Draft Watershed Management Plan for Middle Oconee River

Athens-Clarke County

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Executive Summary

The objective of this watershed management plan (WMP) is to provide ACC with a guidance document that characterizes the Middle Oconee River watershed and provides recommendations for structural and programmatic BMPs that can be implemented to reduce nonpoint source pollution and improve the overall health of the watershed. This WMP is the result of a collaborative effort between Tetra Tech, ARCADIS, and ACC, and incorporates the United States Environmental Protection Agency's (EPA's) Nine Key Elements for WMPs that guide watershed management efforts throughout the country. A watershed characterization was conducted as part of this WMP to document current conditions and watershed impairments through stream walks and a review of existing information, including watershed models, geographical information system (GIS) data, water quality data, and previous reports and studies. A comprehensive analysis of potential site-specific and watershed-wide management improvement opportunities based on watershed needs has identified structural and programmatic BMPs that are recommended for implementation.

The drainage area of the Middle Oconee River watershed is 473 square miles, with 82 percent of the watershed located outside of ACC to the northwest. The study area portion of the watershed is located in the west part of Clark County and is 9 square miles in size. The Middle Oconee River joins the North Oconee River to form the Oconee River. Land cover in the study area is primarily split between forest and developed land, with about 10 percent impervious cover. The National Wetland Inventory (NWI) Map identifies some palustrine forested wetlands along the margins of the Middle Oconee River in the upper portion of the study area. The Middle Oconee River also flows along the western edge of a notable environmental resource in the watershed, the 313-acre State Botanical Garden of Georgia.

Major tributaries of Middle Oconee River within ACC include Bear Creek, Turkey Creek, Hunnicut Creek, Malcom Branch, and Brooklyn Creek, which are all assessed in separate WMPs. The Middle Oconee River, throughout the entire study area, is on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams, as not supporting its designated uses. The Middle Oconee River has the designated use of drinking water from the upstream end of the study area down to McNutt Creek, and has the designated use of fishing below McNutt Creek. The river is impaired for biota-macroinvertebrate (BioM) due to sediment upstream of the confluence with McNutt Creek, and for fecal coliform bacteria throughout the study area. Total maximum daily loads (TMDLs) were developed between 1998 and 2007 for the impaired segments that include identified causes and recommended management measures.

Several point sources were identified in the study area, but only three of the facilities are permitted to discharge to water bodies through NPDES permits. Potential nonpoint sources of pollution in the Middle Oconee River watershed include stormwater runoff from ACC's municipal separate storm sewer system (MS4) as well as runoff from forested and agricultural lands. Results of recent water quality monitoring efforts suggest that surface waters in the study area are generally in compliance with the pH and temperature standards adopted by the State of Georgia, but DO measurements do not meet the standards. FC bacteria data indicate that the Middle Oconee River within the watershed does not

comply with the May-through-October standard. Average conductivity and TSS results meet the benchmark set by ACC.

Stream walks in the Middle Oconee River watershed were conducted in October 2016 through December 2016 along the Middle Oconee River and nine of its tributaries. Segments of the Middle Oconee River received overall stream condition scores ranging from marginal to optimal. Segments of most of its tributaries received poor ratings. Large woody debris jams are common in tributaries with a particularly high number of jams collecting debris and partially obstructing flow. Sand deposits, channel erosion, head cuts, and mass wasting are affecting many tributaries in the Middle Oconee River watershed. Potential sources of FC bacteria include human, dog, and deer.

Based on information obtained in the watershed characterization, FC bacteria, DO, and hydrology are identified as watershed-wide management needs. Wetland preservation is a management need for the upper portion of the Middle Oconee River.

A desktop GIS analysis and field assessment was conducted to identify potential watershed improvement opportunities. Structural projects, including stormwater control best management practices (BMPs) and restoration BMPs were evaluated and prioritized. Fourteen site-specific management measures are recommended for implementation in the Middle Oconee River watershed, including eight restoration BMPs, three stormwater control BMPs, and two programmatic BMPs (Table ES-1). Concept plans and cost estimates were developed for the recommended projects. Programmatic measures that can be implemented watershed-wide are also recommended.

Table ES-1. Recommended Site-Specific Management Measures

BMP ID	Project Name
MO-Prog-01	Middle Oconee River Buffer Preservation
MO-Prog-02	Memorial Park Nutrient Management
MO-Res-01	Ben Burton Park Pet Waste and Managed Access
MO-Res-02	Fire Station #2 Streambank Shaping/Buffer Restoration
MO-Res-03	Memorial Park Pond Outlet Control and Spillway
MO-Res-04	Memorial Park Pond Dredging
MO-Res-05	Memorial Park - South Lumpkin Street Outfall Repair and Bank Stabilization
MO-Res-06	Memorial Park - Dog Park Terracing
MO-Res-07	Memorial Park - Gran Ellen Drive Erosion Control
MO-Res-08	Memorial Park Forebay Replacement
MO-Str-01	Georgia Square Mall Bioretention
MO-Str-02	Georgia Square Mall Detention
MO-Str-03	Georgia Square Mall Treatment Train

This WMP includes an implementation schedule with suggested annual activities, activities that can be taken every 3-5 years, and long-term efforts spanning 5-10 years. As changes occur in the watershed and additional data become available, however, watershed management needs and management opportunities might change. Therefore, this WMP should be revisited regularly and revised as needed to ensure that the watershed continues to be managed effectively into the future.

1 Introduction

1.1 Background

Since 2010, Tetra Tech and ARCADIS, in partnership with Athens-Clarke County (ACC), Georgia, have produced several guidance documents to assess and improve the health of ACC's rivers and streams in support of the Countywide Watershed Improvement Program. The work completed through this partnership has led to development of an analytical process that informs the monitoring and characterization of watershed conditions. This includes the establishment of goals, objectives, indicators, and benchmarks for evaluating management needs and measuring success; and the identification and prioritization of management opportunities, including the use of hydrologic and water quality models to assess structural best management practices (BMPs).

Prior to this effort, the Tetra Tech-ARCADIS-ACC team created watershed management documents for Big Creek, Brooklyn Creek, Carr Creek, Cedar Creek, Hunnicutt Creek, McNutt Creek, Shoal Creek, Tanyard Creek, and Trail Creek in accordance with the overarching goals of the Watershed Improvement Program. In 2016, the team proceeded with development of watershed management plans (WMPs) for nine more watersheds: Bear Creek, East Fork Trail Creek, Malcolm Branch, Middle Oconee River, North Oconee River, Sandy Creek, Sulphur Springs Branch, Turkey Creek, and Walton Creek.

1.2 WMP Objectives

The objective of this WMP is to provide ACC with a guidance document that characterizes the Middle Oconee River watershed and provides recommendations for structural and programmatic BMPs that can be implemented to reduce nonpoint source pollution and improve the overall health of the watershed. The methodology used by the Tetra Tech-Arcadis-ACC team to identify appropriate management measures to accomplish this objective are discussed throughout the following sections. The Middle Oconee River WMP incorporates the United States Environmental Protection Agency's (USEPA) Nine Key Elements for WMPs. The nine key elements are:

1. Identify sources contributing to nonpoint source pollution.
2. Estimated expected load reductions.
3. Describe nonpoint source management measures.
4. Estimate Implementation costs.
5. Educate the public to engage public support.
6. Develop an implementation schedule.
7. Describe interim milestones.
8. Implement adaptive management measures to gauge success.
9. Monitor the effectiveness of implementation efforts.

1.3 Stakeholders

Many departments and entities are stakeholders in ACC's watershed management activities. Following are the key stakeholders:

- ACC Central Services
- ACC Leisure Services
- ACC Mayor and Commission
- ACC Planning
- ACC Public Utilities
- ACC Transportation and Public Works Department Stormwater Management Program
- Georgia Department of Environmental Protection (GaEPD)
- The Public (Businesses, Residents, and other Members of the Community)

The ACC Transportation and Public Works Department Stormwater Management Program coordinates closely on watershed management efforts with other ACC departments, including Public Utilities, Planning, Central Services, and Leisure Services.

To meet National Pollutant Discharge Elimination System (NPDES) permit requirements, the Public Utilities Department has conducted watershed assessments in all of the county's watersheds and developed a watershed protection plan (WPP) in 2009 (JJG 2009). This WMP builds on and supplements information provided in the WPP. The Leisure Services Department manages all of ACC's park properties. These parks compose a large area of land that is owned and managed by ACC and are, therefore, high-priority areas for implementing watershed improvement projects. Interdepartmental meetings are held with these departments, the Planning Department, and the Central Services Department to promote communication and coordination between departments on large projects in order to meet the overall needs of ACC.

2 Watershed Characterization

This watershed characterization describes existing conditions in the portion of the Middle Oconee River watershed within ACC. Geographical information system (GIS) data, along with information from previous studies and monitoring efforts, were reviewed and assessed in order to understand the nature and condition of the watershed. A watershed model was also used to characterize nutrient and total suspended solids (TSS) loads. The following sections include information on watershed location and water resources, land cover, ecoregion, environmentally sensitive areas, potential sources of pollution, stream walk assessments, water quality, and nutrient and TSS loading. Key information is provided in the narrative and depicted in figures and summary tables. Additional details, including stream walk assessment notes and data tables and water quality data, are provided in the appendices.

2.1 Location and Water Resources

The Middle Oconee River joins the North Oconee River to form the Oconee River. The Oconee River then joins the Ocmulgee River to form the Altamaha River, which flows to the Atlantic Ocean. The study area portion of the Middle Oconee River watershed is part of the Calls Creek-Middle Oconee River Hydrologic Unit Code 12 (HUC 12) watershed (030701010307).

The Middle Oconee River watershed is located in the west part of Clark County, and it is roughly bounded by U.S. 78 (Atlanta Hwy), Timothy Rd., Hog Mountain Rd., Bethany Shoals Rd., Phoenix Rd., S. GA-15-ALT (Milledge Ave./Prince Ave.), US 129 (Jefferson Rd.), Quailwood Dr., and Tallassee Rd. Major tributaries of Middle Oconee River within ACC include Bear Creek, Turkey Creek, Hunnicut Creek, Malcom Branch, and Brooklyn Creek. None of these tributaries are included in this characterization, as they have been assessed separately. Smaller, unnamed tributaries are included in the study area. The farthest downstream point of this watershed is the confluence of the Middle Oconee River with the North Oconee River. The drainage area of the Middle Oconee River watershed is 473 square miles, with 82 percent of the watershed located outside of ACC to the northwest. The extent of the Middle Oconee River watershed is shown in Figure 2-1. The study area portion of the watershed, within ACC is 18 square miles in size and is shown in Figure 2-2.

The Middle Oconee River, throughout the entire study area, is on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams, as not supporting its designated uses. The Middle Oconee River has the designated use of drinking water from the upstream end of the study area down to McNutt Creek, and has the designated use of fishing below McNutt Creek. The river is impaired for biota-macroinvertebrate (BioM) due to sediment upstream of the confluence with McNutt Creek, and for fecal coliform bacteria throughout the study area. Impaired segments of the Middle Oconee River and its tributaries within ACC are listed in Table 2-1, along with information on total maximum daily loads (TMDLs) that have been developed. The 2007 TMDL for fecal coliform recommends the following management practices to achieve instream fecal coliform source loads:

- Compliance with National Pollution Discharge Elimination System (NPDES) permit limits and requirements;
- Adoption of Natural Resource Conservation Service (NRCS) conservation practices; and
- Application of best management practices (BMPs) appropriate to agricultural or urban land uses, where applicable.

The 2002 TMDL for sediment recommends the following management practices to help maintain the annual average sediment loads current levels:

- Compliance with the requirements of the NPDES permit program;
- Implementation of Georgia Forestry Commission BMPs for forestry;
- Adoption of NRCS conservation practices;
- Adherence to the Mined Land Use Plan prepared as part of the Surface Mining Permit Application;
- Adoption of proper unpaved road maintenance practices;
- Implementation of Erosion and Sedimentation Control Plans for land disturbing activities; and
- Evaluation of the effects of increased flow due to urban runoff on stream bank erosion.

ACC's Transportation and Public Works Department in collaboration with other ACC departments works to ensure that each of these recommended management practices is being implemented.

There is one United States Geological Survey (USGS) stream gage (USGS 02217500) in the watershed study area where the Middle Oconee flows under Atlanta Highway. There are no groundwater recharge areas in the watershed study area, according to the map of the Most Significant Groundwater Recharge Areas of Georgia (GaEPD 1982).

Table 2-1. Impaired Stream Segments in the Middle Oconee River Watershed in ACC

Stream segment	Impairment(s) /(Cause)	TMDLs	Required Load Reduction
Middle Oconee River, from Mulberry River to Big Bear Creek	Bio M, FC (NP)	TMDL completed FC (2002 & 2007) Bio M (2002)	FC: 53% Sediment: 0%
Middle Oconee River, from Big Bear Creek to McNutt Creek	FC (NP)	TMDL completed FC (2002 & 2007)	FC: 74%
Middle Oconee River, from McNutt Creek to North Oconee River	FC (UR)	TMDL completed FC (2007)	FC: 20%
North Bypass Branch, Tributary to Middle Oconee River	FC (UR)	TMDL completed FC (1998 & 2007)	FC: 52%
Tributary to Middle Oconee River, Downstream closed UGA Botanical Gardens Landfill (Milledgeville Ave. Site)	FC (NP, UR)	None	
*Brooklyn Creek, headwaters to Middle Oconee River	FC (UR)	TMDL completed FC (1998 & 2007)	FC: 88%
*Hunnicut Creek, headwaters to Middle Oconee River	FC (UR)	TMDL completed FC (1998 & 2007)	FC: 73%

*Kingswood Branch, tributary to McNutt Creek	FC, pH (UR)	TMDLs completed FC (1998 & 2007) pH (2002)	FC: 82% pH: Target of 6.0-8.5
*McNutt Creek, Headwaters at GA 316 & Dials Mill Road to Middle Oconee River	FC (NP, UR)	TMDL completed FC 2012. EPD needs to collect more data before a determination is made as to whether pH is meeting water quality criteria.	FC: 40%

* Indicates stream segments outside of the Middle Oconee River study area

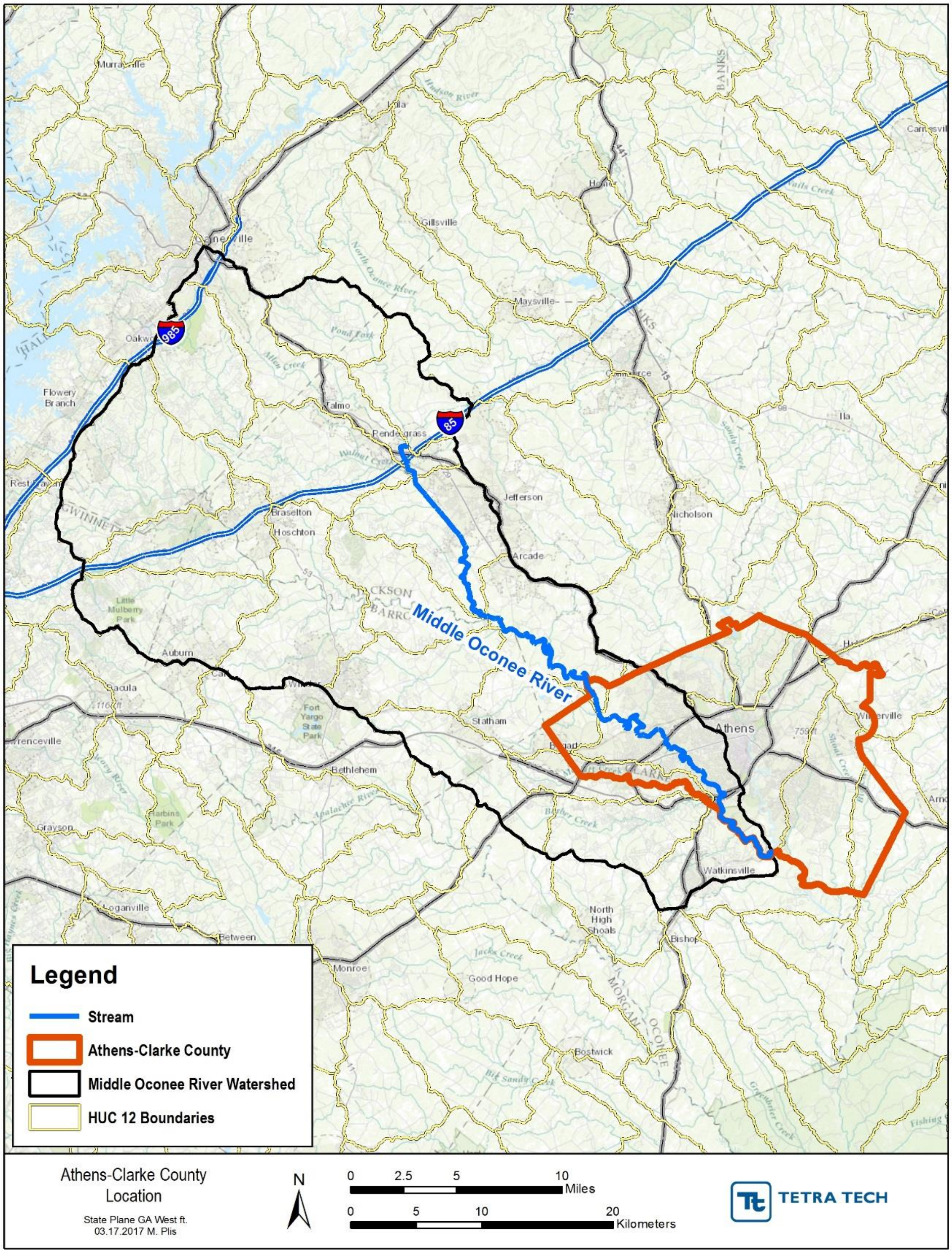

Figure 2-1. Middle Oconee River Watershed Location

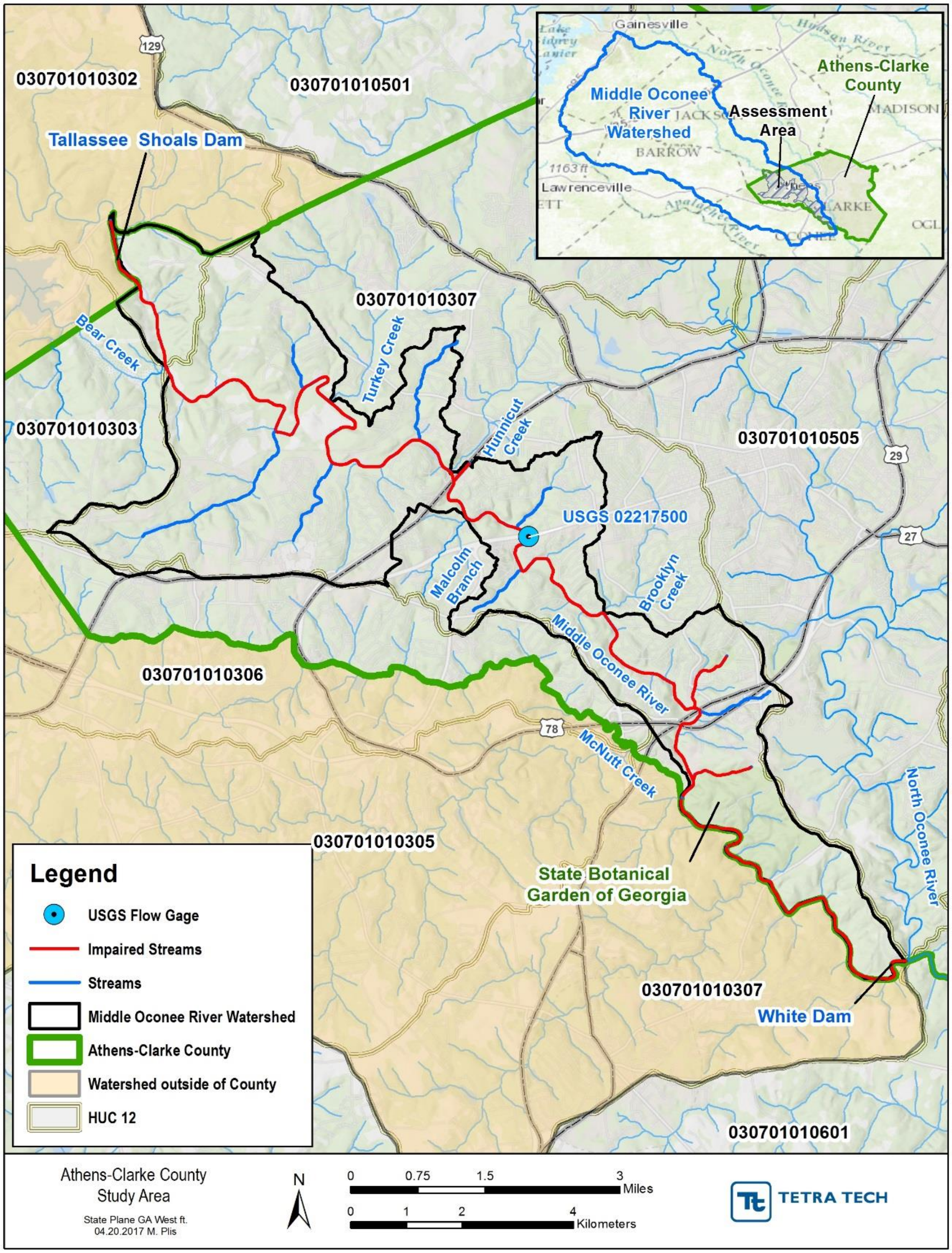

Figure 2-2. Middle Oconee River Watershed Study Area

2.2 Land Cover

The land cover in the study area consists of approximately 43 percent forest, 41 percent developed land, 6 percent is pastureland/cropland, and 5 percent wetland, and the remainder is comprised of other land covers. Land cover information for the watershed was obtained from the 2011 National Land Cover Database (NLCD) as shown in Figure 2-3. This NLCD coverage has a spatial resolution of 30 meters. The percent breakdown by land cover in the study area portion of the watershed is shown in Table 2-2.

Table 2-2. Athens-Clarke County Middle Oconee River Watershed 2011 NLCD Land Cover

NLCD Land Cover	% Land Cover
Open Water	0.9%
Developed	40.8%
Barren	0.3%
Forest	42.5%
Shrub/Scrub	0.3%
Herbaceous	4.7%
Pasture/Crop	6.1%
Wetland	4.5%

There are 46 miles of streams in the study area. Based on the 2011 NLCD land use and land cover data, 0.71 miles of streams in the watershed (approximately 2 percent) are directly connected to cropland or pasture land.

The study area is about 10 percent impervious, with the largest amount of impervious area located along Athens Perimeter Highway, and West Broad Street. Impervious cover is shown in Figure 2-4 and is based on the 2011 NLCD impervious coverage.

