# Draft Watershed Management Plan for Turkey Creek

## 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 Turkey Creek 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 Turkey Creek watershed is located in northwestern ACC and extends outside of ACC to the north. The total drainage area of the watershed is 4.1 square miles, and the study area portion within ACC is 3.7 square miles in size. There are no named tributaries to Turkey Creek, but there is an unnamed stream system that feeds into Turkey Creek within the study area. Turkey Creek flows into the Middle Oconee River, which joins the North Oconee River to form the Oconee River. Land cover in the study area primarily consists of forest and developed land, with about 8 percent impervious cover. The Turkey Creek Watershed is located within a large water supply watershed, as it is located upstream of a water intake on the Middle Oconee River. The National Wetland Inventory (NWI) Map identifies areas of forested wetlands around the edges of Turkey Creek, near where it empties into the Middle Oconee River, and along part of the unnamed tributary of Turkey Creek.

There are no streams in the Turkey Creek watershed study area that are listed as impaired on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams.

There are several point sources in the study area, but none of these facilities discharge to water bodies. Potential nonpoint sources of pollution in the Turkey Creek watershed include stormwater runoff from ACC's municipal separate storm sewer system (MS4) as well as runoff from forested and agricultural lands. Results of water quality monitoring efforts suggest that surface waters in the study area are generally in compliance with the DO, pH, and temperature standards adopted by the State of Georgia, with few exceptions of low pH measurements. There has not been sufficient data collected to calculate FC geometric means, but all measurements are below the instantaneous maximum standard of 4,000 colonies/100mL. Average conductivity values meet the ACC benchmark.

Stream walks in the Sandy Creek watershed were conducted in October 2016 through December 2016 along Turkey Creek and its primary tributary. Most reaches in the watershed received overall stream condition scores of marginal. Three reaches were scored suboptimal. Streambank erosion was generally moderate with severe erosion at channel bends, which is affecting infrastructure elements at two locations.

Based on information obtained in the watershed characterization, wetland preservation is a management need for the lower portion of Turkey Creek and the lower portion of the main tributary of Turkey Creek.

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. One site-specific restoration BMP is recommended for implementation in the Turkey watershed (Table ES-1). A concept plan and cost estimate was developed for the recommended project. Programmatic measures that can be implemented watershed-wide are also recommended.

**Table ES-1. Recommended Site-Specific Management Measures**

| BMP ID | Project Description |
|---|---|
| TC-Res-01 | Catholic High School Erosion Control |

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 Turkey Creek watershed and provides recommendations for structural and programmatic Best Management Practices (BMPs) that can be implemented to reduce nonpoint source pollution and improve the overall health of the Turkey Creek 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 Turkey Creek 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 Turkey Creek 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

Turkey Creek flows into the Middle Oconee River, which 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 Turkey Creek watershed is part of the Calls Creek-Middle Oconee River Hydrologic Unit Code 12 (HUC 12) watershed (30701010307).

The Turkey Creek watershed is located in northwestern ACC and is roughly bounded Tallassee Road to the west, Old Jefferson Road to the northeast, and Quailwood Drive to the southeast (Figure 1). The watershed extends outside of ACC to the north. There are no named tributaries to Turkey Creek, but there is an unnamed stream system that feeds into Turkey Creek within the study area. The farthest downstream point of this study area is the confluence of Turkey Creek with the Middle Oconee River. The drainage area of the Turkey Creek watershed is 4.1 square miles, with 11 percent of the watershed located outside of ACC to the north. The extent of the Turkey Creek watershed is shown in Figure 2-1. The study area portion of the watershed, within ACC, is 3.7 square miles in size and is shown in Figure 2-2.

There are no streams in the Turkey Creek watershed study area that are listed as impaired on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams.

There are no United States Geological Survey (USGS) stream gages in the watershed study area. There also 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).

