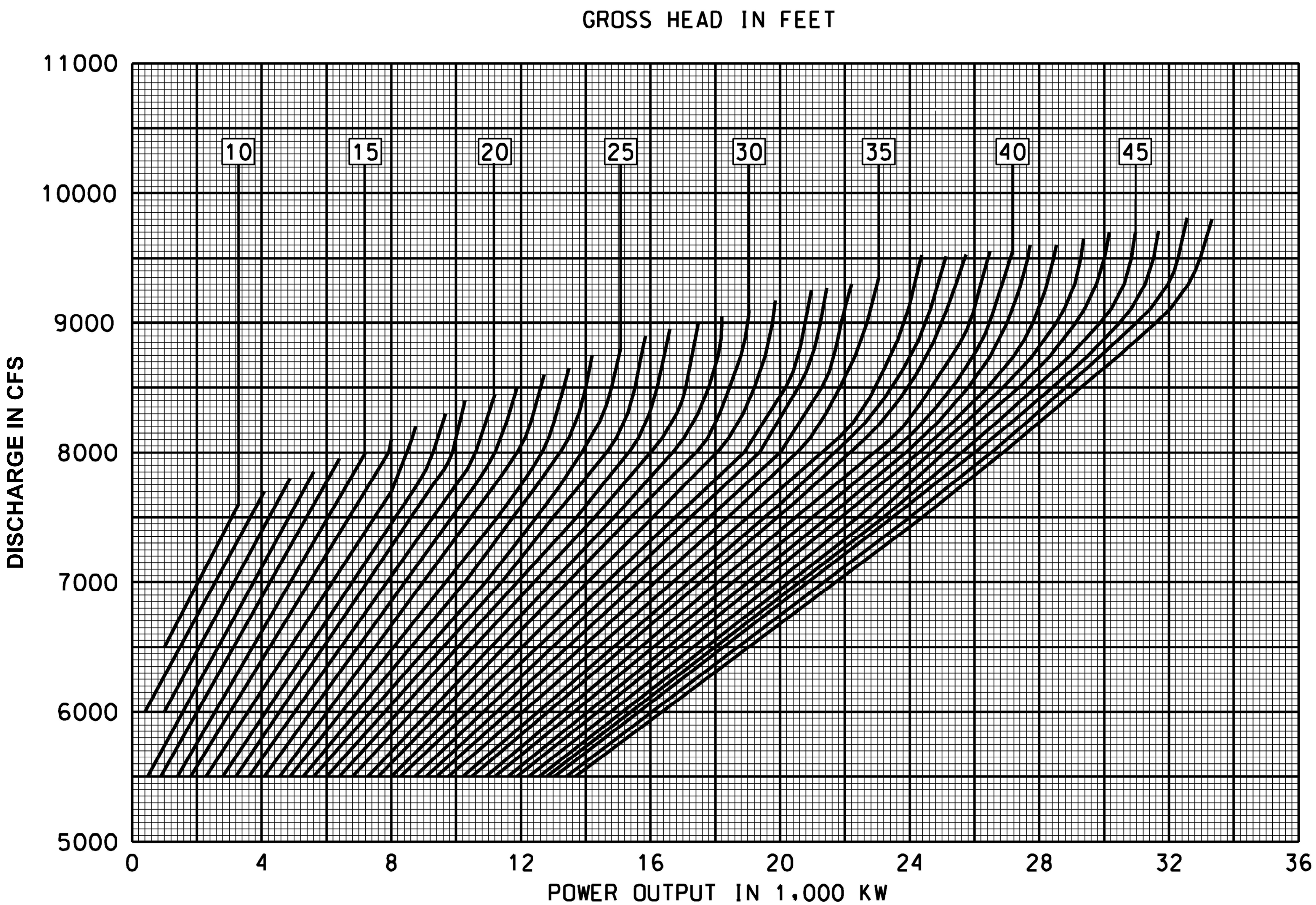
SPILLWAY, LOCK, AND OVERBANK DIKES FLOW RATING CURVE



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

TAILWATER RATING CURVE



NOTES

1 Based on manufacturer's original performance curves dated June 1967 and manufacturer's calculated generator losses.

2 Maximum and minimum limitation on generating equipment to be determined by field test.

3 Performance curves do not reflect the maintenance and rewinding of the units.

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

FLOW VS POWER OUTPUT
SINGLE TURBOGENERATOR UNIT

STEP NO.	GATE OPENING SCHEDULE – GATE NUMBER											SPILLWAY DISCHARGE IN CFS – POOL ELEVATION					
	11	10	9	8	7	6	5	4	3	2	1	123.5	124	124.5	125	125.5	126
	OPENING IN RATCHET STEPS																
1	1	C	C	C	C	C	C	C	C	C	C	101	102	103	103	104	105
2	1	1	C	C	C	C	C	C	C	C	C	202	204	205	207	208	210
3	1	1	1	C	C	C	C	C	C	C	C	303	306	308	310	313	315
4	1	1	1	1	C	C	C	C	C	C	C	404	408	411	414	417	420
5	1	1	1	1	1	C	C	C	C	C	C	506	509	513	517	521	525
6	1	1	1	1	1	1	C	C	C	C	C	607	611	616	620	625	630
7	1	1	1	1	1	1	1	C	C	C	C	708	713	719	724	729	734
8	1	1	1	1	1	1	1	1	C	C	C	809	815	821	827	833	839
9	2	1	1	1	1	1	1	1	C	C	C	1416	1427	1437	1448	1459	1469
10	2	2	1	1	1	1	1	1	C	C	C	2023	2038	2054	2069	2084	2099
11	2	2	2	1	1	1	1	1	C	C	C	2630	2650	2670	2690	2709	2729
12	2	2	2	2	1	1	1	1	C	C	C	3236	3261	3286	3310	3335	3359
13	2	2	2	2	2	1	1	1	C	C	C	3843	3873	3902	3931	3960	3988
14	2	2	2	2	2	2	1	1	C	C	C	4450	4484	4518	4552	4585	4618
15	2	2	2	2	2	2	2	1	C	C	C	5057	5096	5134	5173	5211	5248
16	2	2	2	2	2	2	2	2	C	C	C	5664	5708	5751	5793	5836	5878
17	3	2	2	2	2	2	2	2	C	C	C	6996	7050	7103	7156	7208	7260
18	3	3	2	2	2	2	2	2	C	C	C	8328	8392	8456	8519	8581	8643
19	3	3	3	2	2	2	2	2	C	C	C	9661	9735	9808	9881	9953	10025
20	3	3	3	3	2	2	2	2	C	C	C	10993	11077	11161	11244	11326	11408
21	3	3	3	3	3	2	2	2	C	C	C	12325	12419	12513	12606	12699	12790
22	3	3	3	3	3	3	2	2	C	C	C	13657	13762	13866	13969	14071	14173
23	3	3	3	3	3	3	3	2	C	C	C	14989	15104	15218	15331	15444	15555
24	3	3	3	3	3	3	3	3	C	C	C	16322	16447	16571	16694	16816	16938

ALABAMA-COOSA-TALLAPOOSA BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB"WOODRUFF LAKE

SPILLWAY GATE OPERATION SCHEDULE

STEP NO.	GATE OPENING SCHEDULE											SPILLWAY DISCHARGE IN CFS														
	GATE NUMBER											GROSS HEAD														
	11	10	9	8	7	6	5	4	3	2	1	44.0	42.0	40.0	38.0	36.0	34.0	32.0	30.0	28.0	26.0	24.0	22.0	20.0	18.0	16.0
	OPENING IN RATCHET STEPS																									
25	4	3	3	3	3	3	3	3	C	C	C	20157	19693	19219	18732	18233	17719	17190	16644	16080	15495					
26	4	4	3	3	3	3	3	3	C	C	C	21196	20709	20210	19698	19173	18632	18076	17502	16909	16294					
27	4	4	4	3	3	3	3	3	C	C	C	22235	21724	21201	20664	20113	19546	18962	18360	17738	17093					
28	4	4	4	4	3	3	3	3	C	C	C	23275	22740	22192	21630	21053	20460	19849	19218	18567	17891					
29	4	4	4	4	4	3	3	3	C	C	C	24314	23755	23183	22596	21993	21373	20735	20077	19396	18690					
30	4	4	4	4	4	4	3	3	C	C	C	25353	24770	24173	23561	22933	22287	21621	20935	20225	19489					
31	4	4	4	4	4	4	4	3	C	C	C			25164	24527	23873	23200	22508	21793	21054	20288	19492	18662			
32	4	4	4	4	4	4	4	4	C	C	C			26155	25493	24813	24114	23394	22651	21883	21087	20260	19397			
33	5	4	4	4	4	4	4	4	C	C	C			27112	26425	25721	24996	24250	23480	22683	21858	21001	20107			
34	5	5	4	4	4	4	4	4	C	C	C			28068	27358	26628	25878	25105	24308	23484	22629	21742	20816			
35	5	5	5	4	4	4	4	4	C	C	C			29025	28290	27535	26759	25961	25136	24284	23400	22482	21525			
36	5	5	5	5	4	4	4	4	C	C	C			29981	29222	28443	27641	26816	25964	25084	24172	23223	22235			
37	5	5	5	5	5	4	4	4	C	C	C			30938	30154	29350	28523	27671	26793	25884	24943	23964	22944			
38	5	5	5	5	5	5	4	4	C	C	C			31894	31087	30257	29405	28527	27621	26685	25714	24705	23653			
39	5	5	5	5	5	5	5	4	C	C	C			32851	32019	31165	30287	29382	28449	27485	26485	25446	24363			
40	5	5	5	5	5	5	5	5	C	C	C			33807	32951	32072	31169	30238	29278	28285	27256	26187	25072			
41	5	5	5	5	5	5	5	5	1	C	C								29718	28384	27317	26228	25101	23926	22694	21393
42	5	5	5	5	5	5	5	5	2	C	C								30441	29808	28275	26929	25643	24362	23055	21699
43	5	5	5	5	5	5	5	5	3	C	C								31251	30191	29093	27952	26762	25516	24207	22822
44	5	5	5	5	5	5	5	5	4	C	C								32109	31020	29892	28719	27497	26217	24872	23449
45	5	5	5	5	5	5	5	5	5	C	C								32937	31821	30663	29460	28206	26893	25513	24054
46	5	5	5	5	5	5	5	5	5	1	C								33377	31919	30724	29501	28235	26914	25529	24066
47	5	5	5	5	5	5	5	5	5	2	C								34100	33344	31682	30202	28777	27351	25890	24371
48	5	5	5	5	5	5	5	5	5	3	C								34911	33727	32500	31225	29896	28504	27042	25495
49	5	5	5	5	5	5	5	5	5	4	C								35769	34556	33299	31993	30631	29205	27706	26122
50	5	5	5	5	5	5	5	5	5	5	C								36597	35356	34070	32733	31340	29881	28348	26727
51	5	5	5	5	5	5	5	5	5	5	1								37037	35455	34131	32775	31369	29903	28364	26739
52	5	5	5	5	5	5	5	5	5	5	2								37760	36880	35089	33476	31911	30339	28725	27044
53	5	5	5	5	5	5	5	5	5	5	3								38570	37263	35907	34498	33030	31493	29876	28168
54	5	5	5	5	5	5	5	5	5	5	4								39429	38092	36706	35266	33765	32193	30541	28795
55	5	5	5	5	5	5	5	5	5	5	5								40257	38892	37477	36007	34474	32870	31183	29399
56	6	5	5	5	5	5	5	5	5	5	5								41123	39729	38283	36782	35216	33577	31854	30032
57	6	6	5	5	5	5	5	5	5	5	5								41989	40565	39090	37556	35957	34284	32525	30665
58	6	6	6	5	5	5	5	5	5	5	5								42855	41402	39896	38331	36699	34991	33196	31297
59	6	6	6	6	5	5	5	5	5	5	5								43721	42239	40702	39106	37441	35698	33866	31930
60	6	6	6	6	6	5	5	5	5	5	5								44588	43076	41509	39880	38183	36406	34537	32562
61	6	6	6	6	6	6	5	5	5	5	5								45454	43912	42315	40655	38924	37113	35208	33195
62	6	6	6	6	6	6	6	5	5	5	5								46320	44749	43121	41430	39666	37820	35879	33827
63	6	6	6	6	6	6	6	6	5	5	5								47186	45586	43928	42204	40408	38527	36550	34460
64	6	6	6	6	6	6	6	6	6	5	5								48052	46423	44734	42979	41149	39234	37221	35092
65	6	6	6	6	6	6	6	6	6	6	5								48918	47260	45540	43754	41891	39942	37892	35725
66	6	6	6	6	6	6	6	6	6	6	6								49784	48096	46347	44529	42633	40649	38563	36357

