



Summary of Stream Flow Conditions at Five Riverine Parks in the Southeast Coast Network, 2014

Natural Resource Data Series NPS/SECN/NRDS—2015/979



ON THE COVER

Chute channel flowing on the Congaree River floodplain due to high water in the Congaree River. December 2013. Photo by M.B. Gregory.

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October 2015

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Starkey, E. N. 2015. Summary of stream flow conditions at five riverine parks in the Southeast Coast Network, 2014. Natural Resource Data Series NPS/SECN/NRDS—2015/979. National Park Service, Fort Collins, Colorado.

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Summary and Key Findings

- The National Park Service Southeast Coast Network evaluated stream flow variability and the magnitude and timing of specific flow events at five network parks in 2014. The streams and rivers of these parks range from small creeks to small- and medium-sized rivers that make up significant park acreage along the Chattahoochee, Congaree, Ocmulgee, and Tallapoosa Rivers.
- Flow patterns were characterized and put in historical context using U.S. Geological Survey stream flow data, The Nature Conservancy's Indicators of Hydrologic Alteration (IHA) software, and Flow software (Dowd 2011), which generates graphical representations of annual stream flow data.
- Across all parks, high-flow pulses were more frequent at seven gages, and extreme low-flow pulses were more frequent at three gages. Extreme low-flow pulses ranged from an average of 1 to 5.5 days in length, and high-flow pulses ranged 2–4 days. Extreme low-flow pulses tended to occur July–October at all parks. High-flow pulses occurred mid-February to early April. Small floods (defined as flood events with an initial high flow and a peak flow greater than a two-year return interval event) occurred at Chattahoochee River National Recreation Area, Horseshoe Bend National Military Park, and Kennesaw Mountain National Battlefield Park in 2014. Small flood events, 6 to 20 days in duration, occurred at Chattahoochee River National Recreation Area in January and February and at Horseshoe Bend and Kennesaw Mountain in April.
- At Chattahoochee River National Recreation Area, the most commonly observed flow conditions on all river sections in 2014 were greater than 2,000 cubic feet per second (cfs). These flows are considered optimal for powerboat fishing, mid-level rafting, and canoeing.
- A two-dimensional flow model (Kupfer and Meitzen 2012) predicted that between 60 and 80% of Congaree National Park was inundated for approximately 9 days in 2014, based on flows in the Congaree River at Columbia, South Carolina. Forty to sixty percent of the park was predicted to have been inundated for approximately 42 days. Low-lying eastern areas of the park may have been inundated for up to 127 days in 2014.
- Very few low-flow pulses occurred on the Tallapoosa River in 2014. Two were recorded at the Wadley gage and 12 were recorded downstream of Horseshoe Bend National Military Park at the New Site gage. High-flow pulses were recorded 19 times at the Wadley gage and 17 times at the New Site gage. A single small flood was observed on the Tallapoosa River in April.
- The number of low-flow pulses on the Ocmulgee River—20 low-flow pulses—was above the normal range for the period of record at Macon. The normal range for low-flow pulses is between 8 and 17 occurrences.
- At Kennesaw Mountain in 2014, low-flow pulses occurred 4 times, with an average duration of 5.5 days. High-flow pulses occurred 26 times, with an average duration of 2.5 days. No small flood events were recorded.

Introduction

Evaluation of the flow characteristics of a river or stream offers some of the most appropriate and useful indicators for assessing the integrity of the aquatic ecosystem and for monitoring environmental changes over time. Such evaluation also provides key supporting data for other vital signs including water quality, threatened and endangered aquatic species, wetlands, and riparian habitats. The flow regime of a stream can be considered a primary governing factor that is largely responsible for determining the type and magnitude of various physical and ecological processes that occur in a stream system (Puckridge et al. 1998). Although other environmental factors and characteristics of a stream influence the overall condition of a stream and its biological communities, the flow of a stream is considered the master variable (Power et al. 1995). Stream flow has been shown to provide important conceptual and empirical links between watershed conditions, in-stream habitats, and the biotic integrity of stream biological communities. Due to great uncertainty associated with many projections for water availability changes due to climate change (Brekke et al. 2009, Miller and Yates 2006), more data are likely needed before the direction and magnitude of the influence can be inferred. This uncertainty led to a federal recommendation to increase the tracking of water resources so that changes can be monitored more closely and water availability can be anticipated (Brekke et al. 2009).

Purpose and Scope

To evaluate the significance of changes in flow regimes due to both naturally occurring and regulated conditions, the National Park Service (NPS) Southeast Coast Network (SECN) harvests relevant stream flow data sets collected from selected sites and disseminates this data to network parks in the context of historical flow characteristics and/or park-specific flow thresholds. This report summarizes flow conditions from the previous calendar year in the context of recent historical flows (Table 1) and provides information on overall flow variability as well as the seasonality and timing of ecologically relevant flow events in rivers near or adjacent to SECN parks. Data from the Chattahoochee River in Atlanta, Georgia are put in the context of river flow thresholds that have management or visitor-use implications (Nestler 1986), whereas data collected from the Congaree River in Columbia, South Carolina are presented in the context of a recently published flood inundation model (Kupfer 2012) that estimated the amount of inundation that occurred in the park in the previous year.

The National Park Service makes use of publically available data sets from stations monitored by the U.S. Geological Survey (USGS) Water Science Centers in Alabama, Georgia, and South Carolina as part of various ongoing national, state, and locally funded projects. Links to stream flow data sets, as well as additional ancillary water-quality data sets collected during the previous water year (October to September) for stations included in this analysis, are provided in appendices. This effort is part of the SECN Surface Water Quantity monitoring effort described by DeVivo et al. (2008).

Parks Included in this Summary

SECN parks include diverse stream sizes and types, many (if not all) of which have been altered by human activities, including impoundments, channelization, lowering of water tables, increased runoff due to urbanization, pollution, sedimentation, recreation, and introduced species (including mussels, fishes, and aquatic plants). Stream flow greatly influences stream biota (Hackney and Adams 1992), and nearly all major stream systems in the southeastern United States have been channelized or dammed (Adams and Hackney 1992). Many major reservoirs have been constructed in the southeastern United States, and all large rivers flowing in or adjacent to SECN parks have managed flows. Five parks in the network were selected for evaluation—those characterized by significant non-tidal, flowing water resources in or adjacent to park boundaries (Figure 1). In some cases, stations outside and upstream of these parks were included in the evaluation if it was thought that data from those stations would help characterize flow conditions in the park. The USGS gage on Cedar Creek in Congaree National Park was not included in this analysis because only stage data have been recorded at this site. The lotic resources of the five parks range from small streams to small- and medium-sized rivers, including significant park acreage along the Chattahoochee, Congaree, Ocmulgee, and Tallapoosa Rivers.

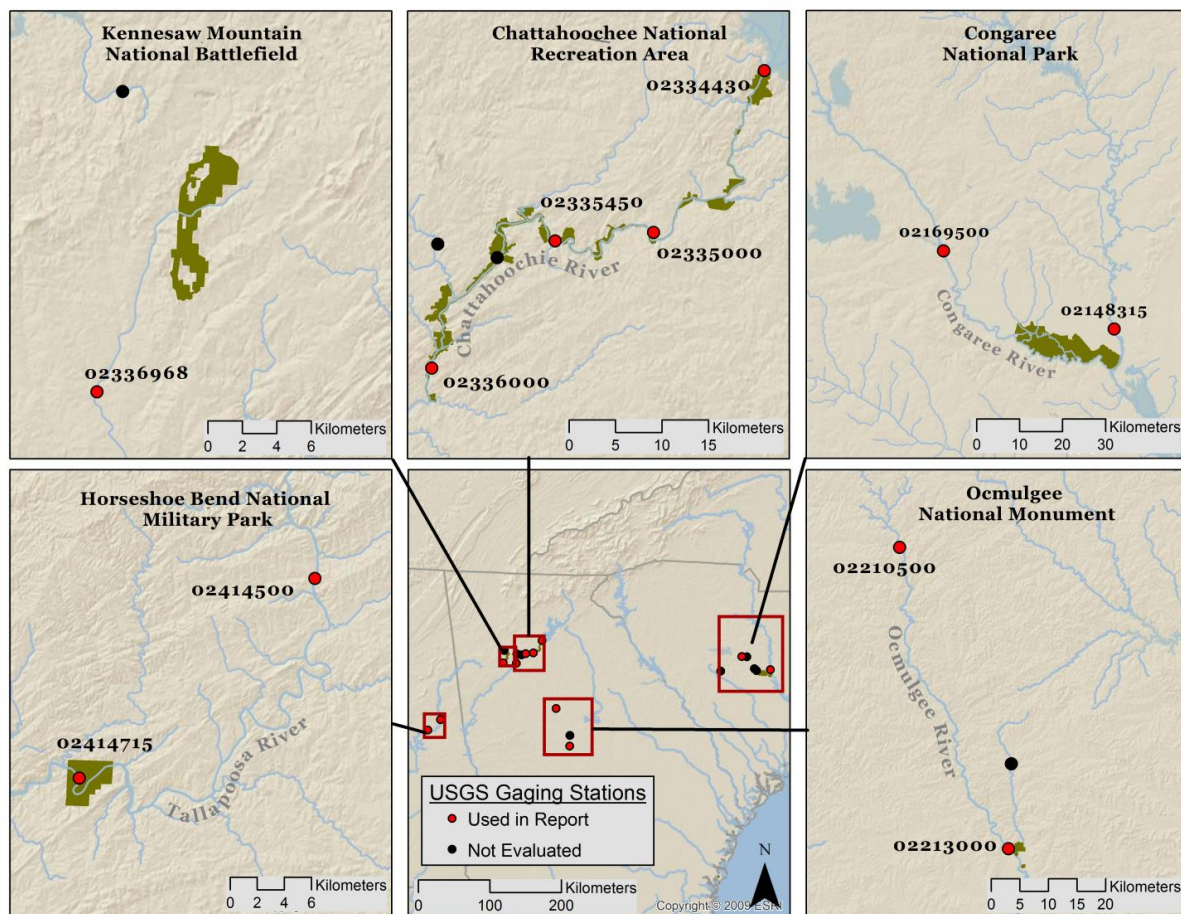


Figure 1. Map showing locations of inland river parks in the Southeast Coast Network. Individual park maps show locations of USGS gages near and within park boundaries. USGS gage 02148315 was discontinued in 2014.