Land cover in the portion of the Middle Oconee River watershed upstream of the study area outside of ACC is dominated by forest (39 percent) and developed land (28 percent) consisting primarily of open space and low intensity development.

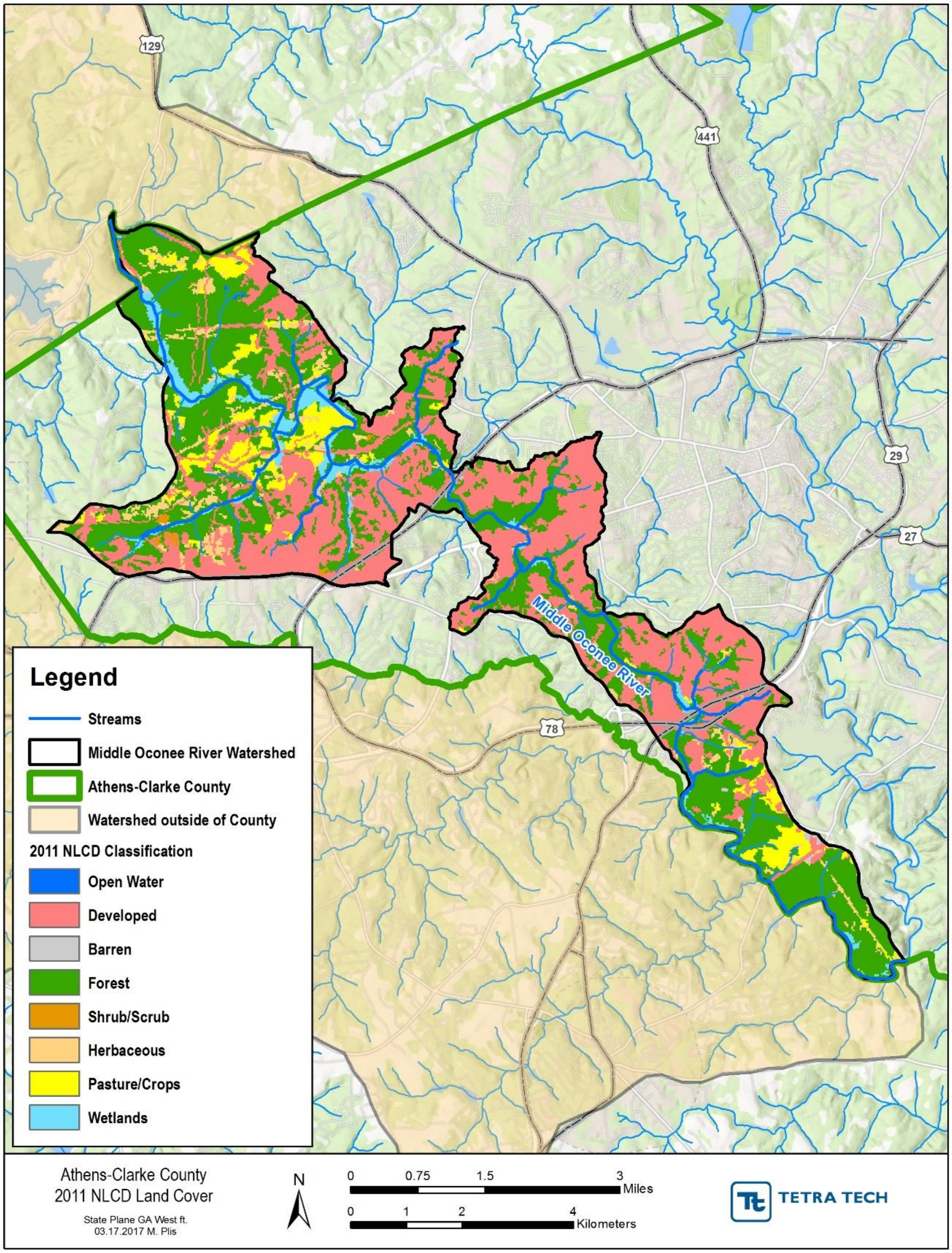

Figure 2-3. 2011 NLCD Land Cover

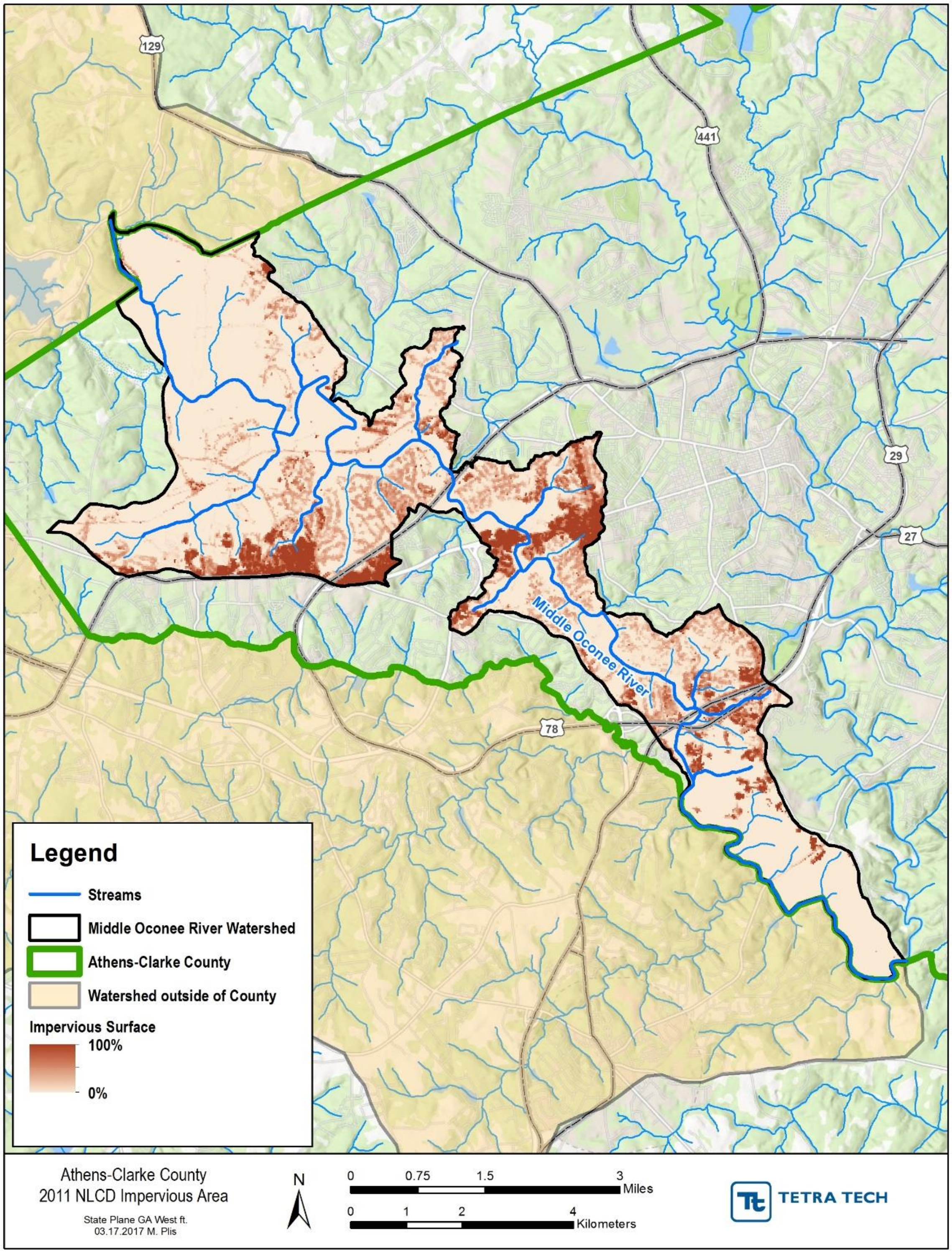

Figure 2-4. 2011 NLCD Impervious Cover

2.3 Ecoregion

The study area and all of ACC are located within the Southern Outer Piedmont level IV ecoregion (45b). This ecoregion has lower elevations, less relief, and less precipitation than the Southern Inner Piedmont ecoregion (45a) to the northwest. Loblolly-shortleaf pine is the major forest type, with less oak-hickory and oak-pine than 45a. Gneiss, schist, and granite are the dominant rock types, covered with deep saprolite and mostly red, clayey subsoils. The majority of soils are Kanhapludults. The southern boundary of the ecoregion occurs at the Fall Line, where unconsolidated coastal plain sediments are deposited over the Piedmont metamorphic and igneous rocks (Griffith et al. 2001).

2.4 Environmentally Sensitive Areas

Environmentally sensitive areas include wetlands, water supply watersheds, and other natural areas that are important for wildlife habitat and/or recreational use. The Middle Oconee River has the designated use of Drinking Water from the upstream end of the study area down to McNutt Creek. A water intake is located on the Middle Oconee River just north of Athens Perimeter Highway. The drainage area above this point is considered a large water supply watershed. This is a classification that refers to a large watershed that serves as a water supply that has no reservoirs within the jurisdiction. The water intake, wetlands, and other natural areas are in the study area shown in Figure 2-5. The National Wetland Inventory (NWI) Map identifies some palustrine forested wetlands along the margins of the Middle Oconee River in the upper portion of the study area, as shown in Figure 2-5. These wetlands provide wildlife habitat and serve as a buffer around the streams, receiving and treating runoff and protecting the stream from nonpoint sources of pollution.

The Middle Oconee River flows along the western edge of a notable environmental resource in the watershed, the State Botanical Garden of Georgia (Garden). The Garden is a 313-acre preserve set aside by the University of Georgia in 1968 for the study and enjoyment of plants and nature. Located three miles south of campus, it is a living laboratory serving educational, research, recreational, and public service roles for the University and the citizens of Georgia. The Garden contains a number of specialized (theme) gardens and collections, over five miles of nature trails, and four major facilities including a tropical conservatory.

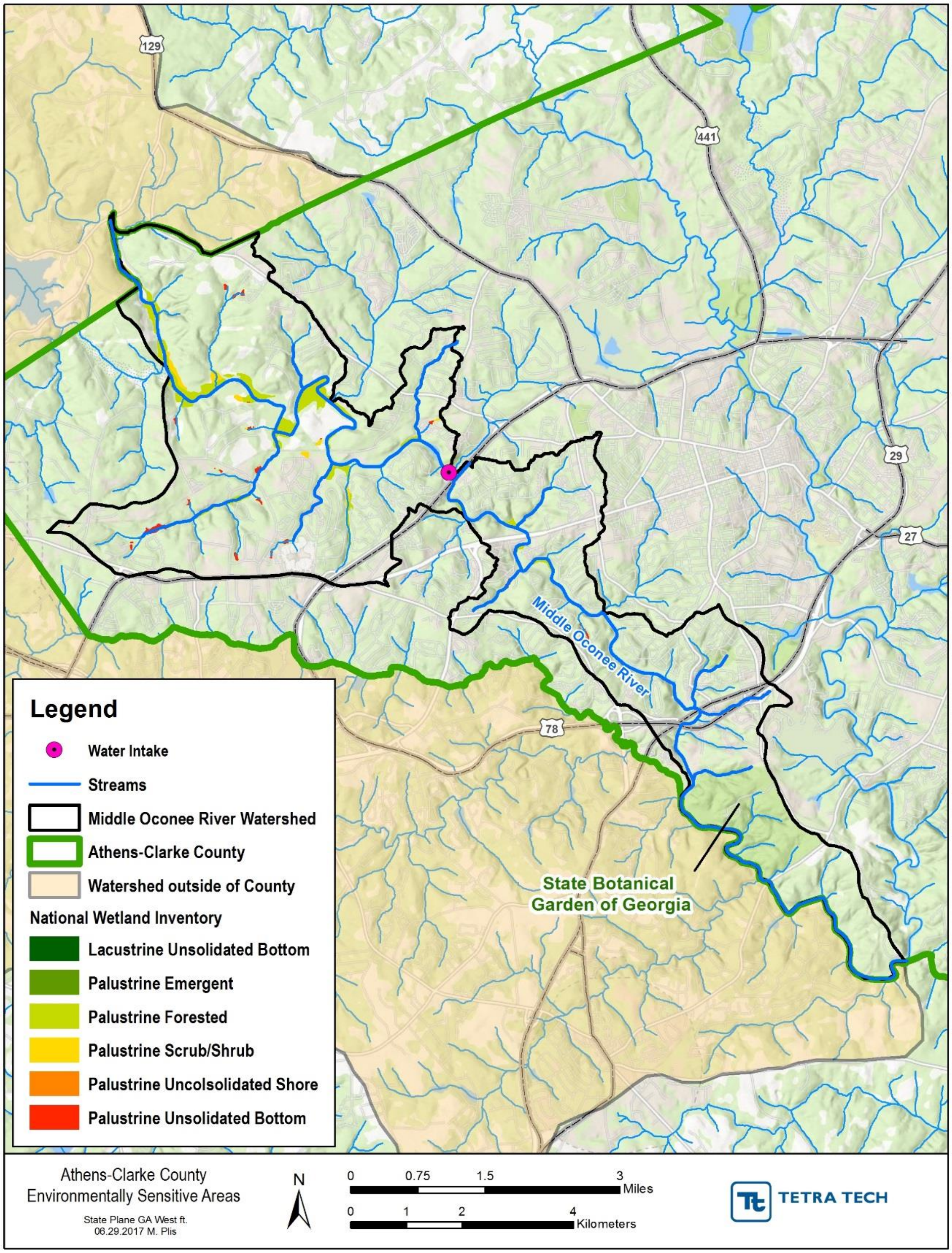

Figure 2-5. Environmentally Sensitive Areas

2.5 Potential Sources of Pollution

A search was conducted for known point sources of pollution from state and Federal databases including the GaEPD database of NPDES permits (GaEPD 2013) and the United States Environmental Protection Agency (USEPA) Envirofacts Multisystem Search (USEPA 2016). The online EPA Multisystem Search pulls multiple environmental databases for facility information. The known point sources obtained from these databases are shown in Figure 2-6 and listed in Table 2-3. Only those facilities with NPDES Permit IDs are permitted to discharge to waterbodies. The Athens-Clarke County – Middle Oconee Water Pollution Control Plant (WPCP) has permit limits based on the average monthly concentration of fecal coliform bacteria that can be discharged.

Table 2-3. Point Sources in Middle Oconee River Watershed in Athens-Clarke County (USEPA 2016, GaEPD 2013)

Facility Name	EPA ID	NPDES ID	Data Source
Aamco Transmissions	110005676465	-	RCRA
Allen Heyward Motor Co Inc	110007488897	-	RCRA
Allen Motors	110005698263	-	RCRA
Athens Chevrolet	110005676027	-	RCRA/AFS
Athens-Clarke County - Middle Oconee WPCP	110039845157	GA0021733	NPDES
Carquest Auto Parts #1371	110069459909	-	RCRA
Griffith Automotive	110005713317	-	RCRA/AFS
Insty-Prints	110005675732	-	RCRA
Ivy-Coile Motors	110005666920	-	RCRA
Kenny Properties Llc #002	110005688309	-	RCRA
Maaco Auto Painting & Body Works	110043975758	-	AFS
Maaco Auto Painting Of Athens	110005700946	-	RCRA
Minish Pontiac-Buick Inc	110005668232	-	RCRA
Mr Transmission	110005682467	-	RCRA
Quality Cleaners	110007398663	-	AFS
Reliance Electric Co	110005699823	-	RCRA
The Body Shop Of Athens, Inc.	110043962432	-	AFS
UGA Hazardous Waste Disposal Facility	110013612457	-	RCRA
University Automotive Incorporated	110002451980	-	AFS
University Motors Inc	110005672281	-	RCRA
Wh Cleaners @ Athens Business Center	110016750577	-	RCRA
Athens Doublegate Pond	-	GA0021687	NPDES
Blue Circle Materials	-	GA0047651	NPDES

Notes: RCRA = Resource Conservation and Recovery Act; AFS = Air Facility System; NPDES = National Pollutant Discharge Elimination System; WPCP = Water Pollution Control Plant.

Potential nonpoint sources of pollution in the Middle Oconee River watershed include stormwater runoff from ACC's municipal separate storm sewer system (MS4) as well as runoff from forested and agricultural lands. Oil, grease, and metals are common pollutants in runoff from urban areas. Fertilizers (nutrient pollution), herbicides, and pesticides can enter streams through runoff from agricultural and residential lands. Fecal coliform (FC) bacteria and other bacteria that are a concern for human health can come from the waste of humans and other animals. These sources can include pets, wild animals, farms, leaky sewer pipes, and septic systems. Sediment can also be a pollutant when excess amounts enter surface waters from eroding upland areas and from eroding stream banks. Runoff from developed land is the greatest concern in this watershed as a nonpoint source of pollution.

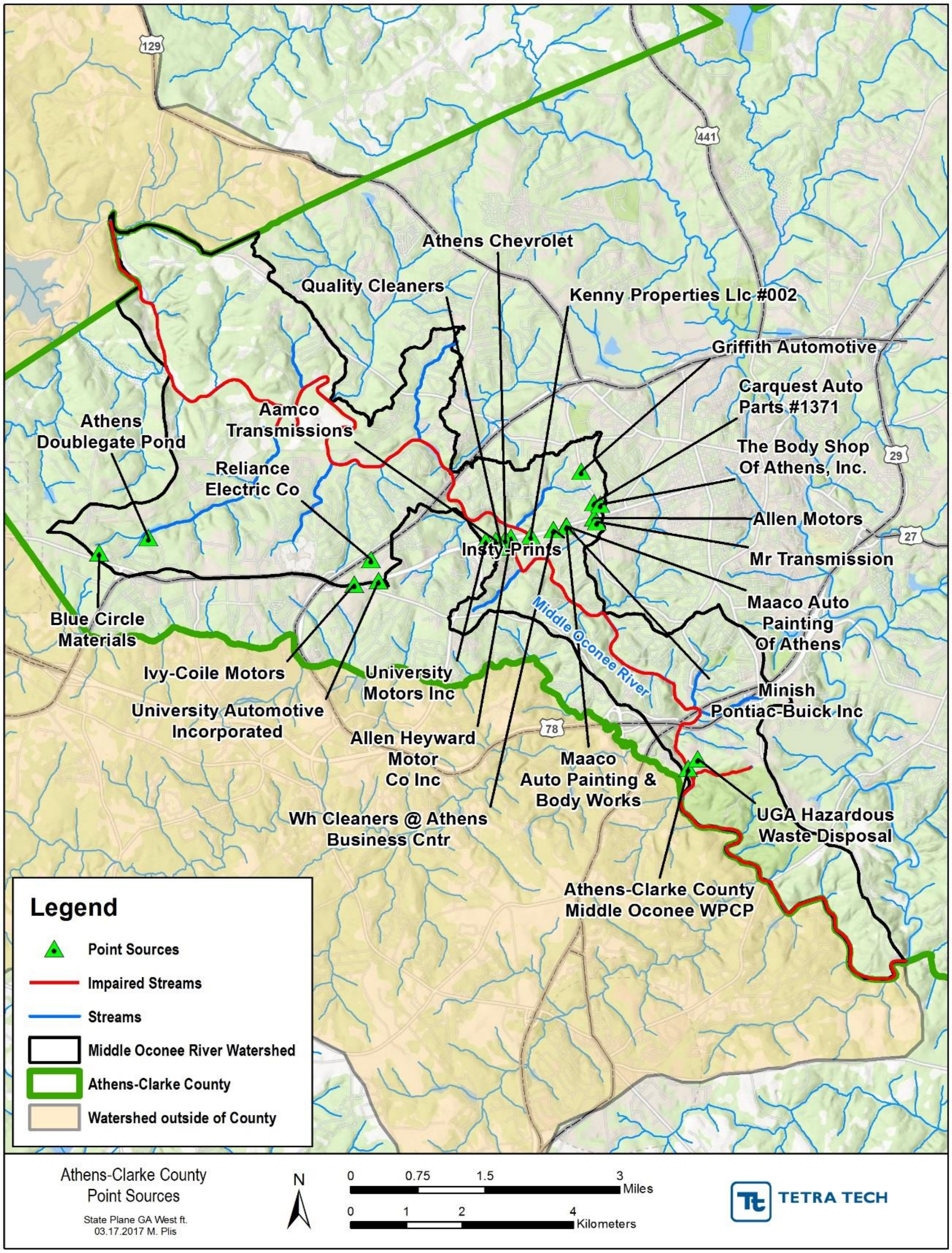

Figure 2-6. Point Sources (USEPA 2016, GaEPD 2013)

2.6 Stream Condition

Stream walks were conducted in October 2016 through December 2016 to characterize existing stream conditions, identify areas of impairment, help identify potential causes of impairment, and help identify priority areas for management efforts. Stream walks in the Middle Oconee River watershed were conducted along the Middle Oconee River and nine of its tributaries (Trib A through Trib I), as shown in Figure 2-7.

2.6.1 Methodology

The stream walks consisted of collecting data points on computer tablets using the Environmental Systems Research Institute (Esri) Collector application while walking within wadeable streams and from the stream bank or by canoe for unwadeable streams. For consistency, data points were selected at distance intervals based on stream size (about 40 times the stream width) or when a significant change in channel form or stream characteristics was observed.

To quantify stream condition, each of four stream condition parameters—in-stream habitat rankings, bankface vegetation density, bank erosion ratings, and floodplain connection—were scored on a scale of 0 to 20, with 20 being the best possible individual parameter score. Overall stream condition for each reach was determined by totaling the scores of the four parameters, with 80 being the best possible score. The total numerical scores were given narrative condition ratings as follows:

- Poor: 0-23
- Marginal: 24-40
- Suboptimal: 41-63
- Optimal: 64-80

In addition to the stream condition parameter scores, each data point included global positioning system information; photographs capturing general stream features; and a reach level assessment that characterized surrounding land use, base flow as a percentage of channel width, dominant substrate, water clarity, aquatic plants in stream, wildlife in and around the stream, stream shading, channel dynamics, and reach accessibility. Geomorphic observations were also recorded that included bank height, channel width, and areas of erosion and mass wasting.

The range of data collected, along with the range of values and classifications defined in the tablets for the field assessments, is summarized in the table of Data Types and Classifications in Tablet (appendix A).

Once the data were collected, they were organized and processed geospatially with corresponding attribute tables in GIS in order to produce figures. The complete set of processed geospatial data was also provided to ACC for future use.

Stream condition and other data collected during this assessment were used to help identify and prioritize capital improvement projects such as stormwater control and stream restoration measures.

Refer to section 3.3.5 for a detailed discussion of evaluation and prioritization of management opportunities.

