ATTACHMENT 5

Etowah River Basin Profile

The Etowah River Basin is located in the northwestern portion of the Metro Water District and represents 24 percent of its total area and 63 percent of the overall HUC-8 Basin area. With 1,183 square miles, it is the largest river basin in the District, entering the District at the northern border of Forsyth County and exiting at the western edge of Bartow County, where it soon joins the Oostanaula River to form the Coosa River. There are portions of 22 cities and the following six counties within the District-portion of the Basin: Bartow, Cherokee, Cobb, Forsyth, Fulton and Paulding. As illustrated on Figure A-1, some of the larger cities include Acworth, Canton, Cartersville, Dallas, Kennesaw, Milton, Mountain Park and Woodstock. Lake Allatoona, located on the mainstem of the Etowah River in the center of this basin, is managed by the U.S. Army Corps Engineers and is a significant recreational destination and water supply source within the District, state and Southeast U.S.

Physical and Natural Features

Geography

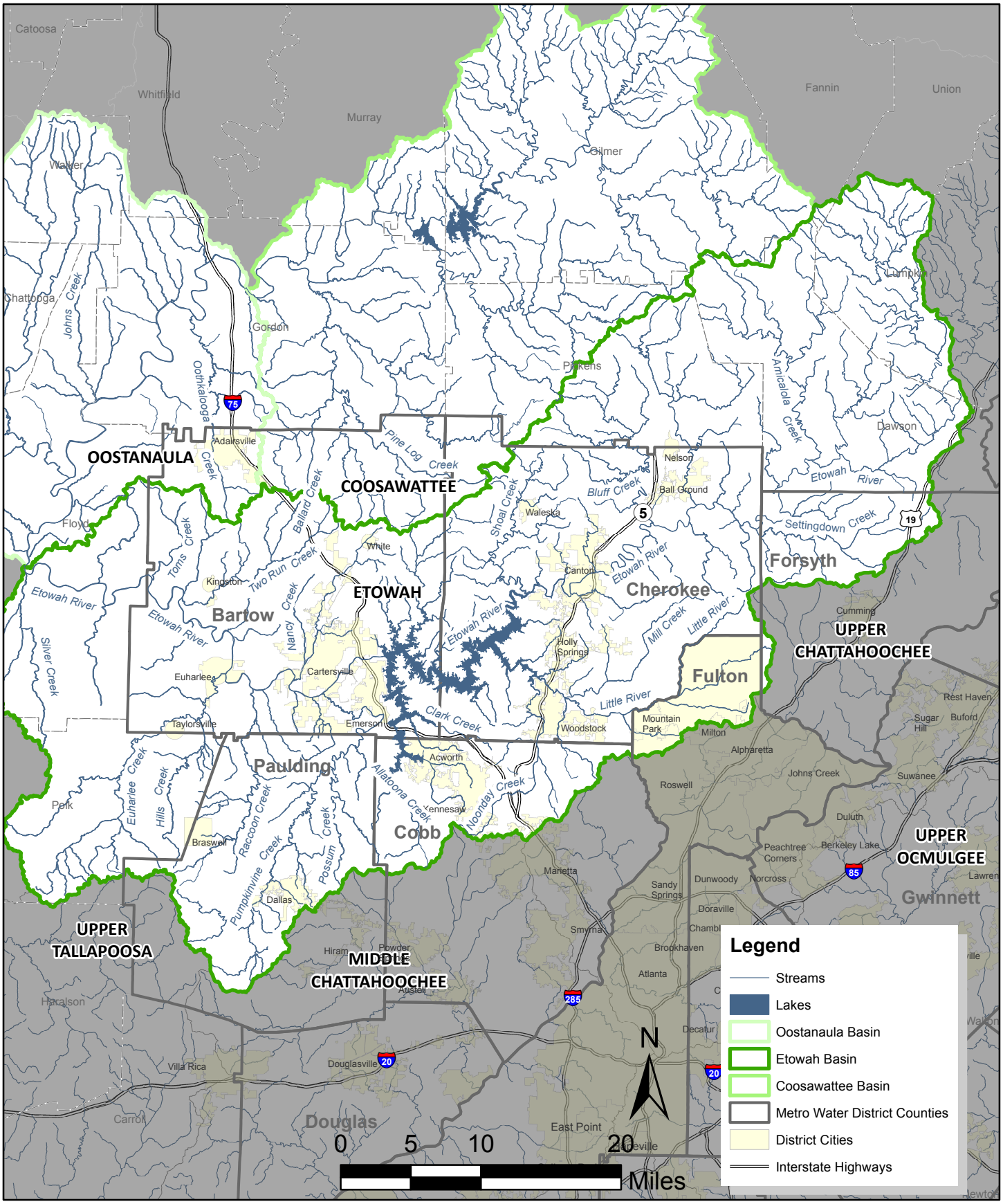
The Etowah River has its headwaters in the Blue Ridge Mountains north of the Metro Water District, northwest of Dahlonega in Lumpkin County. The Etowah River flows southwest to the confluence of the Oostanaula River in Rome, Georgia in Floyd County (Figure ER-1). The Etowah River is entirely within the Piedmont and Valley Ridge provinces, which consist of a series of rolling hills and occasional isolated mountains; however, there are six physiographic districts, making the topography and hydrology highly variable. The Etowah River Basin includes portions of the Blue Ridge Mountains, Central Uplands, Cherokee Uplands, Dahlonega Uplands, Hightower-Jasper Ridges and Great Valley physiographic districts (Metro Water District, 2002).

Hydrology and Soils

The Etowah River joins with the Oostanaula River to form the Coosa River in Rome, Georgia. The Coosa River continues to the southwest, joining the Alabama River north of Montgomery, Alabama before entering the Gulf of Mexico at Mobile Bay. The main tributaries feeding the Etowah River Basin through the Metro Water District include Allatoona Creek, Little River, Settingdown Creek, Noonday Creek, Pumpkinvine Creek, Raccoon Creek, Shoal Creek and Hickory Log Creek. In contrast to the mainstem Etowah River, with the exception of Lake Allatoona, Hickory Log Reservoir, Hollis Q. Latham Reservoir, various NRCS watershed lakes, and other drainage structures, the majority of its tributaries remain free-flowing within this basin. Groundwater availability is limited due to geologic conditions, which restrict the potential yield for water supply.

