ATTACHMENT 2

Middle Chattahoochee River Basin Profile

The Metro Water District represents 30 percent of the overall Middle Chattahoochee River HUC-8 Basin while that portion of this HUC-8 within the District represents 19 percent of the total District area. In spite of the small proportion of the District it represents, the Middle Chattahoochee River Basin serves as the primary receiving water for treated wastewater effluent for over 3.5 million people in the District (Atlanta Regional Commission [ARC], 2010).

Physical and Natural Features

Geography

The Middle Chattahoochee River Basin, HUC-8 #3130002, starts just south of Peachtree Creek in Atlanta and flows southwest, past West Point Lake, to downstream of Lake Harding near Columbus on the Georgia/Alabama state line (Figure A-1). Figure MC-1 illustrates the six counties within the Metro Water District-portion of this river basin (Cobb, Clayton, Coweta, Douglas, Fulton and Paulding) and 18 cities including portions of Atlanta, Marietta, East Point, Fairburn and all of Chattahoochee Hills and Douglasville. The Middle Chattahoochee River Basin within the District covers 915 square miles, which represents 19 percent of the overall District area and 30 percent of the Middle Chattahoochee HUC-8 River Basin area itself.

The Chattahoochee River is entirely within the Piedmont province, which consists of a series of rolling hills and occasional isolated mountains; however, there are six physiographic districts, making the topography and hydrology highly variable. The Middle Chattahoochee River Basin includes portions of the Gainesville Ridge, Greenville Slope and the Winder Slope physiographic districts (Metro Water District and CH2M HILL Engineers, Inc., 2002).