2.6.2 Results

The stream condition scores for each data point collected in the study area are provided in appendix B. Each assessment point and the overall condition rating of each stream reach is shown in Figure 2-7, with detail panels shown in Figure 2-8 through Figure 2-13. Notable features observed in the watershed are shown in Figure 2-14, with detail panels shown in Figure 2-15 through Figure 2-20.

Stream walk data summary tables are included in appendix C. Field notes and photographs from the stream walks are provided in appendix D.

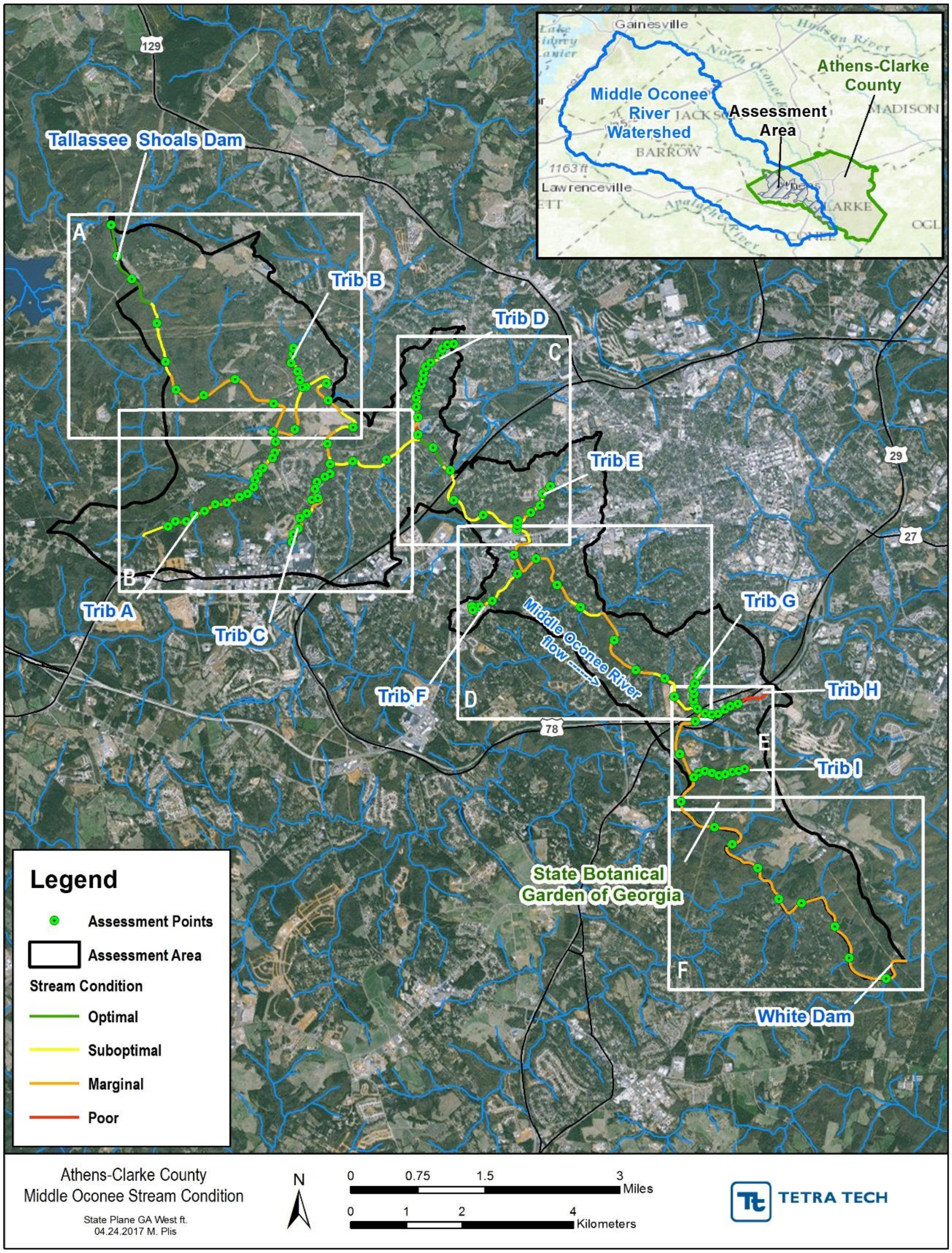

Figure 2-7. Stream Reach Condition Ratings

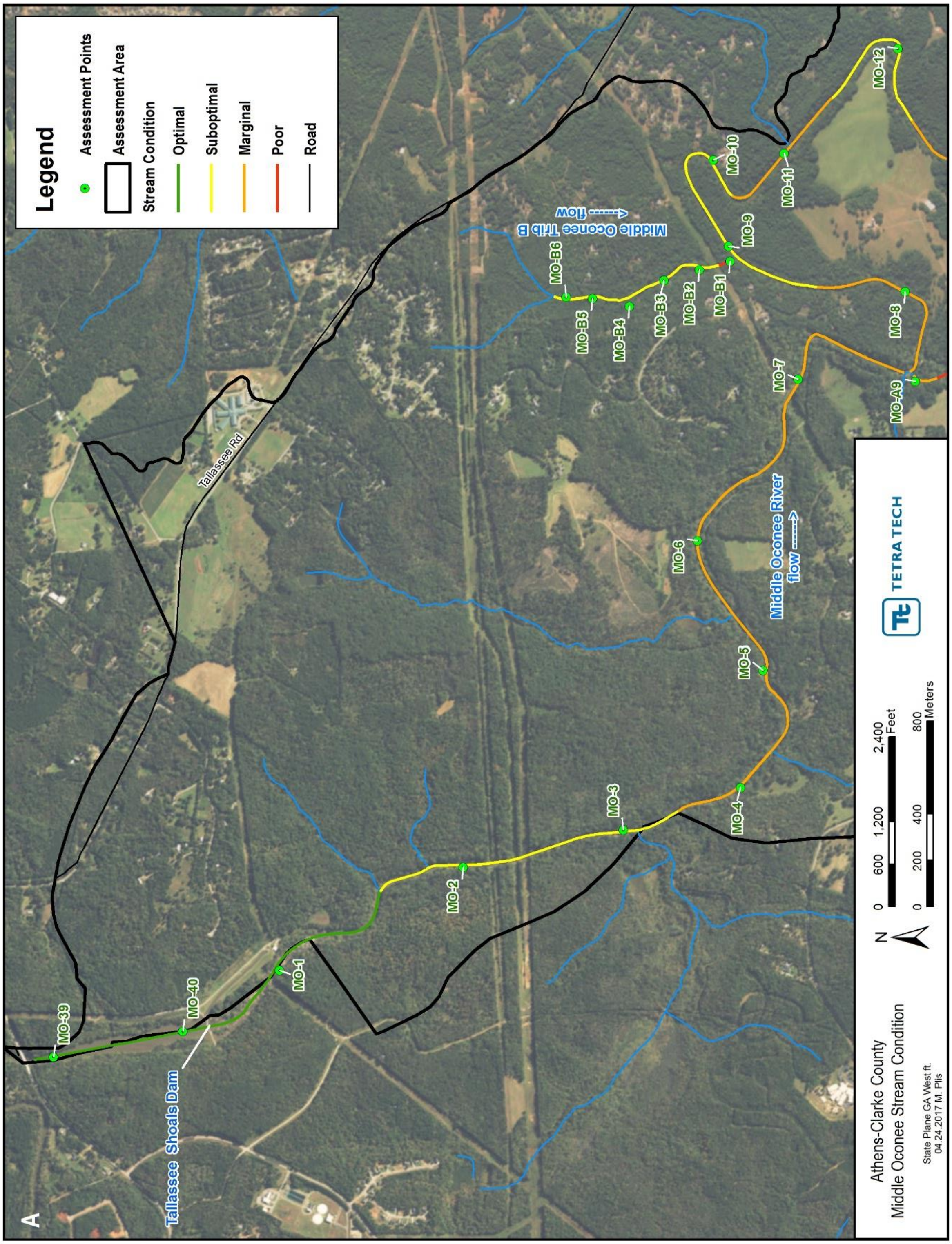

Figure 2-8. Stream Reach Condition Ratings—Panel A

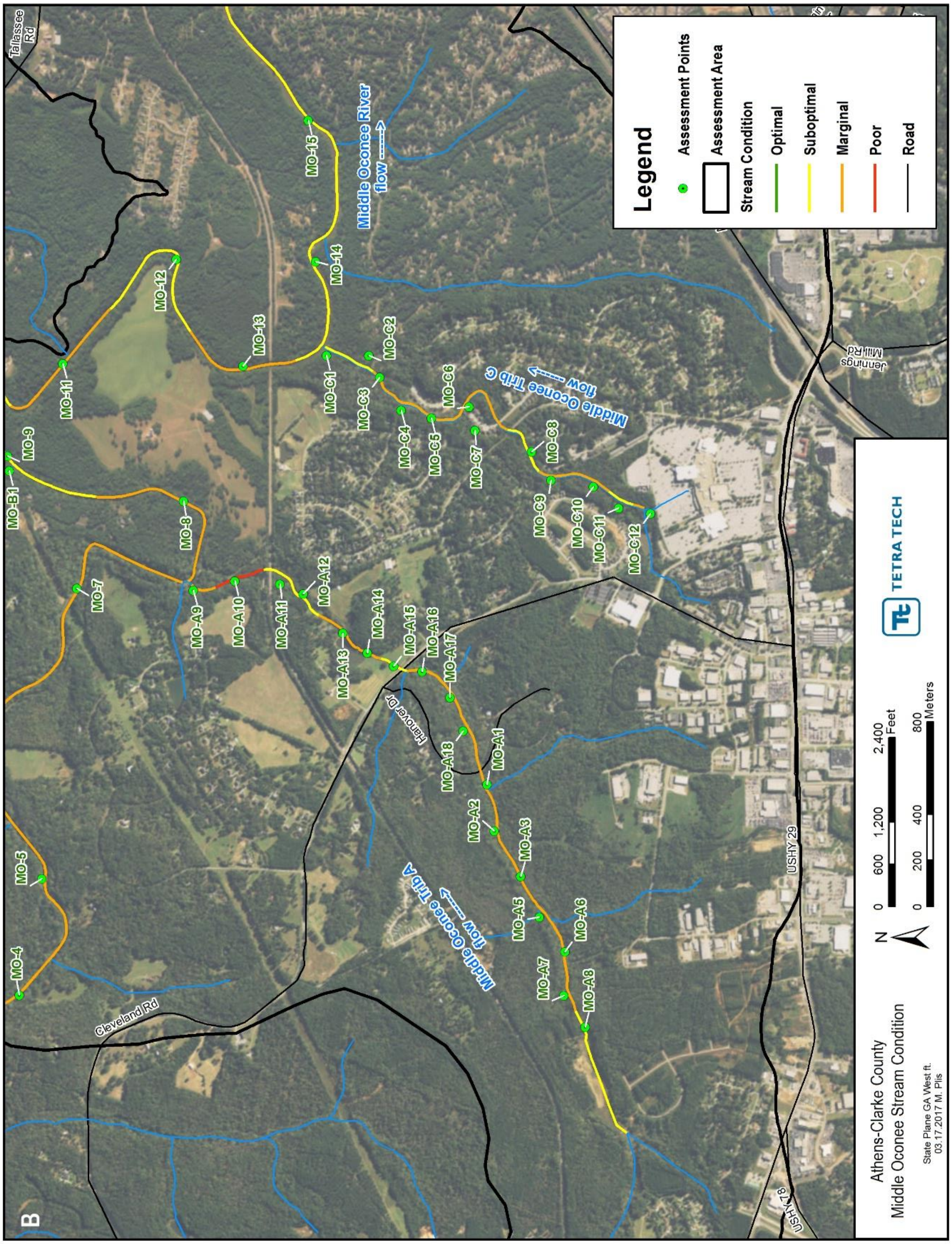

Figure 2-9. Stream Reach Condition Ratings—Panel B

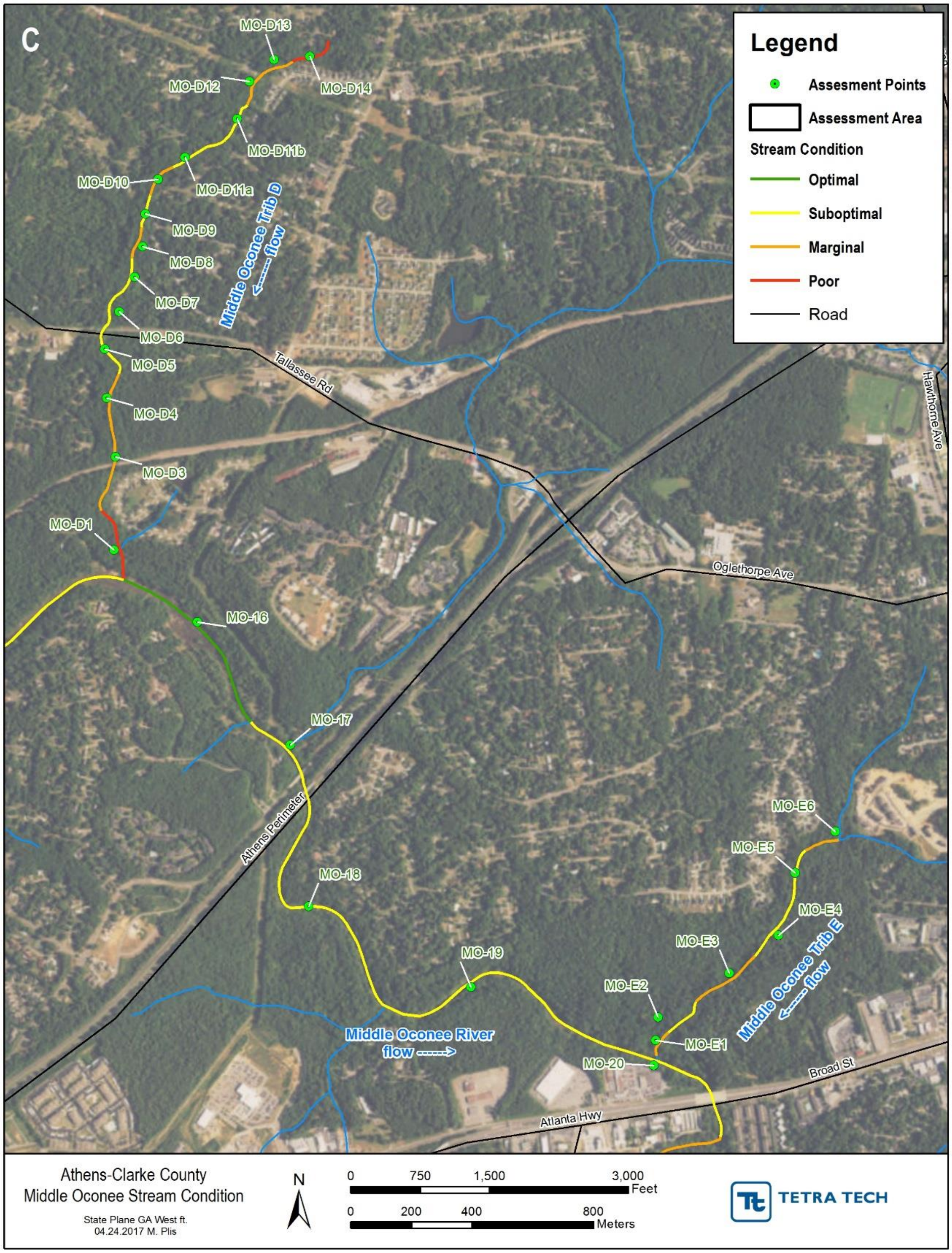

Figure 2-10. Stream Reach Condition Ratings—Panel C

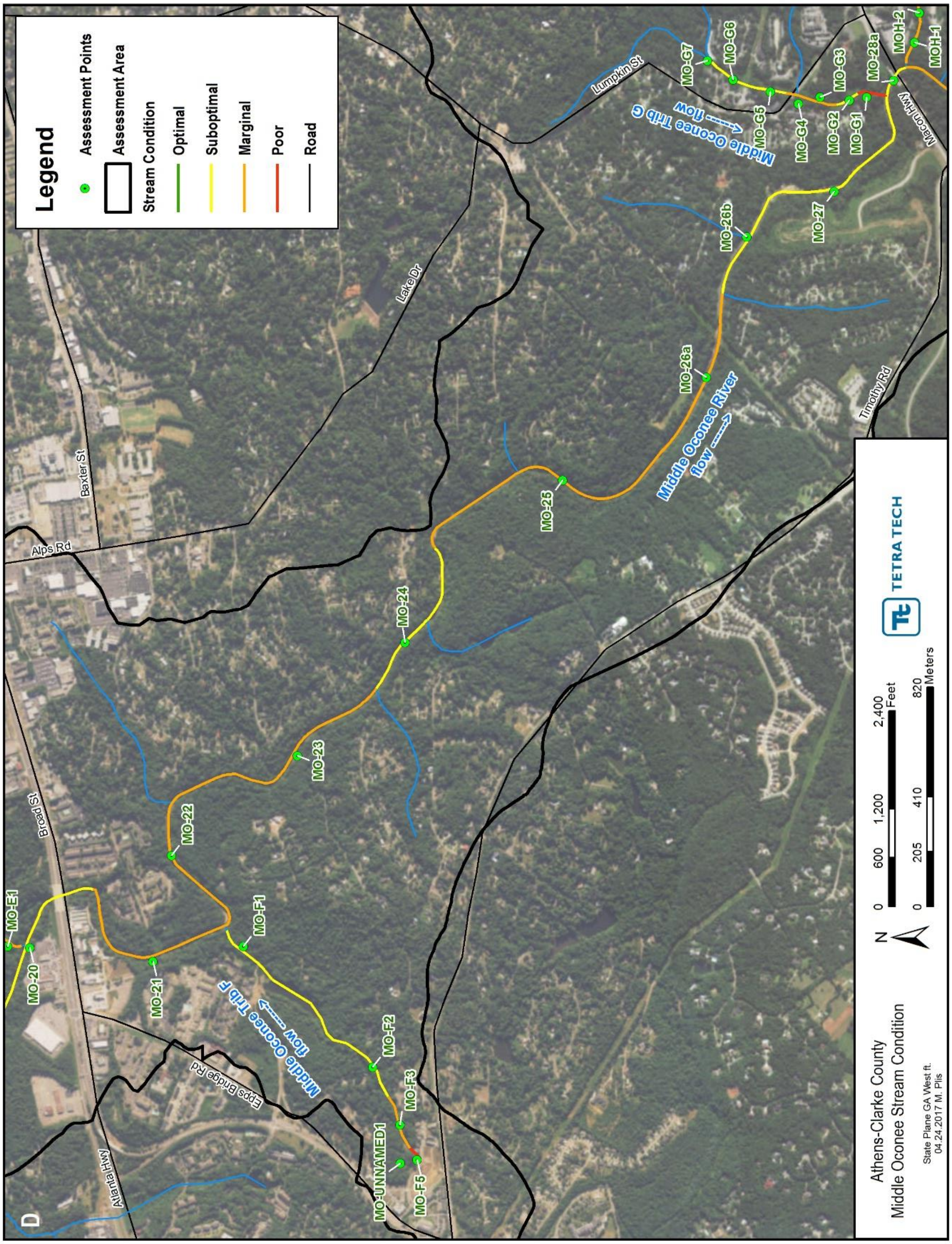

Figure 2-11. Stream Reach Condition Ratings—Panel D

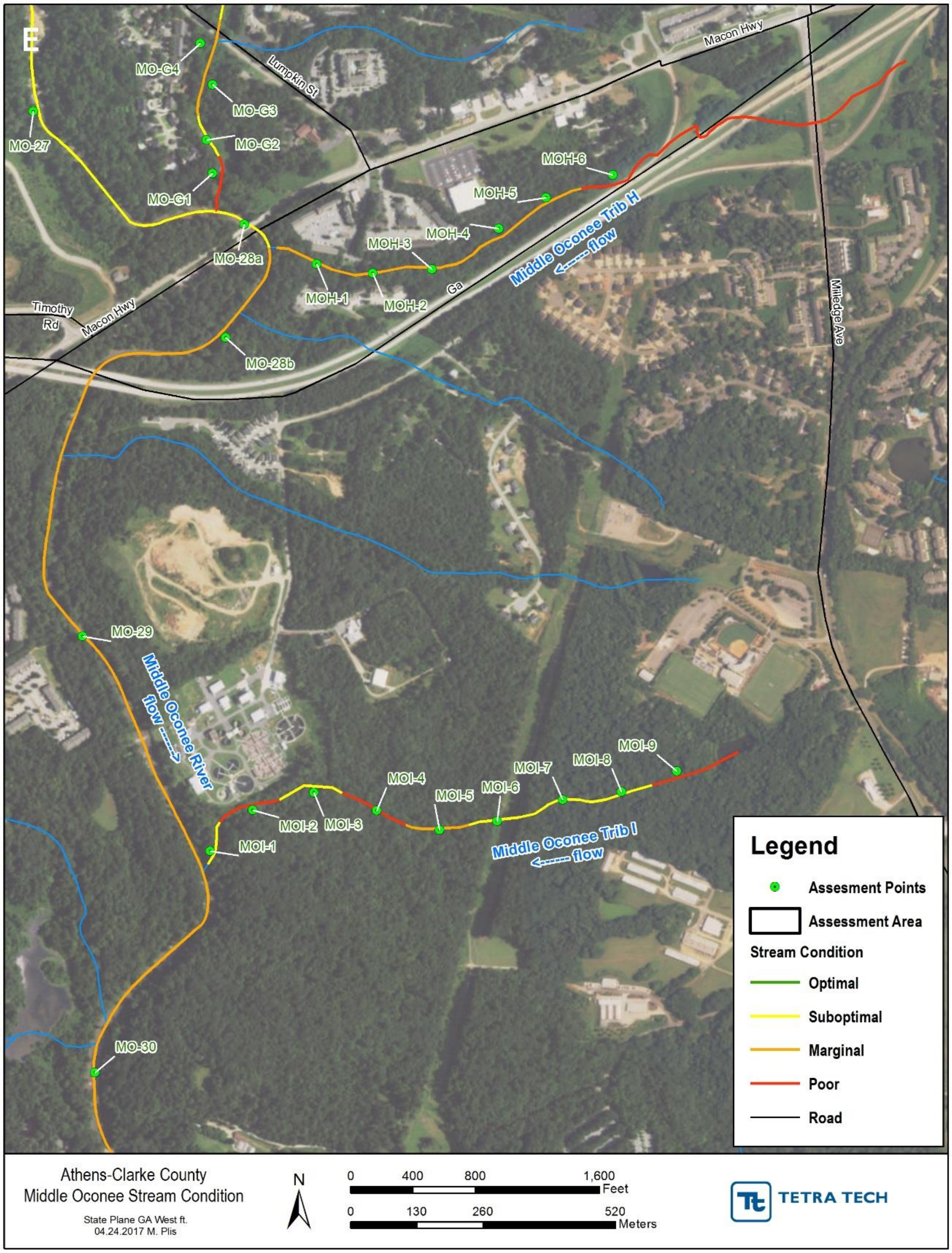

Figure 2-12. Stream Reach Condition Ratings—Panel E

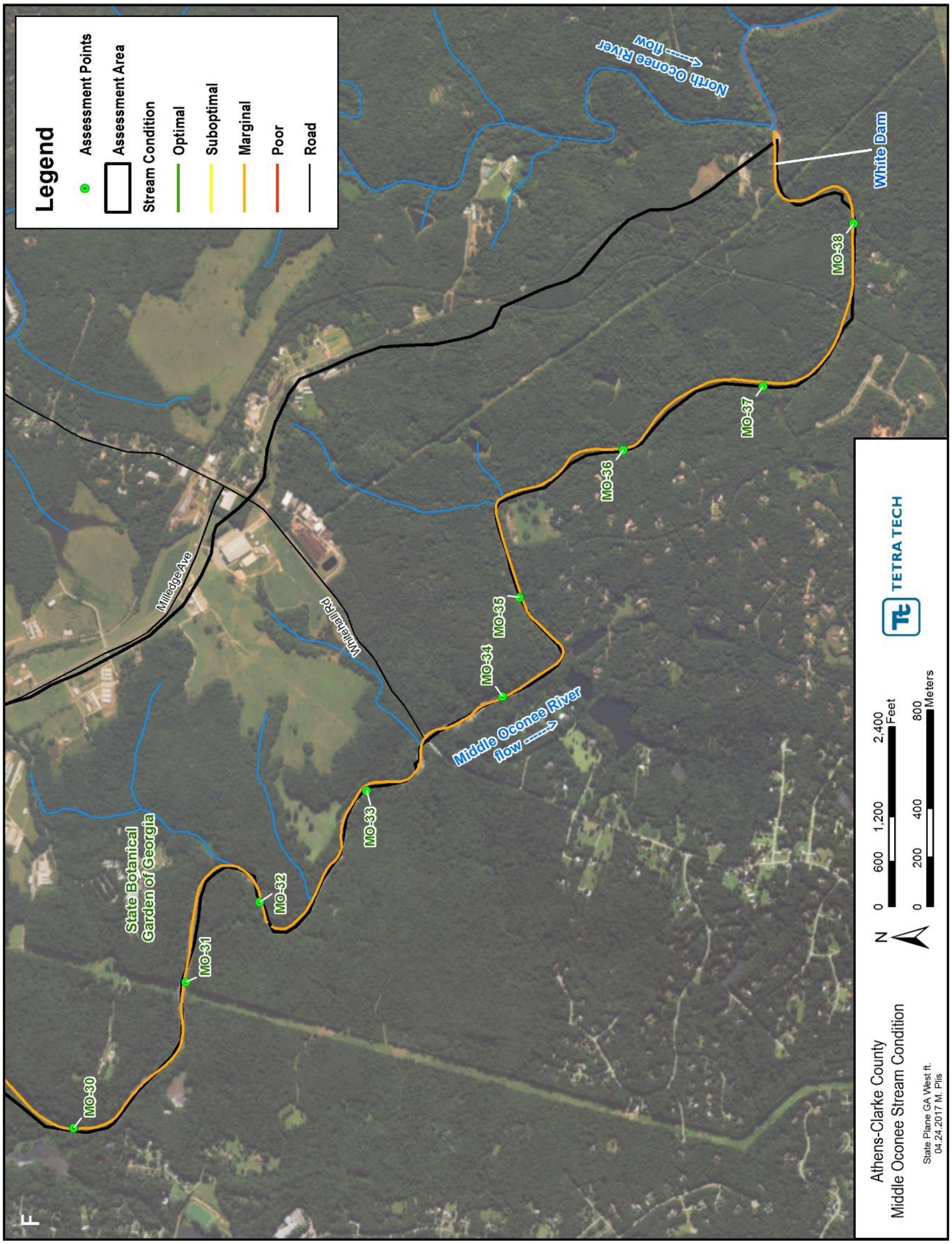

Figure 2-13. Stream Reach Condition Ratings—Panel F

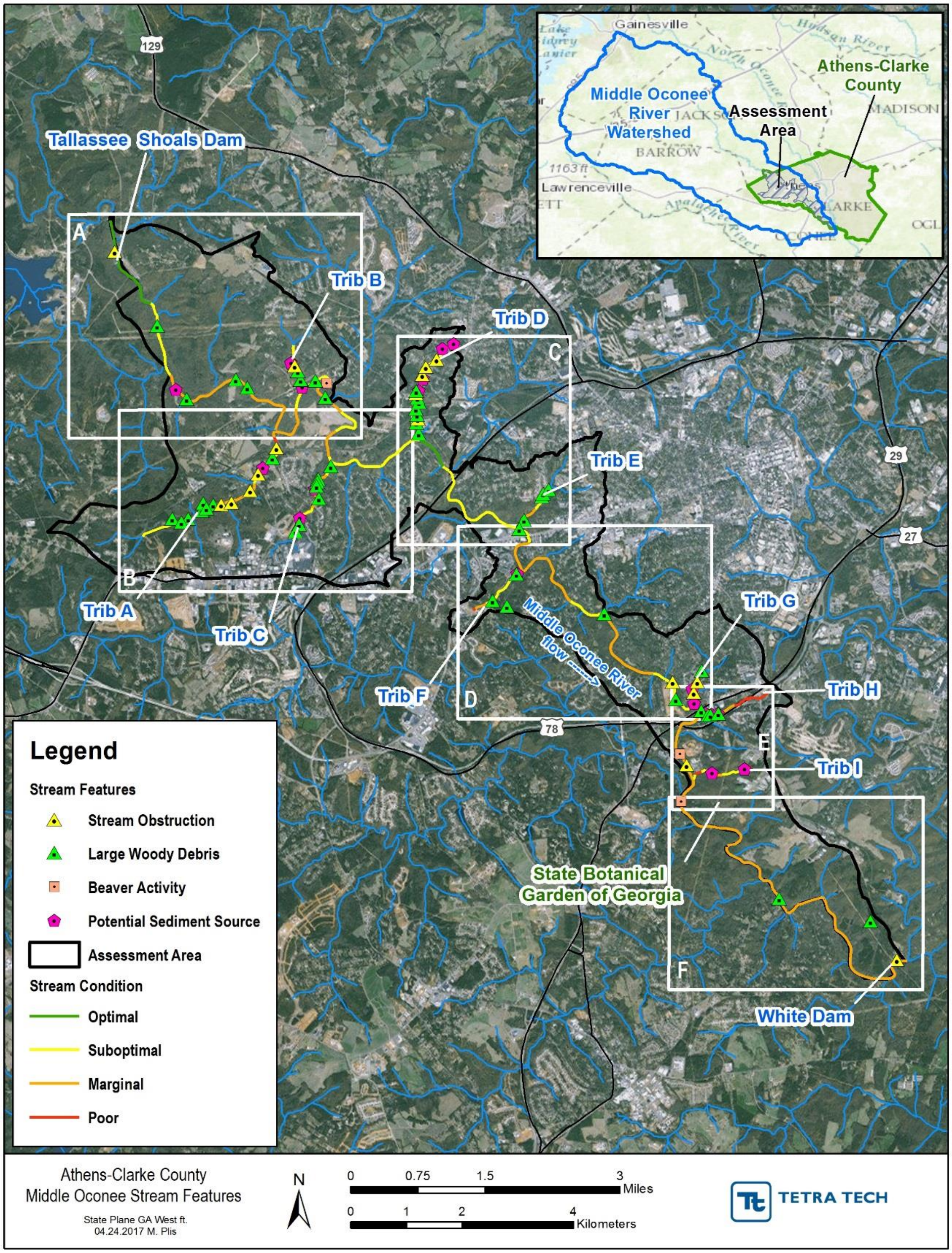

Figure 2-14. Stream Assessment Features

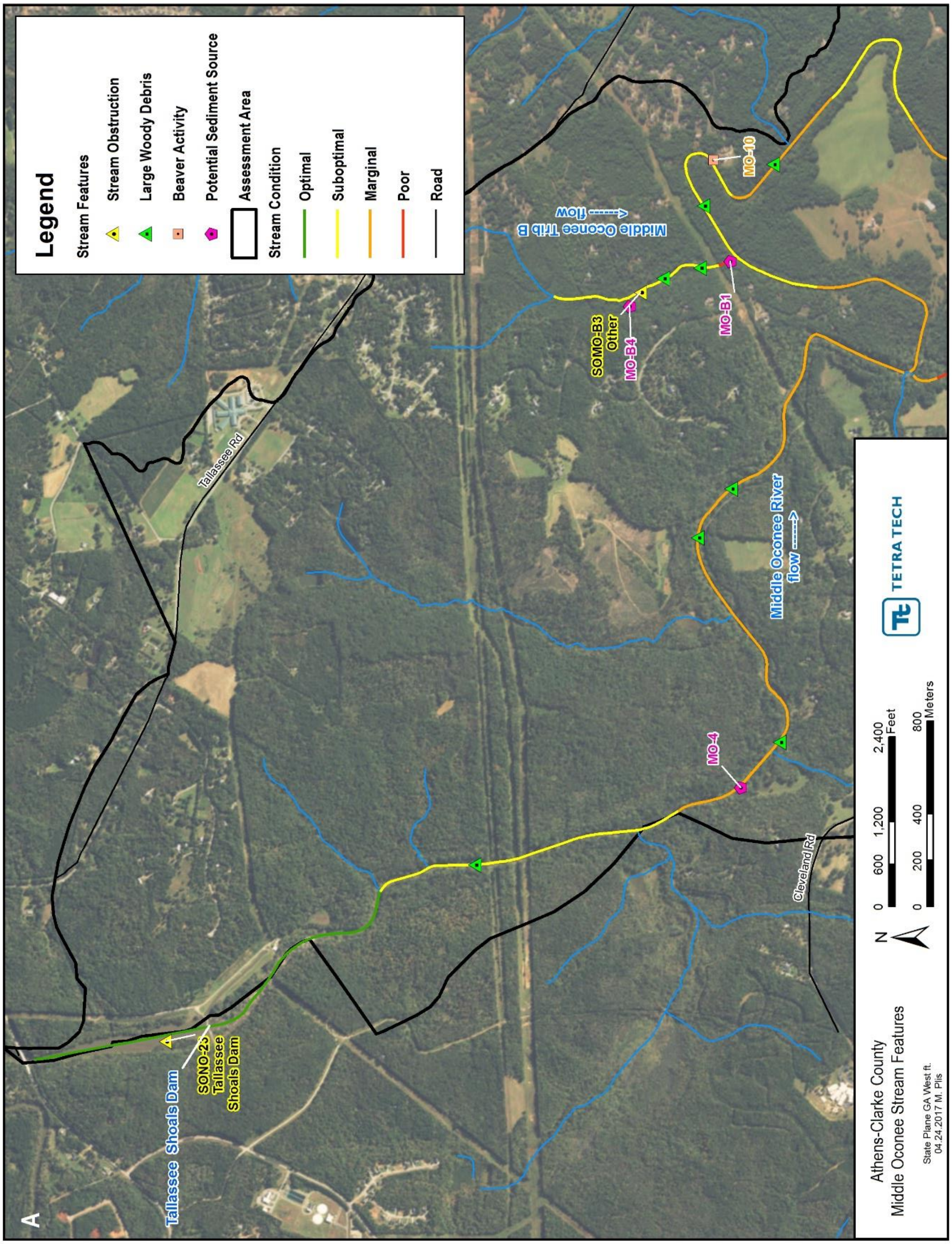

Figure 2-15. Stream Assessment Features—Panel A

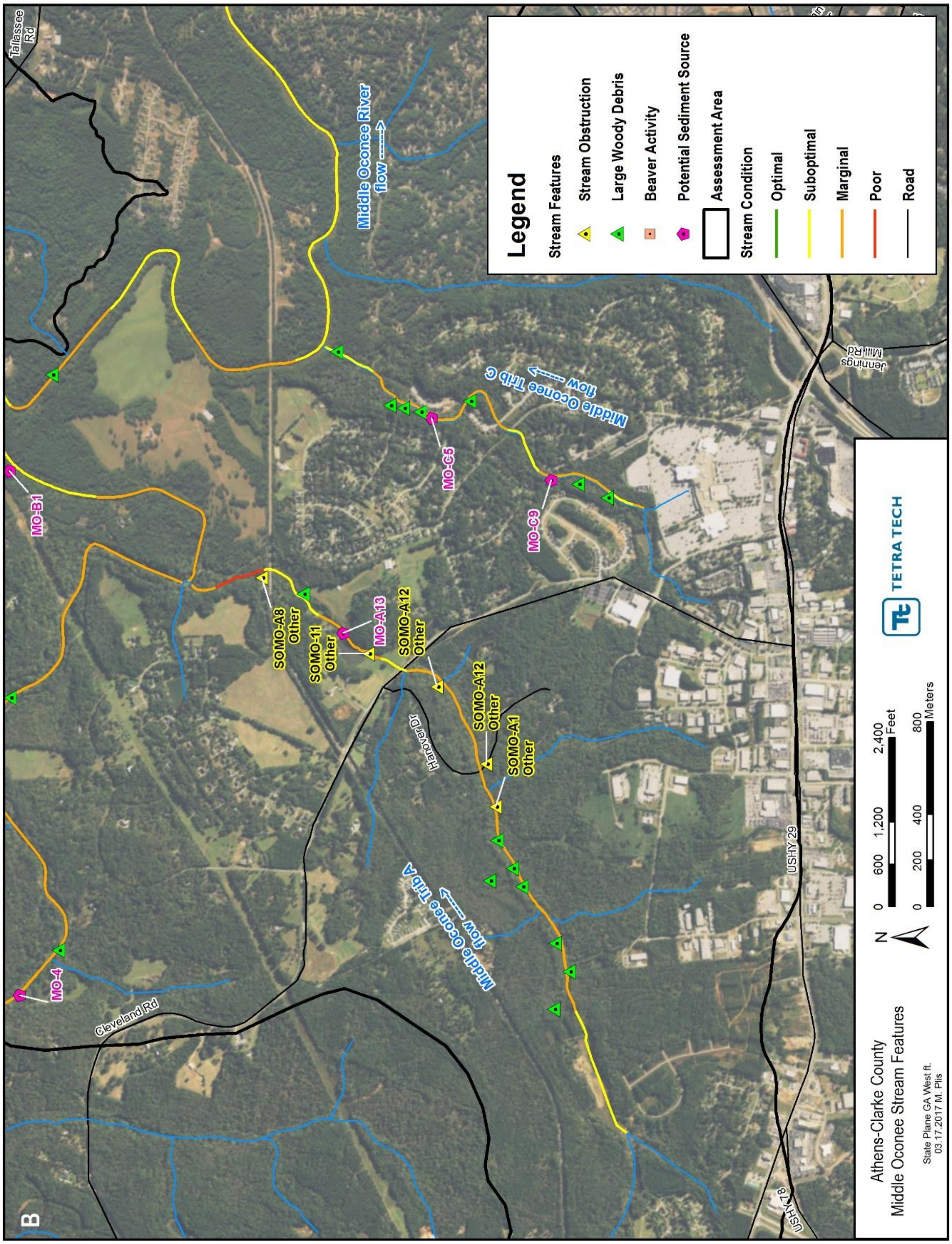

Figure 2-16. Stream Assessment Features—Panel B

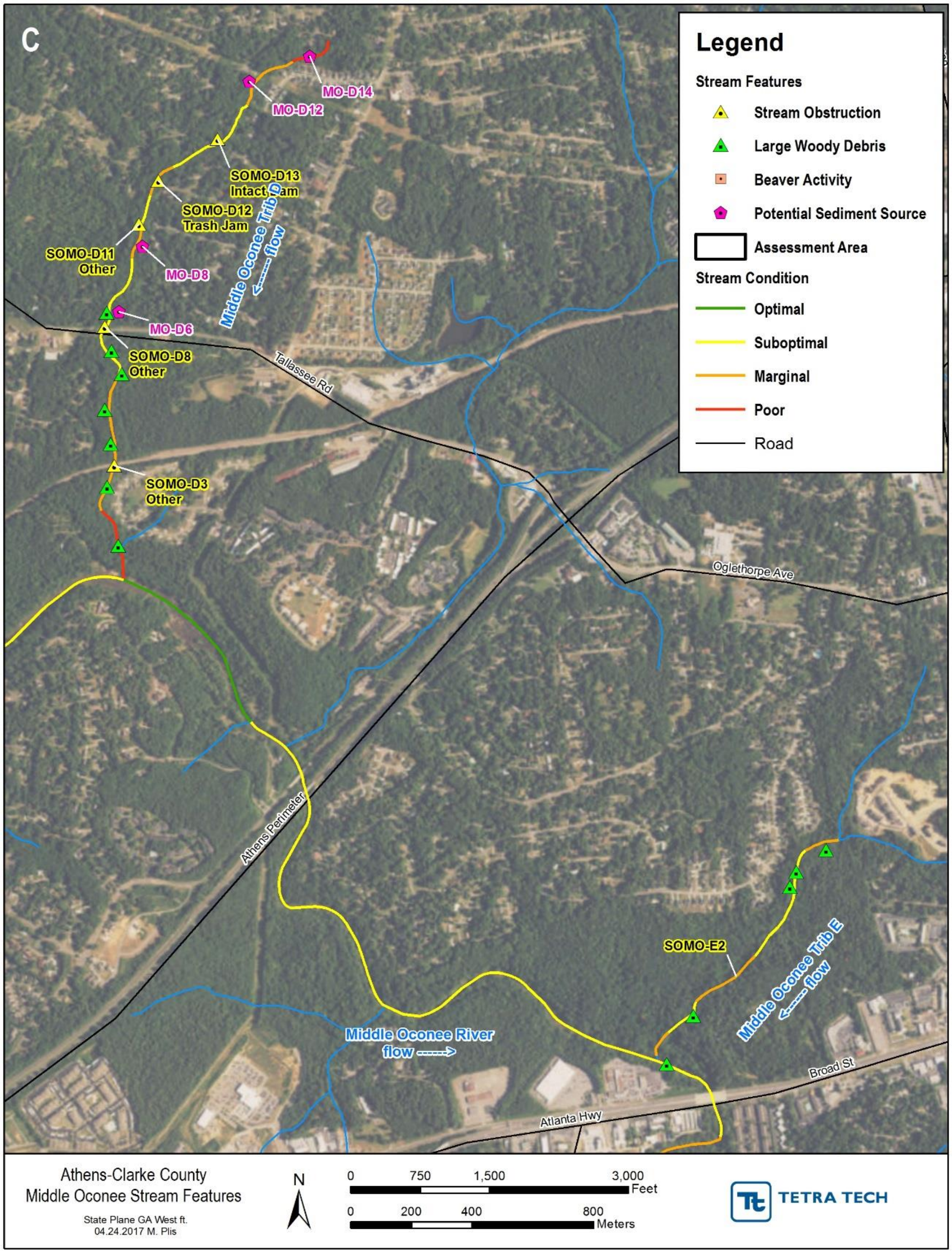

Figure 2-17. Stream Assessment Features—Panel C

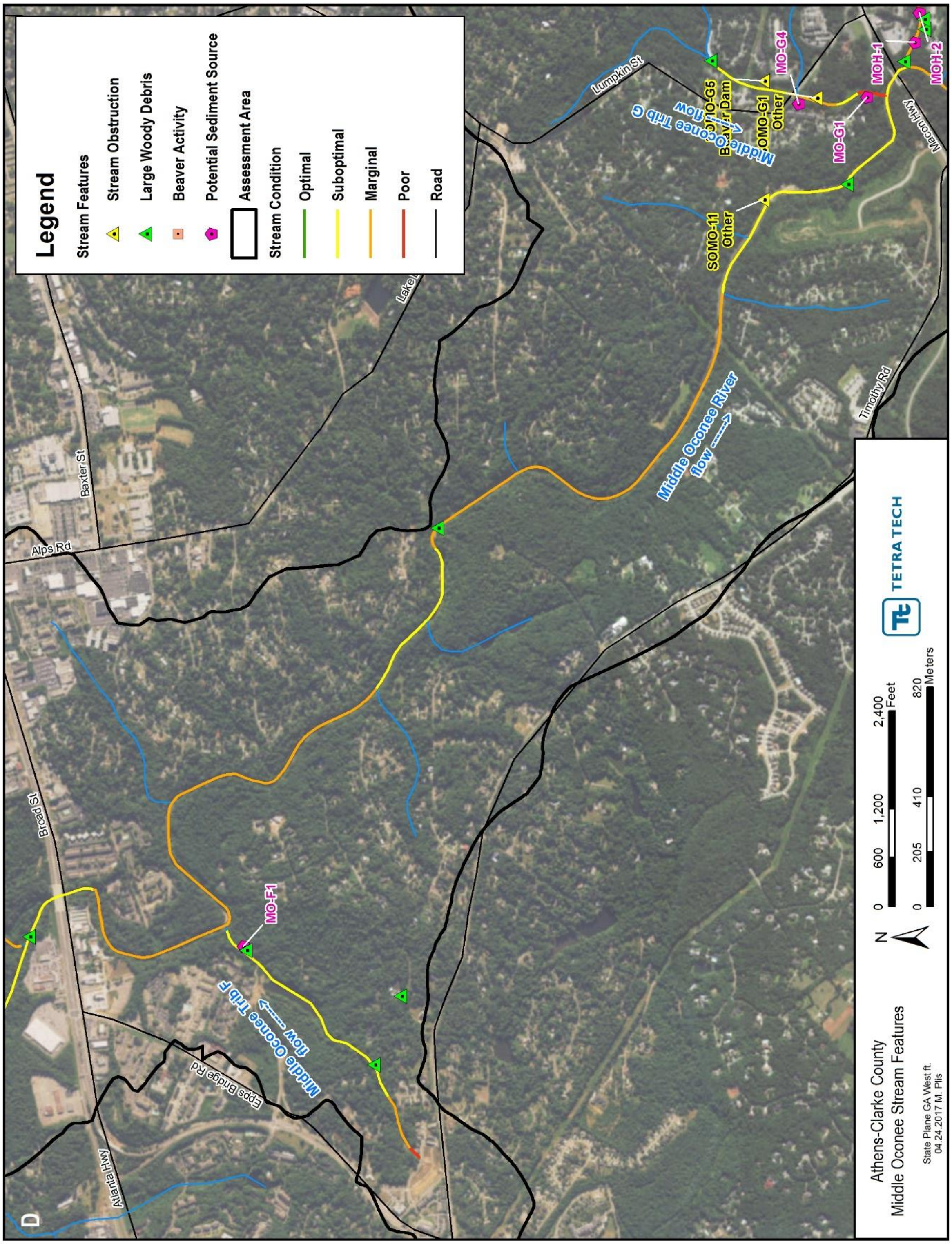

Figure 2-18. Stream Assessment Features—Panel D

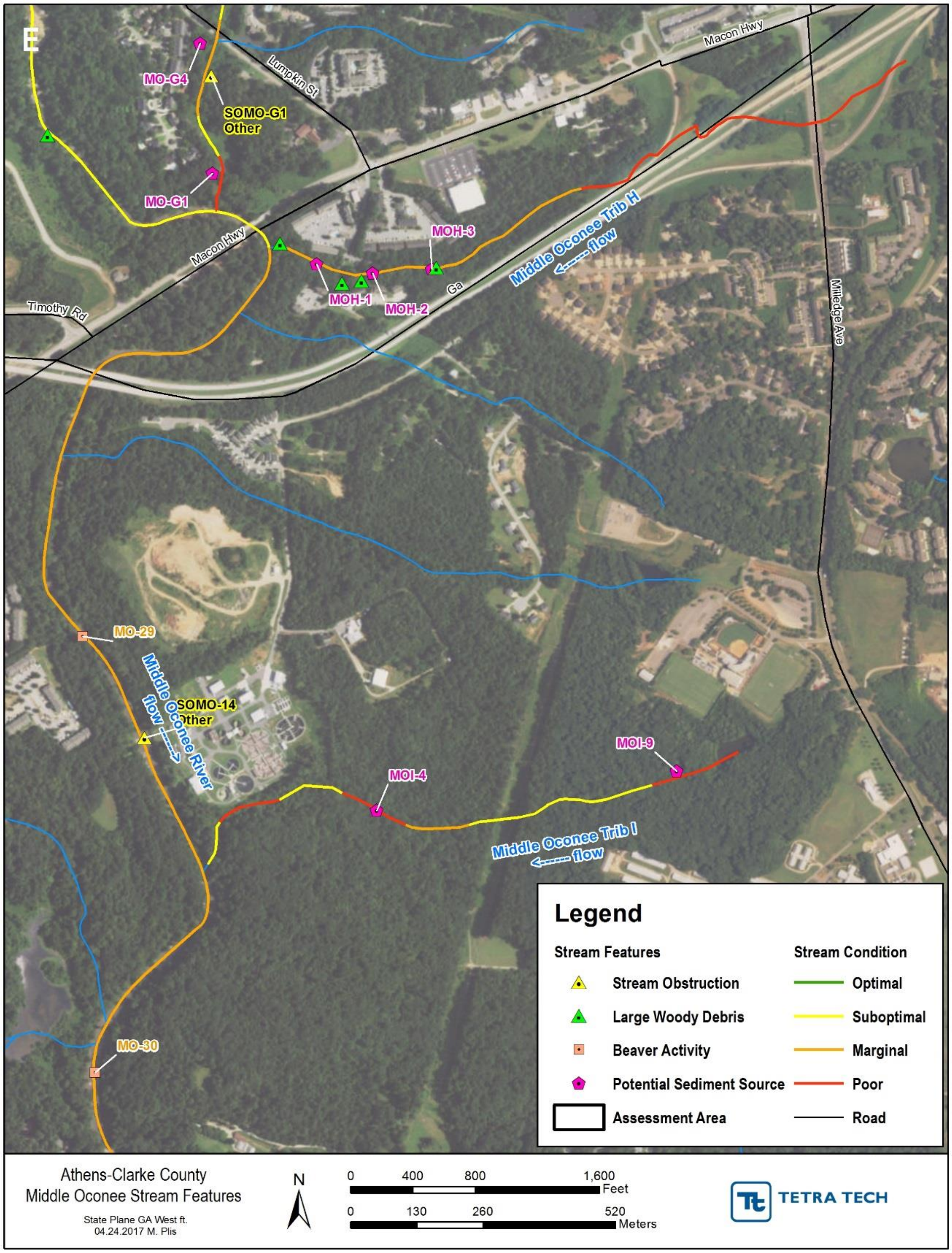

Figure 2-19. Stream Assessment Features—Panel E

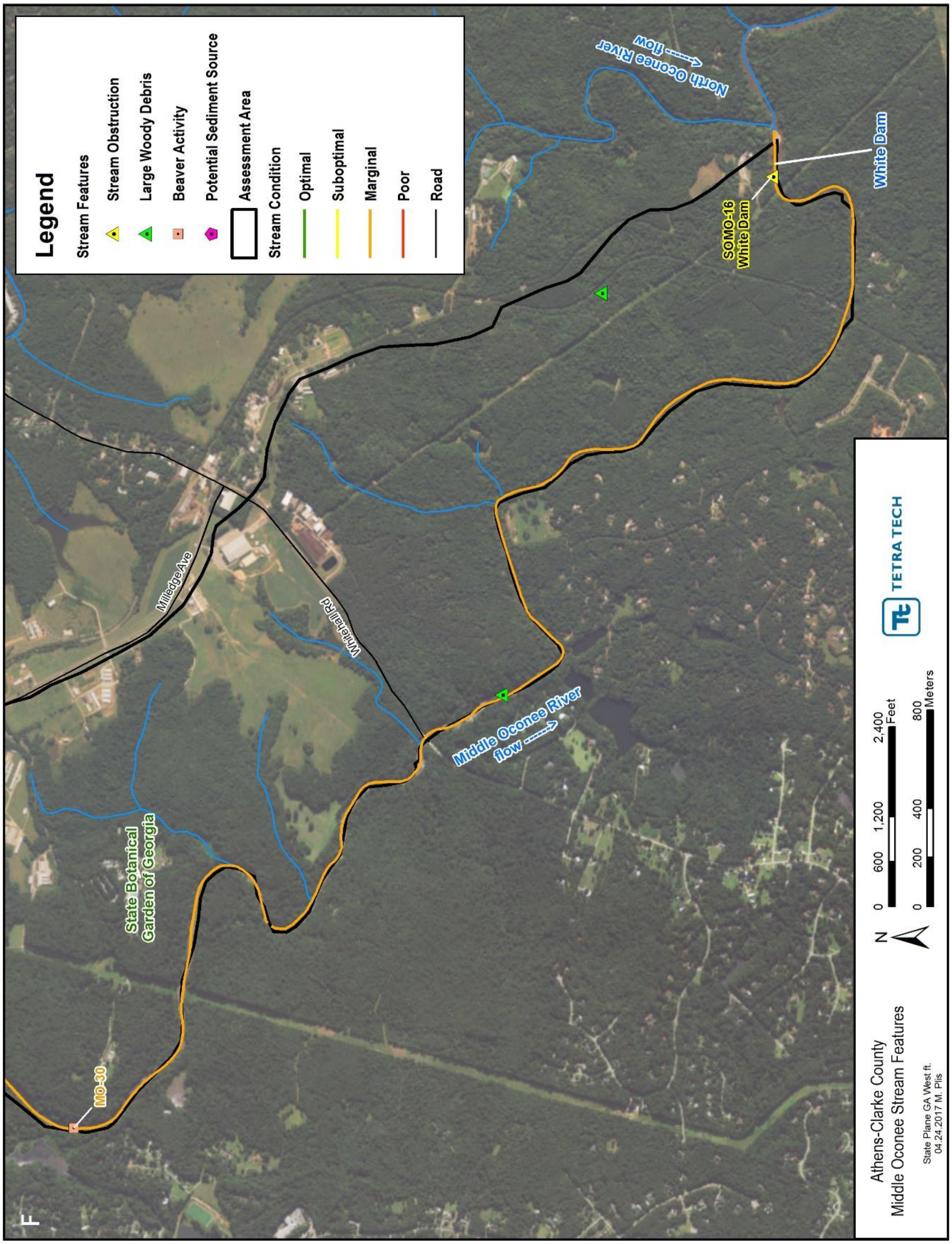

Figure 2-20. Stream Assessment Features—Panel F

2.7 Water Quality

There are three water quality monitoring stations in the study area (MO-1, MO-2, and MO-3) that were monitored by ACC in 2014. Monitoring stations are shown in Figure 2-21. ACC does not have a regulatory obligation to conduct long-term monitoring. However, they have a proactive Stormwater Management Program that includes conducting monitoring on a rotating basis between the different watersheds in ACC to get representative conditions in the major streams and track trends in water quality over time. Collecting and testing water quality samples over time will provide a general picture of what pollutants are a concern in ACC's waterways.