Chattahoochee River National Recreation Area

The Chattahoochee River National Recreation Area (CHAT) is made up of 6,800 acres of mixed pine/hardwood forests and wetlands that buffer 48 miles of the Chattahoochee River (Figure 1) in the urban setting of the greater Atlanta, Georgia metropolitan area. Surface water bodies in the park include: the Chattahoochee River and associated tributaries, Bull Sluice Lake, Sibley Pond (in the Cochran Shoals unit), and Island Ford Pond. Stream flow upstream of the park is regulated by Buford Dam, which has impounded Lake Lanier since its completion in 1956. Current regulations require a flow of 750 cubic feet per second (cfs) at the confluence of the Chattahoochee River and Peachtree Creek; however, beginning in 2008 the Georgia Environmental Protection Division (EPD) allowed this standard to decline by 100 cfs during droughts, to preserve water storage in Lake Lanier (GAEPD 2008). Although flooding is now rare, the river attracts large numbers of visitors that engage in fishing, boating, and rafting activities, all of which depend on adequate flows.

Congaree National Park

Congaree National Park (CONG) lies in the floodplain of the Congaree River in the Coastal Plain physiographic province of South Carolina (Figure 1). The park is made up of 24,180 acres of currently owned land and 26,776 acres of authorized area. The upstream watershed includes over 5 million acres (Knowles 1996), and major flood events along the Congaree River may occur 10 times per year on average, driven primarily by flows from the Broad River. The park consists of old-growth bottomland forests along the Congaree and Wateree Rivers, and it comprises an extensive floodplain ecosystem which depends on periodic inundation by the overflowing Congaree River. Natural flows in the Congaree River have been altered since the late 1920s by the construction of Dreher Shoals Dam, which impounds Lake Murray. The Broad River, a major tributary of the Wateree River, intersects the Wateree approximately 23 river-miles upstream of the Congaree National Park boundary. River flows from the Broad River are also impacted by upstream dams and can further alter river-flow patterns in the park.

Horseshoe Bend National Military Park

Horseshoe Bend National Military Park (HOBE) is made up of 2,040 acres of mixed hardwood forest along the Tallapoosa River in eastern Alabama (Figure 1). Most of the park is upland, but approximately 10% of the area is composed of wetlands. There are many open fields that commemorate historic battlefronts, and the park averages 100,000 visitors per year. Surface water bodies at the park include the Tallapoosa River and Whale Creek. Surface water resources in the Horseshoe Bend study area include the Tallapoosa River and numerous creeks, including Emuckfaw, Timbergut, Hillabee, and Dobbs Creeks (NPS 1997). Flows through the park have been significantly impacted since 1983 by the Harris Dam and Lake hydropower project.

Kennesaw Mountain National Battlefield Park

Kennesaw Mountain National Battlefield Park (KEMO) is located in the northern suburbs of the sprawling Atlanta metropolitan area in the Allatoona Mountain Range (Figure 1) and consists of approximately 3,000 acres of mixed hardwood pine forest and open fields with less than 10% of the park is composed of wetlands. The park commemorates a famous Civil War battle fought during the Atlanta Campaign; however, the park has also become a popular outdoor recreation destination and receives approximately 1.5 million visitors per year (including passing traffic). Multiple creeks are

located within the park, including John Ward Creek, Noses Creek, and Allatoona Creek, all of which originate outside park boundaries and drain highly urban and suburban areas.

Ocmulgee National Monument

Ocmulgee National Monument (OCMU) is located just above the Fall Line in Macon, Georgia (Figure 1). The monument preserves an area once occupied by Native Americans and includes temple and ceremonial burial mounds. The 702-acre monument is surrounded by urban and suburban development and contains approximately 300 acres of wetlands. Surface water resources in the area include the Ocmulgee River and Walnut Creek, as well as other minor creeks including Swift Creek and Town Creek (NPS 2001). Flows in the Ocmulgee River near the monument have been impacted for over 100 years by the Lloyd Shoals Dam (Lake Jackson), which was constructed in 1911. Flows in Walnut Creek have been impacted by upstream development as well as recent beaver activity inside the park.

Table 1. USGS station names, drainage areas, and periods of record used to calculate flow metrics for SECN river parks in 2014. [sq. mi.—square miles]

Park Name	Station Name	USGS Station ID	Drainage Area (sq. mi.)	Period of Record
Chattahoochee River NRA	Chattahoochee River at Buford Dam	02334430	1,040	1960–2014
	Chattahoochee River near Norcross, Ga.	02335000	1,170	1960–2014
	Chattahoochee River near Roswell, Ga.	02335450	1,230	1976–2014
	Chattahoochee River at Atlanta, Ga.	02336000	1,450	1960–2014
Kennesaw Mountain NBP	Noses Creek near Powder Springs, Ga.	02336968	44.5	1999–2014
Congaree National Park	Congaree River at Columbia, S.C.	02169500	7,850	1939–2014
Horseshoe Bend NMP	Tallapoosa River at Wadley, Ala.	02414500	1,675	1984–2014
	Tallapoosa River at New Site, Ala.	02414715	2,058	1984–2014
Ocmulgee National Monument	Ocmulgee River near Jackson, Ga.	02210500	1,420	1988–2014
	Ocmulgee River at Macon, Ga.	02213000	2,240	1960–2014

Methods

Data Acquisition and Analysis

Daily values for flow data spanning the recent periods of record were downloaded from relevant USGS stations and evaluated for inclusion in this analysis. Gages were considered relevant if the station was situated on a major river or large stream located upstream of or within a park boundary. Stations with only stage data available were not used. Although 20 years of data or more is considered an ideal period of record for hydrologic analyses on natural systems (Richter et al. 1997), we used stations with a minimum of 12 years of data for this analysis. Additionally, flow periods prior to the construction and filling of new reservoirs were ignored. Therefore, the historic evaluation and context are more relevant since the analysis incorporated only more-recently collected data and evaluated flow under a river's managed or more-developed conditions (Table 1). Information about all USGS gages located near or within SECN parks (including periods of records and data types) can be found in the SECN Surface Water Monitoring Protocol (Jones et al. 2010).

Indicators of Hydrologic Alteration (IHA) software (TNC 2009a) was used to characterize general flow conditions and significant ecological events by processing the edited period of record at each station. The program used single-period daily values in cubic feet per second to calculate nonparametric statistical metrics including median monthly flow values and extreme event characterization and timing (Table 2). IHA also was used to calculate Environmental Flow Components (EFCs), which are typically used to characterize natural flow and departures from natural conditions (Table 2). EFCs are flow events defined by river ecologists and delineated based on reoccurring flow patterns observed at a site over many years. In this context, EFCs are meant to characterize flow events that have become typical since diversions or development occurred. The EFC procedure set initial high flows as 75% of daily flows for the period of record. We defined small floods as those events with a two-year return interval. We defined large floods as those events with a 10-year return interval. Extreme low flows were defined as being less than 10% of all flows for the period. More detailed information related to the algorithm can be found in the IHA user's manual (TNC 2009b).

Annual river flow characteristics were also described and put into a historical flow context using a program that produces daily flow graphs that depict median monthly flow, interquartile range, and daily flow (Flow software; Dowd 2011). This graphical representation allows quick comparison of basic flow characteristics to historical patterns at each gaging station in or near SECN parks. Similar to the IHA analysis, flow periods prior to long periods of missing data and prior to the construction and filling of reservoirs were ignored.

Assessment Criteria

Where defined, these data sets are also interpreted in the context of existing resource criteria relevant to individual parks in the Southeast Coast Network. These criteria can be found in the published scientific literature or in the park Resource Stewardship Strategy (RSS), which is a plan that includes strategies for managing natural and cultural resources. The Resource Stewardship Strategy is based on science and scholarship and is designed to help park staff achieve and maintain desired conditions for resources as dictated by the General Management Plan for a park unit. Where possible, Vital Signs (such as stream flow) are selected as RSS indicators of resource condition. This facilitates the use of Vital Signs monitoring data when tracking and reporting a park's progress toward attainment of target values as defined in its Resource Stewardship Strategy. At present, Chattahoochee River National Recreation Area is the only SECN park unit that has completed its Resource Stewardship Strategy (NPS 2010).

The CHAT Resource Stewardship Strategy includes minimum waterflow in the Chattahoochee River as an indicator of conditions (NPS 2010). Within the Resource Stewardship Strategy, five management targets are identified based on their relevance to state standards and based on recommended flows for rafting, canoeing, and trout fishing or fishery condition (Table 3; Nestler et al. 1986).

Table 2a. Environmental Flow Components calculated and used in this report. Potential Ecosystem Influences modified from IHA user's manual (TNC 2009b). Table number in parentheses refers to the table in this report where information is presented.

Parameter Type	Definition	Potential Ecosystem Influences
Monthly Low Flows (Table 5)	Median low-flow daily value for each calendar month	• Provide adequate habitat for aquatic organisms • Maintain suitable water temperatures, dissolved oxygen, and water chemistry • Maintain water table levels in floodplain, soil moisture for plants • Provide drinking water for terrestrial animals • Keep fish and amphibian eggs suspended • Enable fish to move to feeding and spawning areas • Support hyporheic organisms (living in saturated sediments)

Table 2b. Indicators of Hydrologic Alteration Metrics calculated and used in this report. Potential Ecosystem Influences modified from IHA user's manual (TNC 2009b). Table number in parentheses refers to the table in this report where information is presented.