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL

ROBERT F. HENRY LOCK AND DAM AND R.E. "BOB" WOODRUFF LAKE

SPILLWAY GATE OPERATION SCHEDULE

STEP NO.	GATE OPENING SCHEDULE											SPILLWAY DISCHARGE IN CFS													
	GATE NUMBER											GROSS HEAD													
	11	10	9	8	7	6	5	4	3	2	1	30.0	28.0	26.0	24.0	22.0	20.0	18.0	16.0	14.0	12.0	10.0	8.0	6.0	4.0
	OPENING IN RATCHET STEPS																								
67	7	6	6	6	6	6	6	6	6	6	6	50651	48933	47153	45303	43375	41356	39234	36990						
68	7	7	6	6	6	6	6	6	6	6	6	51517	49770	47959	46078	44116	42063	39905	37623						
69	7	7	7	6	6	6	6	6	6	6	6	52383	50607	48766	46853	44858	42770	40576	38255						
70	7	7	7	7	6	6	6	6	6	6	6	53249	51443	49572	47627	45600	43478	41247	38888						
71	7	7	7	7	7	6	6	6	6	6	6	54115	52280	50379	48402	46341	44185	41917	39520						
72	7	7	7	7	7	7	6	6	6	6	6	54981	53117	51185	49177	47083	44892	42588	40153						
73	7	7	7	7	7	7	7	6	6	6	6	55847	53954	51991	49952	47825	45599	43259	40785						
74	7	7	7	7	7	7	7	7	6	6	6	56714	54791	52798	50726	48567	46306	43930	41418						
75	7	7	7	7	7	7	7	7	7	6	6	57580	55627	53604	51501	49308	47014	44601	42050						
76	7	7	7	7	7	7	7	7	7	7	6	58446	56464	54410	52276	50050	47721	45272	42683						
77	7	7	7	7	7	7	7	7	7	7	7	59312	57301	55217	53050	50792	48428	45943	43315						
78	8	7	7	7	7	7	7	7	7	7	7	60188	58147	56032	53834	51542	49143	46622	43955						
79	8	8	7	7	7	7	7	7	7	7	7	61064	58994	56848	54618	52292	49859	47300	44595						
80	8	8	8	7	7	7	7	7	7	7	7	61940	59840	57663	55401	53043	50574	47979	45235						
81	8	8	8	8	7	7	7	7	7	7	7	62816	60686	58479	56185	53793	51289	48657	45875						
82	8	8	8	8	8	7	7	7	7	7	7	63693	61533	59295	56968	54543	52005	49336	46514						
83	8	8	8	8	8	8	7	7	7	7	7	64569	62379	60110	57752	55293	52720	50015	47154						
84	8	8	8	8	8	8	8	7	7	7	7	65445	63226	60926	58536	56044	53435	50693	47794						
85	8	8	8	8	8	8	8	8	7	7	7	66321	64072	61741	59319	56794	54151	51372	48434						
86	8	8	8	8	8	8	8	8	8	7	7	67197	64918	62557	60103	57544	54866	52051	49074						
87	8	8	8	8	8	8	8	8	8	8	7	68073	65765	63373	60886	58294	55581	52729	49714						
88	8	8	8	8	8	8	8	8	8	8	8	68949	66611	64188	61670	59045	56297	53408	50353						
89	9	8	8	8	8	8	8	8	8	8	8	69841	67473	65019	62468	59808	57025	54099	51005						
90	9	9	8	8	8	8	8	8	8	8	8	70733	68335	65849	63266	60572	57753	54790	51656						
91	9	9	9	8	8	8	8	8	8	8	8	71625	69197	66680	64064	61336	58482	55481	52308						
92	9	9	9	9	8	8	8	8	8	8	8	72517	70058	67510	64861	62100	59210	56172	52959						
93	9	9	9	9	9	8	8	8	8	8	8	73409	70920	68340	65659	62864	59938	56863	53611						
94	9	9	9	9	9	9	8	8	8	8	8	74301	71782	69171	66457	63628	60667	57554	54262						
95	9	9	9	9	9	9	9	8	8	8	8			70001	67255	64392	61395	58245	54913	51367	47556	43413			
96	9	9	9	9	9	9	9	9	8	8	8			70832	68053	65156	62123	58936	55565	51976	48121	43928			
97	9	9	9	9	9	9	9	9	9	8	8			71662	68851	65920	62852	59626	56216	52586	48685	44443			
98	9	9	9	9	9	9	9	9	9	9	8			72493	69649	66683	63580	60317	56868	53195	49249	44958			
99	9	9	9	9	9	9	9	9	9	9	9			73323	70446	67447	64309	61008	57519	53804	49813	45473			
100	10	9	9	9	9	9	9	9	9	9	9			74150	71241	68208	65034	61696	58168	54411	50375	45986			
101	10	10	9	9	9	9	9	9	9	9	9			74976	72035	68968	65759	62384	58816	55018	50936	46498			
102	10	10	10	9	9	9	9	9	9	9	9			75803	72829	69729	66484	63072	59465	55624	51498	47011			
103	10	10	10	10	9	9	9	9	9	9	9			76630	73624	70489	67209	63760	60113	56231	52060	47524			
104	10	10	10	10	10	9	9	9	9	9	9			77457	74418	71250	67934	64448	60762	56838	52621	48037			
105	10	10	10	10	10	10	9	9	9	9	9			78283	75212	72010	68659	65136	61411	57444	53183	48549			
106	10	10	10	10	10	10	10	9	9	9	9			79110	76007	72771	69384	65824	62059	58051	53745	49062			
107	10	10	10	10	10	10	10	10	9	9	9			79937	76801	73531	70109	66511	62708	58658	54306	49575			
108	10	10	10	10	10	10	10	10	10	9	9			80764	77595	74292	70834	67199	63356	59264	54868	50087			
109	10	10	10	10	10	10	10	10	10	10	9			81590	78389	75052	71559	67887	64005	59871	55430	50600			
110	10	10	10	10	10	10	10	10	10	10	10			82417	79184	75813	72284	68575	64653	60478	55991	51113			

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ROBERT F. HENRY LOCK AND DAM AND
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SPILLWAY GATE OPERATION SCHEDULE