There are also five impaired waters monitoring stations in the watershed including these same three stations plus two additional stations, MO-4 and UT-1, where fecal coliform bacteria monitoring was initiated in 2015 and is ongoing (Figure 2-21). UT-1 is located on an unnamed tributary of Middle Oconee River and all other stations are on the main stem of the Middle Oconee River. This monitoring is required by GaEPD per the ACC Impaired Waters Monitoring Plan because the Middle Oconee River is impaired for fecal coliform bacteria throughout the study area.

The federal Clean Water Act has led to the development of water quality standards to restore and maintain the chemical, physical, and biological health of the nation's surface waters. Agencies use these standards to guide watershed management activities. The classification of a water body's designated use (e.g., drinking water supply) determines the applicable water standards. According to Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03 (O.C.G.A. 2015[1]), the Middle Oconee River has a designated use of fishing, except the segment from Beech Creek to McNutt Creek, which has the designated use of drinking water. State standards for dissolved oxygen (DO), pH, FC bacteria, and temperature for waters with the designated use of drinking water and fishing are listed in Table 2-4.

Table 2-4. Georgia Water Quality Standards for Designated Use of Drinking Water and Fishing (GaEPD 2015)

Dissolved Oxygen	pH	FC Bacteria	Temperature
Daily average of 5.0 mg/L and no less than 4.0 mg/L at all times	6.0-8.5	May-Oct < 200 colonies/100 mL as a geometric mean based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours, and 4,000 colonies/100 mL as a single-sample maximum.	Not to exceed 90 degrees Fahrenheit (32 degrees Celsius)
		Nov–Apr < 1,000 colonies/100 mL as a geometric mean based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours, and 4,000 colonies/100 mL as a single-sample maximum.	

Notes: mg/L = milligrams per liter; mL = milliliters.

[1] O.C.G.A (Official Code of Georgia Annotated). 2015. Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03. Amended: F. Oct. 2, 2015; eff. Oct. 22, 2015.

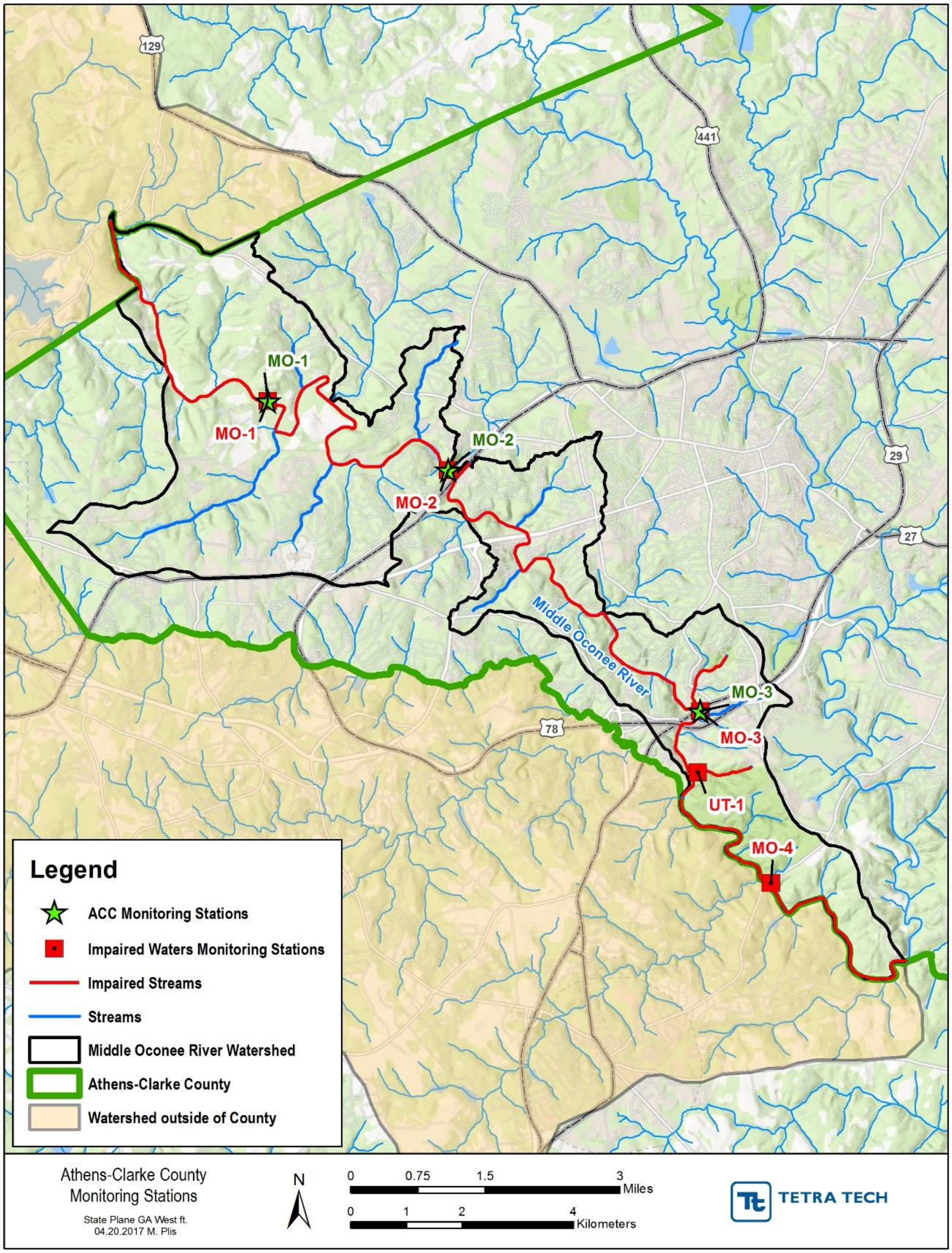

Figure 2-21. Water Quality Monitoring Stations

Water quality data collected by ACC in 2014 is summarized in Table 2-5. In this table, standards are based on the state standards for DO, pH, FC, and temperature, as shown in Table 2-4. Standards for all other parameters are based on benchmark values used by ACC that are not regulatory standards. FC bacteria geometric means are shown in Table 2-6. A single geometric mean was calculated from data collected by ACC in 2014 for each of two stations. Geometric means were calculated for all five stations from 2015 - 2016 as part of the impaired waters monitoring.