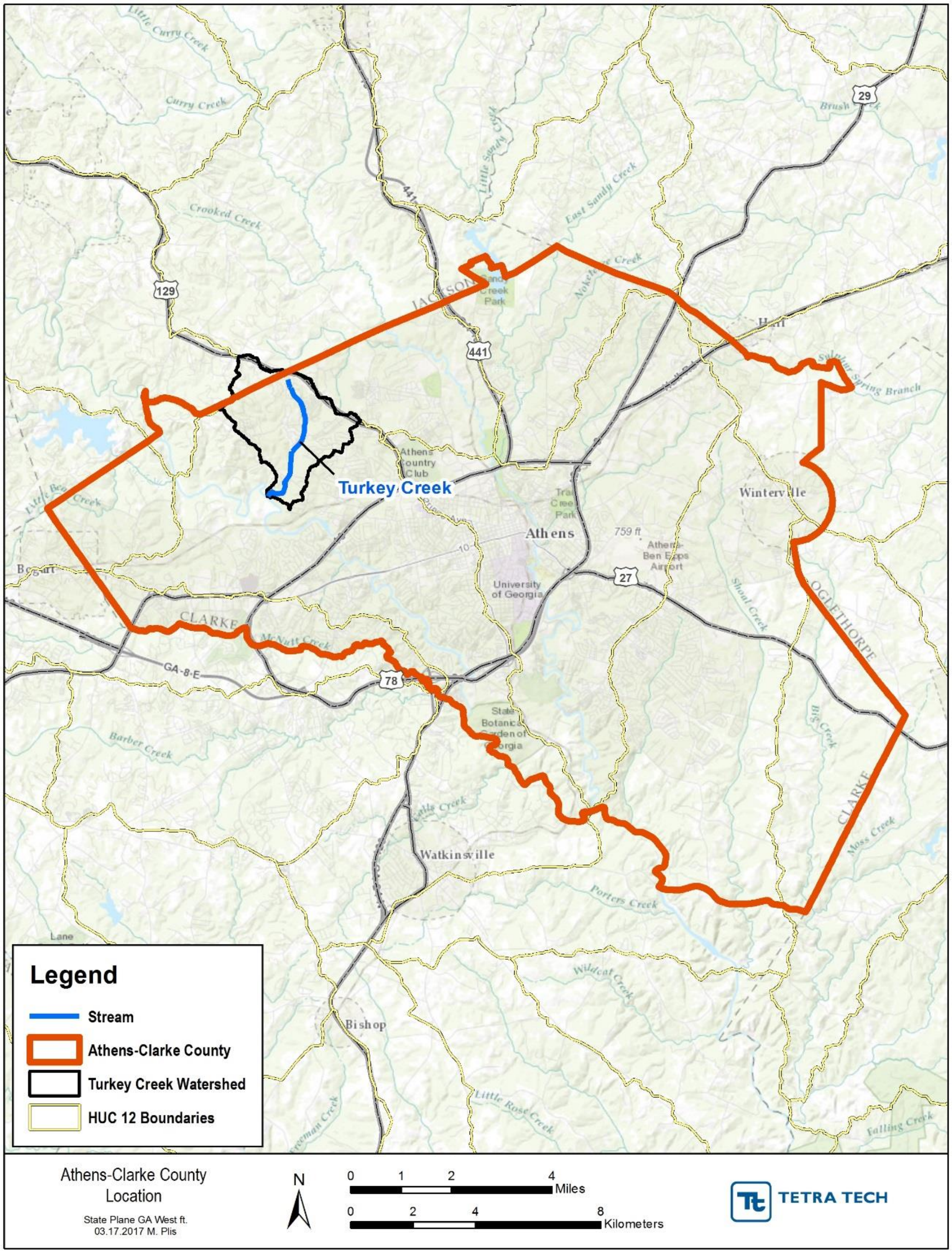


**Figure 2-1. Turkey Creek Watershed Location**

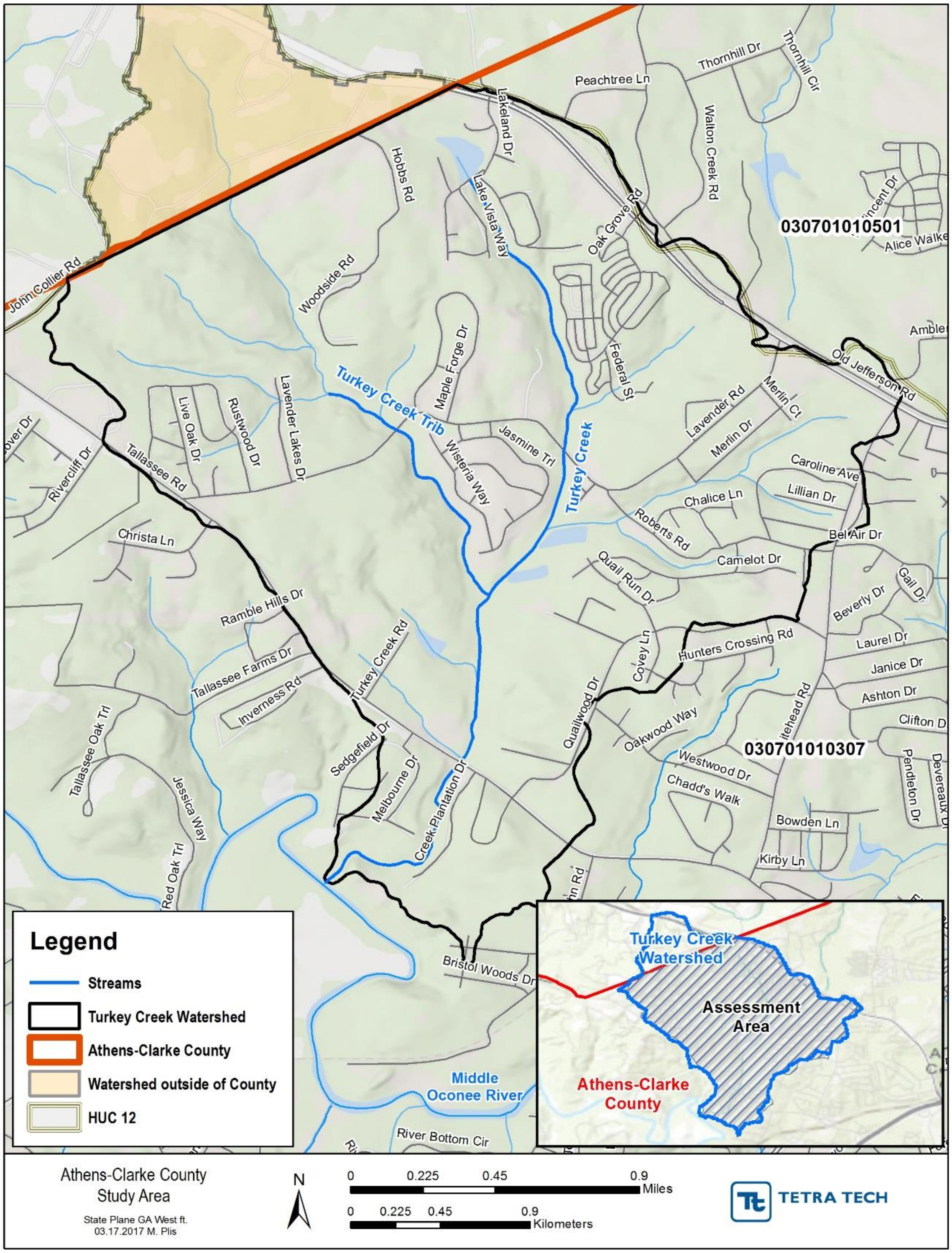


**Figure 2-2. Turkey Creek Watershed Study Area**

## 2.2 Land Cover

The land cover in the study area consists of approximately 47 percent forest, 42 percent developed land, 4 percent is pastureland/cropland, and 2 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 2-1.

**Table 2-1. Athens-Clarke County Turkey Creek Watershed 2011 NLCD Land Cover**

| NLCD Land Cover | % Land Cover |
|---|---:|
| Open Water | 0.3% |
| Developed | 41.7% |
| Barren | 0.1% |
| Forest | 46.6% |
| Shrub/Scrub | 0.1% |
| Herbaceous | 5.4% |
| Pasture/Crop | 3.9% |
| Wetland | 1.8% |

There are 9.6 miles of streams in the study area. Based on the 2011 NLCD land use and land cover data, 0.05 miles of streams (less than 1 percent) are directly connected to cropland or pasture land.

The study area is about 8 percent impervious, primarily associated with residential development. Impervious cover is shown in Figure 2-4 and is based on the 2011 NLCD impervious coverage.

Land cover in the portion of the Turkey Creek watershed upstream of the study area outside of ACC is similar in composition to that of the study area but with a slightly higher percentage of pasture/crop land.