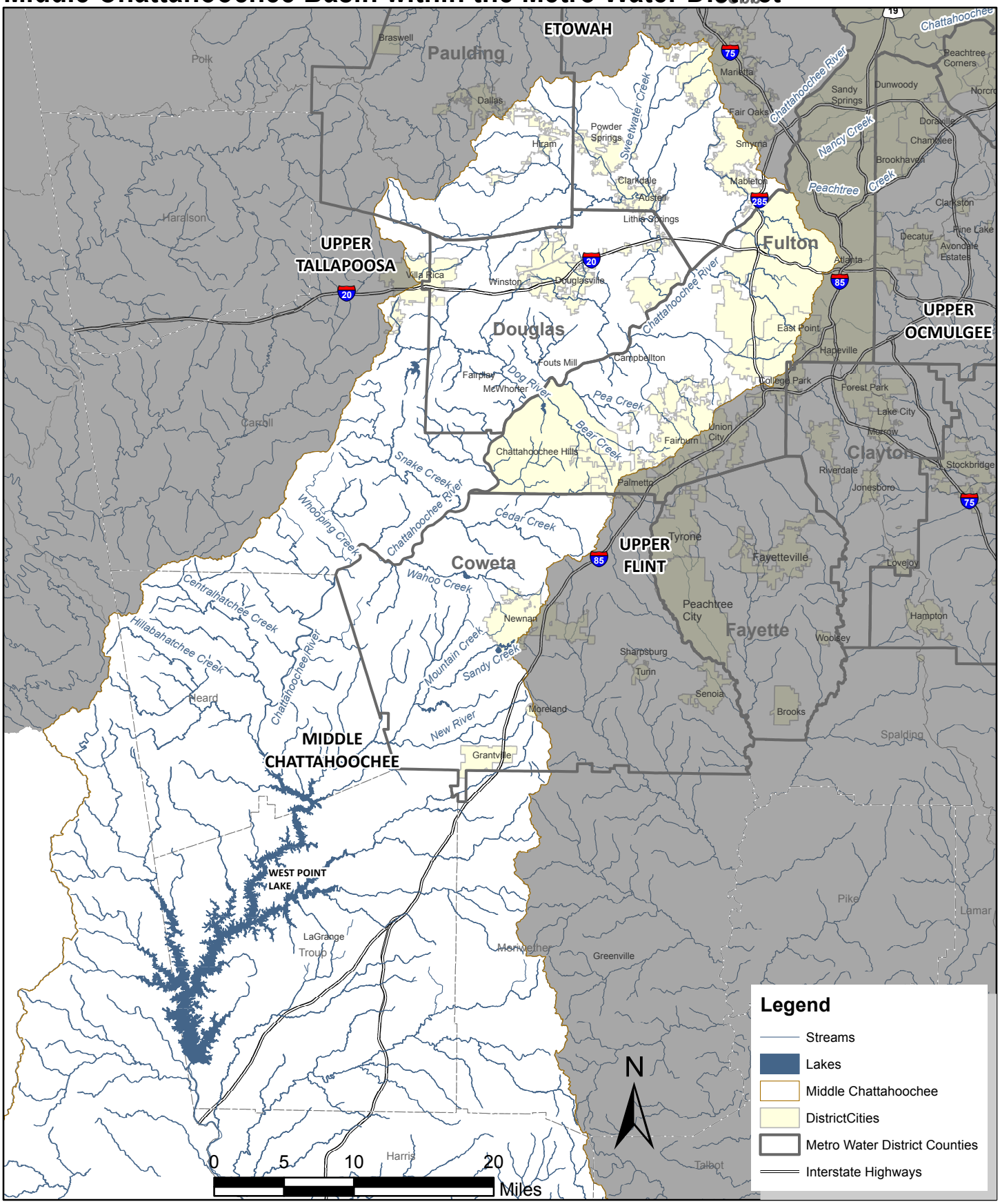
Hydrology and Soils

The Chattahoochee River flows to the Gulf of Mexico after joining with the Flint River to form the Apalachicola River in southern Georgia. West Point Lake is the second major reservoir on the Chattahoochee River system, located just south of the Metro Water District. Authorized in 1962, the U.S. Army Corps of Engineers (USACE) operates West Point for its authorized purposes of flood control, hydroelectric power, navigation, fish and wildlife development and general recreation (USACE, 2015).

The Chattahoochee River within the Metro Water District portion of the Middle Chattahoochee River Basin and the majority of its tributaries remain unimpounded. The main tributaries feeding the Middle Chattahoochee River Basin through the Metro Water District include Proctor Creek, Sweetwater Creek, Anneewakee Creek, Camp Creek, Utoy Creek, Mountain Creek, Cedar Creek, Sandy Creek and New River. Annual average rainfall ranges from 50 to 54 inches per year in the Middle Chattahoochee River Basin, with rainfall generally being lower to the southeast (National Oceanic and Atmospheric Administration, 2015). Measurements recorded near Fairburn indicate annual flows ranging from a low of 1,090 cubic feet per second (cfs) to a high of 18,500 cfs, with a mean flow of 3,250 cfs based on 49 years of record (U.S. Geological Survey, 2015). Water supply reservoirs include the Dog River Reservoir, Cedar Creek Reservoir and J.T. Haynes Reservoir, which provide additional storage capacity.

Surface waters in the Middle Chattahoochee River Basin are designated to have water quality that supports fishing, drinking water or recreation, with the majority designated for fishing.

FIGURE MC-1
Middle Chattahoochee Basin within the Metro Water District



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). Groundwater availability is limited due to geologic conditions, which restrict the potential yield for water supply and therefore none of the Middle Chattahoochee River Basin within the Metro Water District was selected as a priority aquifer for assessment.

The Metro Water District lies almost completely within the Piedmont and the Blue Ridge (Ridge and Valley) geologic provinces. The aquifers in these provinces are in crystalline rocks that crop out in the northern portion of the basin and extend to the fall line. The rock is overlain with deposits of weathered, unconsolidated rock debris (regolith) that make up the available aquifer spaces. These deposits are thickest in valleys, but generally provide insufficient yield for uses other than very low density residential and thus surface water is the primary source of potable water for the District. The Georgia Geologic Survey Hydrologic Atlas 18 database identifies approximately 84 areas, representing about 15 percent of the 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 200 square miles, 18 percent of the total basin area, of potential recharge areas within the Middle Chattahoochee River Basin (Table MC-1).

Table MC-1. Groundwater Recharge Areas within the Middle Chattahoochee River Basin

Recharge Area Type	County	Square Miles of Recharge Area Type within County
Probable Areas of Thick Soil	Cobb [a]	40
	Fulton [a]	66
	Paulding	10
	Douglas	25
	Coweta	55
Total Recharge Areas		200 [b]

[a] Portions of Cobb and Fulton Counties overlap the basin boundary.

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

There are four soil associations that describe the soil types in the Middle Chattahoochee River Basin: Cecil-Madison-Pacolet, Madison-Davidson-Pacolet, Riverview-Chewacla-Cartecay and the "urban" soils that start in north Fulton County (Table MC-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; U.S. Department of Agriculture [USDA], 1976; Thomas, 1982; Wells, 1961; Robertson et al., 1960; USDA, 1958; Tate, 1967; Thomas and Tate, 1964). The Riverview-Chewacla-Cartecay association was found along the banks of some of the major rivers, particularly the lower half of the Chattahoochee River. These soils are variable and less well drained than soils on higher elevations (Thomas and Tate, 1973; USDA, 1976; Thomas, 1982; Thomas, 1982; and USDA, 1958).