Plots of the raw grab sample data for DO, FC, pH, and temperature collected at each station are shown in Figure 2-22 through Figure 2-25. Data was collected over four monitoring events in August 2014. The full set of tabulated data is provided in appendix E.

Table 2-5. ACC Monitoring Station Water Quality Data (2014)

Parameter	Unit	Standard	MO1				MO2				MO3			
			Samples	Average	Min	Max	Samples	Average	Min	Max	Samples	Average	Min	Max
Conductivity	mS/cm	≤ 0.3	4	0.085	0.011	0.120	4	0.088	0.011	0.130	4	0.085	0.011	0.130
Dissolved Oxygen	mg/L	≥ 4*	4	5.18	3.05	8.57	4	3.24	1.77	5.63	4	4.38	3.20	7.51
Fecal Coliform Bacteria	cols/100mL	Varies	5	290	117	708	4	355	78	529	5	639	1	2,042
pH	Standard units	6.0 - 8.5*	4	6.79	6.65	7.01	4	7.26	7.07	7.59	4	7.20	6.99	7.40
Temperature	Degrees Celsius	≤ 32*	4	23.76	23.18	24.81	4	23.97	23.43	24.50	4	24.21	23.73	24.82
Total Suspended Solids	mg/L	≤ 13	1	4	4	4	2	8	5	10	2	1	1	1

Notes: cols/100 mL = colonies per 100 milliliters; mg/L = milligrams per liter; max = maximum; min = minimum; mS/cm = millisiemens per centimeter. Red cells indicate averages not meeting the standard. Orange cells indicate minimum or maximum values not meeting the standard. * indicates state standard.

Table 2-6. Fecal Coliform Data and Water Quality Standard Comparison (2014)

Parameter	Unit	Standard	Sample Dates	MO1				MO2				MO3				MO4				UT1			
				Samples	Geomean	Min	Max	Samples	Geomean	Min	Max	Samples	Geomean	Min	Max	Samples	Geomean	Min	Max	Samples	Geomean	Min	Max
Fecal coliform bacteria May - Oct	cols/ 100 mL	<200	Aug 4-25, 2014	4	257	117	708	N/A	N/A	N/A	N/A	4	526	160	2,042	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fecal coliform bacteria May - Oct	cols/ 100 mL	<200	Oct 14-29, 2015	4	260	80	500	4	115	40	500	4	123	80	170	4	198	170	230	4	110	20	300
Fecal coliform bacteria Nov - Apr	cols/ 100 mL	<1,000	Nov 9-Dec 3, 2015	4	383	170	2,400	4	396	170	3,000	4	285	130	1,100	4	723	140	3,000	4	227	80	500
Fecal coliform bacteria Nov - Apr	cols/ 100 mL	<1,000	Mar 7-21, 2016	4	141	40	300	4	352	170	1,700	4	119	90	170	4	189	110	230	4	229	80	1,100
Fecal coliform bacteria May - Oct	cols/ 100 mL	<200	May 16-Jun 6, 2016	4	185	130	300	4	122	90	170	4	222	70	500	4	118	40	300	4	234	70	1,100
Fecal coliform bacteria May - Oct	cols/ 100 mL	<200	Aug 1-23, 2016	4	168	80	700	4	794	230	2,400	4	685	500	1,100	4	1,039	230	3,000	4	228	170	300
Fecal coliform bacteria Nov - Apr	cols/ 100 mL	<1,000	Nov 9-21, 2016	4	127	70	270	4	91	40	300	4	179	110	500	4	109	60	230	4	70	20	230

Notes: cols/100 mL = colonies per 100 milliliters; max = maximum; min = minimum. Red cells indicate averages not meeting the standard.
2014 data are from general ACC water quality monitoring. 2015-2016 data are from impaired waters monitoring.