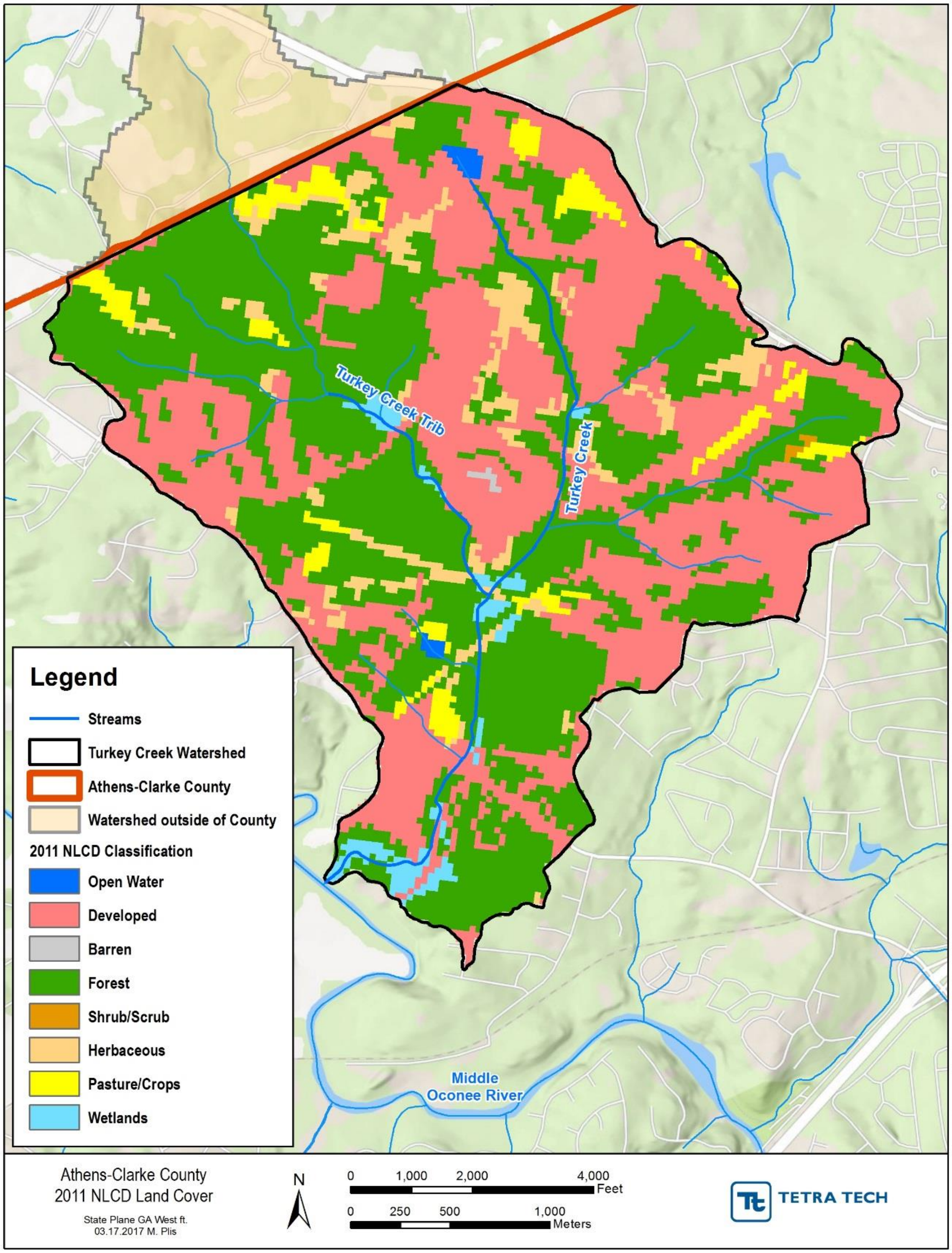


**Figure 2-3. 2011 NLCD Land Cover**

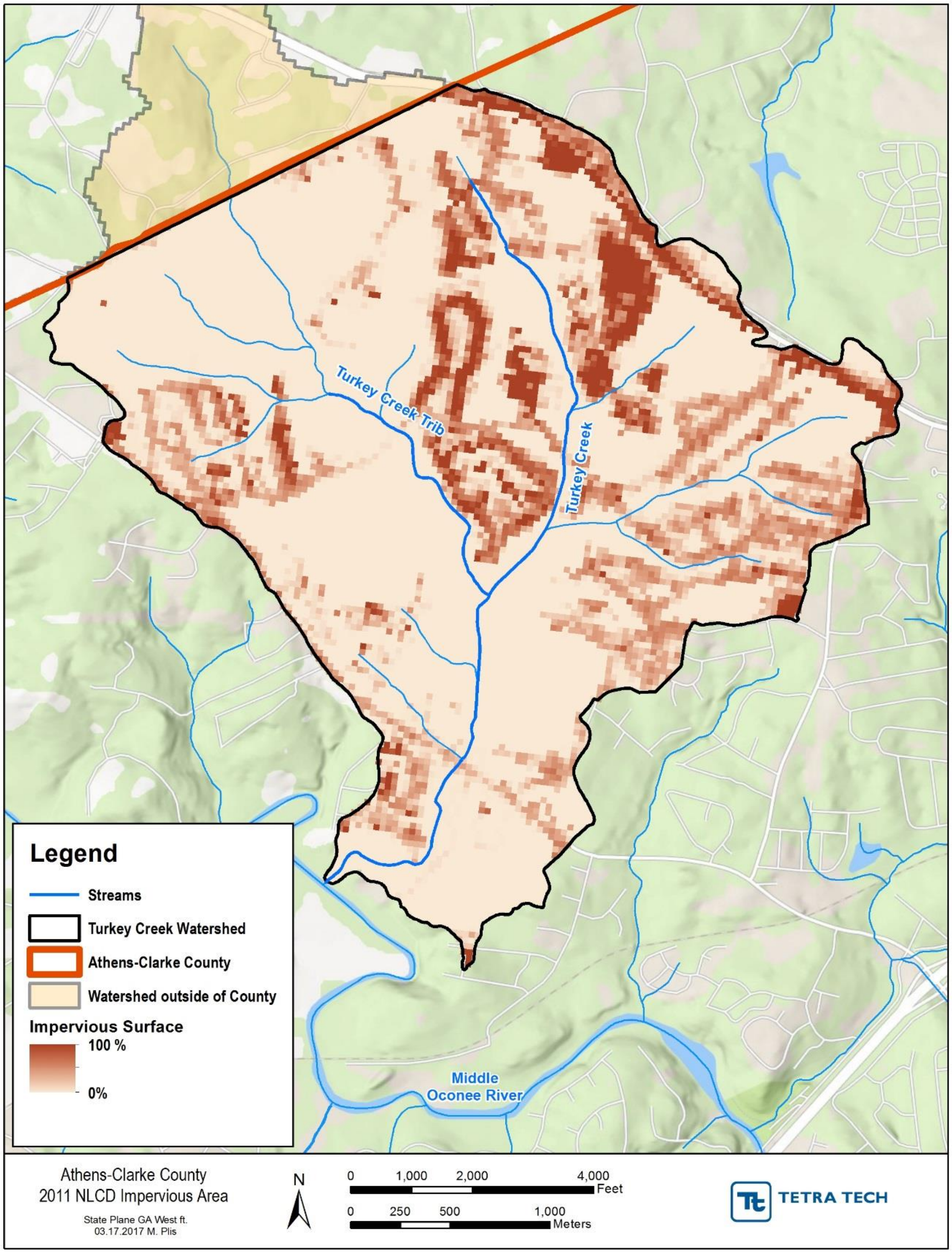


**Figure 2-4. 2011 NLCD Impervious Cover**

## 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 Turkey Creek Watershed is located within 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. Turkey Creek is upstream of a water intake on the Middle Oconee River.

The National Wetland Inventory (NWI) Map identifies areas of forested wetlands around the edges of Turkey Creek, near where it empties into the Middle Oconee River, and along part of the unnamed tributary of Turkey Creek, 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.

No other environmentally sensitive areas were identified.

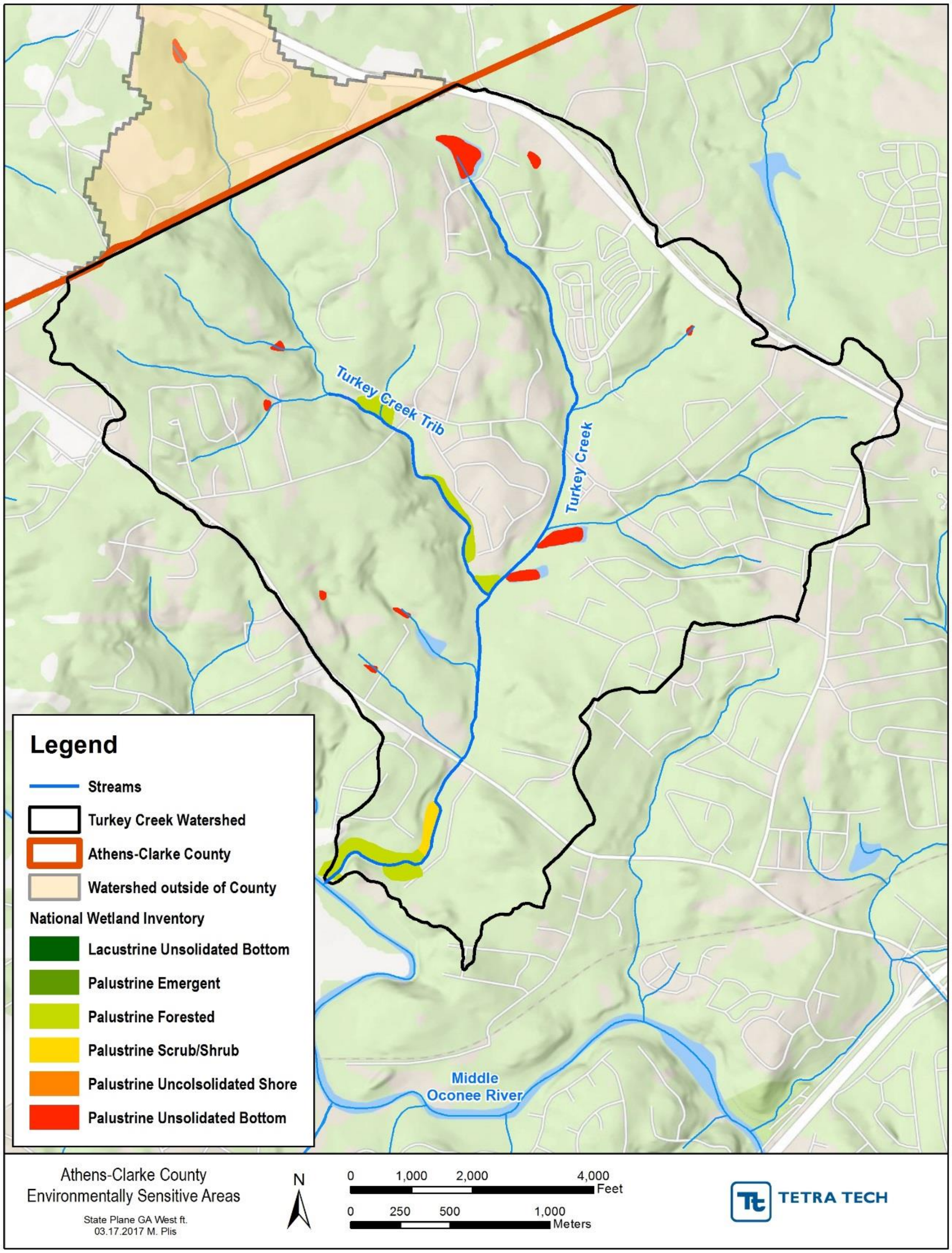


**Figure 2-5. Environmentally Sensitive Areas**

## 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 2-2. None of these facilities discharge to waterbodies.

**Table 2-2. Point Sources in Turkey Creek Watershed in Athens-Clarke County (USEPA 2016)**

| Facility Name | EPA ID | Data Source |
|---|---|---|
| Chemitrol Corp | 110005665119 | RCRA |
| Oconee Heights Auto Parts and Body | 110005704130 | RCRA |

*Note:* RCRA = Resource Conservation and Recovery Act.

Potential nonpoint sources of pollution in the Turkey Creek 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. Roads and lawns are potential sources of pollution in this watershed due to the high percentage of residential development.