Parameter Type	Definition	Potential Ecosystem Influences
Median Monthly Flow Conditions (Table 5)	Median daily value for each calendar month	• Habitat availability for aquatic organisms • Soil moisture availability for plants • Availability of water for terrestrial animals • Availability of food/cover for furbearing mammals • Reliability of water supplies for terrestrial animals • Access by predators to nesting sites • Water temperature, oxygen levels, photosynthesis in water column
Extreme Flow Conditions (Table 6)	1 to 90 day minimum and maximum flows	• Balance of competitive, ruderal, and stress- tolerant organisms • Creation of sites for plant colonization • Structuring of aquatic ecosystems by abiotic vs. biotic factors • Structuring of river channel morphology and physical habitat conditions • Soil moisture stress in plants • Dehydration in animals • Anaerobic stress in plants • Volume of nutrient exchanges between rivers and floodplains • Duration of stressful conditions such as low oxygen and concentrated chemicals in aquatic environments • Distribution of plant communities in lakes, ponds, floodplains • Duration of high flows for waste disposal, aeration of spawning beds in channel sediments
Magnitude of Extreme Flow Conditions (Table 6)	Magnitude of 1 to 90 day high and low	• Compatibility with life cycles of organisms • Predictability/avoidability of stress for organisms • Access to special habitats during reproduction or to avoid predation • Spawning cues for migratory fish • Evolution of life history strategies, behavioral mechanisms
Extreme Low Flow and Low-Flow Pulses (Table 7)	Frequency, duration and timing of low flows and low-flow pulses	• Enable recruitment of certain floodplain plant species • Purge invasive, introduced species from aquatic and riparian communities • Concentrate prey into limited areas to benefit predators
High-Flow Pulses (Table 7)	Frequency, duration and timing of high-flow pulses	• Alter shape and physical character of river channel, including pools and riffles • Determine size of streambed substrates (sand, gravel, cobble) • Prevent riparian vegetation from encroaching into channel • Restore normal water-quality conditions after prolonged low flows, flushing away waste products and pollutants • Aerate eggs in spawning gravels, prevent siltation • Maintain suitable salinity conditions in estuaries • Influence bedload transport, channel sediment textures, and duration of substrate disturbance
Small Floods (Table 7)	Frequency, duration and timing of small floods	• Provide migration and spawning cues for fish • Trigger new phase in life cycle (i.e., insects) • Enable fish to spawn in floodplain; provide nursery area for juvenile fish • Provide new feeding opportunities for fish, waterfowl • Recharge floodplain water table • Maintain diversity in floodplain forest types through prolonged inundation (i.e., different plant species have different tolerances) • Control distribution and abundance of plants on floodplain • Deposit nutrients on floodplains

Table 3. Assessment criteria for evaluating status of flow conditions at Chattahoochee River National Recreation Area, from the NPS Resource Stewardship Strategy (NPS 2010) and Nestler et al. (1986). [cfs—cubic feet per second]

Flow criteria threshold (cfs)	Justification
Days less than 650	State standards for minimum flow at Peachtree Creek (River Mile 300.5).
750–1,000	Life history requirements for juvenile brown trout, adult brook trout. Possible wade and tube fishing, rafting.
1,000–1,500	Optimal conditions for wade and tube fishing, novice rafting and canoeing and hanging out; boat fishing possible.
1,500–2,000	Possible conditions for wade and tube fishing, novice rafting and canoeing and hanging out; optimal conditions for boat fishing.
Greater than 2,000	Powerboat fishing, mid-level rafting and canoeing.

Table 4. Assessment criteria for evaluating status of flow conditions on the Congaree River and in Congaree National Park using a 2-dimensional flow model (Kupfer and Meitzen 2012) and flows at the Columbia, South Carolina. [cfs—cubic feet per second]

Flow thresholds (cfs)	Percent of park inundated	Justification
<5,300	Very little or no inundation	--
5,300–8,300	35	Meander channel inundation; flooding in eastern park areas.
8,300–11,300	35–40	Meander channel inundation; flooding in eastern park areas; back flooding on Cedar Creek and Old Dead River.
11,300–26,000	40–60	Bank flooding into channels; activation of levee breaches; flood transport through floodplain channels.
>26,000	60–80	Entire floodplain inundated; all floodplain waterbodies connected by cross-floodplain flows.

Results

Summary of Flow Conditions in SECN River Parks

Riverine systems in and around SECN parks encompass drainage areas ranging from 44 square miles at Noses Creek in Kennesaw Mountain National Battlefield Park to 7,850 square miles at the Columbia gage upstream of Congaree National Park. Regardless of drainage size, all large river flows through and adjacent to parks included in this report have been altered by the placement of upstream impoundments.

Flows across the Southeast Coast Network were near-normal over the period of record used for this analysis. Gages at Chattahoochee River National Recreation Area, Congaree National Park, and Horseshoe Bend National Military Park had minimum flows that were slightly higher than normal. The monthly median stream flow peaked in January and April and was lowest from September through December. The median monthly flow in the Tallapoosa River at Wadley (near Horseshoe Bend) in April was the highest recorded in 31 years. The median monthly flows in April and June on Noses Creek at Kennesaw Mountain ranked among the highest observed in 16 years. The following section summarizes flow conditions at each park in 2014. Figures 2–12 depict observed daily flows compared to historical variability at each gage.

Chattahoochee River National Recreation Area

- Median monthly flows on the Chattahoochee River were highest from January to May and lowest from September to December.
- Extreme low flows: One-day low flows were above normal in section 1 and 2 on the Chattahoochee River. Three- to ninety-day low flows were near normal in all sections in 2014.
- Extreme high: One-day maximum flows were slightly above normal in section 1 and slightly below normal in section 4 on the Chattahoochee River. Three-day maximum flows were slightly above normal for sections 1 and 3. Seven- to ninety-day high flows were in the normal range for the year over the period of record.
- EFC: Low-flow pulses occurred between 0 and 32 times across the 4 sections of the Chattahoochee River and lasted between 1 and 1.5 days. Low-flow pulses were more common in sections 2–4 than in section 1 near the Buford Dam. High-flow pulses occurred between 22 and 27 times along the Chattahoochee River in 2014 and were most common on section 3. Small flood events occurred between 1 and 2 times across the upper three river sections and lasted between 8 and 15 days. No small floods occurred in section 4 in 2014.
- Flow Criteria: Flows in the Chattahoochee River in 2014 favored activities that require higher flow. Flows greater than 2,000 cfs were recorded for most days on all sections of the river (Table 8). No flows in section 4 were below the State-mandated minimum flow of 750 cfs.

Congaree National Park

- Median monthly flows on the Congaree River were generally highest between January and April.
- Extreme low flows: One-day low flows were slightly above normal and 3- to 90-day low flows were normal on the Congaree River.
- Extreme high flows: One- to ninety-day high flows were in the normal range on the Congaree River.
- EFC: Low-flow pulses occurred 4 times on the Congaree River with an average date of 17 July. High-flow pulses were common in 2014, occurring 23 times on the Congaree River. The number of high-flow pulses recorded on the Congaree River was in the normal range for the period of record .There were no small flood events recorded on the Congaree River in 2014.
- Flow criteria: A two-dimensional flow model (Kupfer and Meitzen 2012) predicted that between 60 and 80% of Congaree National Park was inundated for approximately 9 days in 2014, based on flows in the Congaree River at Columbia, South Carolina. Forty to sixty percent of the park was predicted to have been inundated for approximately 42 days. Low-lying eastern areas of the park may have been inundated for up to 127 days in 2014.

Horseshoe Bend National Military Park

- Median monthly flows on the Tallapoosa River near Horseshoe Bend were generally highest between January and May with increasing flows observed again in December. The highest median monthly flow over the period of record (31 years) was recorded in April at the Tallapoosa River near Wadley.
- Extreme low flows: One- to seven-day low flows were all below normal on the Tallapoosa River at the New Site gage downstream of the park. In contrast, one- to three-day low flows were above normal upstream at Wadley.
- Extreme high: One- to ninety-day high flows were within the normal range over the period of record for the year at both sites on the Tallapoosa River.
- EFC: Very few low-flow pulses occurred on the Tallapoosa River in 2014. Two were recorded at the Wadley gage and 12 were recorded downstream of the park at the New Site gage. High-flow pulses occurred 19 times at the Wadley gage and 17 times at the New Site gage. A single small flood was observed on the Tallapoosa River in April.

Kennesaw Mountain National Battlefield Park

- Median monthly flows in Noses Creek were generally highest in February to April. The second highest median monthly flow over the 16 year period of record occurred in June. The third highest median monthly flow over the period of record occurred in April.
- Extreme flows: One- to ninety-day low flows and high flows were within the normal range over the period of record for the year.

- EFC: Low flow pulses occurred 4 times, with an average duration of 5.5 days and high flow pulses were observed 26 times with an average duration of 2.5 days in 2014. No small flood events were recorded.

Ocmulgee National Monument

- Median monthly flows in the Ocmulgee River near Jackson were highest in March and April and lowest in October and November. Flows in the Ocmulgee River at Macon were generally high from January to May.
- Extreme low flows: One- to ninety-day low flows were within the normal range for the period of record on the Ocmulgee River.
- Extreme high flows: Thirty- to ninety-day high flows in the Ocmulgee River near Jackson for November and December were below the normal range for the period of record (27 years). In contrast, high flows were all in the normal range for the period of record at Macon (55 years).
- EFC: Low-flow pulses were observed 4 times in the Ocmulgee River near Jackson and 8 times at Macon and on average lasted between two and four days. High-flow pulses were more frequent: 15 and 16 high flow pulses were observed respectively, with an average duration of three days. No small flood events were observed on the Ocmulgee River in 2014. The number of low-flow pulses on the Ocmulgee River—20 low-flow pulses—was above the normal range for the period of record at Macon. The normal range for low flow pulses is between 8 and 17 occurrences. Additionally, high flow pulses occurred 16 times, which is slightly above the normal range for Macon of 8 to 15 occurrences. Low- and high-flow pulses on the Ocmulgee River were in the normal range for the period of record near Jackson.

Table 5. Monthly median flow magnitudes for SECN river parks in 2014. Median flow calculated with Indicators of Hydrologic Alteration software (TNC 2009a) using daily data values collected by USGS. Values in cubic feet per second (cfs). Color scale indicates flow magnitude across the year at a site. Darker blue in the cell for a month indicates higher flow magnitude in that month.