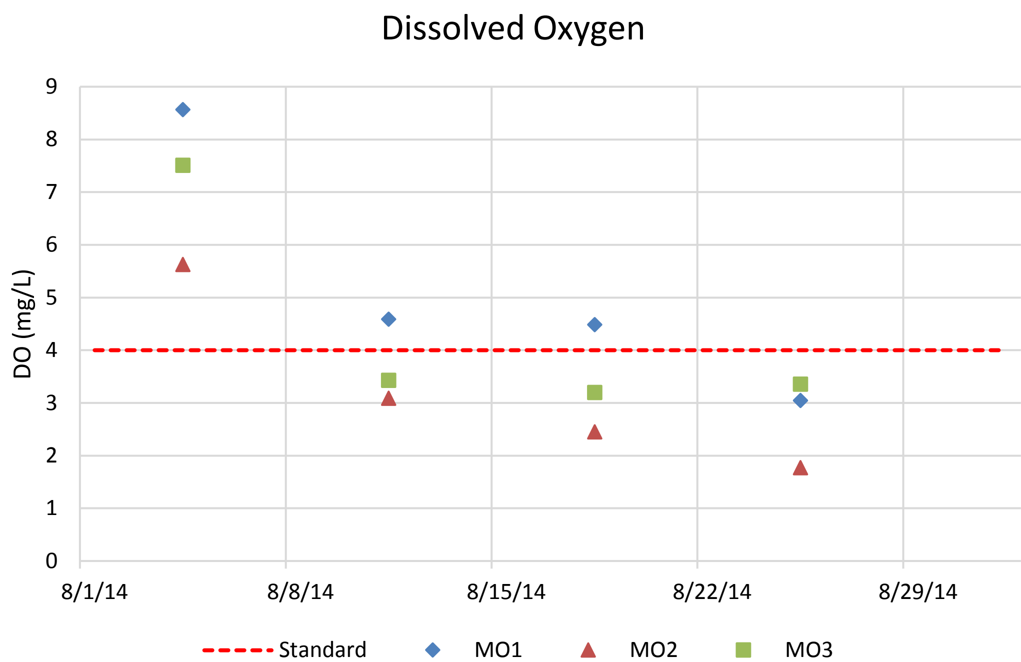

Figure 2-22. Dissolved Oxygen Grab Sample Results for Middle Oconee Stations

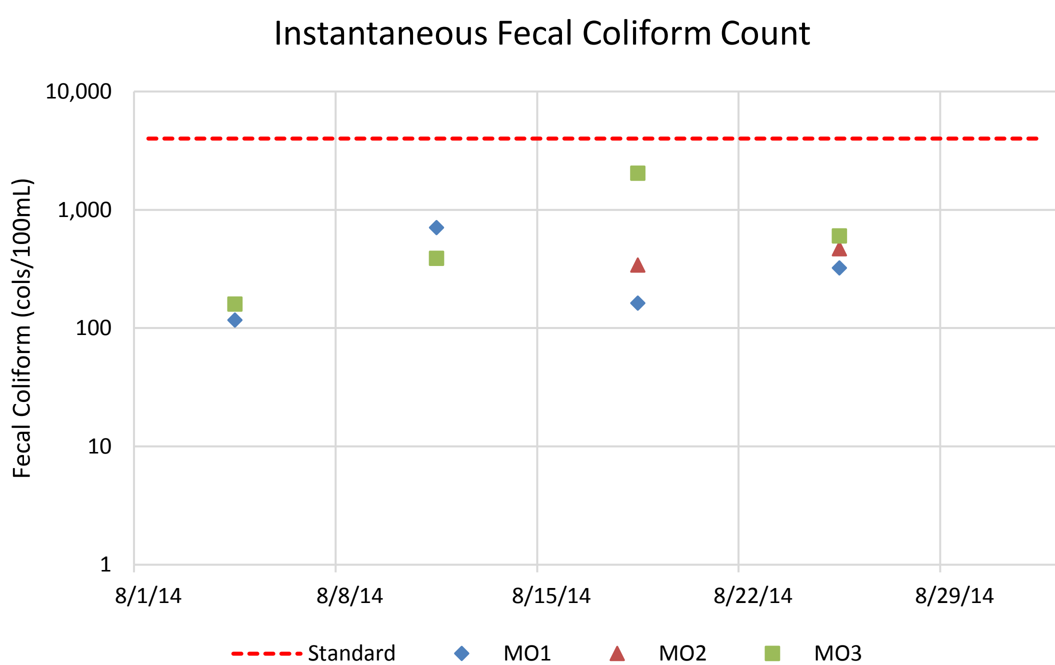

Figure 2-23. FC Bacteria Grab Sample Results for Middle Oconee Stations

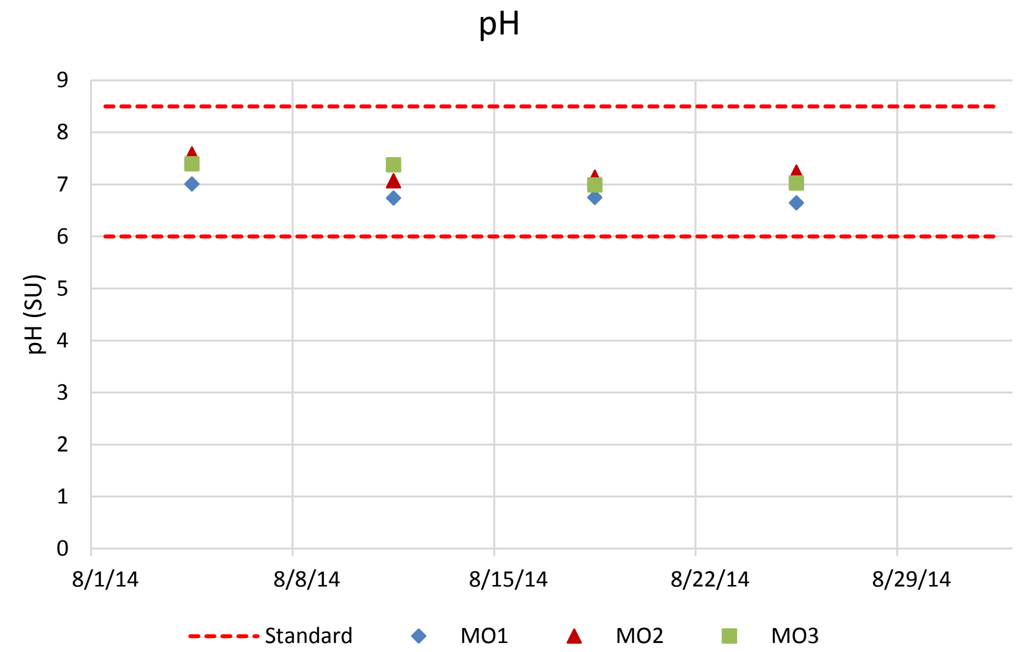

Figure 2-24. pH Grab Sample Results for Middle Oconee Stations

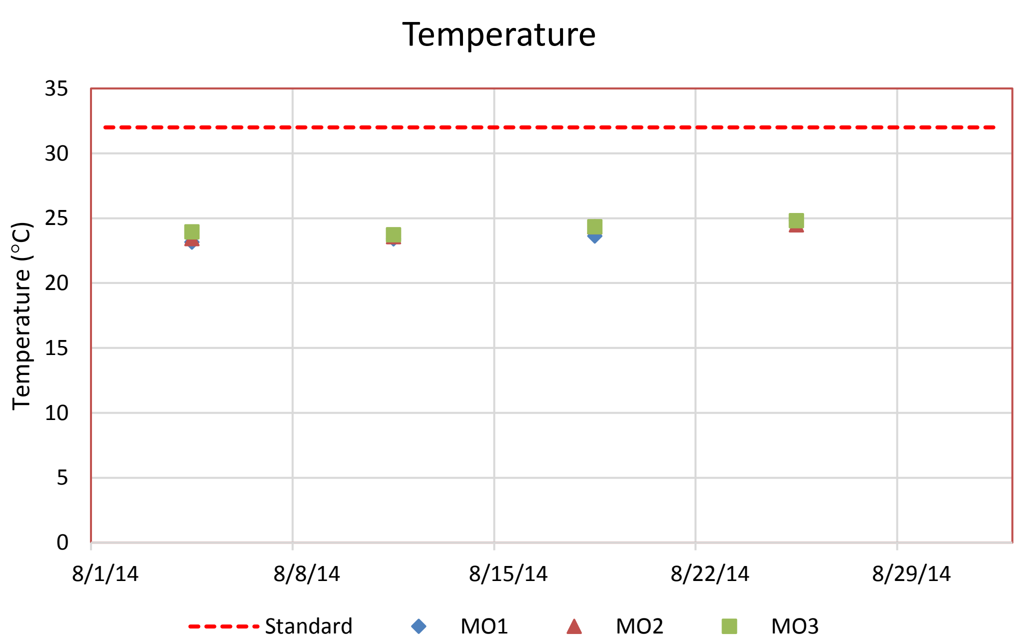

Figure 2-25. Temperature Grab Sample Results for Middle Oconee Stations

Results of the water quality sampling effort suggest that surface waters in the study area meet the pH and temperature standards adopted by the State of Georgia. Average concentrations as well as individual pH and temperature measurements in Middle Oconee River are well within the state standards.

DO measurements do not meet state standards. All stations had at least one measurement that was below the instantaneous minimum standard of 4.0 mg/L, and station MO-2 has an average concentration that is below this standard. FC geometric means indicate that all stations in the Middle Oconee River study area comply with the November-through-April standard but none of the stations comply with the May-through-October standard (Table 2-6). Each station had at least one geometric mean that exceeded the standard of 200 colonies per 100 milliliters (col/100 mL). Average conductivity and TSS results meet the standards at all stations.

2.8 Nutrient and TSS Loading

2.8.1 LSPC Watershed Model

The Loading Simulation Program C++ (LSPC) was used to represent the hydrological and water quality conditions for the study area. LSPC is a comprehensive data management and modeling system that is capable of representing loading, both flow and water quality, from nonpoint and point sources and simulating in-stream processes. It is capable of simulating flow, nutrients, TSS, and other conventional pollutants, as well as temperature and pH for pervious and impervious lands and water bodies. LSPC was configured to simulate the watershed as a series of hydrologically connected subwatersheds. LSPC is based on the Mining Data Analysis System (MDAS), with modifications for nonmining applications such as nutrient modeling. MDAS was developed by EPA Region 3 through mining TMDL applications.

2.8.2 Watershed Segmentation

The contributing drainage area was represented by a series of subwatersheds to evaluate the sources contributing to a water body and to represent the spatial variability of these sources within the watershed model. Subwatersheds were delineated using the National Elevation Dataset in 1/3-arc-second resolution (10 meters) and the National Hydrography Dataset.

2.8.1 Simulation Period

The ACC LSPC model was set up and calibrated to simulate a 10-year period from January 1, 1998, through December 31, 2009. That calibration time period was selected as it captured two drought periods (1999-2001 and 2006-2007) and several wet years, including 2003 and 2005.

2.8.2 Land Cover Representation

The watershed model uses land cover data as the basis for representing hydrology and nonpoint source loading. Land cover data was used from the University of Georgia (UGA) Georgia Land Use Trends (GLUT) coverage, and included urban, forest, crop and pasture land, wetlands, water, barren, golf courses and utility swaths. The GLUT coverage represented conditions in year 2008 based on an existing model developed as part of State water planning efforts. In addition, the LSPC model requires division of land cover in each subwatershed into separate pervious and impervious land units. For this, the GLUT impervious cover was intersected with the GLUT land cover. Again, the GLUT land cover data was used in modeling because of its consistency with State water planning efforts and because it is more representative of the modeled simulation period (January 1, 1998, through December 31, 2009) than the NCDC 2011 Land Cover described in section 1.2.

2.8.3 Loading Maps

Loading maps were created to represent average TN, TP, and TSS loading rates in pounds per acre per year for each of the subwatersheds in the study area (Figure 2-26 through Figure 2-28) using results from the LSPC model developed for ACC. The modeled results identified the greatest TN and TP loads in the central, most heavily developed, parts of the study area. Modeled TSS loads are low to moderate throughout the study area, with slightly higher loads in the in the central, most heavily developed, parts of the study area. There are no numeric standards for TN, TP, or TSS loads in streams in Georgia, so the figures are not meant to show areas that exceed an allowable value, but to depict average nutrient and sediment loads across the watershed based on land use.

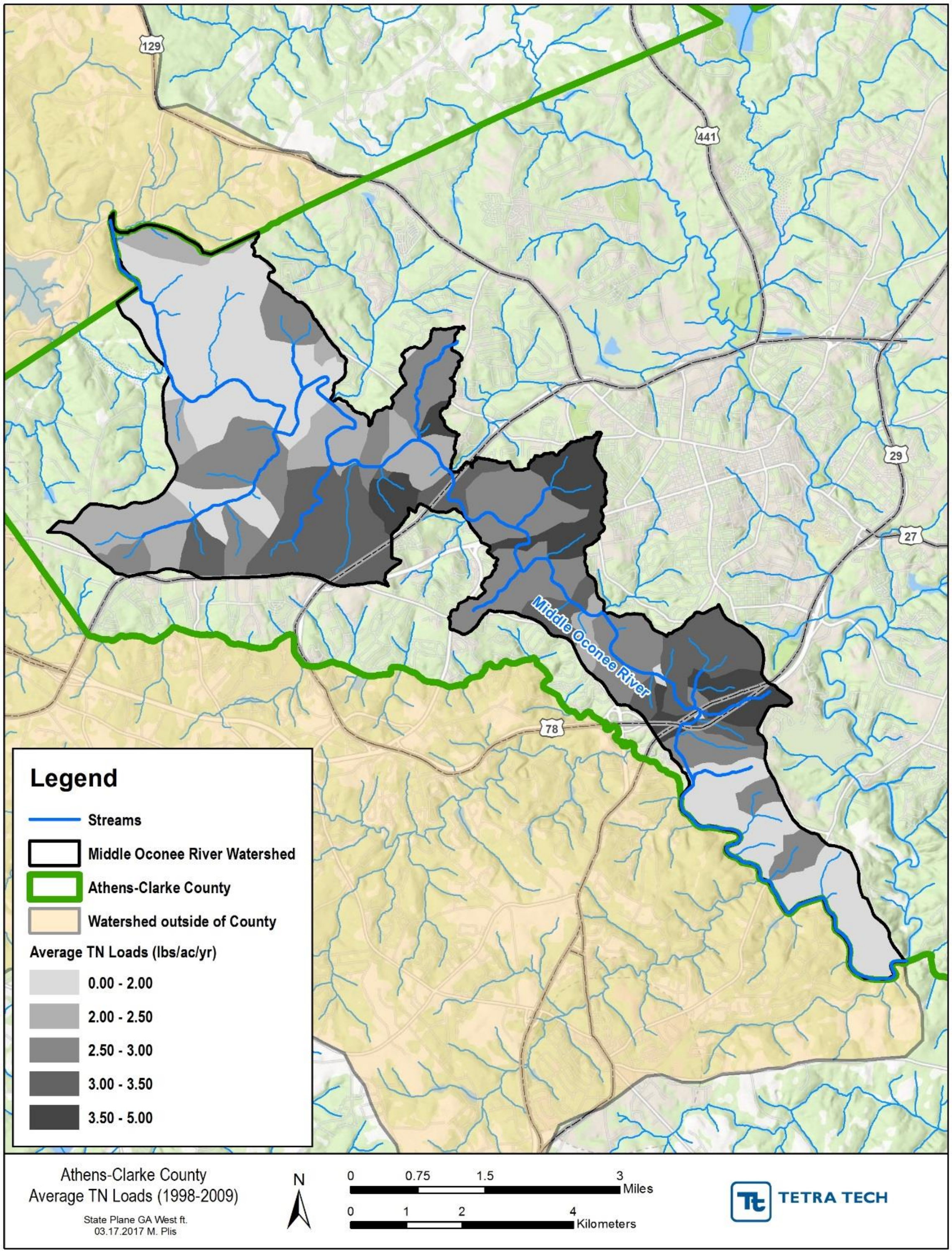

Figure 2-26. Average TN Loads

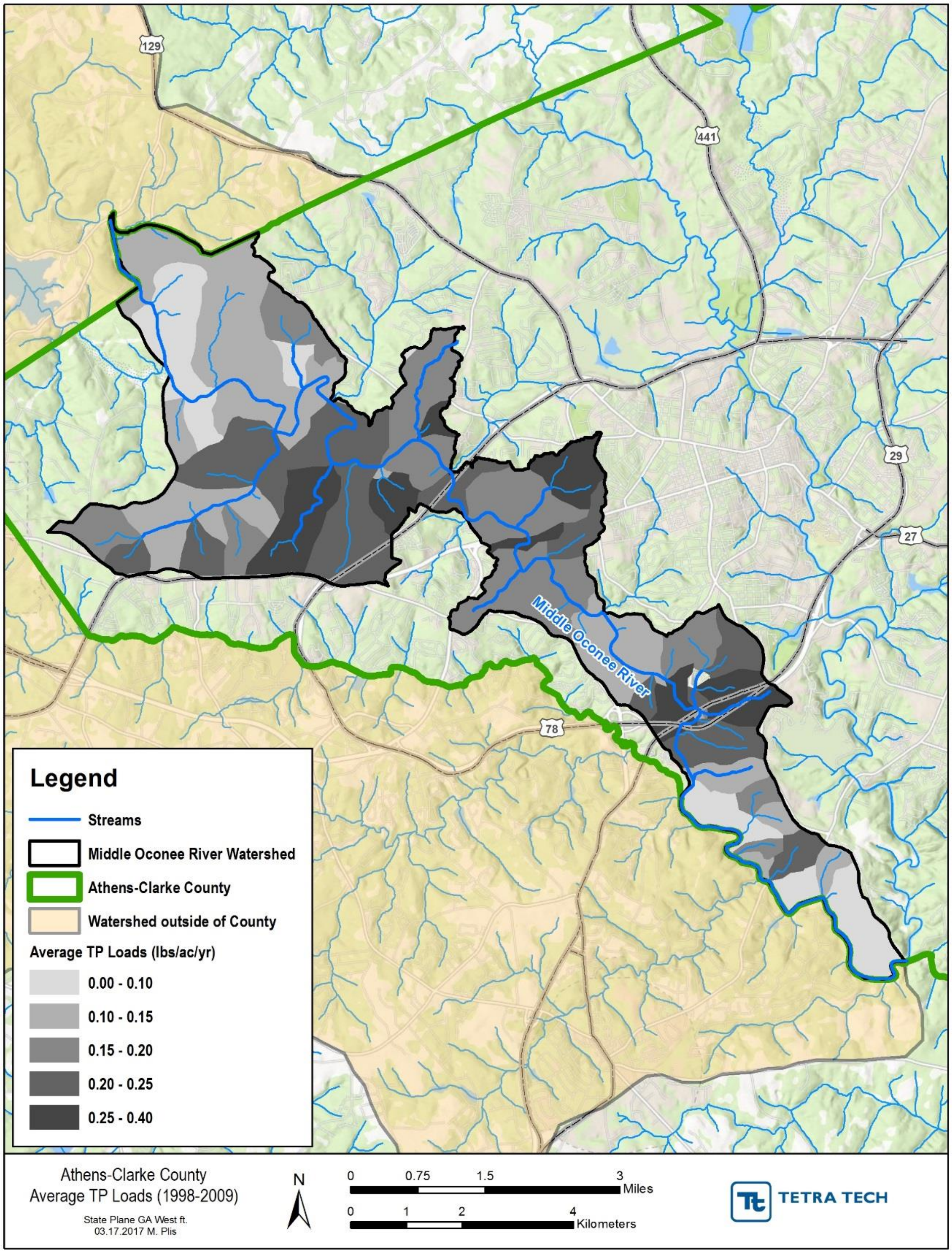

Figure 2-27. Average TP Loads

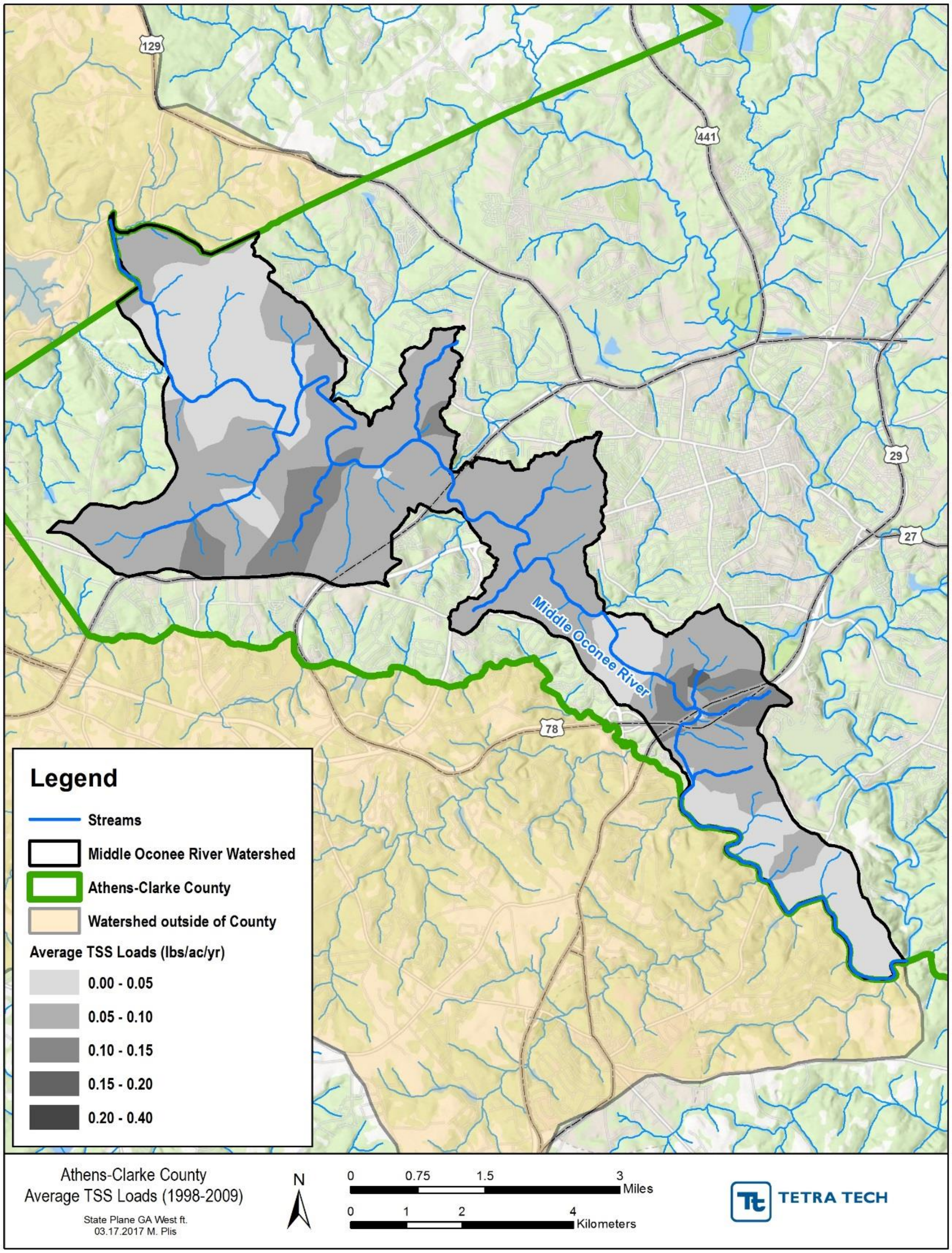

Figure 2-28. Average TSS Load

2.9 Summary

This watershed characterization describes existing conditions in the Middle Oconee River watershed within ACC. The nature and condition of the study area was characterized from previous studies, monitoring efforts, and stream assessments. A watershed model was also used to identify subwatersheds contributing to nutrient and TSS loads.

The Middle Oconee River watershed is composed primarily of forest and developed land. The study area is approximately 10 percent impervious. The Middle Oconee River is impaired for biota-macroinvertebrate (BioM) because of sediment upstream of the confluence with McNutt Creek, and for FC bacteria throughout the study area (GaEPD 2016).

Water quality monitoring data indicate that DO is a concern in the study area. All stations had at least one measurement that was below the instantaneous minimum standard of 4.0 milligrams per liter (mg/L), and station MO-2 has an average concentration that is below this standard. Fecal coliform bacteria is also a concern in this watershed. None of the stations comply with the May-through-October standard, as each station had at least one geometric mean that exceeded the standard of 200 col/100 mL.

Notable key findings from the stream assessment include the following:

- High quality (optimal) stream reaches include the most upstream reach of the Middle Oconee River (near the north county line) and a small optimal reach of the Middle Oconee River between Trib D and Athens Perimeter Highway. No assessed tributaries were rated as optimal.
- Poor quality stream reaches include segments of Middle Oconee Tribs A, B, D, F, G, H, and I. No reaches of the main stem of the Middle Oconee River were rated as poor.
- Potential sources of FC bacteria noted in the watershed include human, dog, and deer. A sewage odor was noted at several locations and boggy conditions were noted in the floodplain of Trib I adjacent to the sewage treatment plant during dry weather conditions.
- Large woody debris jams are common in tributaries with a particularly high number of jams collecting debris and partially obstructing flow on Tribs A, C, D, and E.
- Beaver activity was only noted on the main stem of the Middle Oconee River, in three locations including Trib G.
- Infrastructure appears to be affected in Trib A where a culvert at SOMO-A1 has failed and presently creates a partial stream obstruction, in Trib B where a defunct weir at SOMO-B3 has diverted flow causing new channel to erode, in Trib C where a scour pool below a parking lot outfall (MO-C12) may impact a sewage line crossing, and in Trib H where a sewage pipe is impacted by woody debris causing scour around footing at site O1MOH.
- Sand deposits, channel erosion, head cuts, and mass wasting effect tributaries in the Middle Oconee River watershed including Tribs C, D, E, F, and G.

3 Watershed Management Measures

3.1 Current Measures

ACC is currently implementing numerous structural and programmatic management measures to maintain and improve water quality throughout the county. The implementation of these measures is a collaborative effort by various ACC departments and other stakeholders mentioned in section 1.3.

As part of ACC's efforts to implement watershed protection strategies, measures have been taken to prevent detrimental changes in hydrologic conditions and reduce, prevent, or treat stormwater pollutants through protective ordinances, development reviews/inspection programs, staff training sessions, public education and outreach, compliance with ACC's Phase II MS4 permit, water quality monitoring, and long-term watershed characterization studies. A complete list of BMPs and programmatic management activities implemented from July 2016 through June 2017 is included in Table 2-1 of the 2016-2017 Public Utilities Department WPP Annual Report and provided as appendix F of this WMP.

3.2 Watershed Management Needs

3.2.1 Method for Determining Management Needs

Eight watershed management needs were identified across ACC based on information obtained from the watershed characterizations. Decision criteria were developed to determine if a management need applied to each assessed watershed. The criteria for determining ACC management needs are listed in Table 3-1. The table also identifies which of these management needs apply to the Middle Oconee River watershed. Shaded cells indicate that the need is watershed-wide.