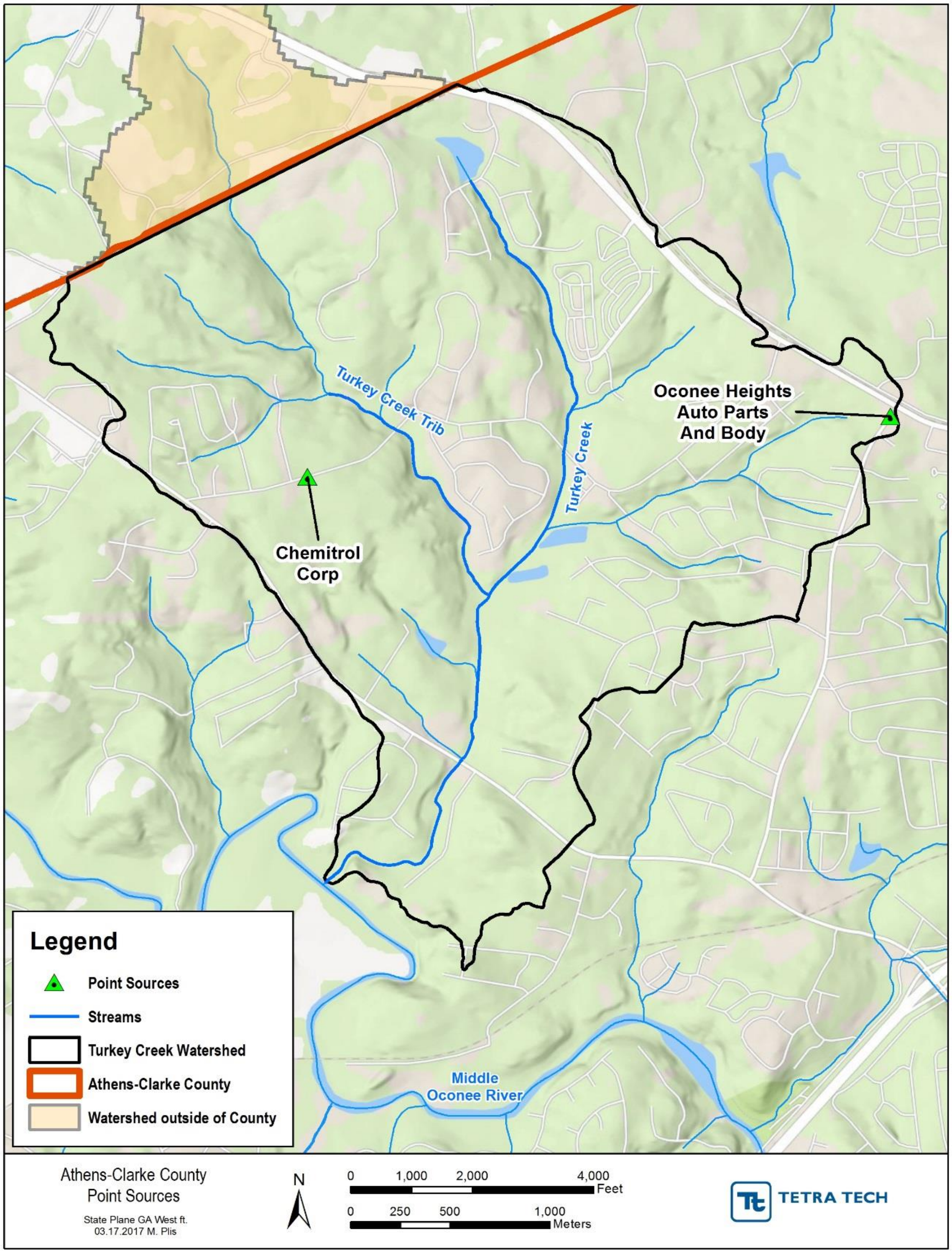


**Figure 2-6. Point Sources (USEPA 2016)**

## 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 Turkey Creek watershed were conducted along Turkey Creek and its primary tributary (Turkey Creek Trib). The stream was divided into reaches at break points such as road or railroad crossings, in-line ponds, or tributaries.

### 2.6.1 Methodology

ACC Stormwater Staff physically walked each reach and conducted an inventory of bed, stream bank, and stream buffer condition.

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 scores, a reach level assessment was performed 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. Cross sections were taken at the beginning and end of each reach, and sketches were made indicating channel width, depth, and other notable features. Photographs were taken capturing general stream features.

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 3.3.4 for a detailed discussion of evaluation and prioritization of management opportunities.

### 2.6.2 Results

The 2012 stream condition scores for each reach in the study area are provided in Table 2-3. Each assessment Reach ID and the overall condition rating of each stream reach is shown in Figure 2-7.

Stream walk assessment figures are included in appendix A. Stream walk assessment forms and data sheets with notes are provided in appendix B. Photos from the 2012 stream walk were not located.

**Table 2-3. 2012 Stream Condition Assessment Scores**

| Reach | In-Stream Habitat Score | Vegetative Protection Score | | Bank Erosion Score | | Floodplain Connection | Total Score | Condition Rating |
|---|---|---|---|---|---|---|---|---|
| | | Left Bank | Right Bank | Left Bank | Right Bank | | | |
| TU1a | 9 | 4 | 5 | 4 | 4 | 6 | 32 | marginal |
| TU1b | 12 | 5 | 5 | 5 | 5 | 5 | 37 | marginal |
| TU1c | 10 | 5 | 5 | 4 | 5 | 6 | 35 | marginal |
| TU1d | 14 | 5 | 7 | 6 | 6 | 7 | 45 | suboptimal |
| TU1e | 15 | 7 | 6 | 6 | 5 | 7 | 46 | suboptimal |
| TU1f | 15 | 7 | 8 | 5 | 5 | 8 | 48 | suboptimal |
| TU1g | 11 | 5 | 8 | 2 | 4 | 6 | 36 | marginal |
| TU2a | 13 | 4 | 4 | 4 | 4 | 5 | 34 | marginal |
| TU2b | 13 | 4 | 3 | 4 | 4 | 5 | 33 | marginal |
| TU2ci | 12 | 5 | 4 | 4 | 3 | 5 | 33 | marginal |
| TU2cii | 11 | 4 | 4 | 2 | 2 | 6 | 29 | marginal |

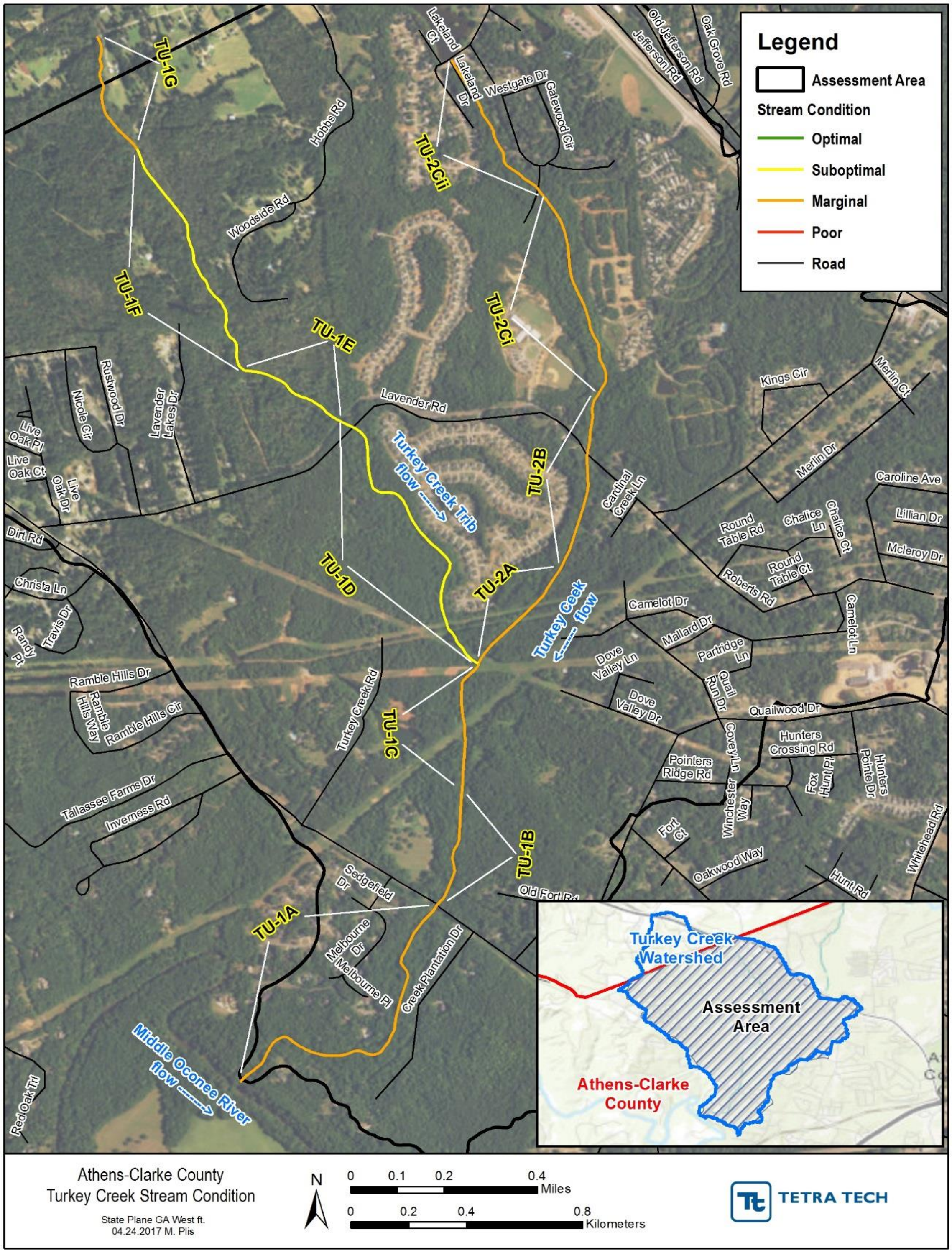


**Figure 2-7. 2012 Stream Reach Condition Ratings**

## 2.7 Water Quality

There are two water quality monitoring stations in the study area (TU1 and TU2) that were monitored by ACC from 2011 to 2012. Monitoring stations are shown in Figure 2-8. 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.