Table MC-2. Major Soil Associations within the Middle Chattahoochee 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.
Riverview-Chewacla-Cartecay	Characteristics: Found along the banks of some of the major rivers; variable and less well drained. Significance to Watershed Management: Located near water bodies this soil type is characterized by flat terrain less susceptible to erosion due to stormwater runoff velocities from impervious surfaces; poor-drained soils are less feasible for infiltration.
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; poor-drained, soils are less feasible for infiltration, restricted water drainage.

Protected Species

Protected species include all species listed as threatened or endangered by the U.S. Fish and Wildlife Service (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

The Metro Water District is home to a number of native species that are considered threatened or endangered. Protecting watershed health is more than protecting water quality; it also includes protection of biological resources. Within the District, there are a number of protected animal 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 MC-3 lists the 10 protected species potentially found within the counties of the Middle Chattahoochee River Basin of the District.

Table MC-3. Aquatic and Semi-Aquatic Protected Species in the Middle Chattahoochee River Basin Counties

Fauna Type	Common Name	Status	Cobb	Coweta	Douglas	Fulton	Paulding
Invertebrates	Gulf Moccasinshell	US	X	X	X	X	X
Invertebrates	Oval Pigtoe	US	X	X	X	X	X
Invertebrates	Purple Bankclimber	US	X	X	X	X	X
Bird	Bachman's Sparrow	GA				X	

Table MC-3. Aquatic and Semi-Aquatic Protected Species in the Middle Chattahoochee River Basin Counties

Fauna Type	Common Name	Status	Cobb	Coweta	Douglas	Fulton	Paulding
Fish	Bluestripe Shiner	GA				X	
Fish	Highscale Shiner	GA	X	X	X	X	
Invertebrates	Chattahoochee Crayfish	GA	X		X	X	
Invertebrates	Delicate Spike	GA	X	X		X	
Invertebrates	Southern Creekmussel	GA		X			
Invertebrates	Southern Elktoe	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); there are no waters designated as primary or secondary trout streams in the Middle Chattahoochee River Basin.

Land Use and Impaired Waterbodies Characteristics

Drinking Water Supply

As described in the Water Supply and Water Conservation Plan, the Middle Chattahoochee River Basin is the primary drinking water supply source for the Metro Water District, providing water to all or parts of eight District counties including two of the most populous, Cobb and Fulton. Withdrawals from this basin account for 72 percent of the District's total public water supplies. Recognizing the linkage between watershed management and water quality for water supply, the Georgia Planning Act of 1989 includes environmental planning criteria (or Part V criteria) to protect natural resources, such as wetlands, stream buffers, water supply watershed areas, groundwater recharge areas, protected rivers and protected mountains. The Act is further described in Section 3. Table MC-4 lists the water supply sources and Figure MC-2 shows those waters that are designated to meet state drinking water criteria within the Middle Chattahoochee River Basin.

Source water assessments were performed for all drinking water supplies within the Middle Chattahoochee River Basin as required by the 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 generally medium to high depending on the location of the water source. These susceptibility rankings indicate the urban and suburban nature of most of the watersheds within the Middle Chattahoochee River Basin.