The flow of the Etowah River through the Metro Water District is regulated primarily by Allatoona Dam, a federal impoundment forming Lake Allatoona, which is operated by the U.S. Army Corps of Engineers. Lake Allatoona has a drainage area of 1,100 square miles, and extends from Allatoona Dam about 43 miles up the Etowah River. Constructed in the 1940s, Lake Allatoona is a multi-purpose reservoir that provides flood protection, power production, water supply, navigation, recreation and fish and wildlife management. It is the second largest reservoir in the District (as well as Georgia) and provides approximately 14 percent of the District's water supply, either through direct withdrawals or downstream releases.

FIGURE ER-1
Etowah River Basin within the Metro Water District



Stream discharges are recorded at U.S. Geological Survey (USGS) station #02392000, the Etowah River at Canton, and #02394000, the Etowah River at Allatoona Dam above Cartersville (USGS, 2015). USGS station #02392000 upstream at Canton has recorded annual flows ranging from a low of 175 cubic feet per second (cfs) to a high of 3,670 cfs, with a mean flow of 966 cfs over the 87-year period of record. The Etowah River Basin is divided into 15 10-digit HUCs and a total of 66 12-digit HUCs. A table of the 12-digit HUCs for the basin is provided in Attachment 10.

An assessment of the availability of groundwater resources in select prioritized aquifers of Georgia was completed as part of Georgia's Comprehensive State-wide Water Management Plan (Georgia EPD, 2010). Within the Etowah River Basin, portions of Bartow and Paulding Counties were included due to the potential of the Valley and Ridge physiographic province of paleozoic rock aquifers. It found that the paleozoic rock aquifer in northwestern Georgia could provide a potential sustainable yield ranging from 27 to 70 million gallons per day.

The Georgia Geologic Survey Hydrologic Atlas 18 database identifies approximately 84 areas, representing about 15 percent of the Metro Water District, likely to contain thick soils considered to be an indicator of significant groundwater recharge areas. The recharge areas were mapped based on outcrop area, lithology, soil type and thickness, slope, density of lithologic contacts, geologic structure, the presence of karst and potentiometric surfaces. There are approximately 198 square miles, or 17 percent of the total basin area, of potential recharge areas within the Etowah River Basin, (see Table ER-1).

Table ER-1. Groundwater Recharge Areas within the Etowah River Basin

Recharge Area Type	County [a]	Square Miles of Recharge Area Type within County
Probable Areas of Thick Soil	Bartow	2
	Cherokee	11
	Cobb	14
	Forsyth	14
	Fulton	4
	Paulding	7
Unconfined Aquifer	Bartow	145
	Paulding	<1
Total Recharge Areas		198 [b]

[a] Portions of Bartow, Cobb, Cherokee, Forsyth, Fulton and Paulding Counties overlap the basin boundary.

[b] Minor differences in mapping methodologies may cause basin totals to vary slightly from county totals.

There are 10 soil associations that describe the soil types in the Etowah River Basin; Cecil-Madison-Pacolet and Madison-Davidson-Pacolet are the dominant soil types (Table ER-2). The Cecil-Madison-Pacolet and Madison-Davidson-Pacolet associations were the most abundant, with the former types associated with moderate rolling hills and the latter with steeper terrain. These soils are well drained and highly weathered, having a red to yellowish-red subsoil (Brock, 1977; Jordan et al., 1973; Murphy, 1979; Thomas and Tate, 1973; USDA, 1976; Thomas, 1982; Wells, 1961; Robertson et al., 1960; USDA, 1958; Tate, 1967; Thomas and Tate, 1964). The Saluda-Edneytown-Evard association was found in Cherokee County north of Lake Allatoona. These soils are very deep, well drained and associated with ridges and side slopes (Thomas and Tate, 1973; USDA, 1976; Thomas, 1982; USDA, 1958).

Table ER-2. Major Soil Associations within the Etowah River Basin

Soil Association	Significance to Watershed Management
Cecil-Madison-Pacolet	Characteristics: Associated with moderate rolling hills, well drained, highly weathered. Significance to Watershed Management: Sloping surfaces may be more susceptible to increased erosion due to stormwater runoff velocities from impervious surfaces; well-drained soils may be more permeable which increases infiltration capacity in areas without impervious cover, also may improve feasibility for infiltration practices.
Madison-Davidson-Pacolet	Characteristics: Associated with steep terrain, well drained, highly weathered. Significance to Watershed Management: Steep terrain may be more susceptible to increased erosion due to stormwater runoff velocities from impervious surfaces; well-drained soils may be more feasible for infiltration practices.
Saluda-Edneytown-Evard	Characteristics: Associated with shallow to very deep, well drained, moderately permeable soils located on ridges or side slopes. Significance to Watershed Management: Well-drained soils may be more permeable, which increases infiltration capacity in areas without impervious cover, also may improve feasibility for infiltration practices.
Etowah-Fullerton-Rome	Characteristics: Associated with very deep, well drained, moderately permeable soils on high stream terraces with medium runoff. Significance to Watershed Management: Well-drained soils may be more permeable, which increases infiltration capacity in areas without impervious cover, also may improve feasibility for infiltration practices. Deep soils have the capacity to store more water for potential groundwater recharge.
Fullerton-Shack-Chewacla	Characteristics: Associated with very deep, moderately to poorly drained, moderately permeable soils located on side slopes and valleys. Significance to Watershed Management: Poorly drained soils are less feasible for infiltration, restricted water drainage.
Shack-Fullerton-Bodine	Characteristics: Associated with very deep, moderately to excessively well drained, moderately permeable soils located mainly on uplands. Significance to Watershed Management: Well-drained soils may be more permeable, which increases infiltration capacity in areas without impervious cover; deep soils have the capacity to store more water for potential groundwater recharge.
Townley-Fullerton-Montevallo	Characteristics: Moderately deep, well-drained, slowly permeable soils on upland ridgetops and side slopes. They formed in clayey residuum weathered from shale or interbedded sandstone and shale. Slope ranges from 2-45%. Significance to Watershed Management: Well-drained soils may improve feasibility for infiltration practices. Sloping surfaces may be more susceptible to increased erosion due to stormwater runoff velocities from impervious surfaces.
Tallapoosa-Chewacla-Madison	Characteristics: Silty sand, clayey-sand, clay, steep terrain, well-drained, weathered material. Significance to Watershed Management: Limited capacity for infiltration due to shallow bedrock and steep slope; infiltration is limited. Very slow infiltration rate. These soils have a very slow rate of water transmission.
Etowah-Whitwell-Chewacla	Characteristics: Consists of very deep, poorly to well-drained, moderately permeable soils located on low and high stream terraces, alluvial fans and foot slopes. Slopes range from 0-35%. Significance to Watershed Management: Well-drained soils may improve feasibility for infiltration practices; poorly drained soils are less feasible for infiltration, restricted water drainage. Deep soils have the capacity to store more water for potential groundwater recharge.