STEP NO.	GATE OPENING SCHEDULE GATE NUMBER											SPILLWAY DISCHARGE IN CFS GROSS HEAD											
	11	10	9	8	7	6	5	4	3	2	1	26.0	24.0	22.0	20.0	18.0	16.0	14.0	12.0	10.0	8.0	6.0	4.0
	OPENING IN RATCHET STEPS																						
111	11	10	10	10	10	10	10	10	10	10	10	83255	79989	76583	73019	69272	65310	61092	56561	51632			
112	11	11	10	10	10	10	10	10	10	10	10	84093	80794	77354	73754	69969	65968	61707	57130	52152			
113	11	11	11	10	10	10	10	10	10	10	10	84931	81599	78125	74489	70666	66625	62322	57699	52672			
114	11	11	11	11	10	10	10	10	10	10	10	85768	82404	78895	75224	71364	67282	62937	58268	53191			
115	11	11	11	11	11	10	10	10	10	10	10	86606	83209	79666	75959	72061	67940	63552	58837	53711			
116	11	11	11	11	11	11	10	10	10	10	10	87444	84014	80437	76694	72758	68597	64166	59407	54231			
117	11	11	11	11	11	11	11	10	10	10	10	88282	84819	81208	77428	73455	69254	64781	59976	54750			
118	11	11	11	11	11	11	11	11	10	10	10	89120	85624	81978	78163	74152	69911	65396	60545	55270			
119	11	11	11	11	11	11	11	11	11	10	10	89958	86429	82749	78898	74849	70569	66011	61114	55789			
120	11	11	11	11	11	11	11	11	11	11	10	90795	87233	83520	79633	75546	71226	66626	61683	56309			
121	11	11	11	11	11	11	11	11	11	11	11	91633	88038	84290	80368	76244	71883	67240	62253	56829			
122	12	11	11	11	11	11	11	11	11	11	11					76964	72562	67876	62841	57365	51309	44435	36281
123	12	12	11	11	11	11	11	11	11	11	11					77684	73241	68511	63429	57902	51789	44851	36621
124	12	12	12	11	11	11	11	11	11	11	11					78404	73920	69146	64017	58439	52270	45267	36960
125	12	12	12	12	11	11	11	11	11	11	11					79125	74599	69781	64605	58976	52750	45683	37300
126	12	12	12	12	12	11	11	11	11	11	11					79845	75278	70417	65193	59513	53230	46098	37639
127	12	12	12	12	12	12	11	11	11	11	11					80565	75958	71052	65781	60050	53710	46514	37979
128	12	12	12	12	12	12	12	11	11	11	11					81285	76637	71687	66369	60587	54190	46930	38318
129	12	12	12	12	12	12	12	12	11	11	11					82006	77316	72322	66957	61123	54670	47346	38658
130	12	12	12	12	12	12	12	12	12	11	11					82726	77995	72957	67545	61660	55151	47762	38997
131	12	12	12	12	12	12	12	12	12	12	11					83446	78674	73593	68134	62197	55631	48178	39337
132	12	12	12	12	12	12	12	12	12	12	12					84167	79353	74228	68722	62734	56111	48594	39676
133	13	12	12	12	12	12	12	12	12	12	12					84888	80033	74864	69311	63272	56592	49010	40017
134	13	13	12	12	12	12	12	12	12	12	12					85610	80714	75501	69900	63810	57073	49427	40357
135	13	13	13	12	12	12	12	12	12	12	12					86332	81395	76138	70490	64348	57555	49844	40697
136	13	13	13	13	12	12	12	12	12	12	12					87054	82075	76774	71079	64886	58036	50261	41038
137	13	13	13	13	13	12	12	12	12	12	12					87776	82756	77411	71668	65424	58517	50677	41378
138	13	13	13	13	13	13	12	12	12	12	12					88497	83436	78047	72258	65962	58998	51094	41718
139	13	13	13	13	13	13	13	12	12	12	12					89219	84117	78684	72847	66500	59479	51511	42058
140	13	13	13	13	13	13	13	13	12	12	12					89941	84797	79320	73437	67038	59961	51927	42399
141	13	13	13	13	13	13	13	13	13	12	12					90663	85478	79957	74026	67576	60442	52344	42739
142	13	13	13	13	13	13	13	13	13	13	12					91385	86158	80594	74615	68114	60923	52761	43079
143	13	13	13	13	13	13	13	13	13	13	13					92106	86839	81230	75205	68652	61404	53178	43419
144	14	13	13	13	13	13	13	13	13	13	13					92850	87540	81886	75812	69206	61900	53607	43770
145	14	14	13	13	13	13	13	13	13	13	13					93593	88241	82541	76419	69760	62395	54036	44120
146	14	14	14	13	13	13	13	13	13	13	13					94337	88941	83197	77026	70314	62891	54465	44471
147	14	14	14	14	13	13	13	13	13	13	13					95080	89642	83853	77633	70868	63387	54894	44821
148	14	14	14	14	14	13	13	13	13	13	13					95823	90343	84508	78240	71423	63882	55324	45172
149	14	14	14	14	14	14	13	13	13	13	13					96567	91044	85164	78846	71977	64378	55753	45522
150	14	14	14	14	14	14	14	13	13	13	13					97310	91745	85820	79453	72531	64873	56182	45872
151	14	14	14	14	14	14	14	14	13	13	13					98054	92446	86475	80060	73085	65369	56611	46223
152	14	14	14	14	14	14	14	14	14	13	13					98797	93147	87131	80667	73639	65865	57041	46573
153	14	14	14	14	14	14	14	14	14	14	13					99540	93848	87786	81274	74193	66360	57470	46924
154	14	14	14	14	14	14	14	14	14	14	14					100284	94549	88442	81881	74747	66856	57899	47274

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ROBERT F. HENRY LOCK AND DAM AND
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SPILLWAY GATE OPERATION SCHEDULE

STEP NO.	GATE OPENING SCHEDULE											SPILLWAY DISCHARGE IN CFS									
	GATE NUMBER											GROSS HEAD									
	11	10	9	8	7	6	5	4	3	2	1	18.0	16.0	14.0	12.0	10.0	8.0	6.0	4.0	2.0	0.5
	OPENING IN RATCHET STEPS																				
155	15	14	14	14	14	14	14	14	14	14	14	101029	95251	89099	82490	75302	67353	58329	47625		
156	15	15	14	14	14	14	14	14	14	14	14	101774	95953	89756	83098	75858	67849	58759	47977		
157	15	15	15	14	14	14	14	14	14	14	14	102519	96656	90413	83706	76413	68346	59189	48328		
158	15	15	15	15	14	14	14	14	14	14	14	103264	97358	91070	84314	76968	68842	59619	48679		
159	15	15	15	15	15	14	14	14	14	14	14	104009	98060	91727	84923	77523	69339	60049	49030		
160	15	15	15	15	15	15	14	14	14	14	14	104754	98763	92384	85531	78079	69836	60479	49381		
161	15	15	15	15	15	15	15	14	14	14	14	105498	99465	93041	86139	78634	70332	60910	49732		
162	15	15	15	15	15	15	15	15	14	14	14	106243	100167	93698	86747	79189	70829	61340	50084		
163	15	15	15	15	15	15	15	15	15	14	14	106988	100870	94355	87356	79744	71326	61770	50435		
164	15	15	15	15	15	15	15	15	15	15	14	107733	101572	95012	87964	80300	71822	62200	50786		
165	15	15	15	15	15	15	15	15	15	15	15	108478	102274	95669	88572	80855	72319	62630	51137		
166	16	15	15	15	15	15	15	15	15	15	15	109232	102985	96334	89188	81417	72822	63065	51493		
167	16	16	15	15	15	15	15	15	15	15	15	109987	103696	96999	89804	81979	73324	63501	51848		
168	16	16	16	15	15	15	15	15	15	15	15	110741	104407	97664	90420	82541	73827	63936	52204		
169	16	16	16	16	15	15	15	15	15	15	15	111495	105119	98329	91035	83104	74330	64372	52559		
170	16	16	16	16	16	15	15	15	15	15	15	112249	105830	98995	91651	83666	74833	64807	52915		
171	16	16	16	16	16	16	15	15	15	15	15	113003	106541	99660	92267	84228	75336	65243	53270		
172	16	16	16	16	16	16	16	15	15	15	15	113758	107252	100325	92883	84790	75838	65678	53626		
173	16	16	16	16	16	16	16	16	15	15	15	114512	107963	100990	93499	85352	76341	66113	53981		
174	16	16	16	16	16	16	16	16	16	15	15	115266	108674	101655	94114	85914	76844	66549	54337		
175	16	16	16	16	16	16	16	16	16	16	15	116020	109385	102320	94730	86476	77347	66984	54692		
176	16	16	16	16	16	16	16	16	16	16	16	116774	110096	102985	95346	87039	77850	67420	55048		
177	17	16	16	16	16	16	16	16	16	16	16	117538	110816	103659	95969	87608	78359	67861	55408		
178	17	17	16	16	16	16	16	16	16	16	16	118301	111536	104332	96593	88177	78868	68301	55768		
179	17	17	17	16	16	16	16	16	16	16	16	119065	112255	105005	97216	88746	79377	68742	56128		
180	17	17	17	17	16	16	16	16	16	16	16	119828	112975	105679	97839	89315	79886	69183	56488		
181	17	17	17	17	17	16	16	16	16	16	16	120592	113695	106352	98463	89884	80394	69624	56847		
182	17	17	17	17	17	17	16	16	16	16	16	121355	114415	107025	99086	90453	80903	70064	57207		
183	17	17	17	17	17	17	17	16	16	16	16	122119	115135	107699	99709	91022	81412	70505	57567		
184	17	17	17	17	17	17	17	17	16	16	16	122882	115854	108372	100333	91591	81921	70946	57927		
185	17	17	17	17	17	17	17	17	17	16	16	123646	116574	109045	100956	92160	82430	71387	58287		
186	17	17	17	17	17	17	17	17	17	17	16	124409	117294	109718	101580	92729	82939	71828	58647		
187	17	17	17	17	17	17	17	17	17	17	17	125172	118014	110392	102203	93298	83448	72268	59007		
188	18	17	17	17	17	17	17	17	17	17	17					93865	83955	72707	59365	41978	20989
189	18	18	17	17	17	17	17	17	17	17	17					94432	84462	73146	59724	42231	21116
190	18	18	18	17	17	17	17	17	17	17	17					94998	84969	73585	60082	42485	21242
191	18	18	18	18	17	17	17	17	17	17	17					95565	85476	74024	60441	42738	21369
192	18	18	18	18	18	17	17	17	17	17	17					96132	85983	74463	60799	42991	21496
193	18	18	18	18	18	18	17	17	17	17	17					96699	86490	74902	61158	43245	21622
194	18	18	18	18	18	18	18	17	17	17	17					97265	86997	75341	61516	43498	21749
195	18	18	18	18	18	18	18	18	17	17	17					97832	87504	75780	61874	43752	21876
196	18	18	18	18	18	18	18	18	18	17	17					98399	88011	76219	62233	44005	22003
197	18	18	18	18	18	18	18	18	18	18	17					98965	88517	76658	62591	44259	22129
198	18	18	18	18	18	18	18	18	18	18	18					99532	89024	77097	62950	44512	22256

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SPILLWAY GATE OPERATION SCHEDULE