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. Turkey Creek has a designated use of fishing according to Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03 (O.C.G.A. 2015[1]). State standards for dissolved oxygen (DO), pH, FC bacteria, and temperature for waters with the designated use of fishing are listed in Table 2-4.

**Table 2-4. Georgia Water Quality Standards for Designated Use of 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.

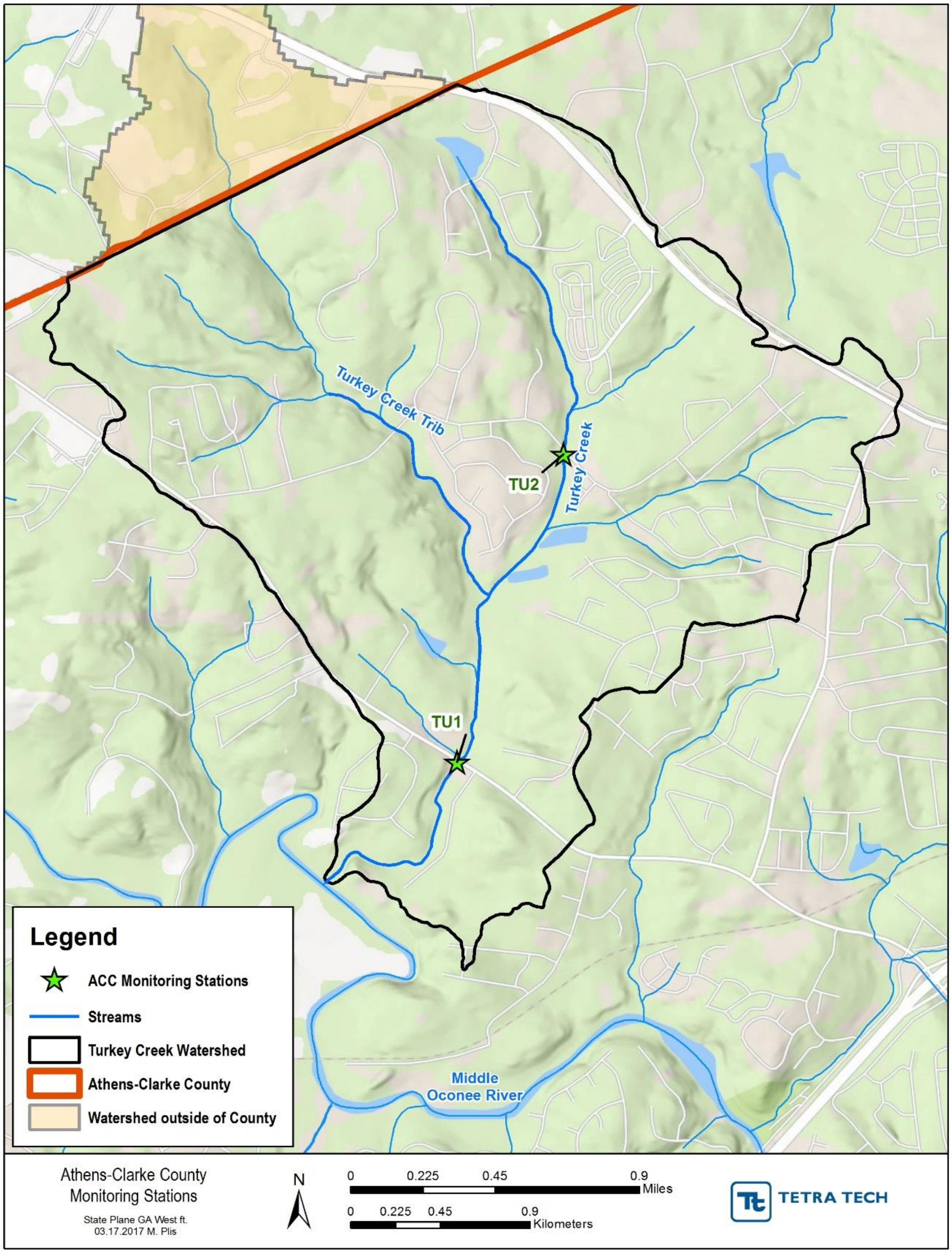


**Figure 2-8. Water Quality Monitoring Stations**

Water quality data collected by ACC from 2011 to 2012 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.

Plots of the raw grab sample data for DO, FC, pH, and temperature collected at each station are shown in Figure 2-9 through Figure 2-12. Data was collected from June 2011 through May 2012. The full set of tabulated data is provided in appendix C.

**Table 2-5. ACC Monitoring Station Water Quality Data (2011-2012)**

| Parameter | Unit | Standard | TU1 | | | | TU2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Samples | Average | Min | Max | Samples | Average | Min | Max |
| Conductivity | mS/cm | **≤ 0.3** | 12 | **0.111** | 0.044 | 0.690 | 12 | **0.046** | 0.032 | 0.058 |
| Dissolved Oxygen | mg/L | **≥ 4*** | 11 | **12.08** | 6.83 | 21.20 | 11 | **10.93** | 5.91 | 17.68 |
| Fecal Coliform Bacteria | cols/100mL | **Varies** | 12 | **309** | 57 | 649 | 12 | **660** | 125 | 1,553 |
| Ammonium ($NH_4$) | mg/L | **not established** | 6 | **0.00** | 0.00 | 0.01 | 6 | **0.00** | 0.00 | 0.01 |
| pH | Standard units | **6.0 - 8.5*** | 11 | **6.35** | 5.10 | 7.21 | 6 | **6.35** | 4.72 | 7.88 |
| Temperature | Degrees Celsius | **≤ 32*** | 12 | **15.42** | 7.77 | 23.48 | 12 | **15.14** | 7.57 | 22.36 |