Park Name	USGS ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chattahoochee River National Recreation Area	02334430	3,170	3,220	2,230	3,825	2,230	1,500	1,280	1,730	1,055	1,050	1,485	1,020
	02335000	3,090	2,900	2,070	2,790	2,160	1,305	1,380	1,550	1,165	1,120	1,505	1,140
	02335450	3,610	3,220	2,250	3,575	2,420	1,535	1,330	1,700	1,110	1,030	1,480	1,110
	02336000	4,820	3,160	2,640	4,510	2,350	1,600	1,450	1,750	1,145	1,110	1,615	1,220
Kennesaw Mountain National Battlefield Park	02336968	42	54	38	59.5	38	38.5	14	7.8	6.4	5.5	6.65	17
Congaree National Park	02169500	16,700	10,200	12,100	15,100	6,680	6,190	5,710	7,260	4,160	3,670	3,920	5,460
Horseshoe Bend National Military Park	02414500	3,170	4,115	3,750	4,995	3,500	2,170	1,190	682	400	1,060	1,220	1,420
	02414715	2,600	3,515	3,210	4,390	2,710	1,890	856	392	231	718	910	1,170
Ocmulgee National Monument	02210500	449	469	608	1,665	534	410	402	425	398.5	387	369.5	402
	02213000	3,020	4,420	3,210	4,290	2,040	1,315	1,150	838	737.5	750	663	1,070

Table 6. One- to ninety-day extreme flow magnitudes at SECN river parks in 2014. Metrics calculated using Indicators of Hydrologic Alteration software (TNC 2009a). Data from USGS in cubic feet per second (cfs). [min—minimum; max—maximum]

Park Name	USGS ID	Min./Max.	1-day	3-day	7-day	30-day	90-day
Chattahoochee River National Recreation Area	02334430	Minimum	590	598	670.5	977.9	1,160
		Maximum	7,970	7,777	6,046	3,614	2,722
	02335000	Minimum	713	836.3	1,004	1,062	1,291
		Maximum	7,610	7,570	6,024	3,759	2,851
	02335450	Minimum	535	699.3	873.7	986.9	1,265
		Maximum	8,340	8,173	6,509	4,098	3,102
	02336000	Minimum	907	934.7	993.7	1,116	1,475
		Maximum	7,530	7,287	6,270	4,333	3,427
Kennesaw Mountain National Battlefield Park	02336968	Minimum	3.7	3.8	3.957	5.313	9.81
		Maximum	1,100	608.7	299	130.8	89.96
Congaree National Park	02169500	Minimum	2,690	2,737	3,350	3,952	4,674
		Maximum	51,300	48,430	34,540	19,640	15,530
Horseshoe Bend National Military Park	02414500	Minimum	219	225	240	412.3	762.3
		Maximum	20,600	19,800	14,520	7,174	5,385
	02414715	Minimum	115	117	123.9	230.9	495.8
		Maximum	29,800	24,900	16,560	7,674	5,104
Ocmulgee National Monument	02210500	Minimum	325	334	344.4	376.9	536.4
		Maximum	10,500	8,023	4,746	1,943	1,562
02213000	Minimum	Minimum	500	502.7	503.4	696.6	989
		Maximum	22,400	19,470	13,380	5,978	4,979

Table 7. Environmental Flow Components (TNC 2009a) for flows at SECN river parks in 2014. Timing refers to the average date (average of Julian dates) of a peak event if more than one occurred. [cfs—cubic feet per second; NC—metric not calculated]

Park Name	USGS ID		Frequency	Peak (cfs)	Duration (days)	Timing ^a
Chattahoochee River National Recreation Area	02334430	Extreme Low Flow	0	NC	NC	NC
		High-Flow Pulses	24	3,490	2	3/31
		Small Flood	2	7,900	8	2/20
	02335000	Extreme Low Flow	24	752.5	1	9/29
		High-Flow Pulses	22	3,885	2	4/1
		Small Flood	1	7,610	19	1/1
	02335450	Extreme Low Flow	23	629	1	9/22
		High-Flow Pulses	22	3,970	3	4/1
		Small Flood	2	8,230	15	2/21
	02336000	Extreme Low Flow	32	1,000	1.5	10/8
		High-Flow Pulses	27	4,660	2	3/8
		Small Flood	0	NC	NC	NC
Kennesaw Mountain National Battlefield Park	02336968	Extreme Low Flow	4	4.15	5.5	9/30
		High-Flow Pulses	26	171.5	2.5	3/12
		Small Flood	1	1,100	6	4/8
Congaree National Park	02169500	Extreme Low Flow	4	2,740	1	7/17
		High-Flow Pulses	23	16,900	4	3/14
		Small Flood	0	NC	NC	NC
Horseshoe Bend National Military Park	02414500	Extreme Low Flow	2	219.5	1.5	9/3
		High-Flow Pulses	19	5,330	3	2/13
		Small Flood	1	20,600	8	4/9
	02414715	Extreme Low Flow	12	209.5	2	8/28
		High-Flow Pulses	17	5,070	2	3/14
		Small Flood	1	29,800	20	4/9
Ocmulgee National Monument	02210500	Extreme Low Flow	4	338.5	2	10/30
		High-Flow Pulses	15	3,060	3	3/28
		Small Flood	0	NC	NC	NC
	02213000	Extreme Low Flow	8	534.5	4	9/29
		High-Flow Pulses	16	4,490	3	3/12
		Small Flood	0	NC	NC	NC

^aAverage timing not calculated (NC) due to distribution of Julian dates.

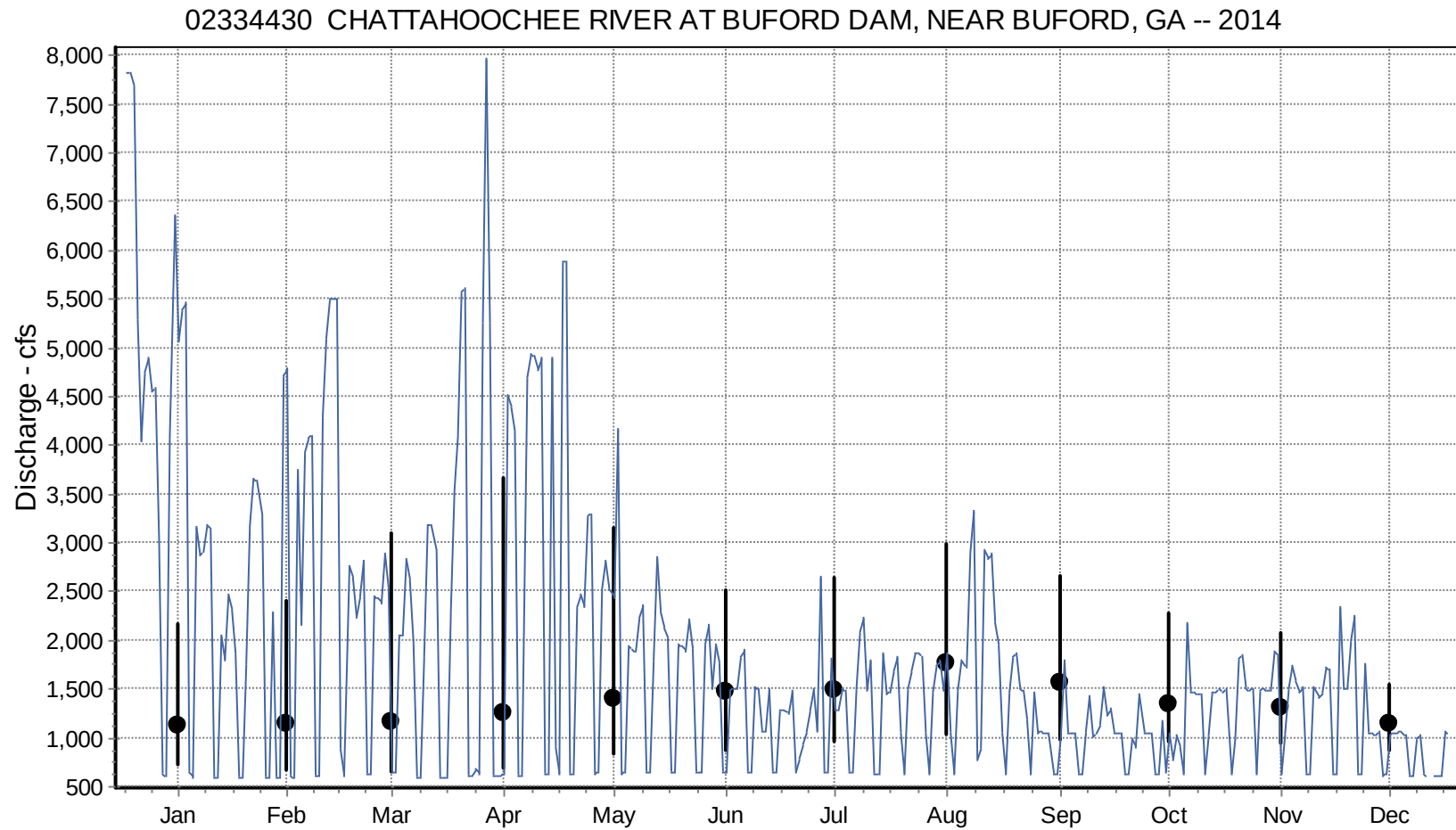


Figure 2. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River Near Buford, Ga. in 2014.

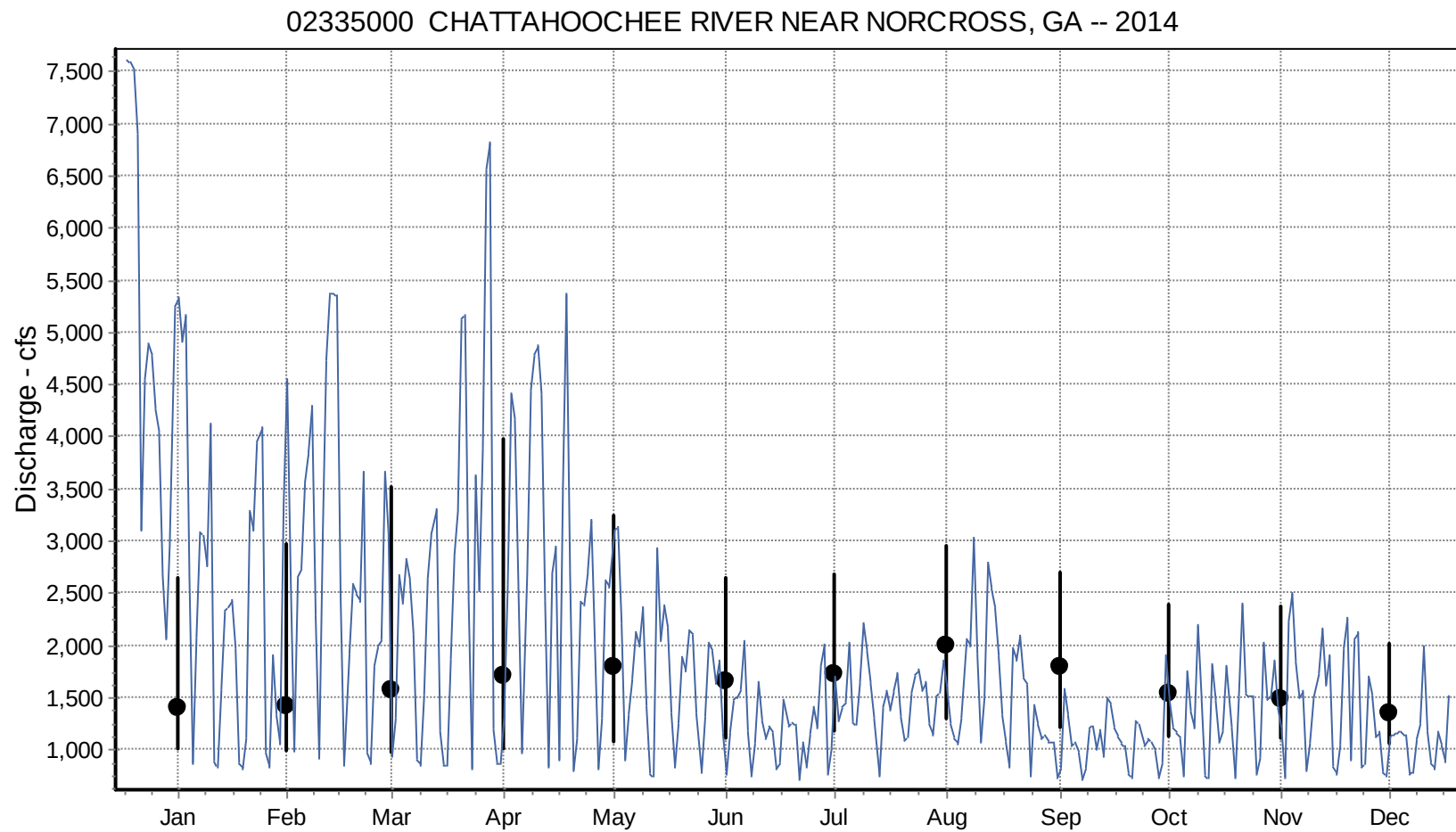


Figure 3. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River Near Norcross, Ga. in 2014.