STEP NO.	GATE OPENING SCHEDULE GATE NUMBER											SPILLWAY DISCHARGE IN CFS GROSS HEAD					
	11	10	9	8	7	6	5	4	3	2	1	10.0	8.0	6.0	4.0	2.0	0.5
	OPENING IN RATCHET STEPS																
199	19	18	18	18	18	18	18	18	18	18	18	100068	89503	77512	63289	44752	22376
200	19	19	18	18	18	18	18	18	18	18	18	100604	89983	77927	63627	44991	22496
201	19	19	19	18	18	18	18	18	18	18	18	101139	90462	78342	63966	45231	22615
202	19	19	19	19	18	18	18	18	18	18	18	101675	90941	78757	64305	45470	22735
203	19	19	19	19	19	18	18	18	18	18	18	102211	91420	79172	64644	45710	22855
204	19	19	19	19	19	19	18	18	18	18	18	102746	91899	79587	64983	45950	22975
205	19	19	19	19	19	19	19	18	18	18	18	103282	92378	80002	65321	46189	23095
206	19	19	19	19	19	19	19	19	18	18	18	103818	92858	80417	65660	46429	23214
207	19	19	19	19	19	19	19	19	19	18	18	104354	93337	80832	65999	46668	23334
208	19	19	19	19	19	19	19	19	19	19	18	104889	93816	81247	66338	46908	23454
209	19	19	19	19	19	19	19	19	19	19	19	105425	94295	81662	66677	47147	23574
210	20	19	19	19	19	19	19	19	19	19	19	106054	94857	82149	67074	47429	23714
211	20	20	19	19	19	19	19	19	19	19	19	106683	95420	82636	67472	47710	23855
212	20	20	20	19	19	19	19	19	19	19	19	107311	95982	83123	67870	47991	23996
213	20	20	20	20	19	19	19	19	19	19	19	107940	96545	83610	68267	48272	24136
214	20	20	20	20	20	19	19	19	19	19	19	108569	97107	84097	68665	48554	24277
215	20	20	20	20	20	20	19	19	19	19	19	109198	97670	84584	69063	48835	24417
216	20	20	20	20	20	20	20	19	19	19	19	109827	98232	85071	69461	49116	24558
217	20	20	20	20	20	20	20	20	19	19	19	110456	98794	85559	69858	49397	24699
218	20	20	20	20	20	20	20	20	20	19	19	111084	99357	86046	70256	49678	24839
219	20	20	20	20	20	20	20	20	20	20	19	111713	99919	86533	70654	49960	24980
220	20	20	20	20	20	20	20	20	20	20	20	112342	100482	87020	71051	50241	25120
221	21	20	20	20	20	20	20	20	20	20	20	112931	101008	87476	71424	50504	25252
222	21	21	20	20	20	20	20	20	20	20	20	113519	101535	87932	71796	50767	25384
223	21	21	21	20	20	20	20	20	20	20	20	114108	102061	88388	72168	51031	25515
224	21	21	21	21	20	20	20	20	20	20	20	114696	102588	88843	72540	51294	25647
225	21	21	21	21	21	20	20	20	20	20	20	115285	103114	89299	72913	51557	25779
226	21	21	21	21	21	21	20	20	20	20	20	115874	103640	89755	73285	51820	25910
227	21	21	21	21	21	21	21	20	20	20	20	116462	104167	90211	73657	52083	26042
228	21	21	21	21	21	21	21	21	20	20	20	117051	104693	90667	74029	52347	26173
229	21	21	21	21	21	21	21	21	21	20	20	117639	105220	91123	74402	52610	26305
230	21	21	21	21	21	21	21	21	21	21	20	118228	105746	91579	74774	52873	26437
231	21	21	21	21	21	21	21	21	21	21	21	118817	106273	92035	75146	53136	26568
232	22	21	21	21	21	21	21	21	21	21	21	119412	106805	92496	75523	53403	26701
233	22	22	21	21	21	21	21	21	21	21	21	120007	107338	92957	75899	53669	26834
234	22	22	22	21	21	21	21	21	21	21	21	120603	107871	93419	76276	53935	26968
235	22	22	22	22	21	21	21	21	21	21	21	121198	108403	93880	76653	54202	27101
236	22	22	22	22	22	21	21	21	21	21	21	121794	108936	94341	77029	54468	27234
237	22	22	22	22	22	22	21	21	21	21	21	122389	109468	94802	77406	54734	27367
238	22	22	22	22	22	22	22	21	21	21	21	122985	110001	95264	77782	55001	27500
239	22	22	22	22	22	22	22	22	21	21	21	123580	110534	95725	78159	55267	27633
240	22	22	22	22	22	22	22	22	22	21	21	124176	111066	96186	78536	55533	27767
241	22	22	22	22	22	22	22	22	22	22	21	124771	111599	96647	78912	55799	27900
242	22	22	22	22	22	22	22	22	22	22	22	125367	112132	97109	79289	56066	28033

STEP NO.	GATE OPENING SCHEDULE GATE NUMBER											SPILLWAY DISCHARGE IN CFS GROSS HEAD					
	11	10	9	8	7	6	5	4	3	2	1	10.0	8.0	6.0	4.0	2.0	0.5
	OPENING IN RATCHET STEPS																
243	23	22	22	22	22	22	22	22	22	22	22	125970	112671	97576	79671	56336	28168
244	23	23	22	22	22	22	22	22	22	22	22	126574	113211	98044	80052	56606	28303
245	23	23	23	22	22	22	22	22	22	22	22	127177	113751	98511	80434	56875	28438
246	23	23	23	23	22	22	22	22	22	22	22	127781	114291	98979	80816	57145	28573
247	23	23	23	23	23	22	22	22	22	22	22	128385	114831	99446	81197	57415	28708
248	23	23	23	23	23	23	22	22	22	22	22	128988	115370	99914	81579	57685	28843
249	23	23	23	23	23	23	23	22	22	22	22	129592	115910	100381	81961	57955	28978
250	23	23	23	23	23	23	23	23	22	22	22	130195	116450	100849	82343	58225	29113
251	23	23	23	23	23	23	23	23	23	22	22	130799	116990	101316	82724	58495	29247
252	23	23	23	23	23	23	23	23	23	23	22	131402	117530	101784	83106	58765	29382
253	23	23	23	23	23	23	23	23	23	23	23	132006	118069	102251	83488	59035	29517
254	24	23	23	23	23	23	23	23	23	23	23	132617	118617	102725	83875	59308	29654
255	24	24	23	23	23	23	23	23	23	23	23	133229	119164	103199	84261	59582	29791
256	24	24	24	23	23	23	23	23	23	23	23	133840	119711	103672	84648	59855	29928
257	24	24	24	24	23	23	23	23	23	23	23	134452	120258	104146	85035	60129	30064
258	24	24	24	24	24	23	23	23	23	23	23	135064	120805	104620	85422	60402	30201
259	24	24	24	24	24	24	23	23	23	23	23	135675	121352	105094	85809	60676	30338
260	24	24	24	24	24	24	24	23	23	23	23	136287	121899	105567	86195	60949	30475
261	24	24	24	24	24	24	24	24	23	23	23	136898	122446	106041	86582	61223	30611
262	24	24	24	24	24	24	24	24	24	23	23	137510	122993	106515	86969	61496	30748
263	24	24	24	24	24	24	24	24	24	24	23	138122	123540	106988	87356	61770	30885
264	24	24	24	24	24	24	24	24	24	24	24	138733	124087	107462	87743	62043	31022
265	25	24	24	24	24	24	24	24	24	24	24	139358	124646	107947	88138	62323	31161
266	25	25	24	24	24	24	24	24	24	24	24	139984	125205	108431	88534	62603	31301
267	25	25	25	24	24	24	24	24	24	24	24	140609	125765	108915	88929	62882	31441
268	25	25	25	25	24	24	24	24	24	24	24	141235	126324	109400	89325	63162	31581
269	25	25	25	25	25	24	24	24	24	24	24	141860	126883	109884	89720	63442	31721
270	25	25	25	25	25	25	24	24	24	24	24	142485	127443	110369	90116	63721	31861
271	25	25	25	25	25	25	25	24	24	24	24	143111	128002	110853	90511	64001	32001
272	25	25	25	25	25	25	25	25	24	24	24	143736	128561	111337	90907	64281	32140
273	25	25	25	25	25	25	25	25	25	24	24	144361	129121	111822	91302	64560	32280
274	25	25	25	25	25	25	25	25	25	25	24	144987	129680	112306	91698	64840	32420
275	25	25	25	25	25	25	25	25	25	25	25	145612	130240	112791	92093	65120	32560
276	26	25	25	25	25	25	25	25	25	25	25	146240	130801	113277	92490	65400	32700
277	26	26	25	25	25	25	25	25	25	25	25	146868	131362	113763	92887	65681	32841
278	26	26	26	25	25	25	25	25	25	25	25	147495	131924	114249	93284	65962	32981
279	26	26	26	26	25	25	25	25	25	25	25	148123	132485	114736	93681	66243	33121
280	26	26	26	26	26	25	25	25	25	25	25	148751	133047	115222	94078	66523	33262
281	26	26	26	26	26	26	25	25	25	25	25	149378	133608	115708	94475	66804	33402
282	26	26	26	26	26	26	26	25	25	25	25	150006	134169	116194	94872	67085	33542
283	26	26	26	26	26	26	26	26	25	25	25	150634	134731	116680	95269	67365	33683
284	26	26	26	26	26	26	26	26	26	25	25	151261	135292	117166	95666	67646	33823
285	26	26	26	26	26	26	26	26	26	26	25	151889	135854	117653	96063	67927	33963
286	26	26	26	26	26	26	26	26	26	26	26	152517	136415	118139	96460	68208	34104

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
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SPILLWAY GATE OPERATION SCHEDULE