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

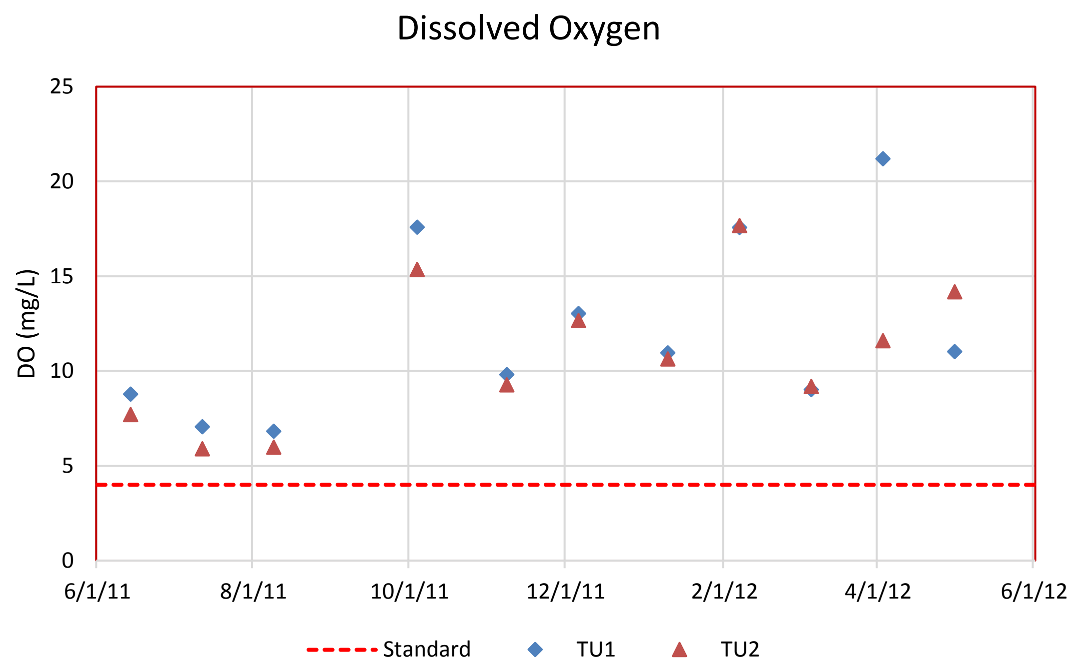


**Figure 2-9. Dissolved Oxygen Grab Sample Results for Turkey Creek Stations**

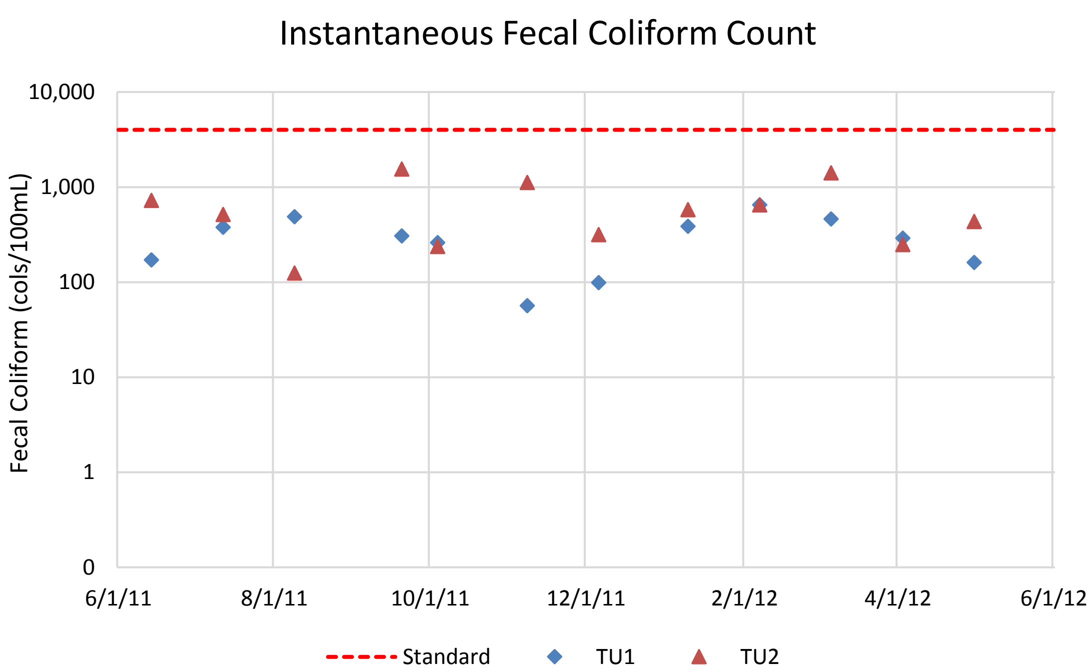


**Figure 2-10. FC Bacteria Grab Sample Results for Turkey Creek Stations**

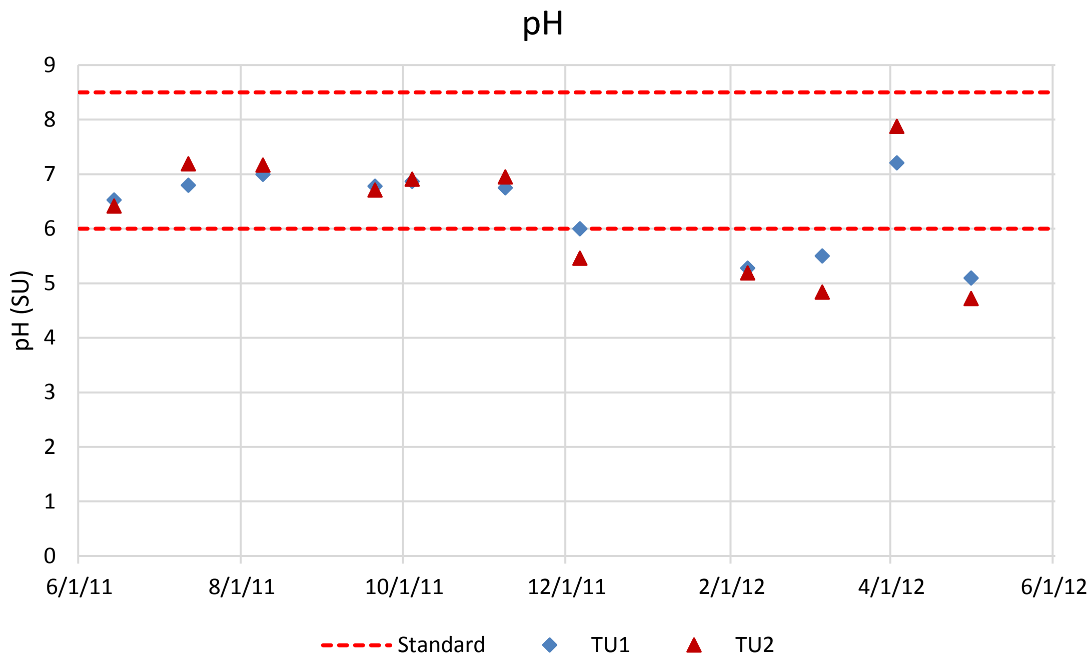


**Figure 2-11. pH Grab Sample Results for Turkey Creek Stations**

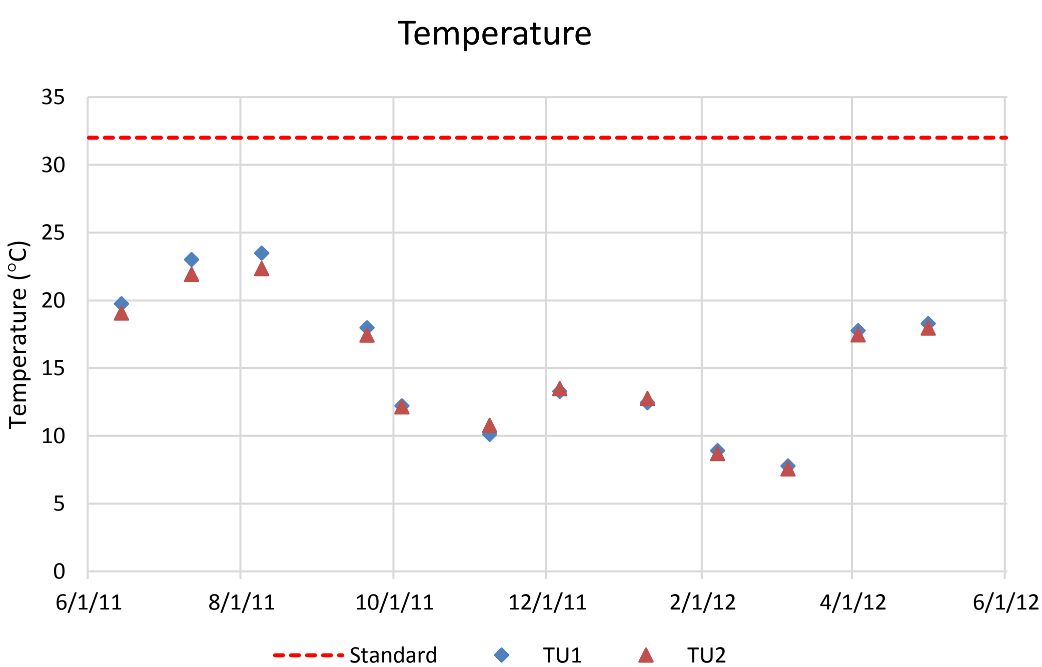


**Figure 2-12. Temperature Grab Sample Results for Turkey Creek Stations**

Results of the water quality sampling effort suggest that surface waters in the study area are generally in compliance with the DO, pH and temperature standards adopted by the State of Georgia. All DO and temperature measurements meet state standards. pH is a potential concern in Turkey Creek. Although average pH values meet state standards, a few individual measurements at both stations were below the standard minimum of 6.0.

There has not been sufficient data collected to calculate FC geometric means, but all measurements are below the instantaneous maximum standard of 4,000 colonies/100mL. Average conductivity values meet the standard at both 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 2-13 through Figure 2-15) using results from the LSPC model developed for ACC. The modeled results identified the greatest TN and TP loads in the northeast portion of the study area. Modeled TSS loads are low to moderate throughout the watershed, with slightly higher loads in the northeast portion 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.