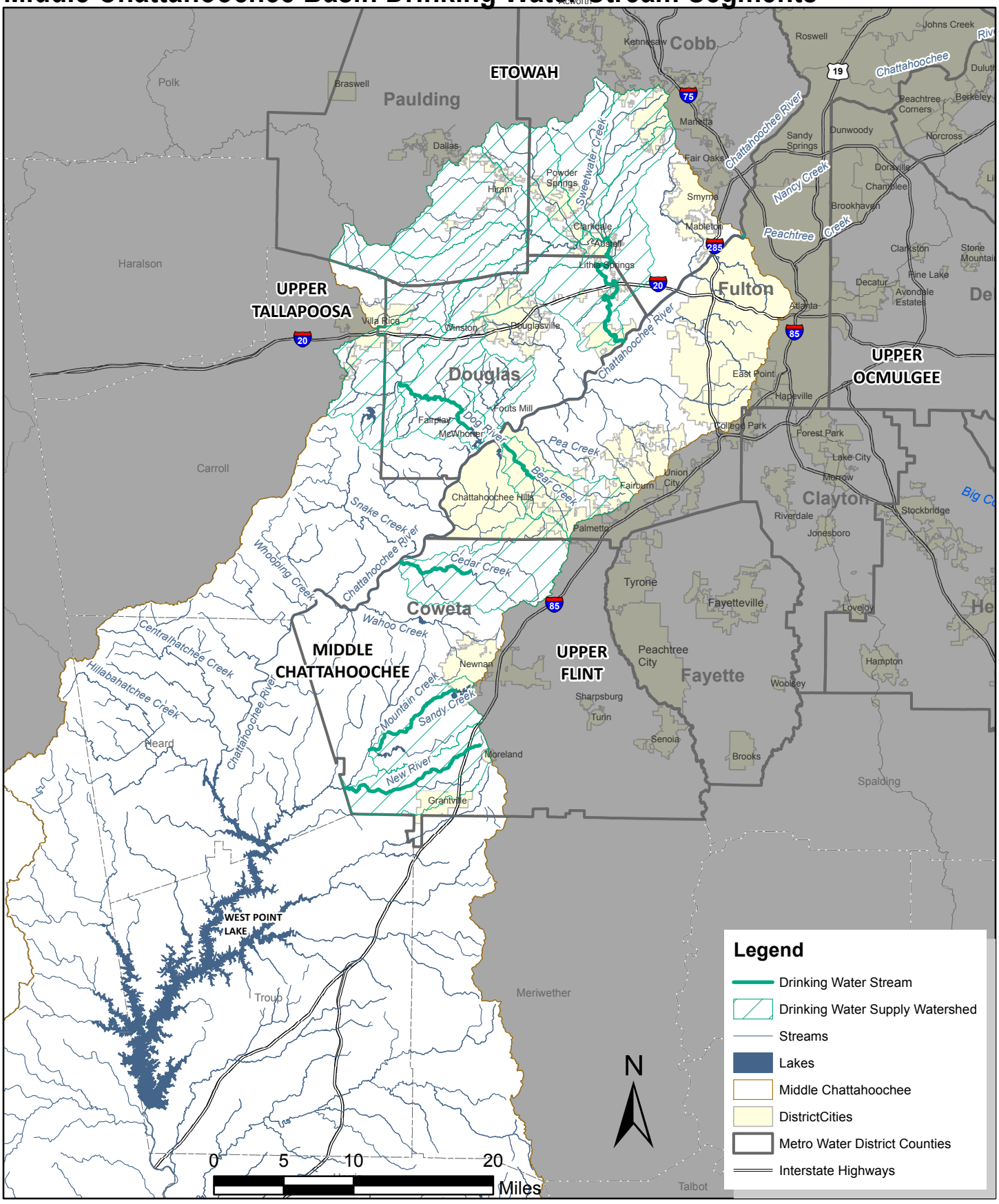
Table MC-4. Middle Chattahoochee River Basin Drinking Water Supply Sources

Water Supply Source	Owner/Operator Utilizing Source
Chattahoochee River	Cobb County-Marietta Water Authority City of Atlanta
Sweetwater Creek	City of East Point
Dog River	Douglasville-Douglas County Water and Sewer Authority
Cedar Creek (Fulton County)	City of Palmetto

Table MC-4. Middle Chattahoochee River Basin Drinking Water Supply Sources

Water Supply Source	Owner/Operator Utilizing Source
Cedar Creek (BT Brown) Reservoir (Coweta County)	Coweta County Water and Sewerage Authority
Sandy Brown Creek J.T. Haynes Reservoir (Coweta County)	Newnan Utilities

FIGURE MC-2
Middle Chattahoochee Basin Drinking Water Stream Segments



Land Cover/Land Use

Land cover/land use characteristics in the Middle Chattahoochee River Basin generally transition from the densely urbanized areas of the City of Atlanta in Fulton and Marietta and Smyrna in Cobb. The legacy of Atlanta's role as a transportation hub is readily apparent with major rail yards in Proctor Creek (Atlanta) and Sweetwater Creek (Austell), as well as the Interstate 20, Interstate 285 and Interstate 85 and Fulton Industrial Boulevard corridors and their associated commercial and industrial uses. With the limited exception of the developed lands around Union City, Fairburn and the City of Newnan, land cover downstream of Anneewakee Creek in Douglas County and Camp Creek in Fulton County, tends to transition to a more rural residential or agricultural character. In 2012, 59 percent of the Middle Chattahoochee River Basin remained undeveloped as either forest/open space or agricultural lands. Over 33 percent of the basin is being used for residential purposes, primarily low or medium density single family uses (Table MC-5, Figure MC-3).