STEP NO.	GATE OPENING SCHEDULE GATE NUMBER											SPILLWAY DISCHARGE IN CFS GROSS HEAD					
	11	10	9	8	7	6	5	4	3	2	1	10.0	8.0	6.0	4.0	2.0	0.5
	OPENING IN RATCHET STEPS																
287	27	26	26	26	26	26	26	26	26	26	26	153155	136986	118633	96863	68493	34246
288	27	27	26	26	26	26	26	26	26	26	26	153793	137556	119127	97267	68778	34389
289	27	27	27	26	26	26	26	26	26	26	26	154431	138127	119621	97671	69063	34532
290	27	27	27	27	26	26	26	26	26	26	26	155069	138698	120116	98074	69349	34674
291	27	27	27	27	27	26	26	26	26	26	26	155707	139268	120610	98478	69634	34817
292	27	27	27	27	27	27	26	26	26	26	26	156345	139839	121104	98881	69919	34960
293	27	27	27	27	27	27	27	26	26	26	26	156983	140410	121598	99285	70205	35102
294	27	27	27	27	27	27	27	27	26	26	26	157621	140980	122093	99688	70490	35245
295	27	27	27	27	27	27	27	27	27	26	26	158259	141551	122587	100092	70775	35388
296	27	27	27	27	27	27	27	27	27	27	26	158897	142122	123081	100495	71061	35530
297	27	27	27	27	27	27	27	27	27	27	27	159535	142692	123575	100899	71346	35673
298	28	27	27	27	27	27	27	27	27	27	27	160179	143268	124074	101306	71634	35817
299	28	28	27	27	27	27	27	27	27	27	27	160822	143844	124572	101713	71922	35961
300	28	28	28	27	27	27	27	27	27	27	27	161466	144420	125071	102120	72210	36105
301	28	28	28	28	27	27	27	27	27	27	27	162110	144995	125570	102527	72498	36249
302	28	28	28	28	28	27	27	27	27	27	27	162754	145571	126068	102934	72786	36393
303	28	28	28	28	28	28	27	27	27	27	27	163397	146147	126567	103342	73074	36537
304	28	28	28	28	28	28	28	27	27	27	27	164041	146723	127066	103749	73361	36681
305	28	28	28	28	28	28	28	28	27	27	27	164685	147299	127564	104156	73649	36825
306	28	28	28	28	28	28	28	28	28	27	27	165329	147875	128063	104563	73937	36969
307	28	28	28	28	28	28	28	28	28	28	27	165973	148450	128562	104970	74225	37113
308	28	28	28	28	28	28	28	28	28	28	28	166616	149026	129060	105377	74513	37257
309	29	28	28	28	28	28	28	28	28	28	28	167260	149602	129559	105785	74801	37400
310	29	29	28	28	28	28	28	28	28	28	28	167904	150178	130058	106192	75089	37544
311	29	29	29	28	28	28	28	28	28	28	28	168548	150754	130556	106599	75377	37688
312	29	29	29	29	28	28	28	28	28	28	28	169191	151329	131055	107006	75665	37832
313	29	29	29	29	29	28	28	28	28	28	28	169835	151905	131554	107413	75953	37976
314	29	29	29	29	29	29	28	28	28	28	28	170479	152481	132052	107820	76240	38120
315	29	29	29	29	29	29	29	28	28	28	28	171123	153057	132551	108227	76528	38264
316	29	29	29	29	29	29	29	29	28	28	28	171766	153633	133050	108635	76816	38408
317	29	29	29	29	29	29	29	29	29	28	28	172410	154208	133548	109042	77104	38552
318	29	29	29	29	29	29	29	29	29	29	28	173054	154784	134047	109449	77392	38696
319	29	29	29	29	29	29	29	29	29	29	29	173698	155360	134546	109856	77680	38840
320	30	29	29	29	29	29	29	29	29	29	29	174350	155943	135051	110268	77971	38986
321	30	30	29	29	29	29	29	29	29	29	29	175001	156526	135555	110681	78263	39131
322	30	30	30	29	29	29	29	29	29	29	29	175653	157109	136060	111093	78554	39277
323	30	30	30	30	29	29	29	29	29	29	29	176305	157692	136565	111505	78846	39423
324	30	30	30	30	30	29	29	29	29	29	29	176957	158275	137070	111917	79137	39569
325	30	30	30	30	30	30	29	29	29	29	29	177609	158858	137575	112330	79429	39714
326	30	30	30	30	30	30	30	29	29	29	29	178260	159441	138080	112742	79720	39860
327	30	30	30	30	30	30	30	30	29	29	29	178912	160024	138585	113154	80012	40006
328	30	30	30	30	30	30	30	30	30	29	29	179564	160607	139090	113566	80303	40152
329	30	30	30	30	30	30	30	30	30	30	29	180216	161190	139595	113979	80595	40297
330	30	30	30	30	30	30	30	30	30	30	30	180868	161773	140099	114391	80886	40443
331	31	30	30	30	30	30	30	30	30	30	30	181519	162356	140604	114803	81178	40589
332	31	31	30	30	30	30	30	30	30	30	30	182171	162939	141109	115215	81469	40735
333	31	31	31	30	30	30	30	30	30	30	30	182823	163522	141614	115627	81761	40880
334	31	31	31	31	30	30	30	30	30	30	30	183475	164105	142119	116040	82052	41026
335	31	31	31	31	31	30	30	30	30	30	30	184127	164688	142624	116452	82344	41172
336	31	31	31	31	31	31	30	30	30	30	30	184779	165271	143129	116864	82635	41318
337	31	31	31	31	31	31	31	30	30	30	30	185430	165854	143634	117276	82927	41463
338	31	31	31	31	31	31	31	31	30	30	30	186082	166437	144139	117689	83218	41609
339	31	31	31	31	31	31	31	31	31	30	30	186734	167020	144644	118101	83510	41755
340	31	31	31	31	31	31	31	31	31	31	30	187386	167603	145148	118513	83801	41901
341	31	31	31	31	31	31	31	31	31	31	31	188038	168186	145653	118925	84093	42046
342	32	31	31	31	31	31	31	31	31	31	31	188696	168775	146164	119342	84388	42194
343	32	32	31	31	31	31	31	31	31	31	31	189355	169364	146674	119759	84682	42341
344	32	32	32	31	31	31	31	31	31	31	31	190014	169953	147184	120175	84977	42488
345	32	32	32	32	31	31	31	31	31	31	31	190672	170543	147694	120592	85271	42636
346	32	32	32	32	32	31	31	31	31	31	31	191331	171132	148205	121008	85566	42783
347	32	32	32	32	32	32	31	31	31	31	31	191990	171721	148715	121425	85860	42930
348	32	32	32	32	32	32	32	31	31	31	31	192649	172310	149225	121842	86155	43078
349	32	32	32	32	32	32	32	32	31	31	31	193307	172899	149735	122258	86450	43225
350	32	32	32	32	32	32	32	32	32	31	31	193966	173489	150245	122675	86744	43372
351	32	32	32	32	32	32	32	32	32	32	31	194625	174078	150756	123092	87039	43519
352	32	32	32	32	32	32	32	32	32	32	32	195283	174667	151266	123508	87333	43667
353	33	32	32	32	32	32	32	32	32	32	32	195949	175262	151782	123929	87631	43816
354	33	33	32	32	32	32	32	32	32	32	32	196615	175858	152297	124350	87929	43964
355	33	33	33	32	32	32	32	32	32	32	32	197280	176453	152813	124771	88226	44113
356	33	33	33	33	32	32	32	32	32	32	32	197946	177048	153328	125192	88524	44262
357	33	33	33	33	33	32	32	32	32	32	32	198612	177644	153844	125613	88822	44411
358	33	33	33	33	33	33	32	32	32	32	32	199277	178239	154359	126034	89119	44560
359	33	33	33	33	33	33	33	32	32	32	32	199943	178834	154875	126455	89417	44709
360	33	33	33	33	33	33	33	33	32	32	32	200608	179430	155391	126876	89715	44857
361	33	33	33	33	33	33	33	33	33	32	32	201274	180025	155906	127297	90012	45006
362	33	33	33	33	33	33	33	33	33	33	32	201940	180620	156422	127718	90310	45155
363	33	33	33	33	33	33	33	33	33	33	33	202605	181216	156937	128139	90608	45304
364	34	33	33	33	33	33	33	33	33	33	33	203257	181799	157442	128551	90899	45450
365	34	34	33	33	33	33	33	33	33	33	33	203909	182382	157947	128963	91191	45595
366	34	34	34	33	33	33	33	33	33	33	33	204561	182965	158452	129375	91482	45741
367	34	34	34	34	33	33	33	33	33	33	33	205212	183548	158957	129788	91774	45887
368	34	34	34	34	34	33	33	33	33	33	33	205864	184131	159462	130200	92065	46033
369	34	34	34	34	34	34	33	33	33	33	33	206516	184714	159967	130612	92357	46178
370	34	34	34	34	34	34	34	33	33	33	33	207168	185297	160472	131024	92648	46324
371	34	34	34	34	34	34	34	34	33	33	33	207820	185880	160976	131437	92940	46470
372	34	34	34	34	34	34	34	34	34	33	33	208472	186463	161481	131849	93231	46616
373	34	34	34	34	34	34	34	34	34	34	33	209123	187046	161986	132261	93523	46761
374	34	34	34	34	34	34	34	34	34	34	34	209775	187629	162491	132673	93814	46907

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SPILLWAY GATE OPERATION SCHEDULE

STEP NO.	GATE OPENING SCHEDULE GATE NUMBER											SPILLWAY DISCHARGE IN CFS GROSS HEAD					
	11	10	9	8	7	6	5	4	3	2	1	10.0	8.0	6.0	4.0	2.0	0.5
	OPENING IN RATCHET STEPS																
375	35	34	34	34	34	34	34	34	34	34	34	210453	188235	163017	133102	94118	47059
376	35	35	34	34	34	34	34	34	34	34	34	211132	188842	163542	133531	94421	47210
377	35	35	35	34	34	34	34	34	34	34	34	211810	189449	164067	133960	94724	47362
378	35	35	35	35	34	34	34	34	34	34	34	212488	190055	164593	134389	95028	47514
379	35	35	35	35	35	34	34	34	34	34	34	213166	190662	165118	134818	95331	47665
380	35	35	35	35	35	35	34	34	34	34	34	213845	191268	165643	135247	95634	47817
381	35	35	35	35	35	35	35	34	34	34	34	214523	191875	166169	135676	95938	47969
382	35	35	35	35	35	35	35	35	34	34	34	215201	192482	166694	136105	96241	48120
383	35	35	35	35	35	35	35	35	35	34	34	215879	193088	167219	136534	96544	48272
384	35	35	35	35	35	35	35	35	35	35	34	216558	193695	167745	136963	96848	48424
385	35	35	35	35	35	35	35	35	35	35	35	217236	194302	168270	137392	97151	48575
386	36	35	35	35	35	35	35	35	35	35	35	217918	194911	168798	137823	97456	48728
387	36	36	35	35	35	35	35	35	35	35	35	218599	195521	169326	138254	97761	48880
388	36	36	36	35	35	35	35	35	35	35	35	219281	196131	169854	138686	98065	49033
389	36	36	36	36	35	35	35	35	35	35	35	219963	196741	170382	139117	98370	49185
390	36	36	36	36	36	35	35	35	35	35	35	220644	197350	170910	139548	98675	49338
391	36	36	36	36	36	36	35	35	35	35	35	221326	197960	171439	139979	98980	49490
392	36	36	36	36	36	36	36	35	35	35	35	222008	198570	171967	140410	99285	49642
393	36	36	36	36	36	36	36	36	35	35	35	222690	199180	172495	140841	99590	49795
394	36	36	36	36	36	36	36	36	36	35	35	223371	199789	173023	141272	99895	49947
395	36	36	36	36	36	36	36	36	36	36	35	224053	200399	173551	141704	100200	50100
396	36	36	36	36	36	36	36	36	36	36	36	224735	201009	174079	142135	100504	50252
397	37	36	36	36	36	36	36	36	36	36	36	225419	201621	174609	142567	100810	50405
398	37	37	36	36	36	36	36	36	36	36	36	226103	202232	175138	143000	101116	50558
399	37	37	37	36	36	36	36	36	36	36	36	226787	202844	175668	143433	101422	50711
400	37	37	37	37	36	36	36	36	36	36	36	227471	203456	176198	143865	101728	50864
401	37	37	37	37	37	36	36	36	36	36	36	228155	204068	176728	144298	102034	51017
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403	37	37	37	37	37	37	37	36	36	36	36	229523	205291	177788	145163	102646	51323
404	37	37	37	37	37	37	37	37	36	36	36	230207	205903	178317	145596	102952	51476
405	37	37	37	37	37	37	37	37	37	36	36	230891	206515	178847	146028	103257	51629
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407	37	37	37	37	37	37	37	37	37	37	37	232259	207739	179907	146893	103869	51935
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409	38	38	37	37	37	37	37	37	37	37	37	233657	208989	180990	147777	104494	52247
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417	38	38	38	38	38	38	38	38	38	38	37	239248	213990	185321	151314	106995	53498
418	38	38	38	38	38	38	38	38	38	38	38	239947	214615	185862	151756	107308	53654