Table 3-1. Watershed Management Needs Decision Criteria

Management Need	Decision Criteria	Applicable to Middle Oconee River[a]
FC Bacteria	Listed as impaired for FC; or Geometric mean not meeting state WQ standards.	Yes
Sediment	Listed as impaired for biota (fish or macro) due to sediment; or Average TSS value greater than standard of 13 mg/L.	
pH	Average value not meeting state WQ standards.	
Conductivity	Average value greater than the standard of 0.3 mS/cm.	
Dissolved Oxygen	Average value not meeting state WQ standards.	Yes
Wetland Preservation	Large wetland areas identified in NWI Map.	Yes
Buffer Enhancement	High percentage of cropland/pastureland directly adjacent to streams.	
Hydrology	Watershed is $\geq$ 10% impervious; or Poor stream condition scores.	Yes

Note: mg/L = milligrams per liter; mS/cm = millisiemens per centimenter.

a Dark shading indicates the management need is watershed-wide.

3.2.2 Management Needs by Area

The Middle Oconee River watershed was determined to have the following watershed management needs. For each management need a rationale is provided in addition to identifying to what area of the watershed it applies. Refer to Figure 3-1 for locations of management needs by area.

FC Bacteria: Monitoring data show that none of the stations comply with the May–October state standard for fecal coliform bacteria, as each station had at least one geometric mean that exceeded the standard of 200 colonies/100 mL. Additionally, The Middle Oconee River is impaired for fecal coliform bacteria throughout the study area. Therefore, this was determined to be a watershed-wide management need. Areas upstream of ACC may also be contributing to high FC concentrations, limiting the ability of ACC to meet state standards.

DO: ACC monitoring data show that all stations had at least one DO measurement that was below the instantaneous minimum standard of 4.0 mg/L, and station MO-2 has an average concentration that is below this standard. Therefore, DO was determined to be a watershed-wide management need.

Wetland Preservation: Wetland preservation is a management need for the upper portion of the Middle Oconee River, upstream of Athens Perimeter Highway, because the NWI Map identifies a great deal of palustrine forested wetlands in this area. Preservation could be achieved through land acquisitions or conservation easements.

Hydrology: Hydrology was identified as a watershed-wide management need because the Middle Oconee River watershed is greater than 10 percent impervious. As the percentage of impervious area increases in a watershed, stream hydrology is altered. This altered hydrology, sometimes referred to as "urban stream syndrome," causes streams to have lower baseflow and higher peak storm flows than they would in a less developed watershed. Stormwater management practices that help detain stormwater runoff and release it slowly, and those that help infiltrate water into the ground can help restore a more natural hydrology to the receiving streams.

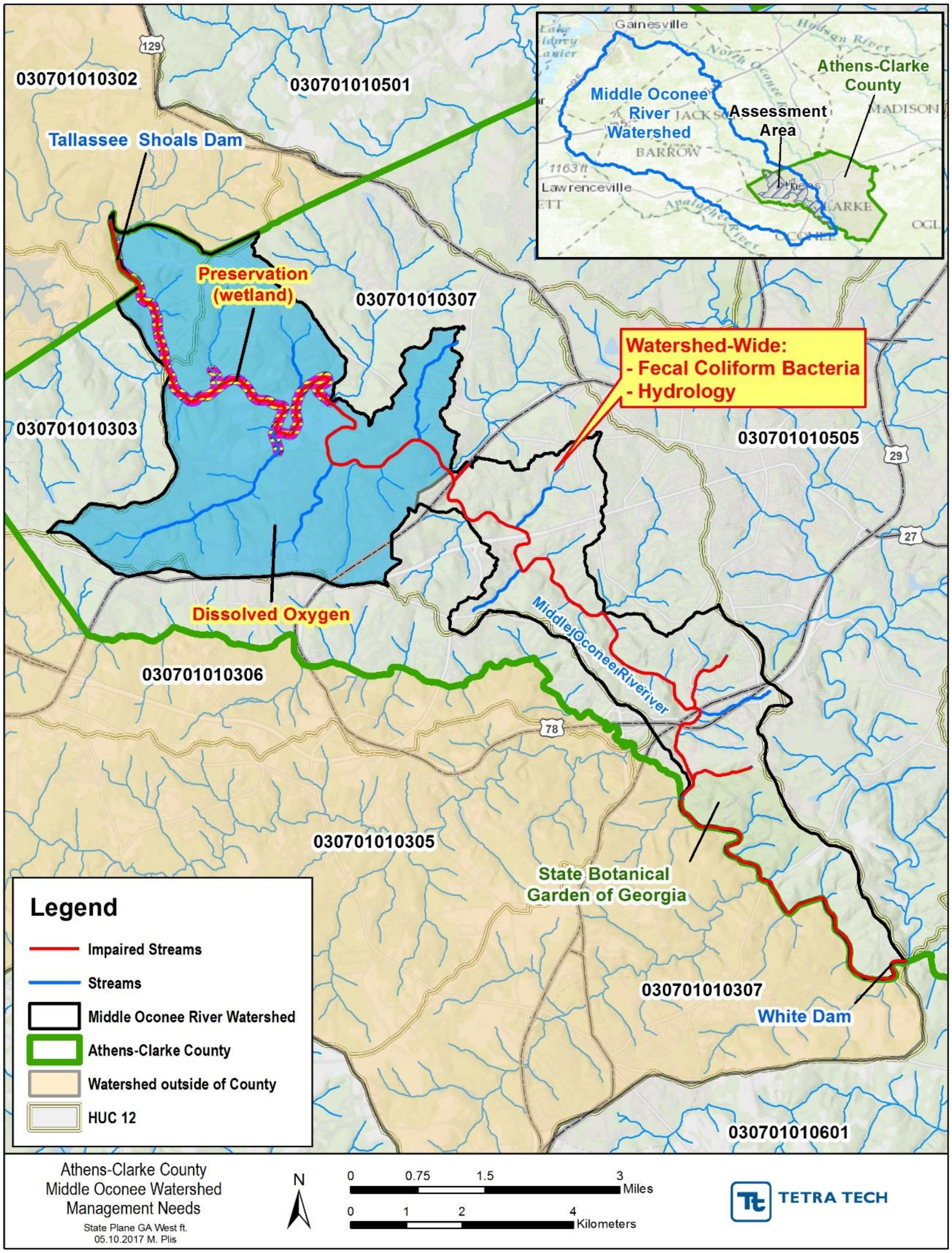

Figure 3-1. Middle Oconee River Management Needs

3.3 Management Opportunities

The Tetra Tech-Arcadis-ACC team conducted a GIS analysis and field assessment to identify watershed management opportunities, including stormwater control, restoration, and programmatic measures. Particular consideration was taken by the team to identify and prioritize opportunities that target the management needs specific to the Middle Oconee River watershed. This section presents details and results of the analytical methodology employed by the team to develop a prioritized list of viable opportunities, including parcel screening criteria, field assessment information, BMP modeling scenarios, and scoring and ranking metrics.

3.3.1 Identification of Potential Sites for Management Opportunities through GIS Analysis

A GIS screening analysis was conducted as an initial step in identifying potential sites for watershed improvement measures. Eleven metrics were used to score all parcels in the watershed. Point values were assigned to different categories within each metric so that preferred attributes received a higher score (Table 3-2). Some site features were preferred over others when selecting candidate sites because they had features such as publicly owned land, large parcel size, and close proximity to an impaired stream. Weighting of preferred features was done within the scoring system itself, rather than applying a weighting factor to each metric. Therefore, the total possible points are different for individual metrics. Individual metric scores were summed to obtain a total score for each parcel in the watershed. The maximum score possible was 119. All parcels in the watershed were scored and ranked based on this system.

The top 20 ranked sites in each watershed were evaluated further using GIS data and Google Earth images to evaluate the potential for management opportunities on these parcels. Some parcels were removed from further consideration if opportunities were limited (based on ownership information, existing land use, position in the watershed, access constraints, and other factors). Some parcels had characteristics that informed programmatic management opportunities (e.g., preservation opportunities, stream buffer enhancement, and agricultural BMPs), but did not require a site visit.

Additional sites were added to the list of places to visit in the field following consultation with the Transportation and Public Works Department and the Leisure Department, both of which provided a list of sites already identified as having stormwater management concerns and other potential management opportunities. Other sites were added based on opportunities identified from stream walks or from a visual scan of the watershed in Google Earth and GIS. The visual scan helped identify sites that might not have been captured by the scoring metrics such as highly disturbed or erosional areas. A list of the sites identified for field assessments is included in Table 3-3 and their locations are shown on Figure 3-2.

Table 3-2. Metrics and Scoring System for Site Prioritization

Parcel Metric		Score	Source	Notes
Publicly Owned	County Gov	20	ACC GIS layer	Higher scores assigned to publicly owned parcels.
	Other County	15		
	State Owned	10		
	No	1		
Planned Development	Yes	20	ACC GIS layer	Targets parcels slated for development as opportunities for BMP incorporation.
	No	0		
Within 150 ft of Agricultural Stream Segment	Yes	10	Based on National Land Cover Database (NLCD)	Targets parcels contributing runoff from agricultural and/or livestock activity.
	No	0		
Impervious Cover %	76-100	10	Based on National Land Cover Database (NLCD)	Targets parcels with higher impervious cover.
	51-75	7.5		
	26-50	5		
	0-25	2.5		
Hydrologic Soil Group	A	10	USDA Web Soil Survey coverage	Targets parcels with more permeable soils.
	B	7.5		
	C	5		
	D	2.5		
Parcel Size (ac)	1.52+	10	ACC tax parcel data	Higher scores for large parcels as they are more suitable for BMP opportunities.
	0.61-1.51	7.5		
	0.34-0.60	5		
	0.0-0.33	0		
Within 150 ft of Impaired Stream Segment	Yes	10		Targets parcels in proximity to stream segments listed as Impaired on the 303(d) list.
	No	0		
Erosion Score	Poor	8	On-site visual assessment	Higher scores assigned to parcels proximal to stream segments with obvious erosion issues.
	Marginal	6		
	Suboptimal	4		
	Optimal	0		
Vegetation Score	Poor	8	On-site visual assessment	Higher scores assigned to parcels lacking vegetative coverage along banks.
	Marginal	6		
	Suboptimal	4		
	Optimal	0		
Overall Score	Poor	8	On-site visual assessment	Composite score combining bank erosion, vegetation coverage, in-stream habitat conditions, floodplain connection, and accessibility.
	Marginal	6		
	Suboptimal	4		
	Optimal	0		
Zoning	C-G	5	ACC GIS layer	Commercial – General.
	C-D	5		Commercial – Downtown.
	C-N	5		Commercial – Neighborhood.

Parcel Metric		Score	Source	Notes
	C-O	5		Commercial – Office.
	E-I	2.5		Employment – Industrial.
	I	2.5		Industrial.

Notes: ac = acres; ft = feet; USDA = U.S. Department of Agriculture.

Table 3-3. Sites Identified for Field Assessment

Parcel No.	Owner	Publicly Owned	Planned Development Parcel	Agricultural Stream Segment	Impervious Cover %	Hydrologic Soil Group	Parcel Size	Impaired Stream Reach	Erosion Score	Vegetation Score	Overall Score	Parcel Zoning	Total Score	Rank in Watershed[a]
Public														
072 007	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	10	2.5	7.5	10.0	10	6	6	8	0	80	2
121 003	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	10	6	6	6	0	68	8
181C1 A003B	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	7.5	0	6	8	8	0	59.5	28
074 D001	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	7.5	7.5	7.5	0	1	1	1	0	45.5	204
061 005	CLARKE COUNTY SCHOOL DISTRICT	15	0	0	5	7.5	10.0	0	1	1	1	0	40.5	508
064 041B	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	0	1	1	1	0	43	285
Private														
063 006F	AFP DEER FARM LLC	1	0	10	2.5	7.5	10.0	10	6	6	8	0.00	61.0	24
071 005L	OHLSSON KURT E & KIMBERLY A OHLSSON	1	0	0	2.5	7.5	10.0	10	1	1	6	0.00	39.0	526
071 005N	ADOLPHSON RYAN B & JENNIFER L ADOLPHSON	1	0	0	2.5	7.5	10.0	0	1	1	1	0.00	24.0	1858

Note:

a Rank indicates rank among all parcels in the watershed. Parcels with the same total score received the same rank.

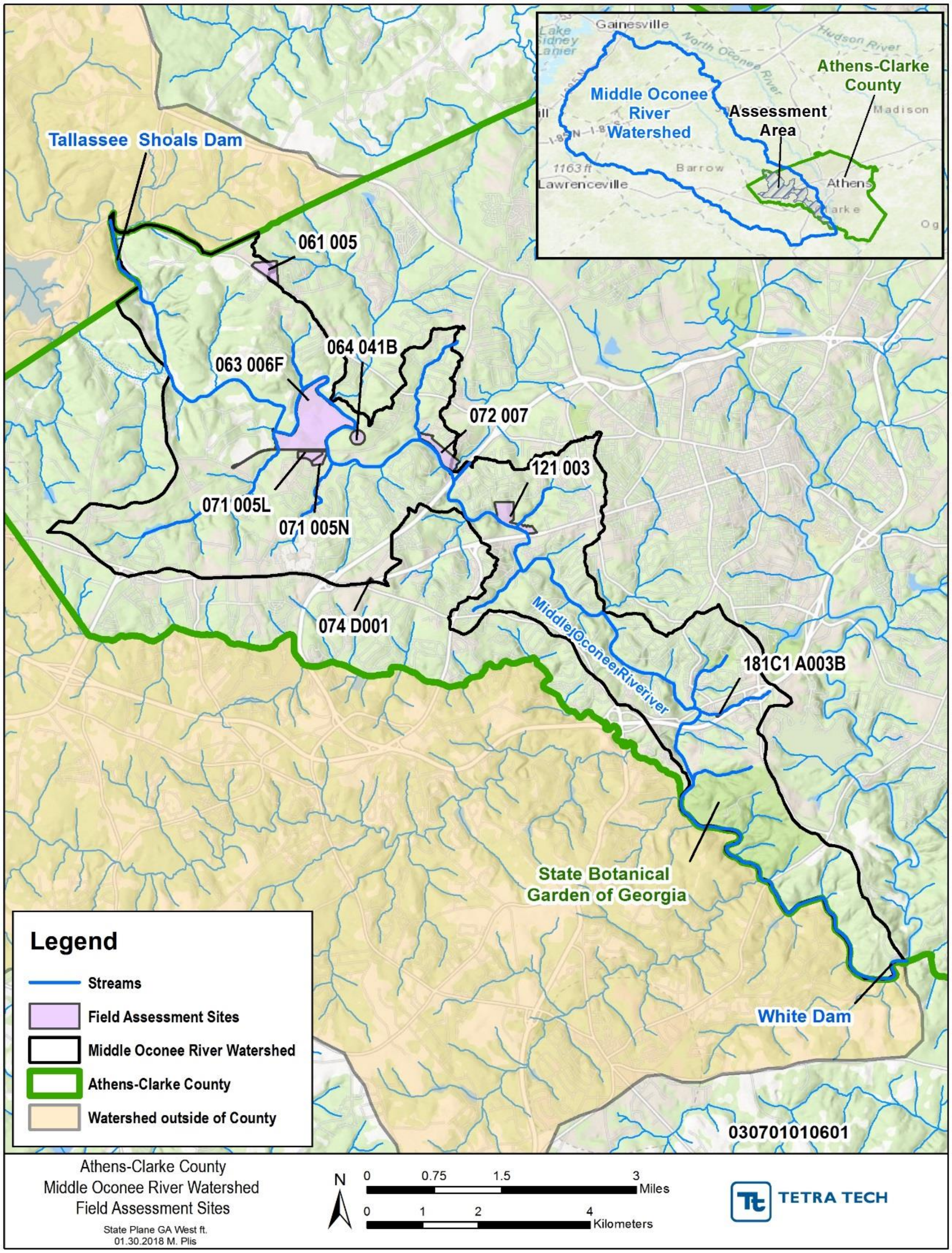

Figure 3-2. Middle Oconee River Field Assessment Sites

3.3.2 Field Assessment

Each site identified for field assessment was visited to further evaluate opportunities for management measures. Access to some sites was limited, either because of private ownership or because of fencing. In addition to the identified site field assessments, a windshield survey was performed while traveling throughout the study area to identify other parcels where opportunities might exist. If new opportunities were identified, they were assessed at that time.

Watershed Improvement Opportunity Field Assessment forms (appendix G) were filled out for sites where management opportunities exist and for sites where it was important to document existing site conditions in support of the general watershed characterization. The forms include information about landowners, existing conditions, land use, and potential utility conflicts as well as a description of proposed management measures and photo notes.

3.3.3 Initial Site Screening and Identification of Management Opportunities

Following the field assessments, sites that had no viable management opportunities and those that had significant constraints or challenges were removed from further consideration. The remaining sites were identified as candidate sites for watershed improvement opportunities. Five sites were identified in the Middle Oconee River watershed. Parcel information and potential opportunities for the candidate sites are listed in Table 3-4 and the site locations are shown in Figure 3-3. BMPs were assigned a unique ID based on an abbreviation of the watershed name and whether the BMP is structural stormwater control (Str), restoration (Res), or programmatic (Prog).

Table 3-4. Candidate Sites for Watershed Improvement Opportunities

Watershed	Parcel Number	Owner	Description	Opportunity	BMP ID
Middle Oconee River	072 007	Athens-Clarke County Unified Government	Ben Burton Park	Pet waste and managed access points to river	MO-Res-01
Middle Oconee River	074 D001	Athens-Clarke County Unified Government	Fire Station #2	Streambank shaping and buffer restoration	MO-Res-02
Middle Oconee River	181A1 C001	Athens-Clarke County Unified Government	Memorial Park	Redesign/modify emergency spillway and outlet control structure	MO-Res-03
Middle Oconee River	181A1 C001	Athens-Clarke County Unified Government	Memorial Park	Pond dredging	MO-Res-04
Middle Oconee River	181A1 C001	Athens-Clarke County Unified Government	Memorial Park	South Lumpkin Street outfall repair and bank stabilization	MO-Res-05
Middle Oconee River	181A1 C001	Athens-Clarke County Unified Government	Memorial Park	Dog park terracing	MO-Res-06
Middle Oconee River	181A1 C001	Athens-Clarke County Unified Government	Memorial Park	Gran Ellen Drive Erosion control	MO-Res-07

Watershed	Parcel Number	Owner	Description	Opportunity	BMP ID
Middle Oconee River	181A1 C001	Athens-Clarke County Unified Government	Memorial Park	Forebay replacement	MO-Res-08
Middle Oconee River	073 016	KDI Athens Mall LLC	Georgia Square Mall	Bioretention cells	MO-Str-01
Middle Oconee River	073 016	KDI Athens Mall LLC	Georgia Square Mall	Detention pond	MO-Str-02
Middle Oconee River	073 016	KDI Athens Mall LLC	Georgia Square Mall	Stormwater runoff treatment train	MO-Str-03
Middle Oconee River	121C1 E008	Athens-Clarke County Unified Government	Forested parcel along Middle Oconee River	Buffer preservation	MO-Prog-01
Middle Oconee River	181A1 C001	Athens-Clarke County Unified Government	Memorial Park	Nutrient management	MO-Prog-02

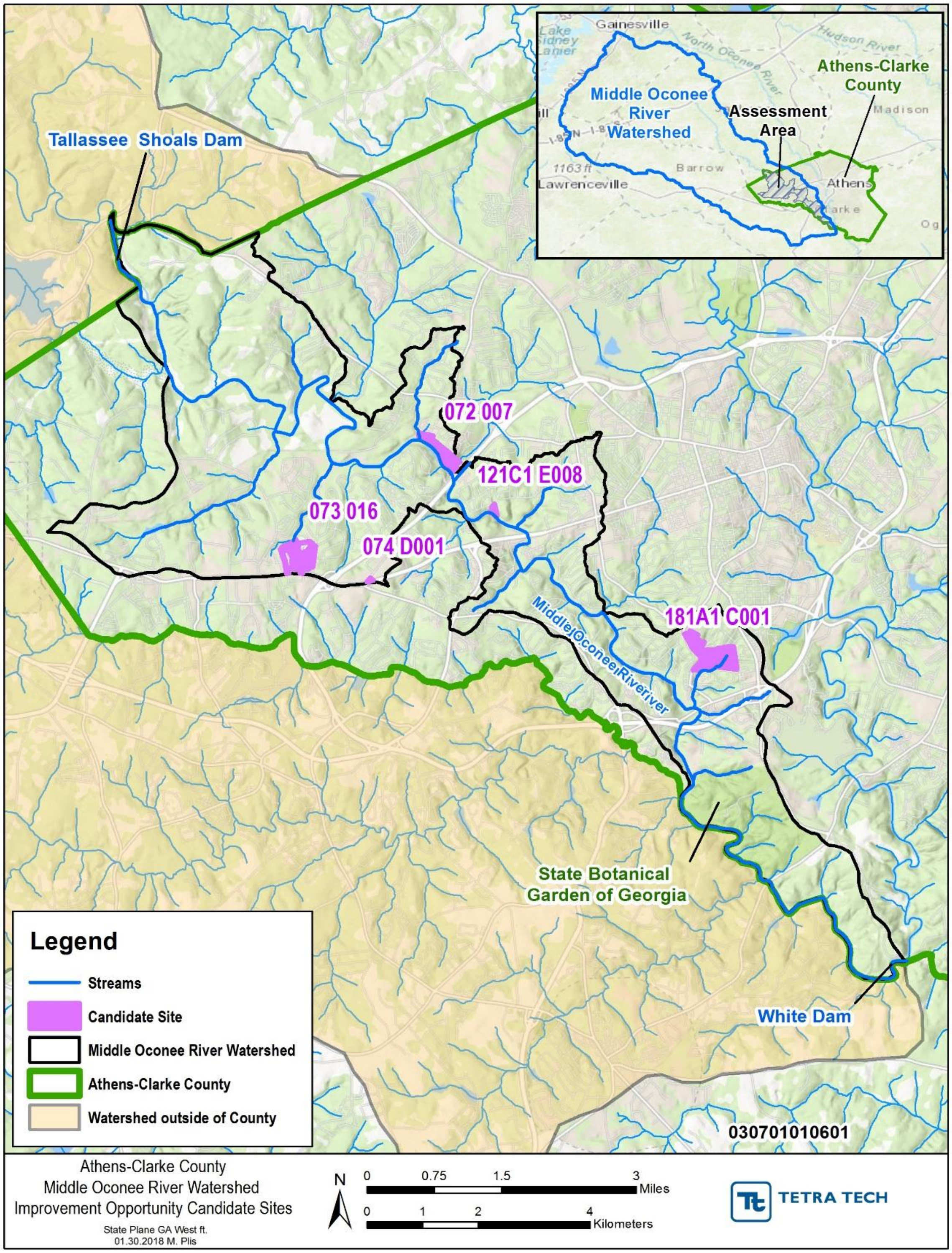

Figure 3-3. Middle Oconee River Watershed Improvement Opportunity Sites

Programmatic watershed improvement opportunities were identified through the GIS analysis and field assessments. These programmatic opportunities include measures such as the development or modification of standard operating procedures for vegetation management, review of inspection and maintenance programs, development of education programs, creation of incentives for stormwater management retrofits, encouragement of green infrastructure and low impact development practices, and the development of a more comprehensive stormwater inventory. A full list of programmatic management opportunities is provided in Table 3-5.