02335450 CHATTAHOOCHEE RIVER ABOVE ROSWELL, GA -- 2014

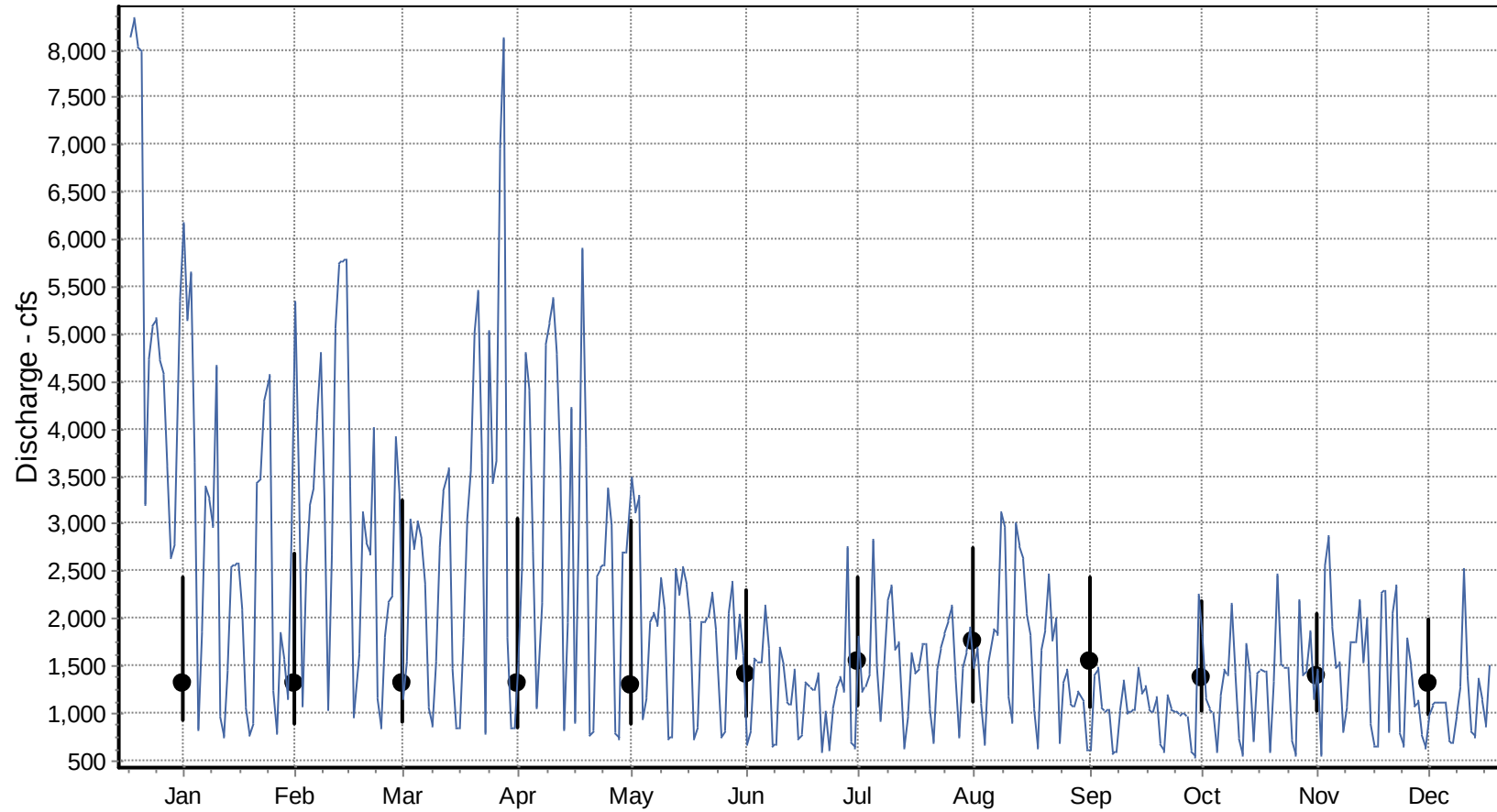


Figure 4. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River above Roswell, Ga. in 2014.

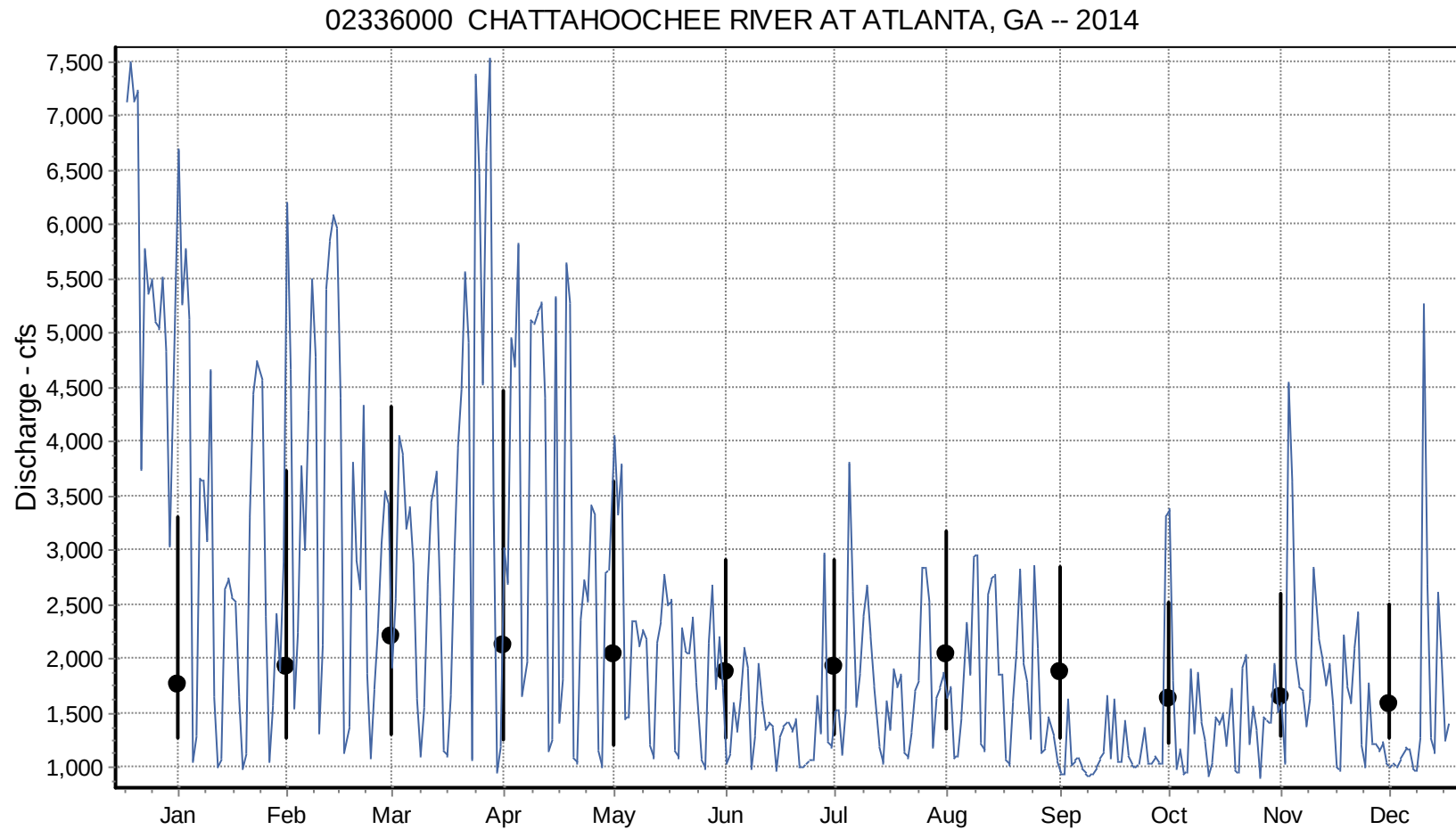


Figure 5. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River at Atlanta, Ga. in 2014.