Table ER-2. Major Soil Associations within the Etowah River Basin

Soil Association	Significance to Watershed Management
Dekalb-Tallapoosa-Chewacla	Characteristics: Shallow to very deep, poorly to excessively drained, moderately to rapidly permeable soils. Formed in material weathered from gray and brown acid sandstone in places interbedded with shale and greywacke. Slope ranges from 0-80%. Significance to Watershed Management: Sloping surfaces may be more susceptible to increased erosion due to stormwater runoff velocities from impervious surfaces; well-drained soils may improve feasibility for infiltration practices; poorly drained soils are less feasible for infiltration, restricted water drainage.
Ashe-Tusquitee-Edneytown	Characteristics: Moderately to very deep, moderately permeable, well-drained soils on gently sloping to very steep ridges and side slopes. Slope ranges from 2-95%. Significance to Watershed Management: Sloping surfaces may be more susceptible to increased erosion due to stormwater runoff velocities from impervious surfaces; well-drained soils may improve feasibility for infiltration practices.
Madison-Tallapoosa-Hayesville	Characteristics: Shallow to very deep, well-drained, moderately permeable soils that formed in residuum weathered from felsic or intermediate, high grade metamorphic or igneous rocks high in mica content. Slope ranges from 2-80%. Significance to Watershed Management: Well-drained soils may improve feasibility for infiltration practices. Sloping surfaces may be more susceptible to increased erosion due to stormwater runoff velocities from impervious surfaces. Deep soils have the capacity to store more water for potential groundwater recharge.
Urban Soils	Characteristics: Highly disturbed and compacted soils created as a result of human activity, vertical and spatial variability. Significance to Watershed Management: Compacted soils; poorly drained, soils are less feasible for infiltration, restricted water drainage.

Protected Species

Protected species include all species listed as threatened or endangered by the USFWS or National Marine Fisheries Service, and those listed as endangered, threatened, rare or unusual by the state of Georgia. The USFWS also may designate critical habitat for a federally listed species, which provides protection for the habitat as well as the species itself. The current listings of these endangered species, including their status, range and habitat, can be accessed via the USFWS's automated Information, Planning and Conservation System (IPaC, http://ecos.fws.gov/ipac/).

Native Species

Within the Metro Water District, and Etowah River Basin in particular, there are a number of protected species that spend all or part of their life cycle in rivers and streams or depend on streams for a significant portion of their life history. In addition, there are protected plants that are either aquatic or semi-aquatic and grow within or along the margins of rivers and streams. Table ER-3 lists the 21 protected species potentially found within the counties of the Etowah River Basin of the District. Of the 12 protected species of fish found in this basin, seven are various species of darters, potentially indicating reasonably good fish habitat.

Table ER-3. Aquatic and Semi-Aquatic Protected Species in the Etowah River Basin

Fauna Type	Common Name	Status	Bartow	Cherokee	Cobb	Forsyth	Fulton	Paulding
Bird	Bald Eagle	GA		X				
Bird	Bachman's Sparrow	GA					X	
Fish	Cherokee Darter	US	X	X	X		X	X
Fish	Etowah Darter	US	X	X				X
Fish	Coosa Chub	GA	X	X				
Fish	Frecklebelly Madtom	GA		X				
Fish	Freckled Darter	GA		X				
Fish	Lined Chub	GA	X					X
Fish	Rock Darter	GA	X	X				
Invertebrates	Cylindrical Lioplax	US	X					
Invertebrates	Finelined Pocketbook	US						X
Invertebrates	Etowah Crayfish	GA		X				

Trout Streams

Trout streams are classified in accordance with the primary and secondary designations and criteria defined in Section 15 of Georgia's Water Use Classifications and Water Quality Standards (391-3-6-.03). Streams designated as primary trout streams are waters supporting a self-sustaining population of Rainbow, Brown or Brook Trout. Streams designated as secondary trout streams are those with no evidence of natural trout reproduction, but are capable of supporting trout throughout the year. Seasonal secondary trout streams are located in Boston Creek in Bartow County and Cherokee County upstream of Georgia Highway 20. Seasonal secondary trout streams are located on Pumpkinvine Creek and Raccoon Creek in Paulding County. Year-round trout streams are located in the following Bartow County streams: Connesena Creek, Dykes Creek, Pine Log Creek, Pyle Creek, Salacoa Creek, Spring Creek, Stamp Creek, upstream from Bartow County Road 269, Toms Creek upstream Bartow County Road 82, Two Run Creek and Ward Creek. Year-round trout streams are located in the following Cherokee County streams: Bluff Creek, Pine Log Creek, Salacoa Creek. Soap Creek, Stamp Creek and Wiley Creek. Year-round trout streams are located in the following Paulding County streams; Possum Creek, Powder Creek, Pyle Creek, Thompson Creek and Ward Creek.