Table 3-5. Programmatic Watershed Improvement Opportunities

Measure	Description
Bacterial Source Tracking	Bacterial source tracking (BST) may help identify the source (e.g., human, dog, goose, or deer) of FC bacteria in the watershed. Specific sampling locations may be selected based on anecdotal evidence to help determine the type of management measures that will be most effective at reducing FC levels.
Vegetated Stream Buffers	Educate Department of Leisure Services and contractor personnel not to mow within the 75-ft buffer along perennial streams. Allow limited mowing once or twice a year in specific areas to limit growth of woody vegetation. Leave as tall as possible. Educate landscape companies, farmers, golf courses, and homeowners to leave a vegetated buffer along streams. Fliers and/or in-person meetings with farmers about federal programs that provide funding to move feeding operations away from streams.
Mowing Maintenance Practices[a]	Develop standard operating procedures for ACC departments and contractors mowing ACC and ACC School District properties about landscaping BMPs for protection of water resources. Mowing height should be at least 2 inches.
Bank Stabilization[a]	Use site-specific measures to stabilize eroding banks, using vegetation and natural materials that will provide wildlife habitat where feasible.
Retrofit Incentives	Increase incentives to retrofit older developments that have no stormwater management so they provide it, possibly through utility fee credit.
New and Redevelopment Inspections[a]	Continue NPDES inspections of new and redevelopment sites for compliance with required erosion and sediment control practices.
Linear Infrastructure BMPs	For linear projects such as transportation, sanitary sewer, or stormwater sewer improvements, assist in reducing sediment and pollutant loading in streams through inspections and education.
Cisterns on Public Buildings	Assess the need for harvested rainwater. Does ACC currently use potable water for irrigation, dust control, or other needs? Use cisterns at ACC facilities to reduce cost, increase infiltration, recharge the groundwater, and reduce runoff from impervious surfaces, thereby helping protect the county's streams. Filtration may be needed/considered for specific sites.
GIS Stormwater Inventory	Develop a more comprehensive stormwater inventory, including a complete inventory of structures, conveyances, outfalls, stormwater ponds, and runoff reduction BMPs. This watershed improvement opportunity will help the Transportation and Public Works Department analyze the stormwater system

Measure	Description
	capacity, determine BMP inspection schedules, and assist in future development plans.
Green Infrastructure / Low Impact Development	Include in development and redevelopment an assessment of opportunities for runoff reduction through green infrastructure and low impact development practices, including permeable pavement, cisterns, bioretention, and green roofs. This could be incorporated into plan review or ordinance revisions.

Note:
a Some of these measures may already be partially addressed by programs from other departments. Similar BMPs are listed in Table 2-1 of the 2016-2017 ACC Watershed Protection Plan Public Utilities Department Annual Report.

3.3.4 BMP Modeling and Optimization

Potential watershed improvement measures identified in the Middle Oconee River watershed include stormwater control measures, restoration measures, and programmatic measures (structural BMPs). Stormwater control measures are stormwater best management practices (BMPs) that store and/or infiltrate stormwater runoff. These measures address both water quality and water quantity concerns. BMP simulation and optimization modeling was performed on site-specific stormwater control measures to evaluate BMP effectiveness at reducing flows and pollutant loads and to optimize the BMPs to identify the best size to achieve the greatest benefit for the least cost. Modeling results were then used to help develop cost estimates, and to help score and rank potential projects.

Proposed BMPs were modeled using the Stormwater Management Optimization Tool (Opti-Tool) developed by Tetra Tech for EPA Region 1.

After the model was used to optimize the size of BMPs, engineers estimates of probable cost were developed for each BMP. Without detailed engineering data, these costs are assumed to be accurate within plus 50 percent to minus 30 percent of actual implementation costs. Each cost estimate is comprised of construction costs, mobilization, and design. Land acquisition costs were not incorporated into the cost estimates and need to be considered should any of the proposed structural measures be selected for implementation.

The construction costs were estimated with RSMeans CostWorks software, using construction cost data for the Athens area. The unit rate cost assumptions are shown in the final cost opinions in appendix J. Design and engineering costs were assumed to be 25 percent of the construction cost.

Table 3-6 provides a summary of the runoff volume and peak flow reductions and estimated total cost for each of the modeled structural BMPs in the Middle Oconee River watershed.

Table 3-6. Modeling Results and Cost Estimates of Structural BMPs in the Middle Oconee River Watershed

Parcel Number	Project Name	BMP ID	Drainage Area (ac)	BMP Area (ac)	Runoff Volume % Reduction	Runoff Peak Flow % Reduction	Total Cost
073 016	Georgia Square Mall Bioretention	MO-Str-01	5.00	0.43	63%	24%	$547,000
073 016	Georgia Square Mall Detention	MO-Str-02	63.35	1.61	3%	75%	$1,059,000
073 016	Georgia Square Mall Treatment Train	MO-Str-03	63.35	1.68	59%	77%	$1,388,000

3.3.5 Evaluation and Prioritization of Stormwater Control and Restoration BMPs

A meeting was held with Tetra Tech, Arcadis, and ACC to discuss the identified watershed improvement opportunities. Tetra Tech and ACC staff visited several sites to discuss potential improvement measures and to see examples of current management practices that appear to be working well. Feedback from this meeting was used to develop a list of attributes for prioritizing projects.

Stormwater control BMPs were evaluated based on 10 attributes and restoration BMPs were evaluated based on 9 attributes:

Stormwater Control BMP Attributes

- Drainage Area
- Ownership
- Education Potential
- Public Amenity Potential
- Constructability/Conflicts
- Maintenance Needs
- Storm Flow Control
- Runoff Reduction
- Overall Impact or Environmental Benefit
- Cost level

Restoration BMP Attributes

- Drainage Area
- Ownership
- Education Potential
- Public Amenity Potential
- Constructability/Conflicts
- Maintenance Needs
- Habitat Enhancement
- Overall Impact or Environmental Benefit
- Cost level

BMPs were evaluated by scoring the attributes for each project, with each attribute receiving a possible score between 0 and 10. The attributes and scoring system were developed in close coordination with ACC so that they reflect the priorities important to ACC.

Some attributes were recognized as having more importance for than others for the purpose of achieving the goals and objectives of the WMP. To account for this relative difference in attribute importance, weighting factors of 0.5, 1, or 2 were applied to each attribute. This was done in such a way that the total the total possible score is 100 points after the weightings are applied, for both stormwater control and restoration projects. Attribute weighting factors for stormwater control and restoration BMPs are shown in Table 3-7.

Table 3-7. BMP Attribute Weighting Factors

BMP Ranking Attribute	*Weighting Factors*	
	Stormwater Control BMPs	Restoration BMPs
Drainage area treated	2	N/A
Stream Size	N/A	2
Ownership	2	2
Education potential	0.5	0.5
Public amenity potential	0.5	0.5
Ease of Constructability	0.5	0.5
Maintenance Needs	0.5	0.5
Storm flow control	1	N/A
Runoff Reduction	1	N/A
Habitat Enhancement	N/A	1
Overall Impact/ Environmental Benefit	1	2
Cost Level	1	1

Once all projects were evaluated and scored, they could be ranked from highest to lowest score. Higher ranking projects represent higher priority projects for ACC. A complete description of the methodology used to evaluate and prioritize projects is provided in appendix H, including a detailed description of the scoring criteria for each BMP attribute. A prioritized list of stormwater control and restoration projects for the Middle Oconee River watershed is provided in Table 3-8.

Table 3-8. Scoring and Prioritization for Stormwater Control and Restoration Projects in the Middle Oconee River Watershed

Parcel Number	BMP ID	Drainage Area/Stream Size	Ownership	Education Potential	Public Amenity Potential	Constructability/ Conflicts	Maintenance Needs	Storm Flow Control	Runoff Reduction	Habitat Enhancement	Overall Impact or Environmental Benefit	Cost Level	Total Weighted Score	Rank
		Attribute Score												
072 007	MO-Res-01	10	10	10	10	5	5	N/A	N/A	10	5	7.5	82.5	**1**
181A1 C001	MO-Res-05	5	10	10	0	5	5	N/A	N/A	0	10	7.5	67.5	**2**
181A1 C002	MO-Res-03	5	10	10	10	0	5	N/A	N/A	0	10	5	67.5	**2**
181A1 C002	MO-Res-04	5	10	10	10	0	5	N/A	N/A	0	10	2.5	65	**4**
181A1 C001	MO-Res-07	5	10	10	5	5	5	N/A	N/A	5	5	5	62.5	**5**
181A1 C001	MO-Res-08	5	10	10	10	5	5	N/A	N/A	0	5	5	60	**6**
073 016	MO-Str-03	10	0	10	10	5	0	7.5	10	N/A	5	2.5	57.5	**7**
073 016	MO-Str-02	10	0	10	10	5	10	7.5	0	N/A	5	2.5	52.5	**8**
181A1 C001	MO-Res-06	0	10	10	10	5	10	N/A	N/A	0	5	5	52.5	**8**
074 D001	MO-Res-02	5	10	0	0	10	10	N/A	N/A	5	0	7.5	52.5	**8**
073 016	MO-Str-01	7	0	10	10	5	0	0	10	N/A	5	2.5	44	**11**

3.4 Recommended Management Measures

Stormwater control, restoration, and programmatic management measures have been selected for ACC to serve as the basis for this WMP, which is tailored to the county's watershed goals and objectives. The selection of site-specific opportunities was based on a comprehensive prioritization using remote spatial data, on-site review of opportunities and constraints, and modeling.

3.4.1 Stormwater Control and Restoration Management Recommendations

Stormwater control and restoration BMPs can be very effective at improving watershed health by reducing storm flows and harmful pollutants in stormwater runoff, or they can address a particular watershed concern. This WMP prioritized project opportunities that target multiple objectives in the Middle Oconee River watershed. Recommended projects are listed in Table 3-9, from highest to lowest priority based on the project ranking from Table 3-8. Concept plan sheets for these projects are provided in appendix I and planning level cost estimates are provided in appendix J.

Table 3-9. Recommended Stormwater Control and Restoration Measures

BMP ID	Project Description
MO-Res-01	**Ben Burton Park Pet Waste and Managed Access** This project involves the augmentation of pet waste collection measures through pet waste stations and additional signage to reduce fecal coliform pollution in conjunction with construction of managed access points to the Middle Oconee River that include steps and a vegetated buffer to mitigate bank erosion. Potentially deter park users from unofficial access points through fencing and strategic vegetation. Benefits include nutrient uptake, runoff sediment reduction, and beautification.
MO-Res-03	**Memorial Park Outlet Control and Spillway** This project involves redesigning and modifying the emergency spillway and outlet control structure of Memorial Park Pond, including repairs to the gully in the form of bank stabilization and vegetative buffer enhancements. Observations during the field visit indicated that high flows are contributing to mass wasting of the banks in the gully downstream of the emergency spillway and high sediment deposits. Benefits include peak flow attenuation, nutrient uptake, sediment removal, beautification, and improved stream function.
MO-Res-05	**Memorial Park – South Lumpkin Street Outfall Repair and Bank Stabilization** This project involves the construction of a stormwater outfall and reshape/stabilize the banks of a drainage channel that are currently mass wasting during high flows from a road culvert crossing South Lumpkin Street. The channel is nearly six feet deep with bare vertical walls and is a tributary to one of the main streams flowing through Memorial Park. Benefits include reduced sediment transport, beautification, and improved stream function.
MO-Res-04	**Memorial Park Pond Dredging** This project involves dredging accumulated sediment from the Memorial Park pond, and possibly removing the island in the upper portion of the pond, to continue to provide a safe and enjoyable public amenity. A survey will need to be conducted to determine the quantity of sediment that will be removed. Benefits include nutrient uptake, sediment removal, and beautification.
MO-Res-07	**Memorial Park – Gran Ellen Drive Erosion Control** This project involves construction of ditch and channel improvements including bank stabilization and energy dissipation measures in areas of the park where concentrated runoff from adjacent roads and residential areas is resulting in significant erosion and sediment transport. Areas of concern were identified along the parks border with Gran Ellen Drive. Potential benefits include reduction of sediment transport, beautification, and improved stream function.

BMP ID	Project Description
MO-Res-08	**Memorial Park Forebay Restoration** This project involves replacing the Memorial Park Pond forebay outfall and possibly reconfiguring the forebay outfall into an aesthetic feature. Benefits include sediment removal and beautification.
MO-Str-03	**Georgia Square Mall Treatment Train** This project involves the design and construct a stormwater runoff treatment train consisting of bioretention
MO-Res-02	**Fire Station #2 Streambank Shaping/Buffer Restoration** This project involves reshaping and stabilizing the banks of the stream flowing along the eastern border of the Fire station property, and improving the vegetated buffer through strategic plantings. The banks currently experience high amounts of scour and sloughing due to a minimal vegetated cover, frequent mowing, and substantial grade towards the stream. Potential project benefits include removal of sediment from runoff, beautification, and overall improved stream function.
MO-Res-06	**Memorial Park – Dog Park Terracing** This project includes regrading or terracing the sloped area currently being used as a dog park and planting additional vegetative cover. Groundcover vegetation is sparse and overland stormwater flow has caused widespread erosion that visibly transports soil to the lake below. Regrading or terracing this area, possibly using supplemental dredge material from the lake, may allow for vegetation to become established and reduce erosional activity. This project should be done prior to dredging the pond in Memorial Park, if feasible.
MO-Str-02	**Georgia Square Mall Detentio**n This project involves the construction of a large wet detention pond to manage stormwater runoff for the Mall property. The mall property is 95% impervious. Stormwater runoff is conveyed through a conventional stormwater system that does not contain any stormwater BMPs and does not meet current stormwater management requirements. Benefits include substantial peak flow attenuation, nutrient uptake, sediment removal, and beautification.
MO-Str-01	**Georgia Square Mall Bioretention**This project involves retrofitting the current parking lots through a system of bioretention cells distributed throughout the property. Bioretention cells outfitted with underdrains would collect stormwater runoff from the mall roof and parking lots currently serviced by a convential drain system. Overflow from larger storms could be routed to the existing stormwater drainage system. Bioretention would provide nutrient uptake, remove sediment from runoff, and beautification benefits.

The design of structural BMPs should follow guidelines set forth in the *2016 Georgia Stormwater Management Manual* (ARC 2016). This manual provides estimated pollutant load reductions for various BMPs. Pollutant removal estimates for applicable measures are shown in Table 3-10.

Table 3-10. BMP Pollutant Removal Estimates

BMP Type	TSS	Total Phosphorus	Total Nitrogen	Metals	Fecal Coliform
Stormwater Ponds	80%	50%	30%	50%	70%
Dry Detention Basins	60%	10%	30%	50%	NA*
Bioretention Basins	85%	80%	60%	95%	90%

Notes:

* - Helps restore pre-development hydrology, which implicitly reduces post-construction stormwater runoff rates, volumes, and pollutant loads.

3.4.1 Programmatic Management Recommendations

General programmatic recommendations for watershed improvement are listed in Table 3-5. In addition, site-specific programmatic management measures were identified through observations made during the on-site field assessments of potential BMP opportunities. Concept plan sheets for two of the general programmatic measures (mowing maintenance practices and bank stabilization) and the recommended site-specific programmatic measures are provided in appendix I. Site-specific programmatic measures are listed in Table 3-11. Pollutant load reductions are expected from the recommended programmatic measures, but cannot be accurately quantified.

Table 3-11. Recommended Site-Specific Programmatic Measures

BMP ID	Project Description
MO-Prog-01	**Middle Oconee River Buffer Preservation** Tetra Tech recommends the continued preservation of this parcel when ACC considers County-wide development plans. The area surrounding the property has experienced the expansion of suburban housing development, the effects of which include disturbing natural stream drainage through increased runoff that tends to cause erosion and the transport of pollutants and sediment. Benefits of preservation include nutrient uptake, sediment removal, beautification, and improved stream function.
MO-Prog-02	**Memorial Park Nutrient Management** This involves a possible investigation into nutrient contamination from the Bear Hollow Park Zoo. Innovative waste management practices can reduce potential harmful effects of stormwater runoff that could be contributing nutrient loads to the surrounding natural water ways. Benefits include nutrient uptake.

4 Plan Implementation and Evaluation

4.1 Implementation Schedule

Scheduling the implementation of management measures is crucial to the success of the WMP. The challenge in creating a realistic schedule is balancing the WMP objectives with the different components that dictate the timeline of their required tasks, such as securing funding, stakeholder approval and participation, and public involvement. The WMP schedule should be adaptable and easily revised by ACC according to shifting priorities, unexpected constraints and delays, and new opportunities as they appear. Table 4-1 proposes a WMP implementation schedule that ensures that watershed conditions are assessed regularly and that ACC will continue implementing watershed management measures.

Table 4-1. WMP Implementation Schedule

Time Frame	Watershed Management Measure
Annually	Review the recommended projects from each of the ACC WMPs and determine which projects will be implemented in ACC over the next 1–3 years. Coordinate with other ACC departments as necessary on the planning and design stages of structural and restoration projects. Develop a plan for implementing selected programmatic measures.
Annually	Develop a monitoring and maintenance plan for stormwater improvement projects under construction.
Annually	Monitor and maintain all ACC-managed BMPs according to the monitoring and maintenance schedule. Maintain a database of records of monitoring and maintenance events, including BMP monitoring checklists.
Annually	Review water quality data from the previous year and flag or highlight measurements that exceed state water quality standards or ACC benchmark values.
Annually	Document progress such as monitoring, maintenance, and project implementation in the annual report to GaEPD.
Every 3–5 Years	Review water trends and identify areas of improvement or degradation. If the monitoring results indicate water quality degradation, ACC should: o Try to identify point sources of any degradation; o Attempt to identify the cause of the degradation; o Evaluate the current BMPs established; and o Propose additional BMPs that might address the cause of the degradation.
Every 3-5 Years	Review the long-term monitoring program. Plan which watersheds will be monitored over the next 3 years as part of the rotating schedule. Determine if there should be any changes to monitoring station locations.
Every 5-10 Years	Conduct stream assessments in the watershed to identify areas of erosion, maintenance needs, and opportunities for bank stabilization or stream restoration.
Every 5-10 Years	Update the WMP to reflect changes in the watershed, updated stream assessment and water quality data, BMPs that were implemented (remove from the list), and new watershed management opportunities.

4.2 Monitoring and Maintenance

Regular monitoring and maintenance will need to be conducted for any site-specific management measures that are implemented. Visual assessments should be conducted regularly to ensure that measures are functioning properly and in good repair, and that the vegetation is healthy and well maintained. Structural measures should be monitored at least quarterly during the first 2 years after construction and annually thereafter. Additionally, they should be inspected after the first couple of large rain events following construction to assess their performance following storm events.

Regular monitoring events should include an assessment of general site conditions, notes on areas of failure or instability, a vegetation assessment, photographic documentation, and identification of any maintenance needs or adaptive management measures that might be required. BMP monitoring checklists are provided for numerous types of BMPs in the *2016 Georgia Stormwater Management Manual* (ARC 2016).

4.3 Potential Funding Sources

The implementation costs for both programmatic and structural BMPs can be restrictive for local governments when budgeting for projects across several departments. Fortunately, a number of programs exist to help fund projects to achieve water resource management goals. The following list summarizes the most relevant funding opportunities for ACC:

- **USEPA Clean Water Act Nonpoint Source Grant (Section 319 Grants):** Funded by USEPA through the Clean Water Act and administered by GAEPD, these grants provide funding for best management practices (BMPs) and other water quality improvement efforts. They require a 40% non-federal match that can be met through local funds, in-kind services, or other non-federal sources. Applications are typically due in the fall of each year, and awards are announced in the spring.
https://epd.georgia.gov/section-319h-georgias-nonpoint-source-implementation-grant

- **USEPA Clean Water State Revolving Fund (CWSRF):** Administered by the Georgia Environmental Finance Authority, the CWSRF provides low-interest loans for a variety of pollution prevention projects, including: water quality and water conservation; repairing and replacing stormwater control projects; and implementing water conservation projects and programs. Loans are available at a low interest rate for a maximum of 30 years. http://gefa.georgia.gov/clean-water-state-revolving-fund

- **U.S. Department of Transportation (USDOT) Transportation Alternatives Set-Aside:** The Transportation Alternatives Set-Aside provides funding for many activities relating to highways, including stormwater management, control, and water pollution prevention or abatement related to highway construction or due to highway runoff. Projects involving streetscaping and corridor landscaping may also be eligible. Transportation projects funded under this grant program must originate through a competitive grant project selection process in consultation

with Georgia DOT. Most awards require a 20% state or local match.
http://www.fhwa.dot.gov/environment/transportation_alternatives/

4.4 Milestones and Evaluation Criteria

The achievement of any plan requires evaluation criteria and measures of success. Milestones met relative to this WMP (such as completion of a management action from the implementation schedule) will be noted in appropriate sections of the annual report.

Short-term and long-term evaluation criteria listed in this section can be used to determine the level of success of WMP implementation.

4.4.1 Short-Term Criteria

- Have BMPs been monitored according to schedule? Are records up to date?
- Has water quality monitoring been conducted as scheduled? Are records up to date?
- Have stream assessments been conducted as scheduled? Are records up to date?
- Have watershed improvement projects been implemented as planned?

4.4.2 Long-Term Criteria

- Does water quality monitoring indicate an improvement in water quality?
- Have BMPs implemented as part of the Impaired Waters Monitoring Plan made progress towards addressing stream impairments? This can be measured through BMP monitoring or through documenting the utilization of ACC programs (i.e. attendance at educational workshops or use of pet waste stations).

4.5 Adaptive Management

This WMP was developed based on the best available information at the time. As changes occur in the watershed, or additional water quality data become available, or as funding opportunities change, watershed management needs and management opportunities might change. Sometimes the best opportunities are those that take advantage of other planned projects or situations of the time such as a planned transportation or infrastructure project in which stormwater improvement measures could be incorporated cost effectively, or the presence of a strong advocate or partner such as a school superintendent who wants to use green infrastructure as an educational opportunity for the school system. Therefore, this WMP should be revisited regularly and revised as needed to ensure that the watershed continues to be managed effectively into the future.

5 References

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