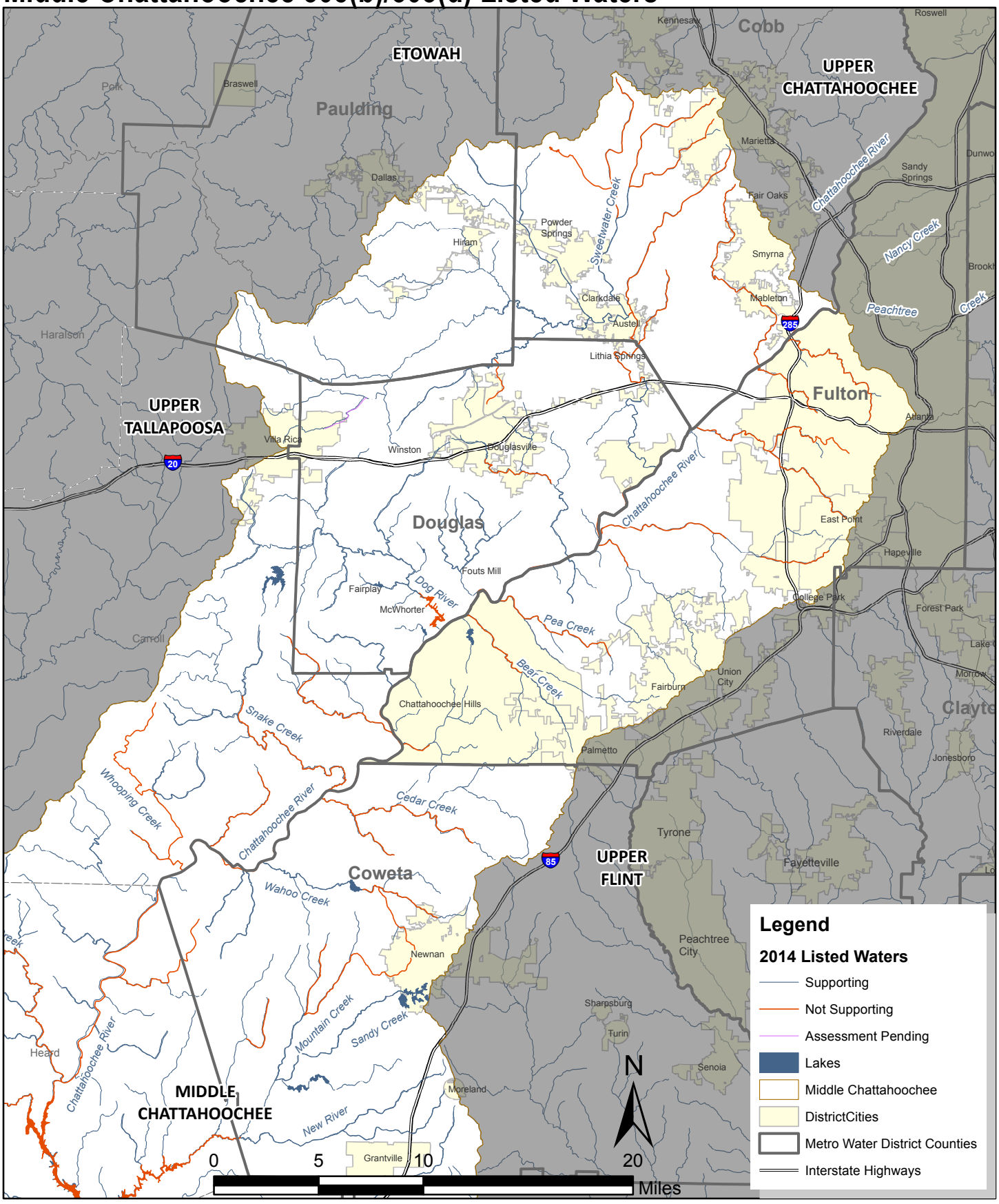
Table MC-5. Middle Chattahoochee River Basin Land Cover / Land Use within the Metro Water District

Land Cover/Land Use	2012 Existing (%)
Agricultural Lands	12
Commercial	4
Forest/Open Space	45
High Density Residential	2
Industrial/Institutional	1
Low Density Residential	11
Medium Density Residential	20
Transitional/Extractive Lands	1
Transportation and Utilities	2
Water/Wetlands	2
Undeveloped	59
Developed	41

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

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

FIGURE MC-5
Middle Chattahoochee 305(b)/303(d) Listed Waters



Over the course of the planning horizon, the basin is expected to have steady growth based on population projections. Much of this growth is anticipated to occur in the northeast portion of the basin in south Fulton and Coweta Counties, while infill development and redevelopment resulting in increased density is expected to continue in Cobb, Douglas and Fulton Counties based on current land-use data.

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).