Land Use and Impaired Waterbodies Characteristics

Drinking Water Supply

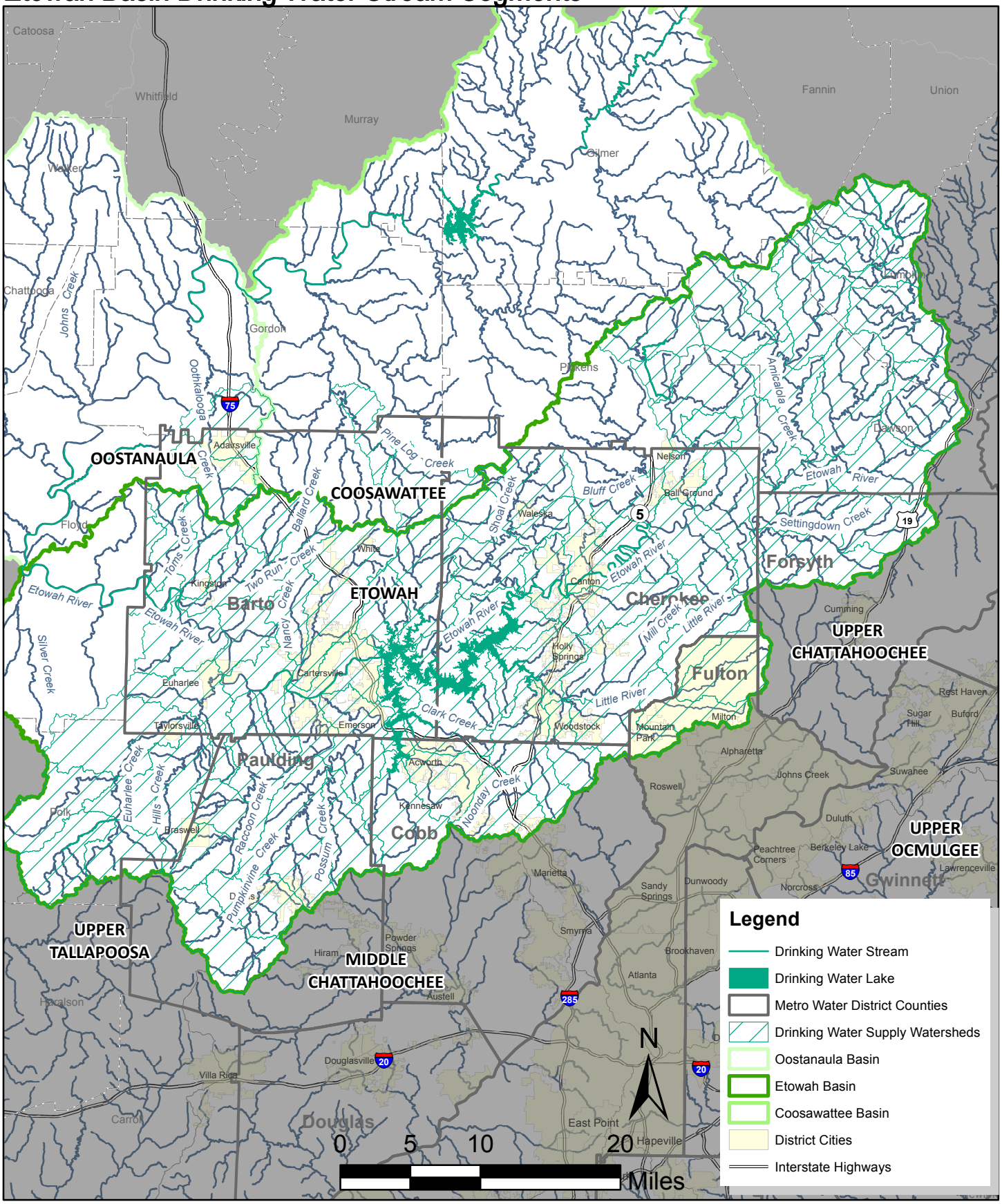
As described in the Water Supply and Water Conservation Plan, the Etowah River Basin is a primary drinking water supply source for several of the Metro Water District counties including Bartow, Cherokee, Cobb, Forsyth and Paulding. Withdrawals from this basin provide approximately 14 percent of the District's total public water supplies. Approximately 71 miles, or 10 percent, of the assessed streams in the basin are designated for drinking water and thus must meet the corresponding state criteria to achieve their designated uses. Table ER-4 lists the water supply sources and Figure ER-2 shows their corresponding water supply watersheds and those waters that are designated to meet state drinking water criteria within the Etowah River Basin.

Source water assessments were performed for all drinking water supplies within the Etowah River Basin as required by EPA. The source water assessments determined the potential for pollution based on a number of watershed characteristics and assigned a susceptibility ranking to each source. The susceptibility rankings throughout the basin were medium for Allatoona Creek and Etowah River. These susceptibility rankings indicate the suburban and rural nature of most of the watersheds within the Etowah River Basin.

Table ER-4. Etowah River Basin Drinking Water Supply Sources

Water Supply Source	Owner/Operator Using Source
Etowah River	City of Canton City of Cartersville
Etowah Watershed Reservoir	Fulton County
Etowah River/Yellow Creek (Hollis Q. Lathem Reservoir)	Cherokee County Water and Sewerage Authority
Etowah River/Hickory Log Creek	Cobb County-Marietta Water Authority City of Canton
Allatoona Lake	Cobb County-Marietta Water Authority City of Cartersville
Etowah River/Richland Creek	Paulding County
Moss Springs	City of Emerson
Bolivar Springs	Bartow County
Bannister Creek	Forsyth County
Etowah Watershed Reservoir	Forsyth County

FIGURE ER-2
Etowah Basin Drinking Water Stream Segments



Land Cover/Land Use

Draining the northwestern portion of the Metro Water District, the central portion of the Etowah River Basin is bisected by Interstates 75 and 575, while its headwaters are crossed by Georgia 19 (GA 400) in northern Forsyth County. It also includes major east/west corridors, such as Georgia Highways 20 and 92 and the corresponding development that accompanies them. Approximately 76 percent of the basin remained undeveloped in 2012, including 59 percent as forested or open space lands, 1 percent as water or wetlands and 16 percent was being used for agricultural purposes. Almost one-fifth, 18 percent, of the Etowah River Basin was classified as residential, primarily either low- or medium-density. Most of these residential lands, as well as the commercial and industrial lands in this basin, are clustered around the Cities of Marietta, Acworth, Woodstock, Canton and Cartersville (Table ER-5, Figure ER-3).