STEP NO.	GATE OPENING SCHEDULE GATE NUMBER											SPILLWAY DISCHARGE IN CFS GROSS HEAD					
	11	10	9	8	7	6	5	4	3	2	1	10.0	8.0	6.0	4.0	2.0	0.5
	OPENING IN RATCHET STEPS																
419	39	38	38	38	38	38	38	38	38	38	38	240653	215247	186409	152202	107623	53812
420	39	39	38	38	38	38	38	38	38	38	38	241359	215878	186956	152649	107939	53969
421	39	39	39	38	38	38	38	38	38	38	38	242065	216509	187503	153095	108255	54127
422	39	39	39	39	38	38	38	38	38	38	38	242771	217141	188049	153542	108570	54285
423	39	39	39	39	39	38	38	38	38	38	38	243476	217772	188596	153988	108886	54443
424	39	39	39	39	39	39	38	38	38	38	38	244182	218403	189143	154434	109202	54601
425	39	39	39	39	39	39	39	38	38	38	38	244888	219035	189689	154881	109517	54759
426	39	39	39	39	39	39	39	39	38	38	38	245594	219666	190236	155327	109833	54916
427	39	39	39	39	39	39	39	39	39	38	38	246300	220297	190783	155774	110149	55074
428	39	39	39	39	39	39	39	39	39	39	38	247006	220929	191330	156220	110464	55232
429	39	39	39	39	39	39	39	39	39	39	39	247711	221560	191876	156666	110780	55390
430	40	39	39	39	39	39	39	39	39	39	39	248417	222191	192423	157113	111096	55548
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441	41	40	40	40	40	40	40	40	40	40	40	256182	229136	198437	162023	114568	57284
442	41	41	40	40	40	40	40	40	40	40	40	256887	229767	198984	162470	114884	57442
443	41	41	41	40	40	40	40	40	40	40	40	257593	230398	199531	162916	115199	57600
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457	42	42	42	42	42	42	41	41	41	41	41	267606	239354	207287	169249	119677	59839
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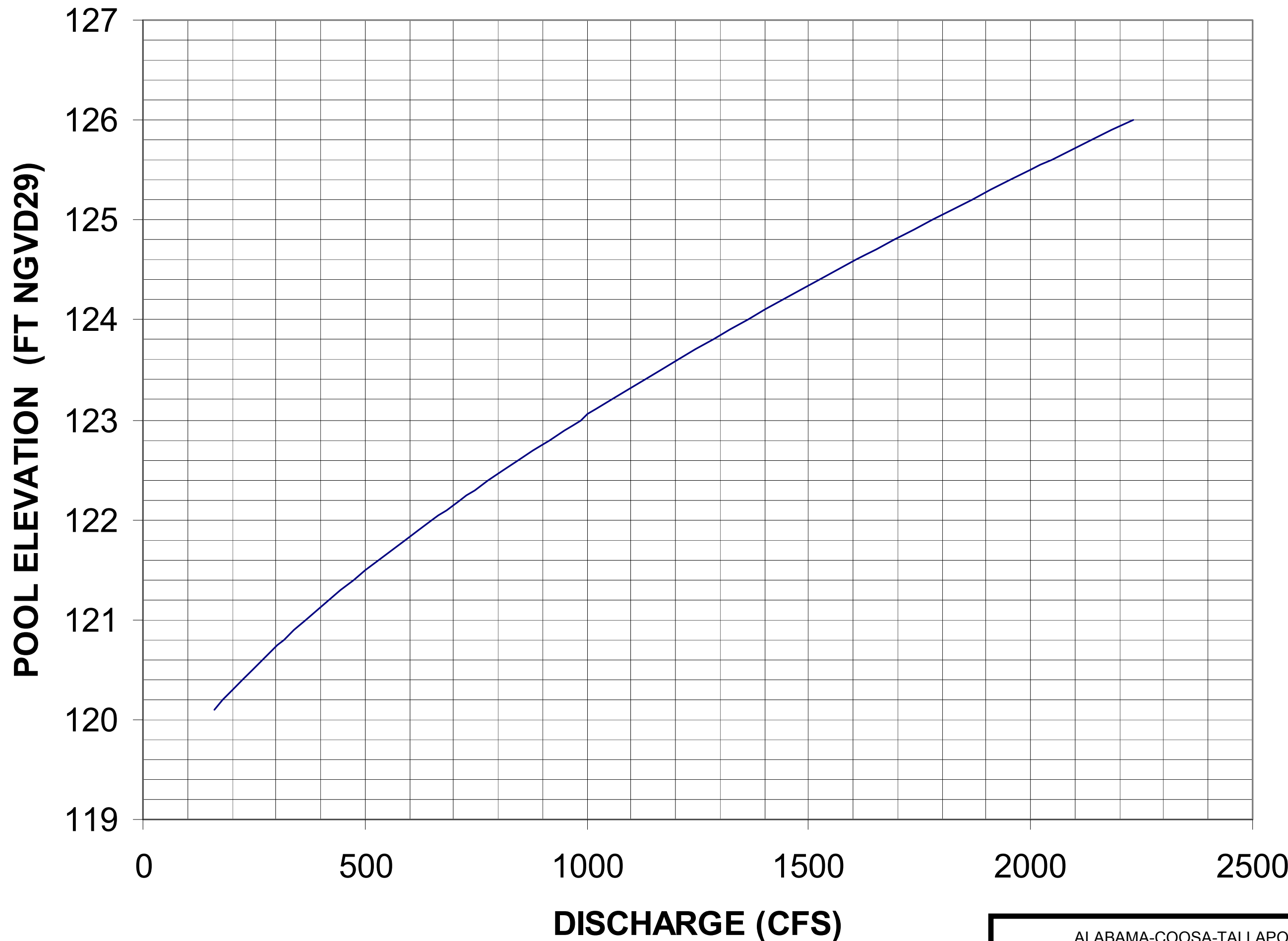
461	42	42	42	42	42	42	42	42	42	42	41	270517	241958	209542	171090	120979	60489
462	42	42	42	42	42	42	42	42	42	42	42	271245	242609	210105	171550	121304	60652