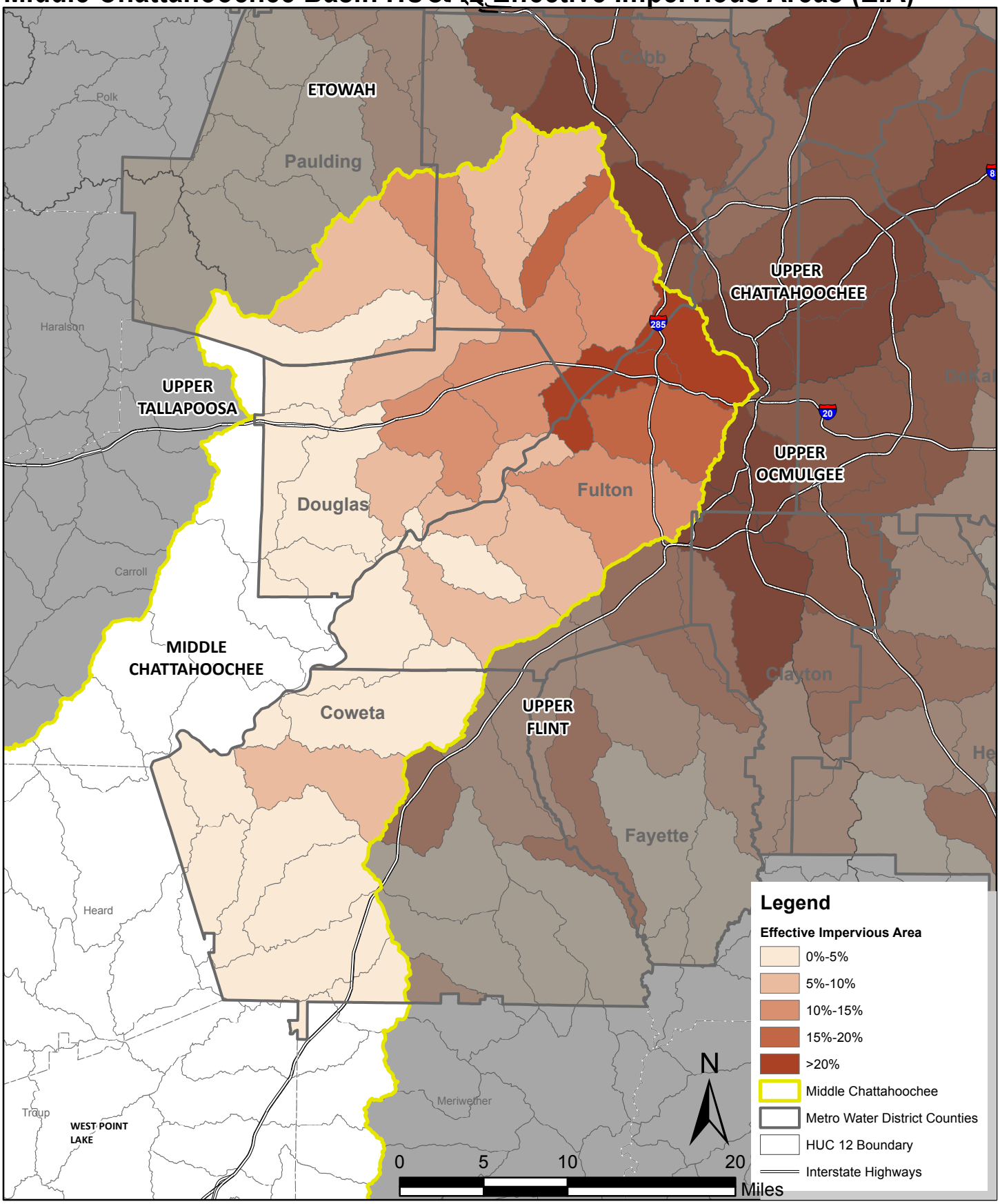
Impervious surfaces (such as roofs, streets, parking lots) have a significantly different hydrologic response from pervious surfaces (lawns, forests); therefore, it is important to clearly define terms and assumptions related to the calculation of pervious and impervious areas for the purposes of watershed management. "Total impervious area" quantifies all of the land surfaces impervious to rainfall for the particular land cover category while "effective impervious area" (EIA) refers to the directly connected impervious area used for water quality and stormwater conveyance modeling. For the 2003 District-wide Plan, EIA values were initially defined based on previous studies, including the local watershed assessments, and then further refined based on calibration using available water quality data. For the 2016 District-wide Plan, the EIA of the HUC-12 subwatersheds within the Metro Water District was calculated using the same methodology as in 2003, but using the 2010 land use/land cover. Attachment 10 lists HUC-12 watershed numbers and descriptions.