Table ER-5. Etowah Basin Land Cover / Land Use within the Metro Water District

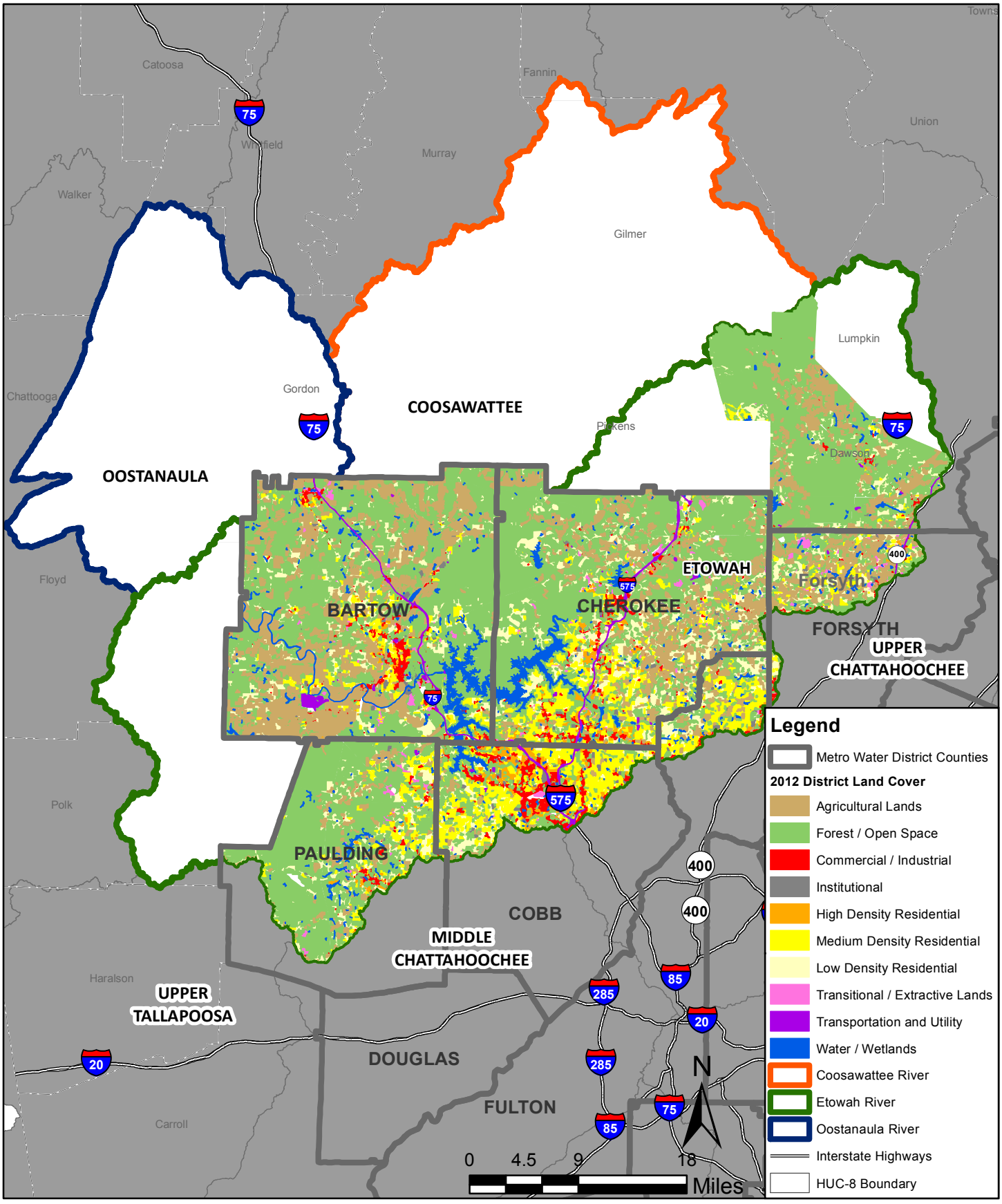
Land Cover/Land Use	2012 Existing (%)
Agricultural Lands	16
Commercial	3
Forest/Open Space	59
High Density Residential	1
Industrial/Institutional	0
Low Density Residential	9
Medium Density Residential	8
Transitional/Extractive Lands	2
Transportation and Utilities	1
Water/Wetlands	1
Undeveloped	76
Developed	24

Notes: Undeveloped = Agricultural, Forest / Open Space and Water / Wetlands

Data Source: Aggregated Land Cover categories from ARC's 2012 LandPro Geographic Information System (GIS)

Over the course of the planning horizon, the basin is expected to have moderate to steady growth based on population projections. The relative percent distribution and general character of these growth areas are illustrated in Figure ER-4. Much of this growth is anticipated to occur in the southern portion of the basin as infill development and redevelopment resulting in increased density in Cherokee, Cobb, Forsyth and Fulton Counties, with slow to moderate growth in the existing developed areas of Bartow and Paulding Counties