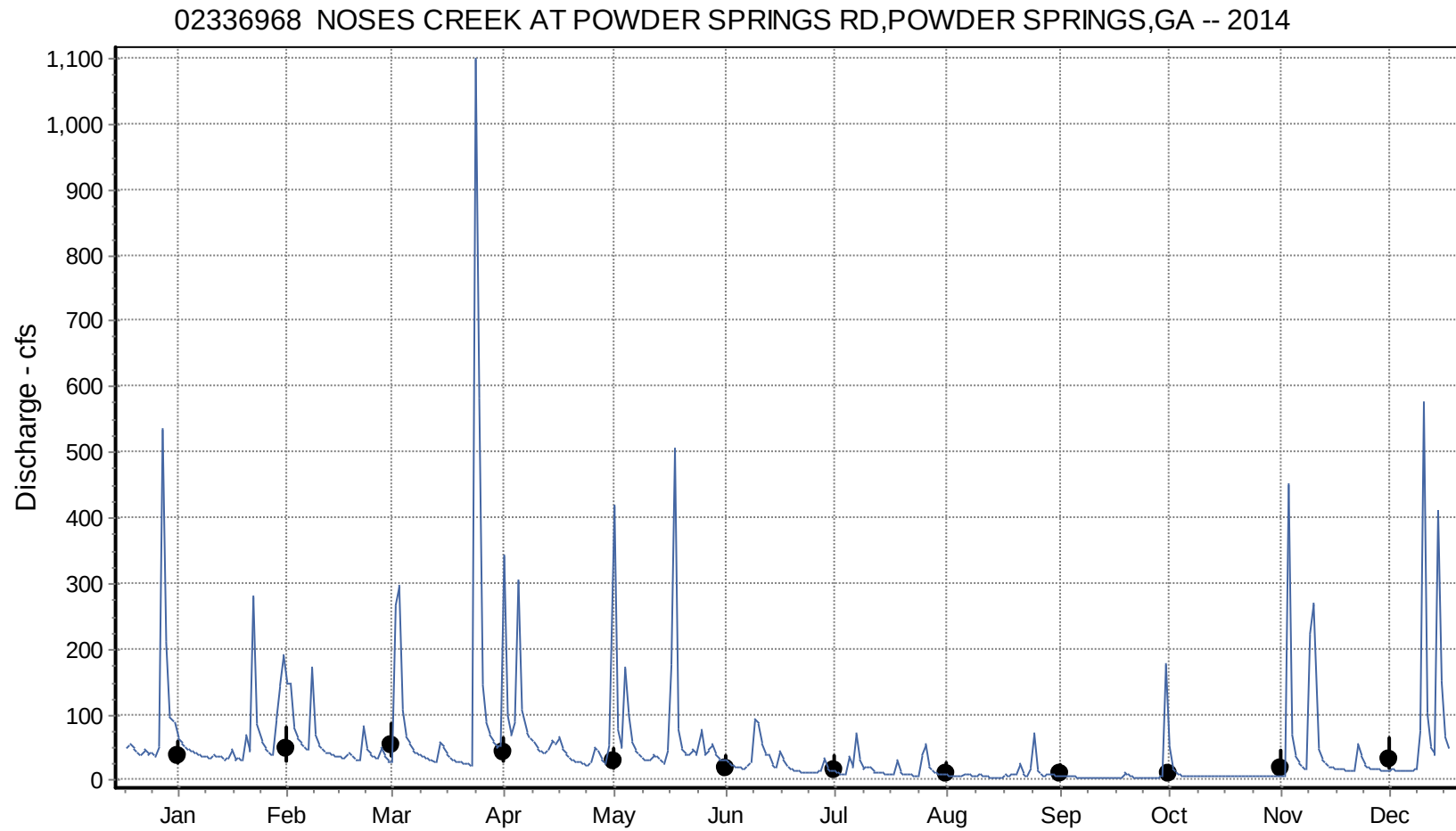


Figure 6. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for Noses Creek at Powder Springs Road, Powder Springs, Ga. in 2014.

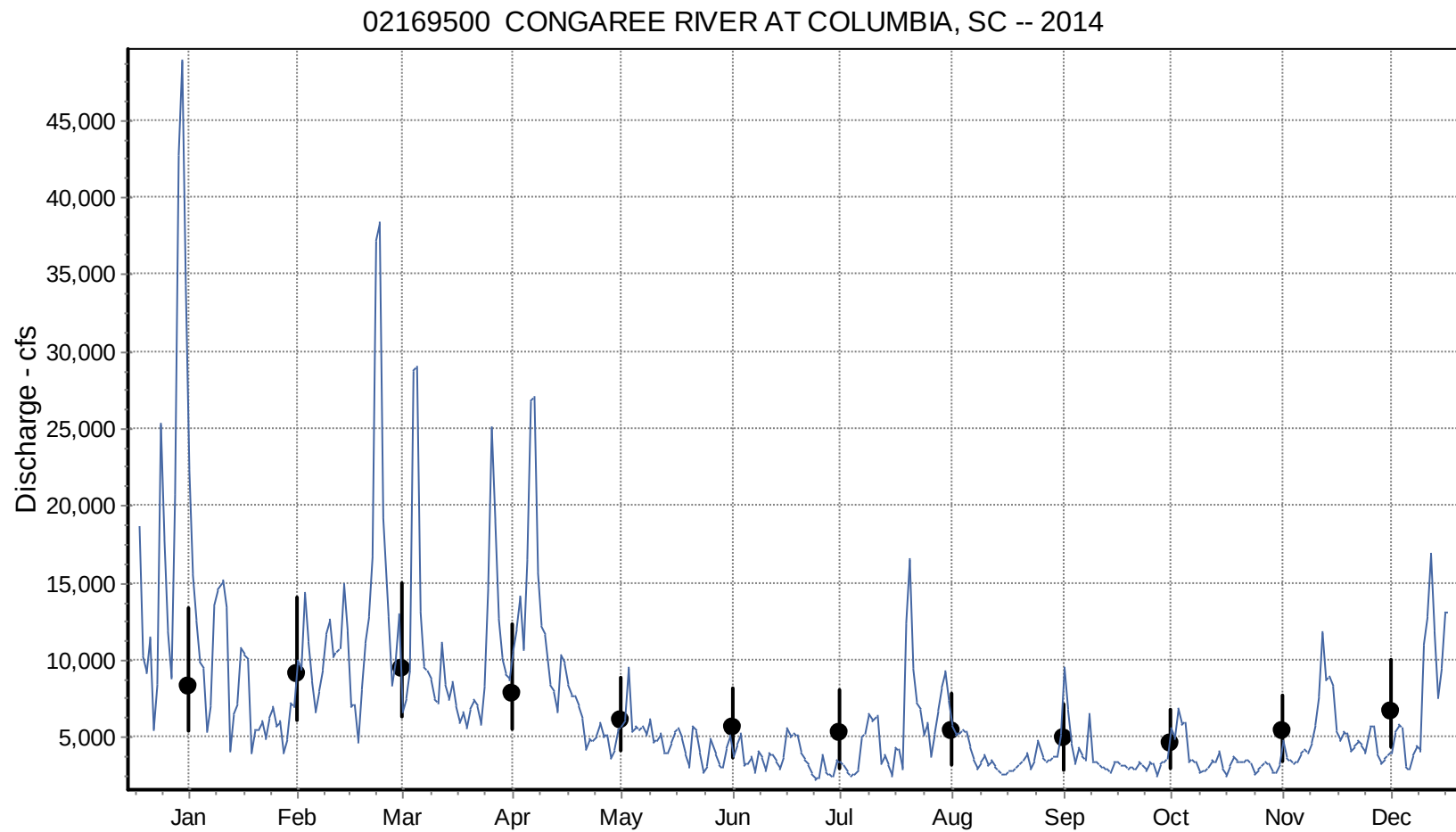


Figure 7. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Congaree River at Columbia, S.C. in 2014.

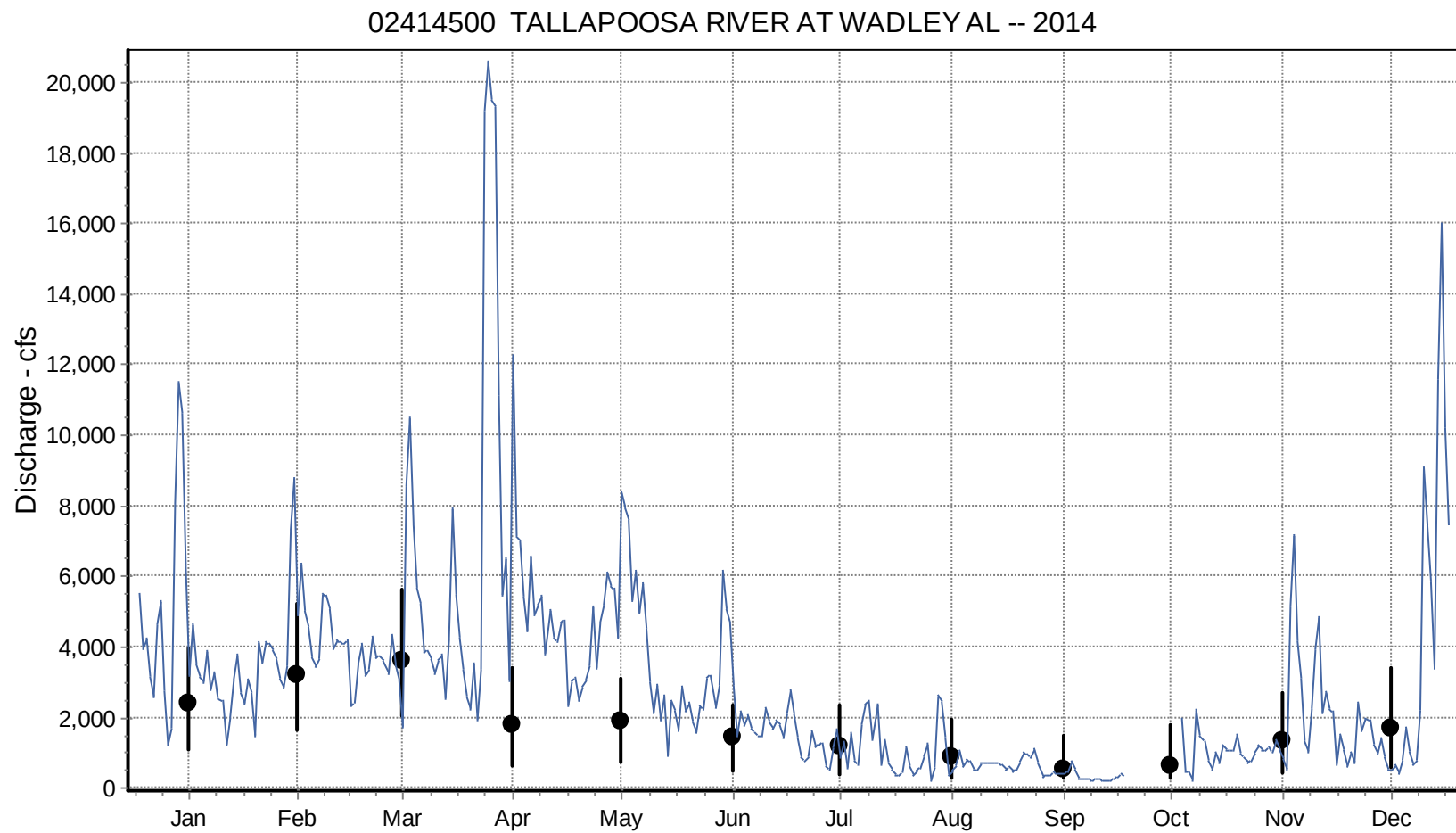


Figure 8. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Tallapoosa River at Wadley, Ala. in 2014.