Of the 35 HUC-12s within the Metro Water District portion of Middle Chattahoochee River Basin, 9 had an EIA of greater than 10 percent and are primarily those HUC Basins that either straddle a major transportation corridor or are located within the more densely urbanized area located within Interstate 285. For example, the only HUC-12 watersheds with an EIA greater than 20 percent are the Proctor Creek watershed, which drains the western side of downtown Atlanta, and that portion of the mainstem of the Chattahoochee River (HUC-12 name of Wilson Creek) that straddles the Fulton/Cobb/Douglas lines and includes Fulton County Airport - Brown Field, Six Flags over Georgia as well as the western Interstate 20/Interstate 285 interchange (Figure MC-4).

Combined-sewer Overflow Areas

Combined-sewer overflow (CSO) areas within the Middle Chattahoochee River Basin are limited to two small drainage areas within the Proctor Creek (HUC-12 # 031300020101) subwatershed in the City of Atlanta. Major infrastructure improvement projects related to potential CSOs from the Greensferry and Proctor Creek areas during storm events as well as sanitary sewer overflows from the wastewater conveyance systems are ongoing and continue to reduce the bacteria contributions from these sources.

FIGURE MC-4
Middle Chattahoochee Basin HUC-12 Effective Impervious Areas (EIA)



Impaired Waterbodies

As described in Section 3, Georgia EPD determines whether a waterbody is supporting its designated uses by collecting water quality data and comparing these 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 399 stream miles assessed in the Metro Water District portion of the Middle Chattahoochee River Basin, 255 miles, or 64 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 MC-6 by parameter and graphically shown in Figure MC-5. Several streams are listed for violations of more than one parameter, therefore the sum of impaired miles by parameter will not equal the miles of not supporting stream.

Table MC-6. Middle Chattahoochee River Basin Summary of Impaired Streams

Criterion Violated	Miles of Stream	% of 2014 Assessed Streams
Fecal Coliform Bacteria	183	72
Biota (Fish Community)	78	31
Biota (Macroinvertebrate Community)	11	4
Fish Consumption Guidance (polychlorinated biphenyls)	77	30
Dissolved Oxygen	6	2
Zinc	5	2
Total Impaired Stream Mileage[a]	255	64
Total Mileage Assessed for Possible Impairment	399	
Total Stream Mileage in Basin	1,865	

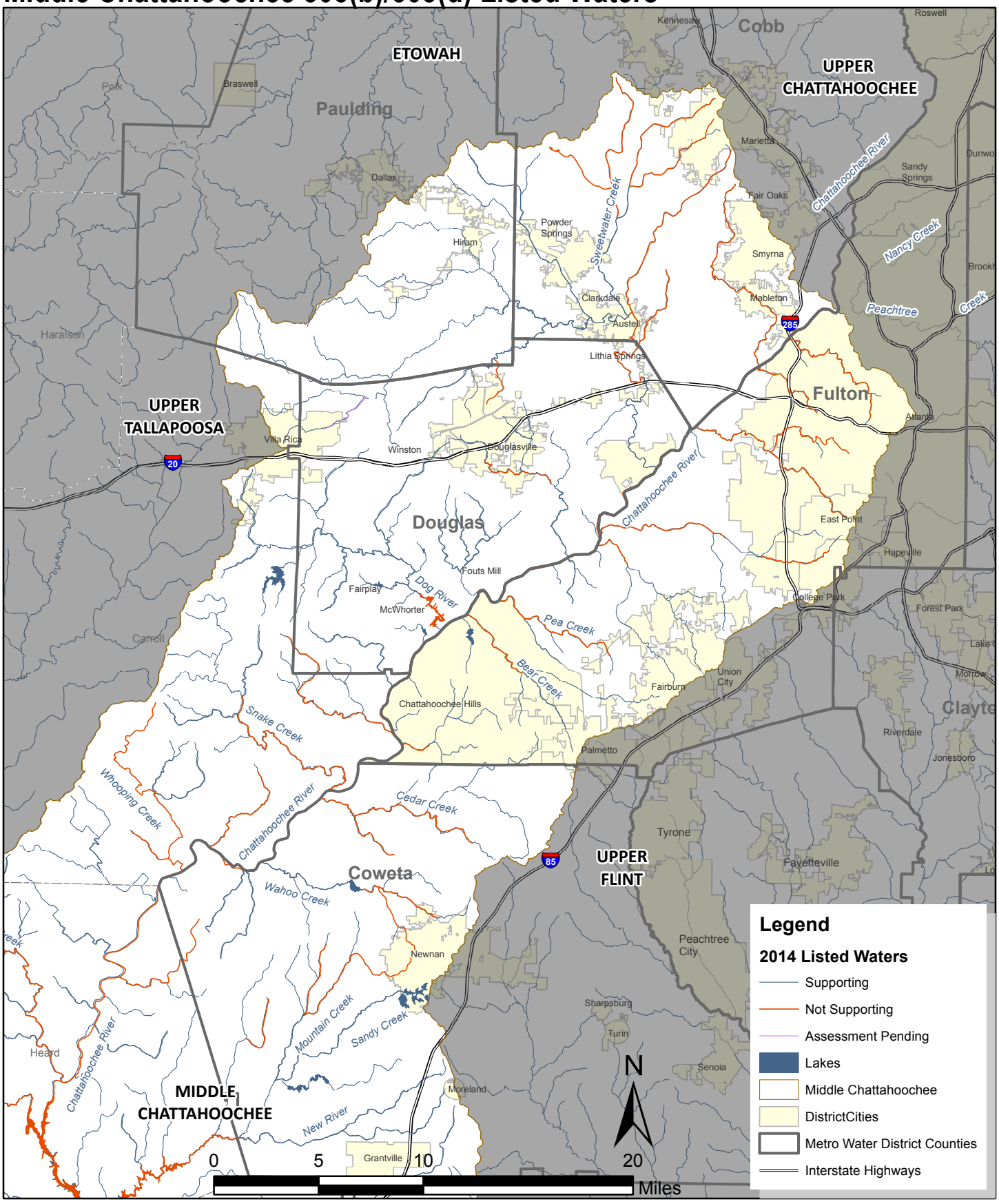
[a] Several streams are listed for violations of multiple parameters within the same stream segment; therefore, the total of impaired miles by parameter will not equal the total stream mileage of impaired streams.