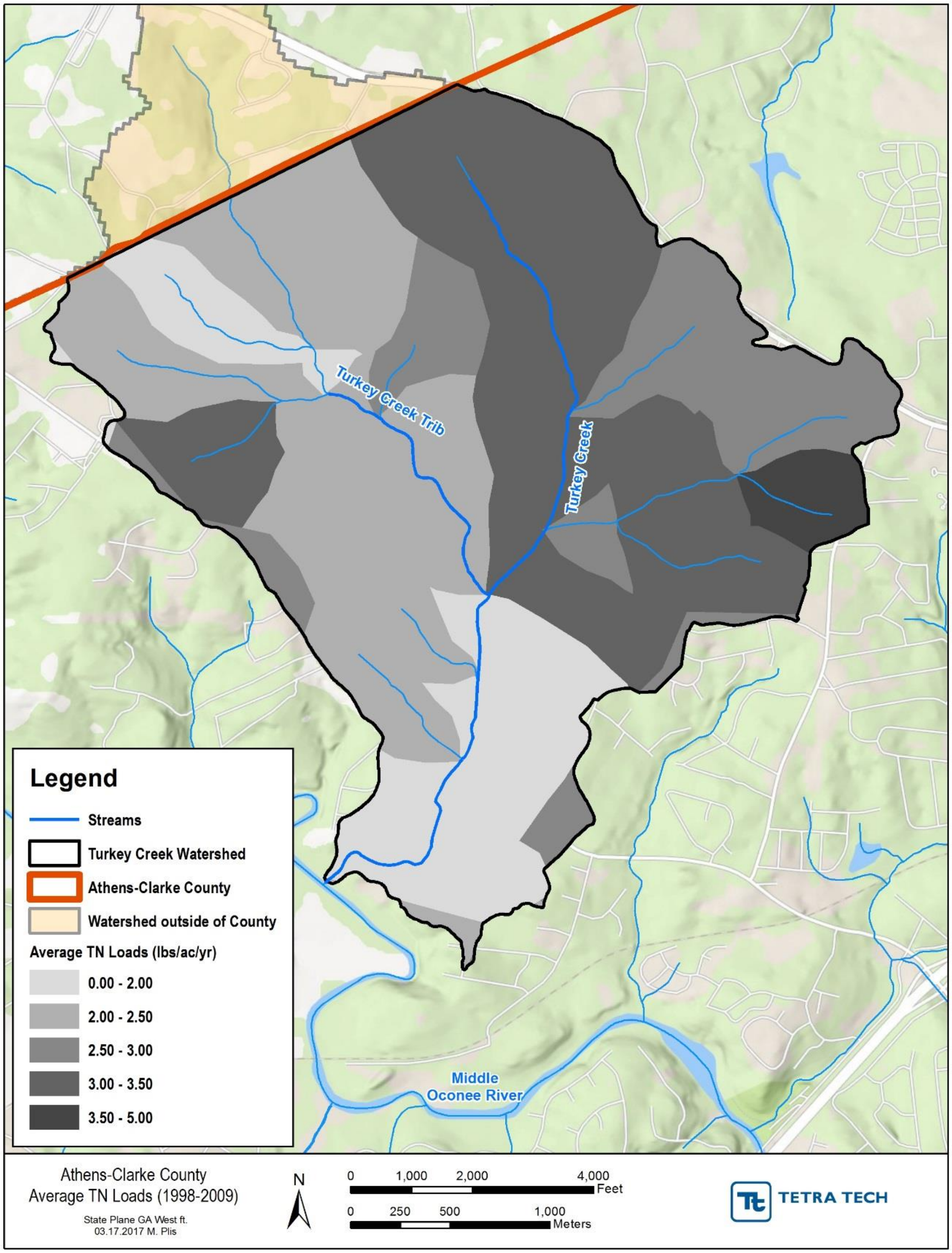


**Figure 2-13. Average TN Loads**

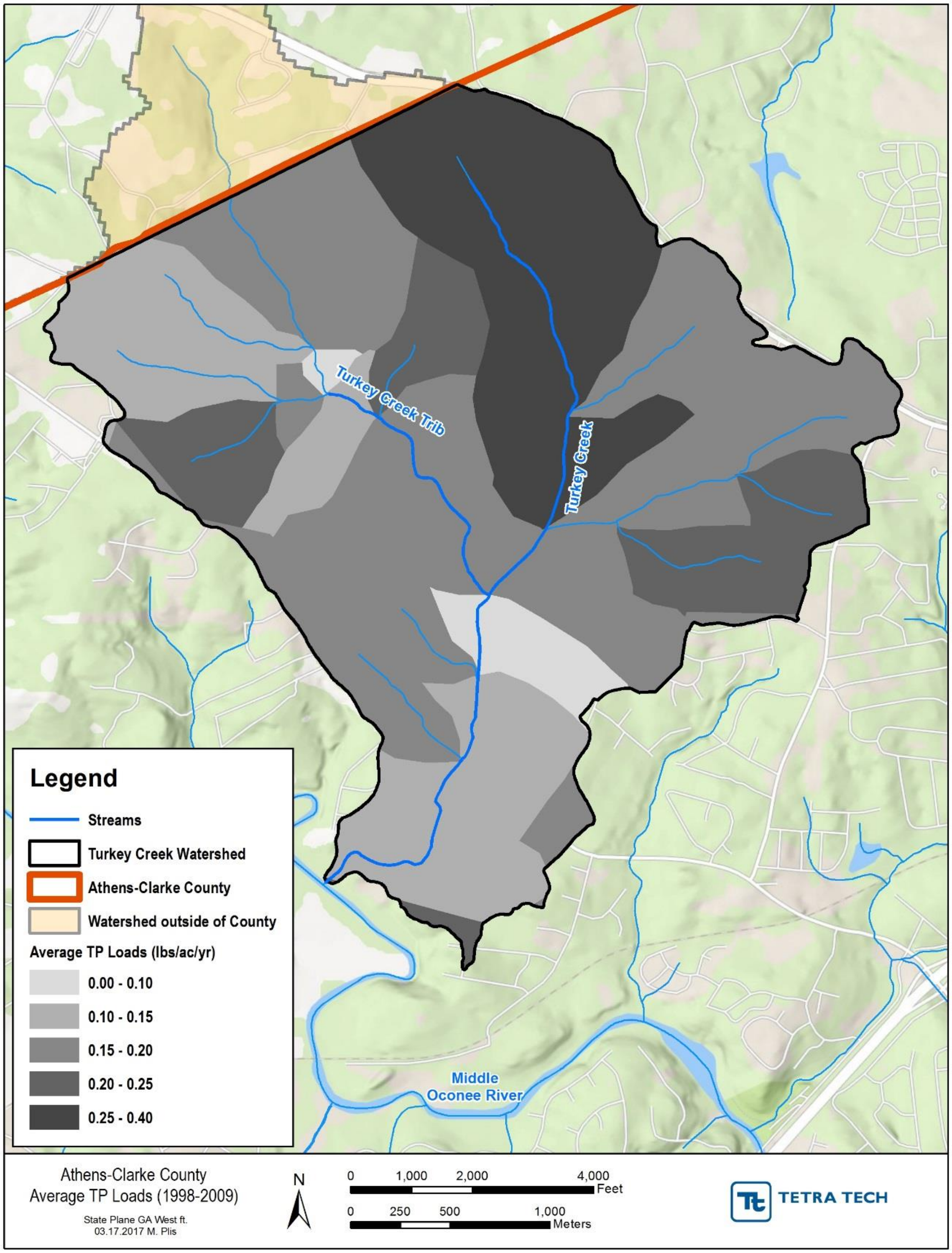


**Figure 2-14. Average TP Loads**

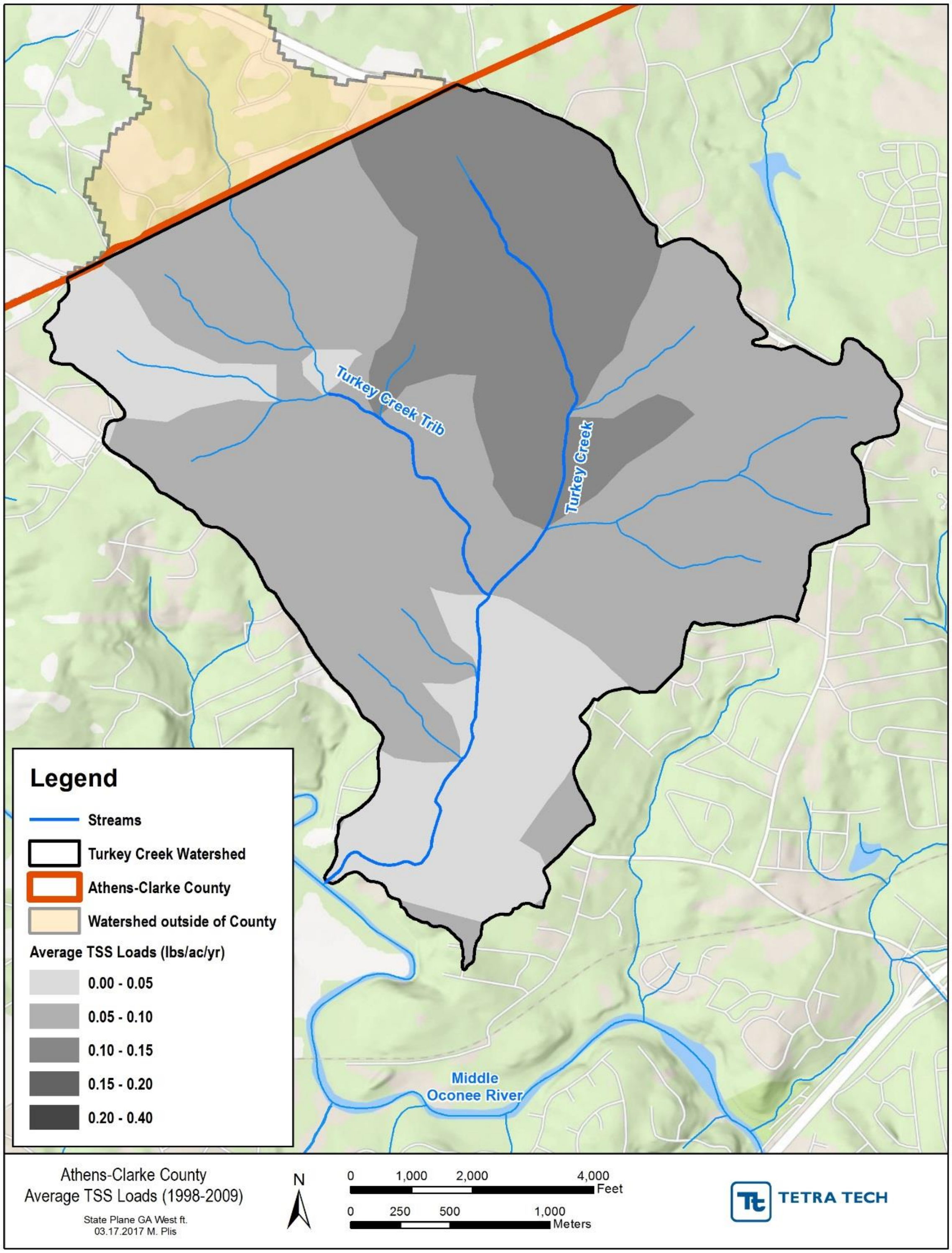


**Figure 2-15. Average TSS Load**

## 2.9 Summary

This watershed characterization describes existing conditions in the Turkey Creek 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 Turkey Creek watershed is composed primarily of forest and developed land. The study area is approximately 8 percent impervious, and does not contain any impaired streams on Georgia's draft 2016 Integrated 305(b)/303(d) List of Streams.