FIGURE ER-3
Etowah River Basin 2012 Land Cover



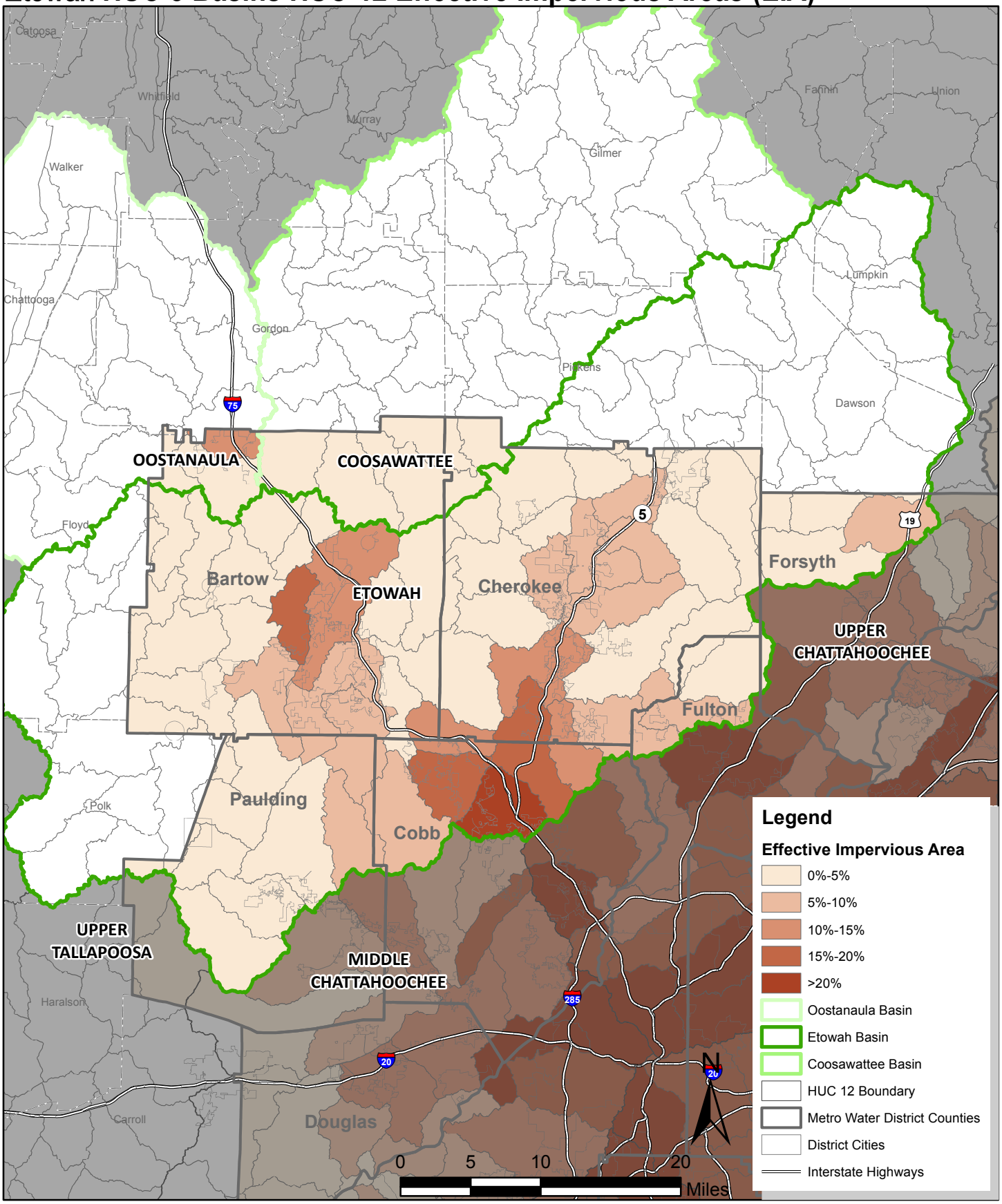
Effective Impervious Areas

The level of watershed imperviousness has long been linked to impacts on changes in hydrologic regimes that lead to increased intensity and frequency of peak stormwater flows, which affect stream stability, water quality and aquatic habitat and biotic community integrity. In general, the most sensitive aquatic organisms are affected at impervious levels greater than 10 percent. Between 11 and 25 percent of most stream communities become impacted, and over 25 percent of streams are generally no longer able to support viable biotic communities (Schueler, 2001). Of the 66 HUC-12s within the Metro Water District portion of Etowah River Basin, nine had an effective impervious area (EIA) greater than 10 percent, primarily those HUCs that either straddle a major transportation corridor such as the Interstate 75 / Interstate 575 interchange, or the HUCs include the more densely urbanized areas of the cities of Acworth and Cartersville (Figure ER-4). Attachment 10 lists HUC-12 watershed numbers and descriptions.

Combined-sewer Overflow Areas

There are no combined-sewer overflow areas in the Etowah River Basin.

FIGURE ER-4
Etowah HUC-8 Basins HUC-12 Effective Impervious Areas (EIA)



Impaired Waterbodies

Georgia EPD determines whether a waterbody is supporting its designated uses by collecting water quality data and comparing this data against the water quality criteria. Georgia EPD describes their listing methodology and "preferred minimum dataset" at http://epd.georgia.gov/georgia-305b303d-list-documents. This methodology is important to understand the sample size, extent and timeframe of the dataset that was used to list a waterbody. Feedback can be given to Georgia EPD if additional data or information are known that may affect future sampling or listing evaluations.

Of the 537 stream miles assessed in the Metro Water District portion of the Etowah River Basin, 305 miles, or 57 percent, did not meet state water quality standards based on the 2014 303(d) list. The streams listed as not supporting are summarized in Table ER-6 by parameter and graphically shown in Figure ER-5. Several streams are listed for violations of more than one parameter; therefore, the total of impaired miles by parameter will not equal the miles of not supporting stream.

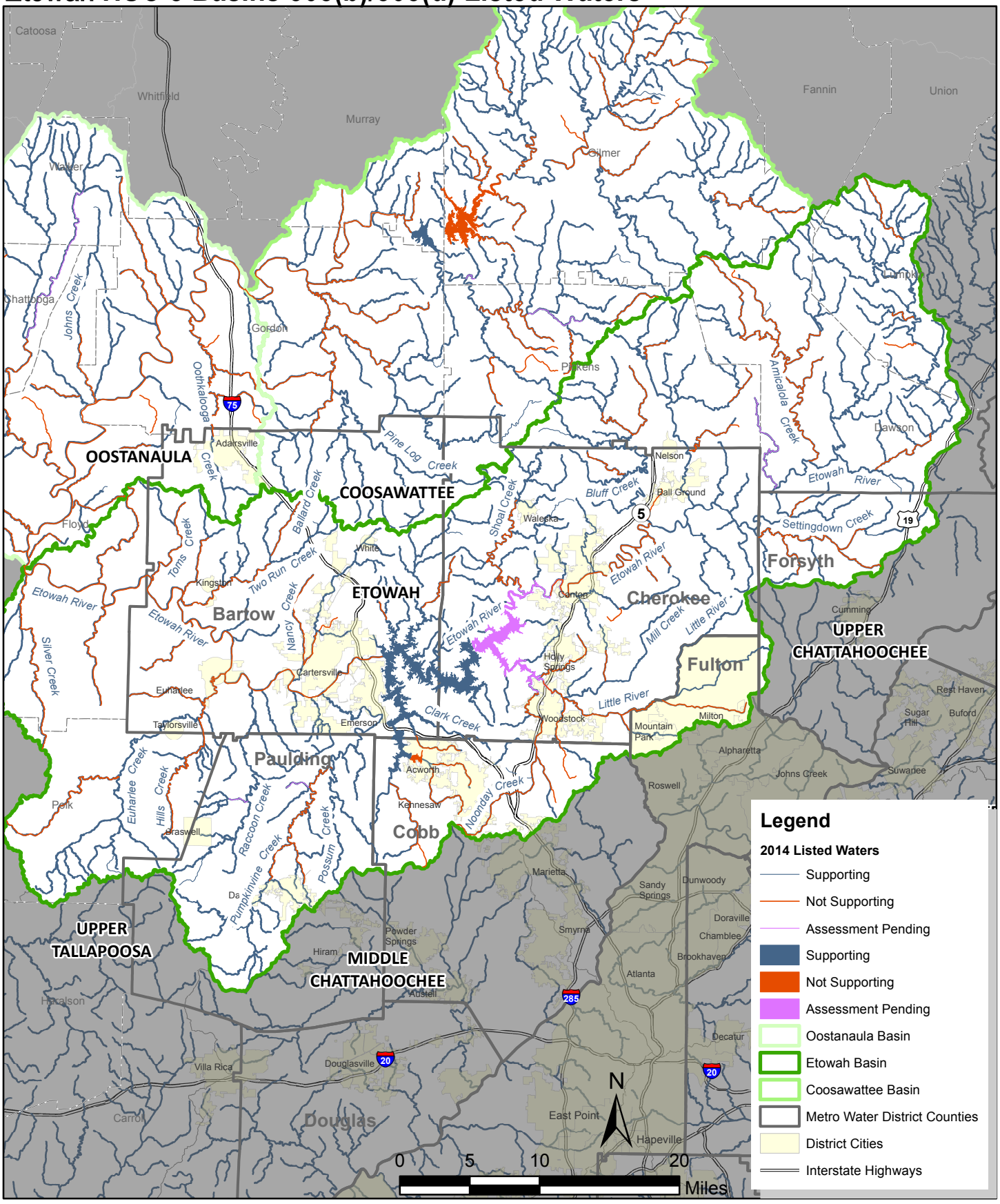
Table ER-6. Etowah River Basin Summary of Impaired Streams