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL

ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

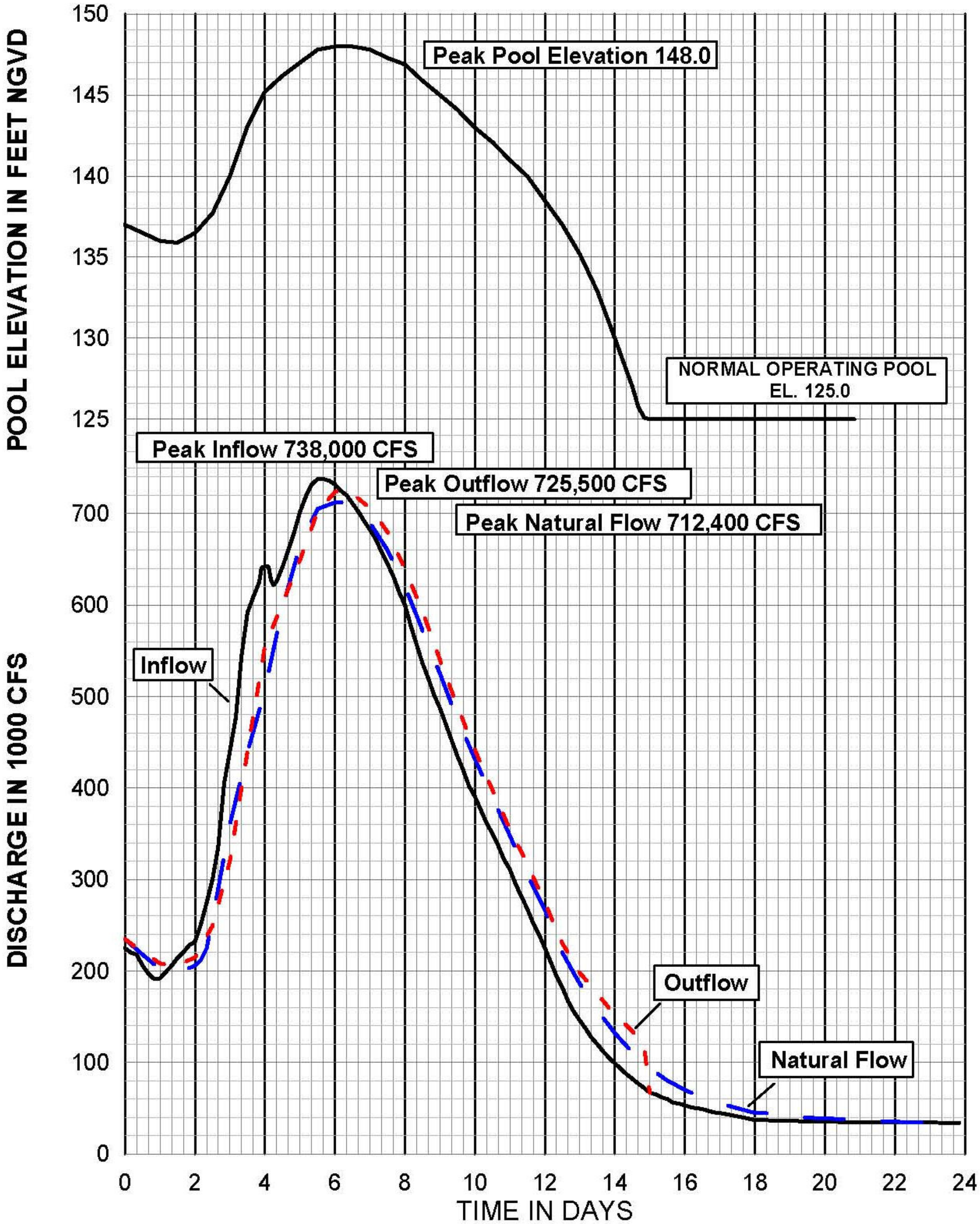
SPILLWAY GATE OPERATION SCHEDULE



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

TRASH GATE FLOW RATING CURVE

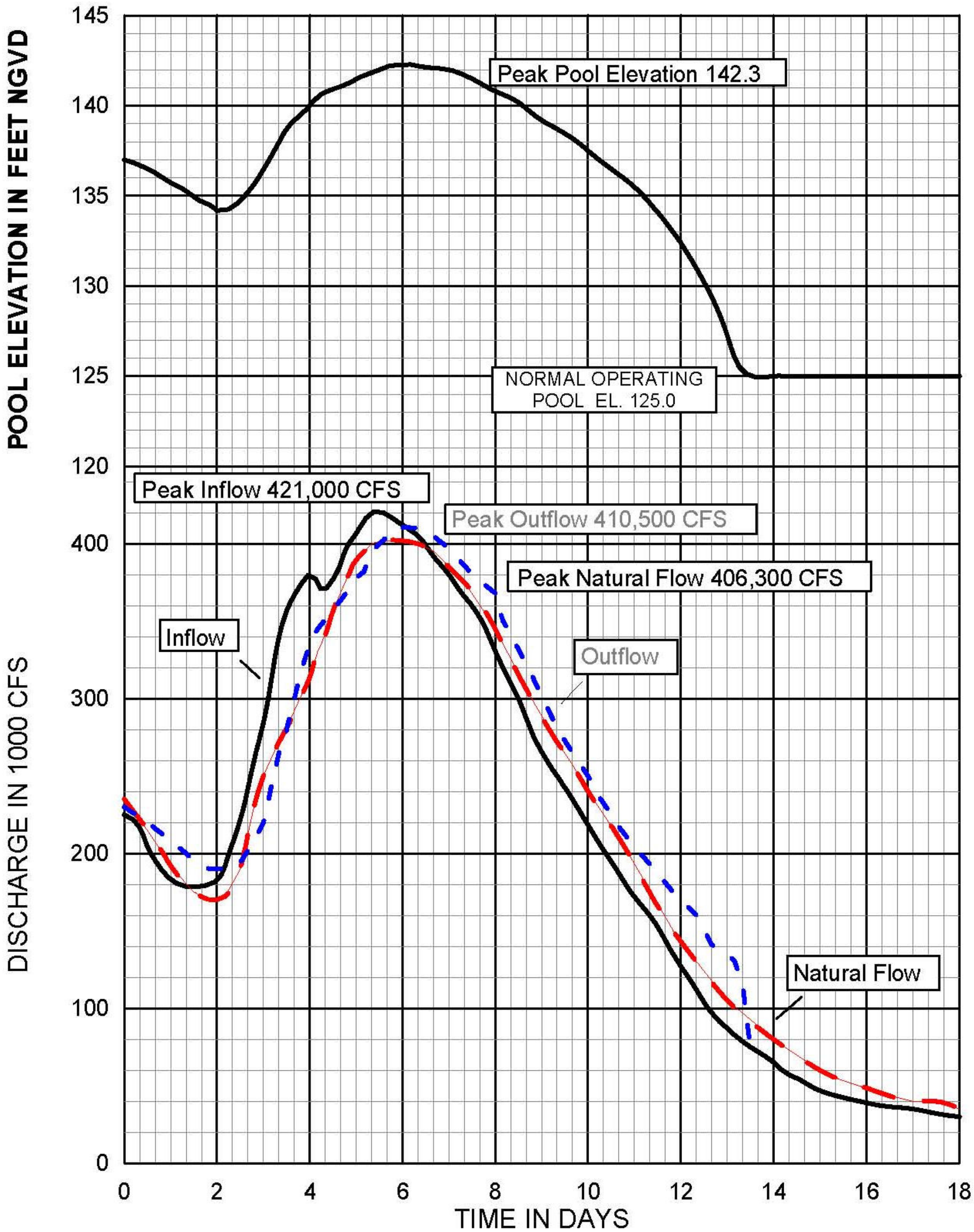


NOTES:
Spillway design flood series- Flood of March 1929 followed by spillway design flood. Hydrographs prior to beginning of spillway design flood not shown.
Spillway- 11-50' x 35' Tainter Gates with crest at El. 91.0.
Existing and proposed APC dams assumed in operation.

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS FOR SPILLWAY DESIGN FLOOD

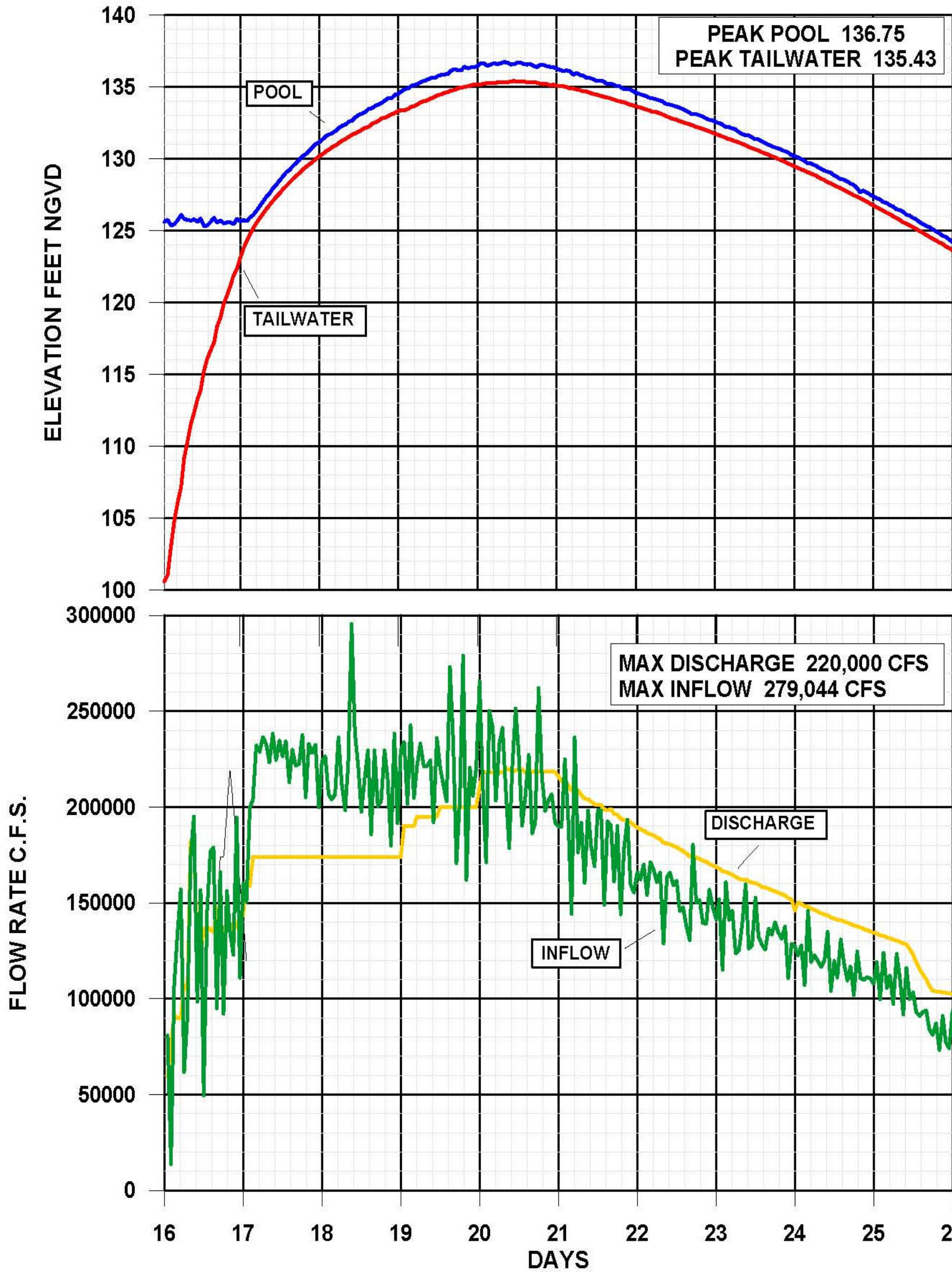


NOTES:
Standard project flood series- Flood of March 1929 followed by standard project flood. Hydrographs prior to beginning of standard project flood not shown.
Existing and proposed APC dams assumed in operation.

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS FOR STANDARD PROJECT FLOOD