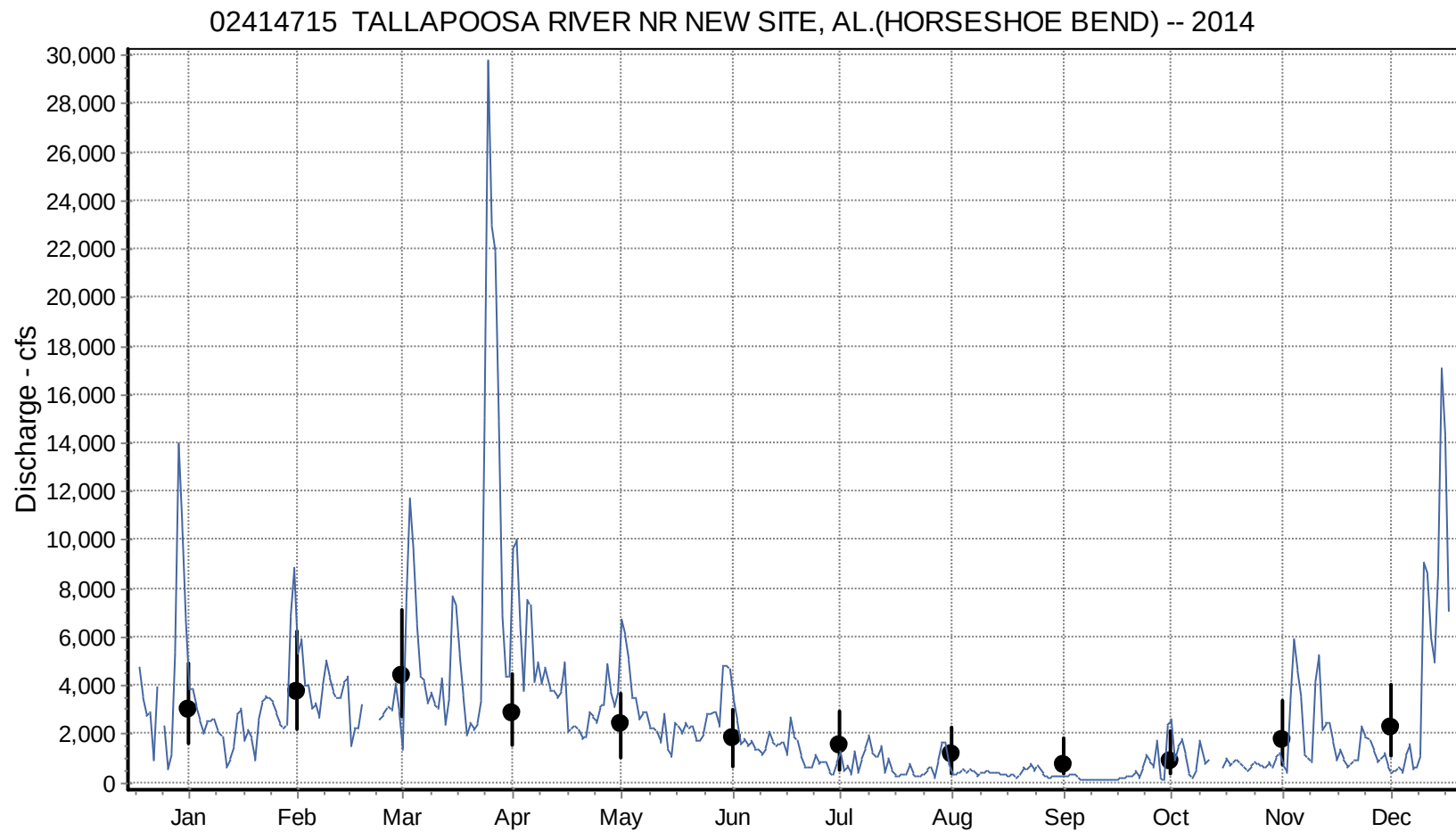


Figure 9. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Tallapoosa River near New Site, Ala. (Horseshoe Bend) in 2014.

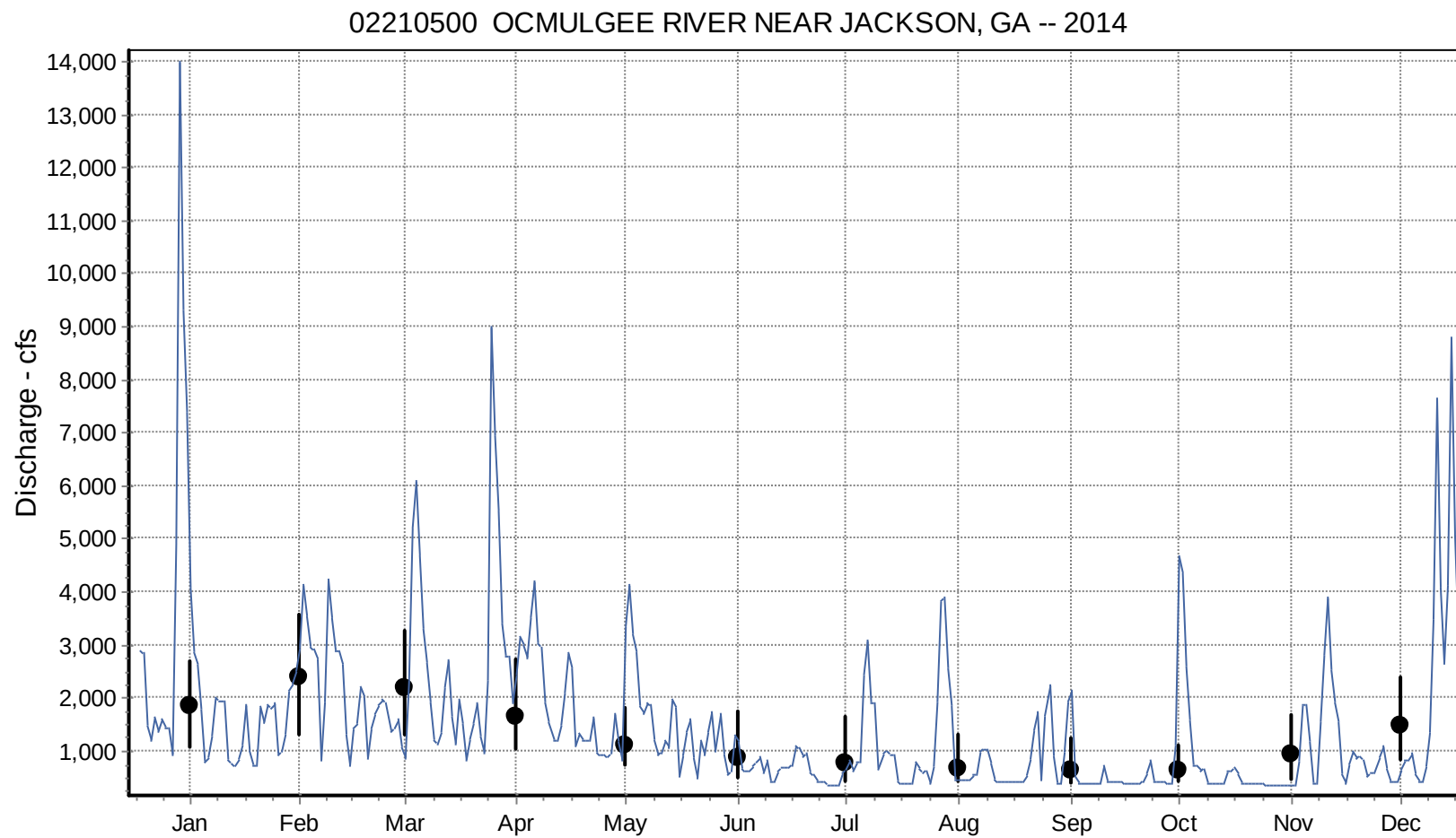


Figure 10. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Ocmulgee River near Jackson, Ga. in 2014.

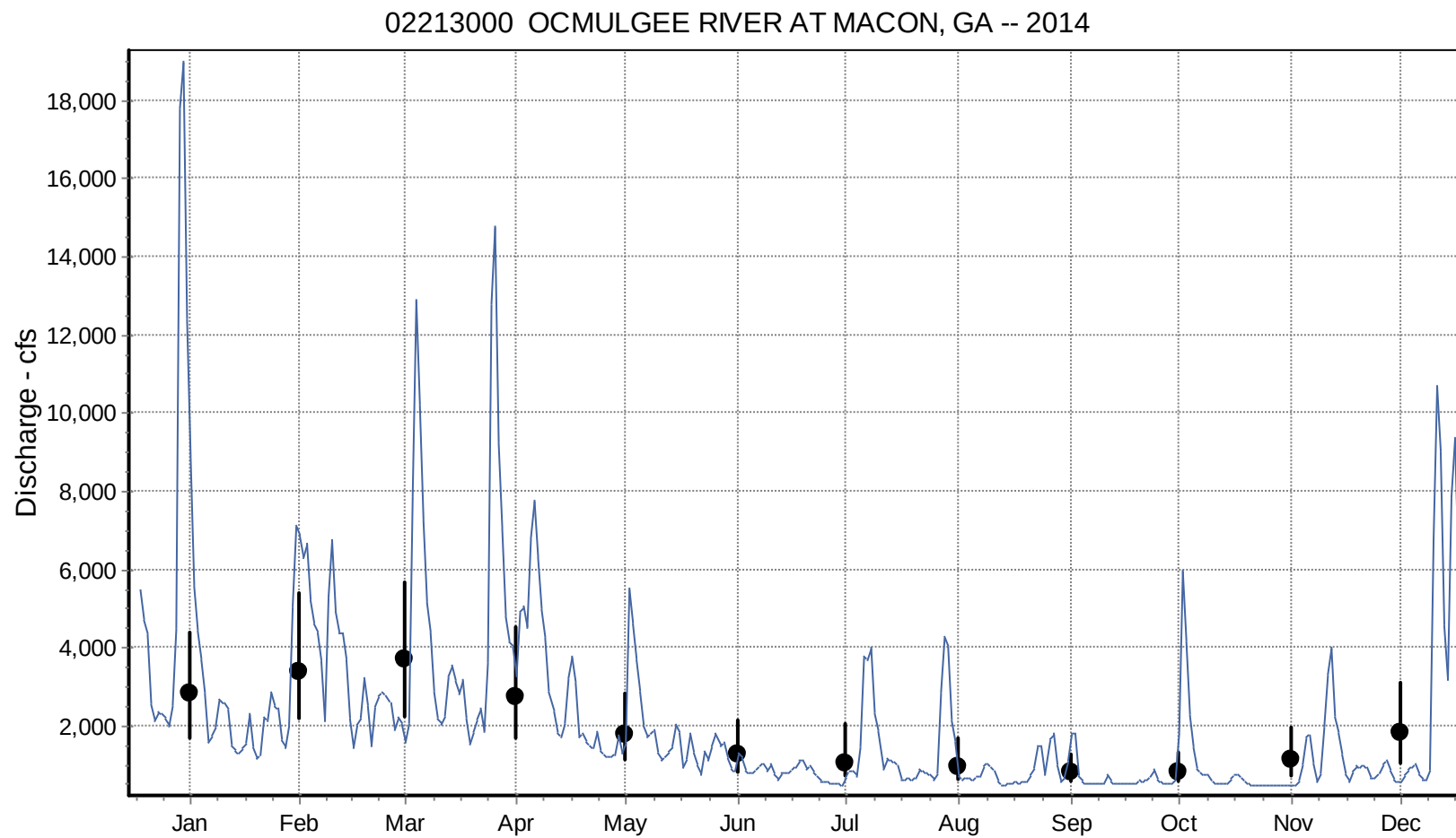


Figure 11. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Ocmulgee River at Macon, Ga. in 2014.