Criterion Violated	Miles of Stream	% of 2014 Assessed Streams
Fecal Coliform Bacteria	165	31
Biota (Fish Community)	152	28
Biota (Macroinvertebrate Community)	36	7
Commercial Fishing Ban	44	8
Fish Consumption Guidance (polychlorinated biphenyls)	48	9
Dissolved Oxygen	6	1
Total Impaired Stream Mileage[a]	305	57
Total Mileage Assessed for Possible Impairment	537	
Total Stream Mileage in Basin	1,474	

[a] Several streams are listed for violations of multiple parameters within the same stream segment; therefore, the total of impaired miles by parameter will not equal the total stream mileage of impaired streams.

The majority of assessed streams in the Etowah River Basin do not meet water quality standards for either fecal coliform bacteria (31 percent) or biota (fish community [28 percent]) as a result of nonpoint source pollution. Lake Acworth does not meet water quality standards for fecal coliform bacteria as a result of urban runoff. These bacteria enter the stream from both anthropogenic and non-anthropogenic sources, including sanitary sewer overflows, leaking sewer lines, failing septic systems and pet/wildlife waste. Fecal coliform typically is found in both developed and undeveloped watersheds, and monitoring programs in Georgia have found levels that exceed state standards in urban, agricultural and forested areas (Georgia EPD, 2011). While fecal coliform is ubiquitous in streams across the country (Georgia EPD, 2011), concentrations of bacteria can increase as a result of the higher density of potential pollutant sources and decreased stormwater filtration and stormwater treatment from population growth and development. Biota listings typically indicate high sediment loads in streams, which decreases habitat quality for benthic macroinvertebrates and fish. Sediment sources include runoff from construction sites as well as from streambank erosion due to accelerated streamflow velocities from impervious cover associated with urbanization. Additionally, the following four stream segments, located west of Lake Allatoona, are listed for Commercial Fishing Ban as a result of legacy polychlorinated biphenyl levels: Connesena Creek, Toms Creek, Two Run Creek and Etowah River from Highway 441 to Coosa River.

FIGURE ER-5
Etowah HUC 8 Basins 305(b)/303(d) Listed Waters



Lake Allatoona has a designated use of Recreation and Drinking Water with corresponding chlorophyll a and total nitrogen criteria. A portion of the lake, the Etowah River arm and Little River Embayment are pending assessment of the designated uses of Recreation and Drinking Water by meeting state water quality standards for chlorophyll a. A total of 69 percent of Lake Allatoona is listed as supporting its designated use. When Georgia EPD completed modeling to establish total maximum daily loads (TMDLs) to address these exceedances and preliminary load reductions were applied, the growing season average chlorophyll a levels were still occasionally above 5.0 micrograms per liter at some locations; therefore, Georgia EPD has reevaluated the chlorophyll a criteria at these locations (Georgia EPD, 2013).

TMDLs and TMDL Implementation Plans have been developed to help jurisdictions address impaired streams and specific parameters of concern. More information on specific TMDLs in the Etowah River Basin can be found on the Georgia EPD website.

Management Issues and Recommendations

Initial Screening of Priority Areas

Within the Metro Water District, the proposed implementation actions will vary between basins depending on the existing land uses, water quality, stream and waterbody condition and other watershed-specific management issues. The timeframe for implementation will also vary based on a variety of factors such as TMDL listings, presence of source water watersheds and potential for significant development in the future. Priority areas, also known as critical areas per EPA guidance, were identified at the District-level by HUC-12 watershed as an initial screening to enable communities to perform more detailed prioritizations on a subwatershed basis. The priority areas were identified at the HUC-12 level in Table ER-7, if they include a stream or waterbody with a TMDL, water supply watersheds or existing EIA greater than 10 percent.

Table ER-7. Etowah River Basin Initial Screening of Priority Areas Based on HUC-12 Watersheds

Total HUC-12 Watersheds (Etowah River Basin)	Watersheds that Include a 303(d)-listed Stream (TMDL)	Water Supply Watersheds [a]	Existing Effective Impervious Cover (EIA > 10%)
66	48	64	9
Percent of Total Watersheds	73%	97%	14%

[a] Water Supply Watersheds represent HUC-12 watersheds that drain to a water supply intake. Many of the HUC-12s do not actually contain any water supply intakes.

Management Issues and Recommended Strategies

Table ER-8 outlines management issues and strategies for the Etowah River Basin within the Metro Water District. These issues and strategies were used to inform and guide the more specific management measures and requirements found in Sections 5, 6 and 7. The recommended strategies presented in Table ER-8 are based on data presented within this River Basin Profile. These strategies are provided to further describe the commonality of causes and potential solutions to the watershed issues. They provide a foundation for guidance, but are not presented here as mandatory requirements.

Table ER-8. Etowah River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
Source water quality	Source water watershed protection of Lake Allatoona, Etowah River and small water supply watersheds.	• Implement source water protection measures in all subwatersheds draining to Lake Allatoona.