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

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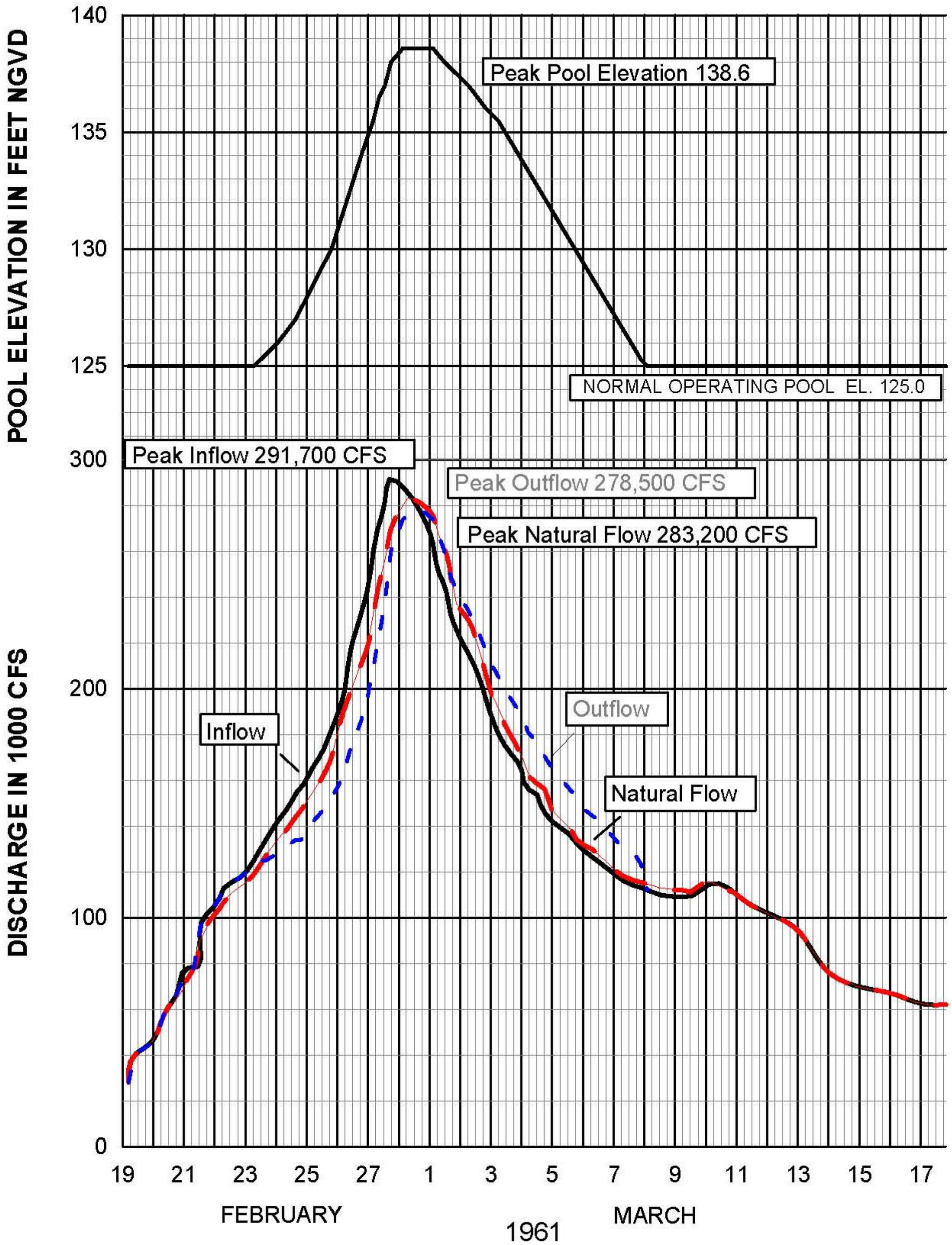
ROBERT F. HENRY LOCK AND DAM AND
R.E. “BOB” WOODRUFF LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS FOR FLOOD OF MARCH 1990



NOTES: Effect of proposed APC dams not considered.

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
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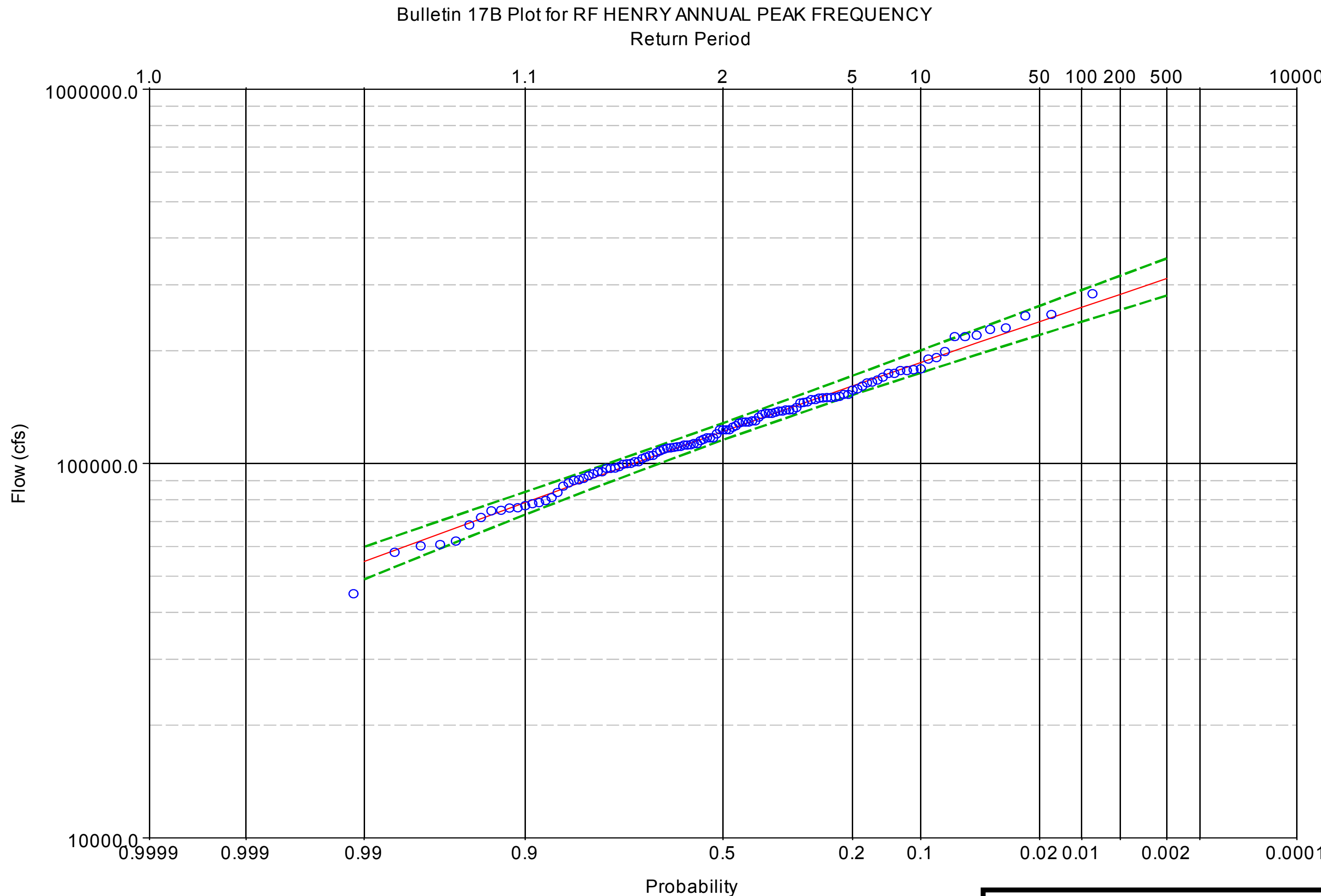
R.E. "BOB" WOODRUFF LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS FOR FLOOD OF FEBRUARY - MARCH 1961

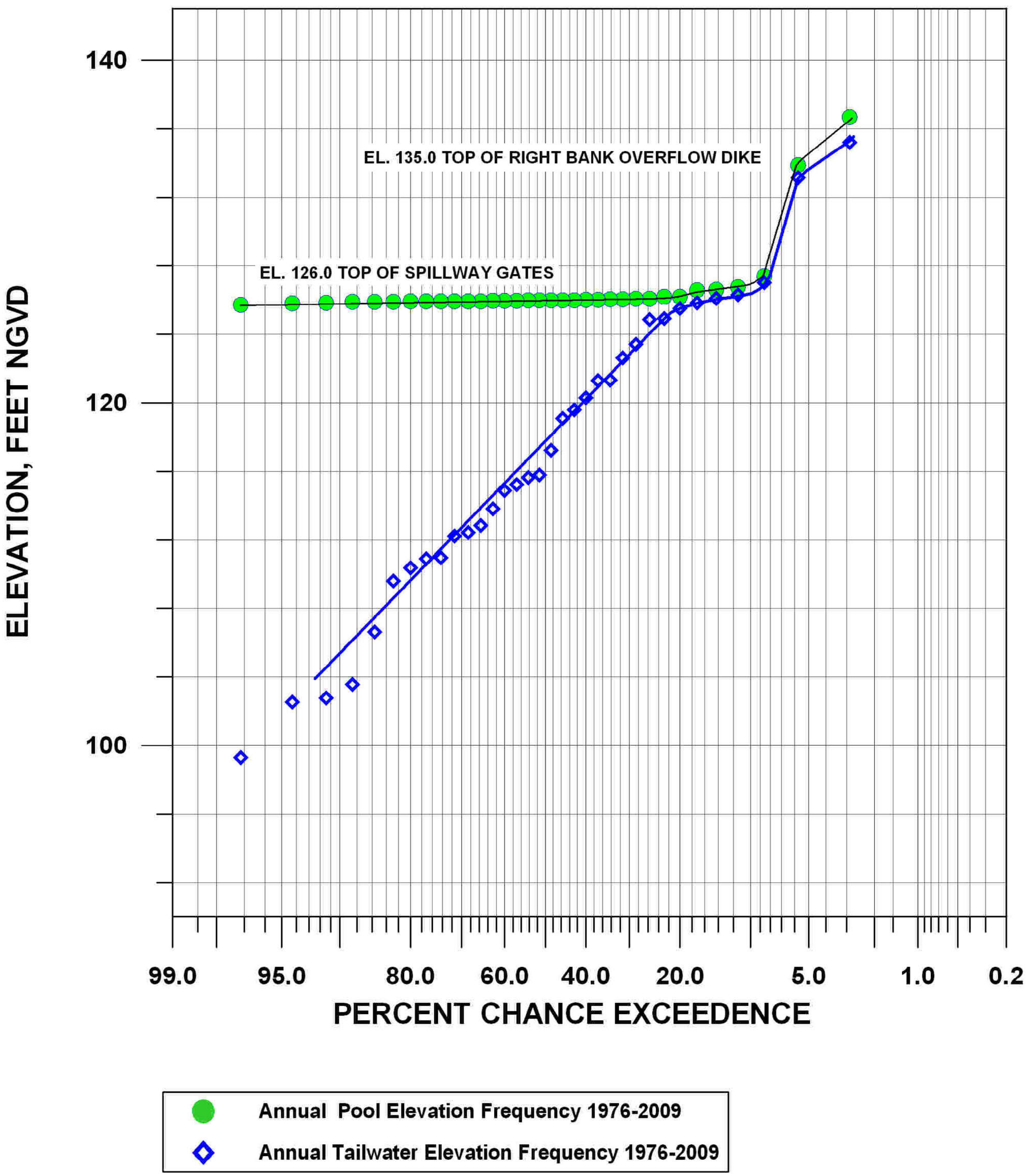


1886 – 1984 DATA FROM USGS GAGE 02423000
1984 – 2009 DATA FROM MOBILE DISTRICT WATER MANAGEMENT

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. “BOB” WOODRUFF LAKE

ANNUAL PEAK FLOW FREQUENCY
1886-2009



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
ROBERT F. HENRY LOCK AND DAM AND
R.E. "BOB" WOODRUFF LAKE

HEADWATER-TAIILWATER ANNUAL STAGE FREQUENCY CURVES