The majority of streams that were assessed (72 percent) in the Middle Chattahoochee River Basin do not meet water quality standards for fecal coliform bacteria as a result of nonpoint source pollution. 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 decrease 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.

The Chattahoochee River from Morgan Falls Dam to West Point Lake, downstream of the Metro Water District, is listed for Fish Consumption Guidance as a result of legacy polychlorinated biphenyl levels. Utoy Creek is listed for zinc impairment with the cited source as urban runoff. Total maximum daily loads (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 Middle Chattahoochee River Basin can be found on the Georgia EPD website.

FIGURE MC-5
Middle Chattahoochee 305(b)/303(d) Listed Waters



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 MC-7, if they include a stream or waterbody on the 2014 303(d) list (TMDLs), water supply watersheds, or existing EIA greater than 10 percent.

Table MC-7. Middle Chattahoochee River Basin Initial Screening of Priority Areas Based on HUC-12 Watersheds

Total HUC-12 Watersheds (Middle Chattahoochee River Basin)	Watersheds that Include a 303(d) Listed Stream (TMDLs)	Water Supply Watersheds[a]	Existing Effective Impervious Cover (EIA > 10%)
35	28	14	9
Percent of Total Watersheds	80%	40%	26%

[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 MC-8 outlines management issues and strategies for the Middle Chattahoochee 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 MC-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 MC-8. Middle Chattahoochee River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
Source water quality	Source water watershed protection of Chattahoochee River, and small water supply watersheds.	• Implement source water protection measures in all subwatersheds upstream of Peachtree Creek. • Continue collaborative efforts in small drinking water supply watersheds, such as Sweetwater Creek, Dog River and Cedar Creek, to protect the viability of these supplies.
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 % HUC-12 watersheds with EIA of > 10%.	• 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 streambanks 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.
Biota TMDLs	31% of assessed instream fish communities and 4% 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 streambanks to reduce instream sediment load contributions.
Bacteria TMDLs	72% of assessed stream segments in the Middle Chattahoochee 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).

Table MC-8. Middle Chattahoochee River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
Lake management	Lake Lanier is the largest lake within this basin, but there are other public and privately-held and managed lakes that play a significant role in meeting designated uses and downstream hydrologic regimes and water quality. Lakes within this HUC-8 include Dog River Reservoir as well as lakes downstream of the District.	• 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, particularly of small lakes 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.

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. As discussed in Section 5, the Plan includes implementation actions related to watershed monitoring and conducting condition 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 Middle Chattahoochee River Basin are listed below, 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 U.S. Geological Survey 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.
- 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 to determine if water quality degradation is being prevented. 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.

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