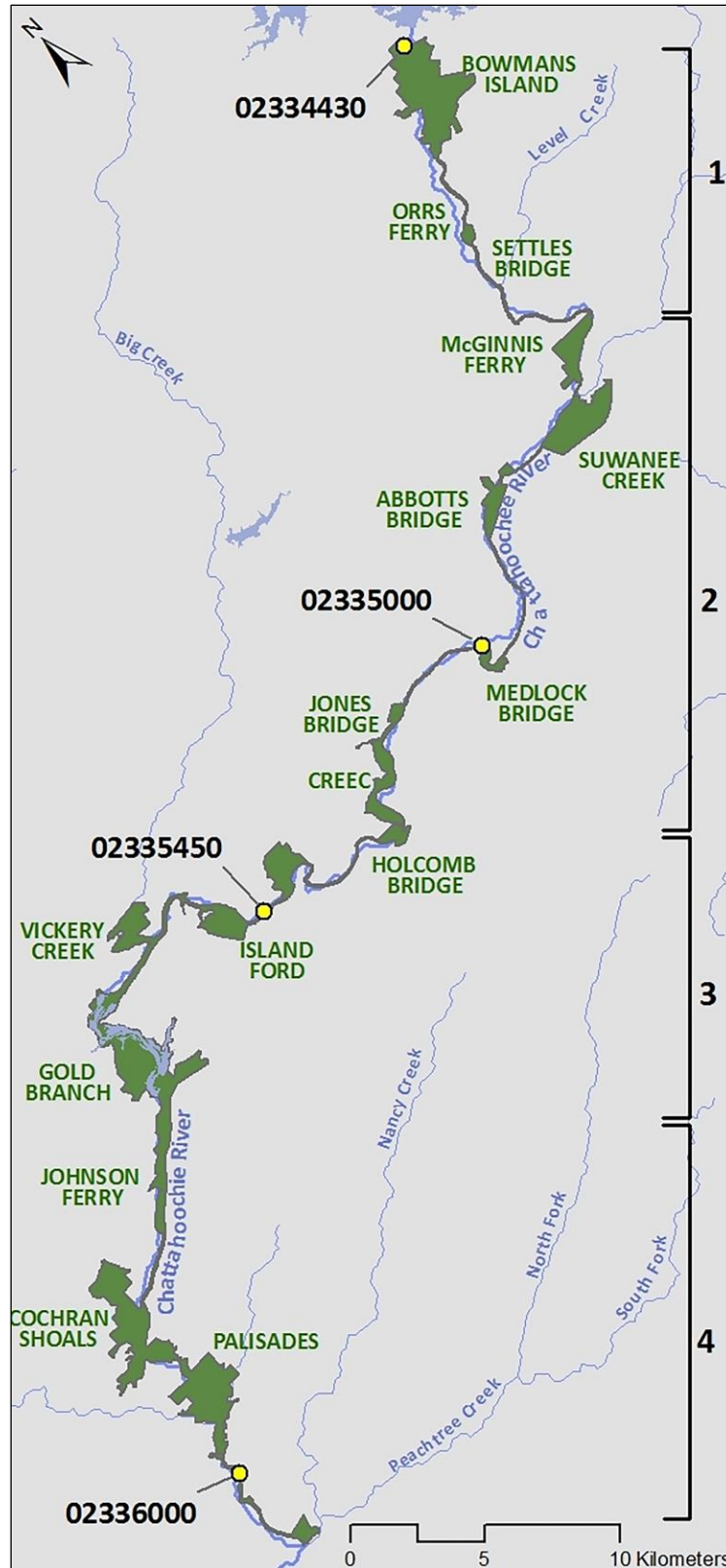


Figure 12. Park units and management sections along the Chattahoochee River National Recreation Area in Atlanta, Ga.

Table 8. The number of days that flow criteria and activity thresholds were met or exceeded in four sections of the Chattahoochee River National Recreation Area in Atlanta, Georgia in 2014. Flow criteria and activities modified from Nestler et al. (1986); low flow standard (<750 cfs) on river segment 4 from GAEPD. River segments are based on proximity to the nearest relevant gaging station and are shown in Figure 2. [RS—River Segment; NA—not applicable to segment; cfs—cubic feet per second]

Flow criteria threshold (cfs)	Justification	RS-1 ^a	RS-2 ^b	RS-3 ^c	RS-4 ^d
Stream flow less than 750 at River Segment 4	State standards for minimum flow at Peachtree Creek (River-mile 300.5).	NA	NA	NA	0
750–1,000	Life history requirements for juvenile brown trout, adult brook, possible wade and tube fishing, rafting.	11	60	41	26
1,000–1,500	Optimal conditions for wade and tube fishing, novice rafting and canoeing, and hanging out; boat fishing possible.	93	109	93	120
1,500–2,000	Possible conditions for wade and tube fishing, novice rafting and canoeing, and hanging out; optimal conditions for boat fishing.	56	62	57	69
Greater than 2,000	Powerboat fishing, mid-level rafting, and canoeing.	106	123	132	150

^aUSGS Gage ID 02334430—River-miles from mouth: 348 (Buford dam) to 340

^bUSGS Gage ID 02335000—River-miles from mouth: 340 to 325.5

^cUSGS Gage ID 02335450—River-miles from mouth: 325.5 to 317(Bulls Sluice Lake)

^dUSGS Gage ID 02336000—River-miles from mouth: 312.5 (Morgan Falls dam) to 300.5

Table 9. Percentage of inundation and duration at Congaree National Park due to high flows on the Congaree River in 2014, as predicted by a two-dimensional flood model (Kupfer and Meitzen 2012). Flows from USGS gage at Columbia, S.C. (USGS 02169500). [cfs—cubic feet per second]

Congaree River Discharge (cfs)	Percentage of park inundated	Duration (days)	Modeled Flood Description
<5,300	very little or no inundation	185	NA
5,300–8,300	35	82	Meander channel inundation; flooding in eastern park areas.
8,300–11,300	35–40	45	Meander channel inundation; flooding in eastern park areas; back flooding on Cedar Creek and Old Dead River.
11,300–26,000	40–60	42	Bank flooding into channels; activation of levee breaches; flood transport through floodplain channels.
>26,000	60–80	9	Entire floodplain inundated; all floodplain waterbodies connected by cross-floodplain flows.

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Appendix A. Station Metadata Information

Chattahoochee River at Buford Dam (02334430)

Latitude: 34°09'25"/Longitude: 84°04'44"/Datum: NAD83

Gwinnett County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,040.00 square miles

Datum of gage: 912.04 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02334430&PARAMeter_cd=00065,00060,00062

Chattahoochee River near Norcross, GA (02335000)

Latitude: 33°59'50"/Longitude: 84°12'07"/Datum: NAD83

Gwinnett County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,170 square miles

Datum of gage: 878.14 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02335000&PARAMeter_cd=00065,00060,00062

Chattahoochee River above Roswell, GA (02335450)

Latitude: 33°59'09"/Longitude: 84°18'58"/Datum: NAD27

Fulton County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,220 square miles

Datum of gage: 858.01 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02335450&PARAMeter_cd=00065,00060,00062

Chattahoochee River at Atlanta, GA (02336000)

Latitude: 33°51'33"/Longitude: 84°27'16"/Datum: NAD83

Fulton County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,450 square miles

Datum of gage: 750.10 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02336000&PARAMeter_cd=00065,00060,00062

Congaree River at Columbia, SC (02169500)

Latitude: 33°59'35"/ Longitude: 81°03'00"/Datum: NAD27

Lexington County, South Carolina

Hydrologic Unit 03050110

Drainage area: 7,850 square miles

Datum of gage: 113.02 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/sc/nwis/uv/?site_no=02169500&PARAMeter_cd=00065,00060,00062

Tallapoosa River at Wadley, AL (02414500)

Latitude: 33°07'00"/ Longitude: 85°33'39"/Datum: NAD27

Randolph County, Alabama, Hydrologic Unit 03150109

Drainage area: 1,675.00 square miles

Datum of gage: 599.87 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/al/nwis/uv/?site_no=02414500&PARAMeter_cd=00065,00060

Tallapoosa River at New Site, AL (Horseshoe Bend) (02414715)

Latitude: 32°58'38"/ Longitude: 85°44'23"/Datum: NAD27

Tallapoosa County, Alabama

Hydrologic Unit 03150109

Drainage area: 2,058.00 square miles

Datum of gage: 528.62 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/al/nwis/uv/?site_no=02414715&PARAMeter_cd=00065,00060

Ocmulgee River near Jackson, GA (02210500)

Latitude: 33°18'28"/Longitude: 83°50'18"/Datum: NAD27

Butts County, Georgia

Hydrologic Unit 03070103

Drainage area: 1,420 square miles

Datum of gage: 419.29 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02210500&PARAMeter_cd=00065,00060,00062

Ocmulgee River at Macon, GA (02213000)

Latitude: 32°50'19"/ Longitude: 83°37'14"/Datum: NAD83

Bibb County, Georgia

Hydrologic Unit 03070103

Drainage area: 2,240 square miles

Datum of gage: 269.80 feet above NGVD29.

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02213000&PARAMeter_cd=00065,00060,00062

Noses Creek at Powder Springs Road at Powder Springs, GA (02336968)

Latitude: 33°51'33"/Longitude: 84°39'10"/Datum: NAD27

Cobb County, Georgia

Hydrologic Unit 03130002

Drainage area: 44.5 square miles

Datum of gage: 882.8 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02336968&PARAMeter_cd=00065,00060,00062

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 910/130034, October 2015

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