Table ER-8. Etowah River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
		• Continue collaborative efforts in small drinking water supply watersheds to protect the viability of these supplies.
Nutrient loading	Portions of Lake Allatoona are pending assessment for chlorophyll a standards; therefore, Georgia EPD is in the process of reevaluating the chlorophyll a criteria.	• Implement post-construction stormwater controls and infiltration practices to reduce NPS pollutants associated with multiple land uses, particularly suburban/urban and agricultural. • Educate the public on NPS pollution reduction and proper fertilizer application and the impacts of excess nutrients on the lake and local economy. • Evaluate restrictions on sale of certain fertilizers. • Coordinate with Georgia EPD's NPS Program to develop nutrient management plans and strategies to reduce nutrient loading from animal feeding operations in concentrated production regions, as funding allows. • Participate in efforts to educate agricultural stakeholders about the importance of implementing Best Management Practices for Georgia Agriculture Manual for animal production facilities (poultry) and grazing operations. • Coordinate with Georgia Department of Agriculture Livestock/Poultry Section on inspections, complaint investigations, nutrient management plan reviews, permit administrative support and enforcement assistance (Georgia EPD, 2014).
Increases in impervious cover (new development)	Increases in impervious cover can lead to a change in the hydrologic regime of a watershed by causing more intense, high-velocity stormwater flows and increased erosion and sedimentation. 9 (14%) HUC-12 watersheds with EIA> 10%. 5% shift from undeveloped to developed land cover (2010 - 2040).	• Manage nonpoint source pollution. • Adopt and enforce the post-construction stormwater control ordinance and use of Georgia Stormwater Management Manual design standards. • Watershed improvement projects, such as stream restoration and streambank stabilization, are recommended in areas with failing stream banks to reduce instream sediment load contributions.
Inadequate stormwater controls on existing impervious cover	Much of the development in the basin occurred prior to current Georgia Stormwater Management Manual design standards. Limited resources and cost of maintaining and repairing stormwater infrastructure. Varying local strategies of funding stormwater management.	• Implement an asset management program to identify and prioritize maintenance and capital improvement projects to maximize benefit. • Consider updating stormwater controls during redevelopment. • Identify opportunities for watershed improvement projects to retrofit or install updated stormwater controls, green infrastructure, stormwater treatment or other controls. • Consider dedicated funding sources, such as stormwater utilities, and seek out opportunities for grants, loans and partnerships.
Aquatic resources	Several secondary trout streams are located within the Etowah River Basin.	• Balancing nonpoint source temperature inputs from tributaries with natural cold water base flows to meet secondary trout stream criteria.

Table ER-8. Etowah River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
Biota TMDLs	28% of assessed instream fish communities and 7% of the benthic macroinvertebrate communities are impaired. Biota impairment in this basin are the result of high sediment loads, primarily associated with existing development with inadequate stormwater controls, which is a concern for drinking water source supplies, biota and recreation.	• Enforce post-construction stormwater ordinance on new development and seek opportunities to retrofit stormwater controls to maximize water quality and channel protection. • Recommend watershed improvement projects, such as stream restoration and streambank stabilization, in areas with failing stream banks to reduce instream sediment load contributions.
Bacteria TMDLs	31% of assessed stream segments in the Etowah River Basin (within the Metro Water District) are listed for fecal coliform.	• Identify bacteria sources through inspections, monitoring, source tracing and stream walks. • Educate public on pollution prevention, proper septic system maintenance and reporting a potential illicit discharge. • Address fecal coliform bacteria contributions from sanitary sewer overflows as outlined in the Wastewater Management Plan. • Perform regular maintenance to ensure proper functioning of decentralized systems (such as septic tanks) near the Etowah River and Lake Allatoona.
Lake Management	Lake Allatoona is the largest lake within this basin. There are 303(d) assessments pending for potential chlorophyll (a) exceedances in the Little River Embayment. There are also other publicly and privately held and managed lakes that play a significant role in meeting designated uses, water supply needs and downstream hydrologic regimes. Other major reservoirs and lakes are found in Table ER-4.	• Develop a central inventory of lakes, ownership and management practices to facilitate pollutant source identification both up and downstream of the lake. • Coordinate available water quality data and management activities for inventoried lakes. • Implement shoreline protection and upstream sediment management to prevent excessive nutrients and sedimentation within the lake. • Facilitate proper maintenance and management, by providing resources, links or other materials to assist with periodic activities, such as inspections, water quality sampling or dredging. • Conduct public education and involvement activities to promote watershed stewardship to protect lake quality.

NPS = nonpoint source pollution

Identify Indicators and Monitoring to Measure Implementation Success

A critical component of any watershed management program is the ability to assess progress and determine if management strategies are effectively addressing issues. The Plan includes implementation actions related to watershed monitoring and conducting conditions assessments to evaluate implementation success. These implementation actions include long-term ambient trend monitoring (5.F.1) and habitat and biological monitoring (5.F.2), as well as resource-specific implementation actions for TMDL Management (4.H.2). Communities may choose to conduct project-specific monitoring associated with a watershed improvement project, such as biological or geomorphological monitoring to evaluate success.

As included in EPA (2008), a monitoring program should "…track progress in meeting load reduction goals and attaining water quality standards and other goals. Measurable progress is critical to ensuring continued

support of watershed projects, and progress is best demonstrated with the use of monitoring data that accurately reflect water quality conditions relevant to the identified problems. Monitoring programs should include baseline (before), project-specific (during) and post-project (after) monitoring."

Some potential indicators to measure implementation success for the Etowah River Basin are listed as follows, but this list is not exhaustive:

- Select representative monitoring stations within the watershed to monitor for pollutants of concern and other water quality or biological parameters.
- Use USGS stream gage data or collect data to establish stream stage-discharge relationships and calculate or model water quality pollutant loads and potential reductions.
- Calculate or model improvements to hydrologic and hydraulic conditions based on structural project implementation.
- Estimate streambank stability and habitat improvement based on annual stream cross section surveys and bank erosion monitoring.
- Conduct stream walks or structure inspections to inventory structure condition and performance, streambank stability and riparian condition over time.
- Conduct project monitoring to establish pre-, during- and post-project conditions, as well as upstream/downstream monitoring during the same time period to reduce the effects of environmental variability.
- To determine if water quality degradation is being prevented, conduct GIS analysis to identify high-activity areas of a watershed using aerial overlays, work orders, facility inspection, erosion and sedimentation control or new construction inspection data. Identify if monitoring data and GIS data follow similar patterns.
- Track number, location, size or features (that is, drainage area treated or linear feet of restored stream) of watershed improvement, green infrastructure or other nonpoint source reduction projects.
- Compare percentage of TMDL stream segments over time.
- Track implementation actions by jurisdiction within the basin, and their measured effectiveness.
- Track enforcement actions by category and location.
- Track stream buffer variances and local permits issued.
- Conduct public surveys for pollution prevention awareness or education effectiveness, particularly pre- and post-data associated with an education event.
- Compare existing water quality modeled loads against future water quality modeled loads.