Water quality monitoring data indicate that pH is a potential concern in the study area because the standard minimum of 6.0 was not met on a few occasions at both stations.

Notable key findings from the stream assessment include the following:

- Streambank erosion is generally moderate with severe erosion at channel bends.
- Infrastructure is affected by stream bank erosion at Reach TU-1A (points 1 and 3) and in reach TU-2B where the culvert at the Lavendar Road crossing acts as a fish barrier.
- ATVs or utility vehicles appear to cross the stream in a utility easement at point 102 in reach TU-2A.
- Dense Chinese privet (an invasive species) was noted at point 103 in Turkey Creek reach TU-2A.
- Beaver dams were noted in the lower section of Reach TU-2Ci.

# 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 D 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 Turkey Creek watershed. Shaded cells indicate that the need is watershed-wide.

**Table 3-1. Watershed Management Needs Decision Criteria**

| Management Need | Decision Criteria | Applicable to Turkey Creek |
|---|---|---|
| FC Bacteria | Listed as impaired for FC; or<br>Geometric mean not meeting state WQ standards. | |
| Sediment | Listed as impaired for biota (fish or macro) due to sediment; or<br>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. | |
| 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<br>Poor stream condition scores. | |

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

### 3.2.2 Management Needs by Area

The identification of management opportunities by the Tetra Tech-Arcadis-ACC team is discussed throughout the following sections. Both structural and programmatic management opportunities were considered throughout the identification process. Moreover, measures were taken by the team to prioritize those sites determined to have a higher potential of providing structural or programmatic opportunities that target the management needs specific to the Turkey Creek watershed. The sections below present 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.

**Wetland Preservation:** Wetland preservation is a management need for the lower portion of Turkey Creek and the lower portion of the main tributary of Turkey Creek because the NWI Map identifies a great deal of palustrine wetlands in this area that serve as a buffer between stormwater runoff and the stream. Preservation could be achieved through land acquisitions or conservation easements.

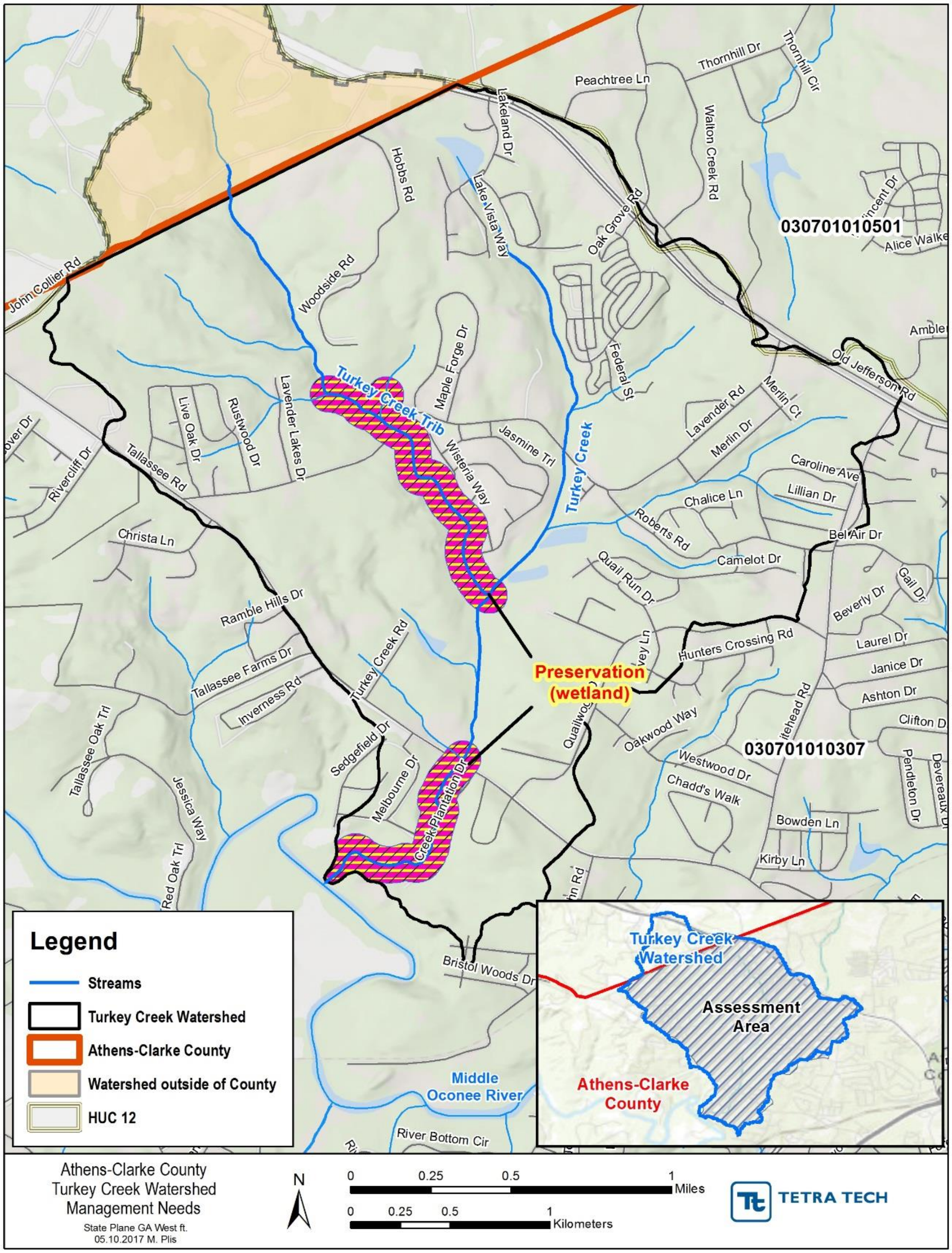


**Figure 3-1. Turkey Creek Management Needs**

## 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 Turkey Creek 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** | | | | | | | | | | | | | | |
| 062 011 | CLARKE COUNTY SCHOOL DISTRICT | 15 | 0 | 0 | 2.5 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 0 | 38 | 140 |
| 061 005 | CLARKE COUNTY SCHOOL DISTRICT | 15 | 0 | 0 | 2.5 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 0 | 38 | 140 |
| **Private** | | | | | | | | | | | | | | |
| 062 024 | NEW OAK GROVE RES LLC | 1 | 20 | 0 | 2.5 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 5.00 | 49.0 | 3 |
| 054 001 | NEW OAK GROVE RES LLC | 1 | 20 | 0 | 5.0 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 0.00 | 46.5 | 7 |
| 062 023A | MONSIGNOR WALTER J DUNOVAN CATHOLIC HIGH | 1 | 0 | 0 | 2.5 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 0.00 | 24.0 | 249 |
| 103 011K | FREEMAN RICHARD B | 1 | 0 | 10 | 2.5 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 0.00 | 34.0 | 12 |
| 103 011G | SOUTHERN OAKS FARM LLC | 1 | 0 | 10 | 2.5 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 0.00 | 34.0 | 12 |
| 103 010A | 76 LW LOTS LLC | 1 | 0 | 0 | 7.5 | 7.5 | 10.0 | 0 | 1 | 1 | 1 | 0.00 | 29.0 | 22 |
| 103 007 | COX RADIO INC | 1 | 0 | 0 | 2.5 | 7.5 | 10 | 0 | 1 | 1 | 1 | 0 | 24 | 28 |
| 103 001A | TAFF CLYDE WILLIAM DR & BENNIE MAE TAFF | 1 | 0 | 0 | 2.5 | 7.5 | 10 | 0 | 1 | 1 | 1 | 0 | 24 | 28 |
| 101 001 | SCHULTZ WILLIAM J | 1 | 0 | 0 | 2.5 | 7.5 | 10 | 0 | 1 | 1 | 1 | 0 | 24 | 28 |

*Note*:

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

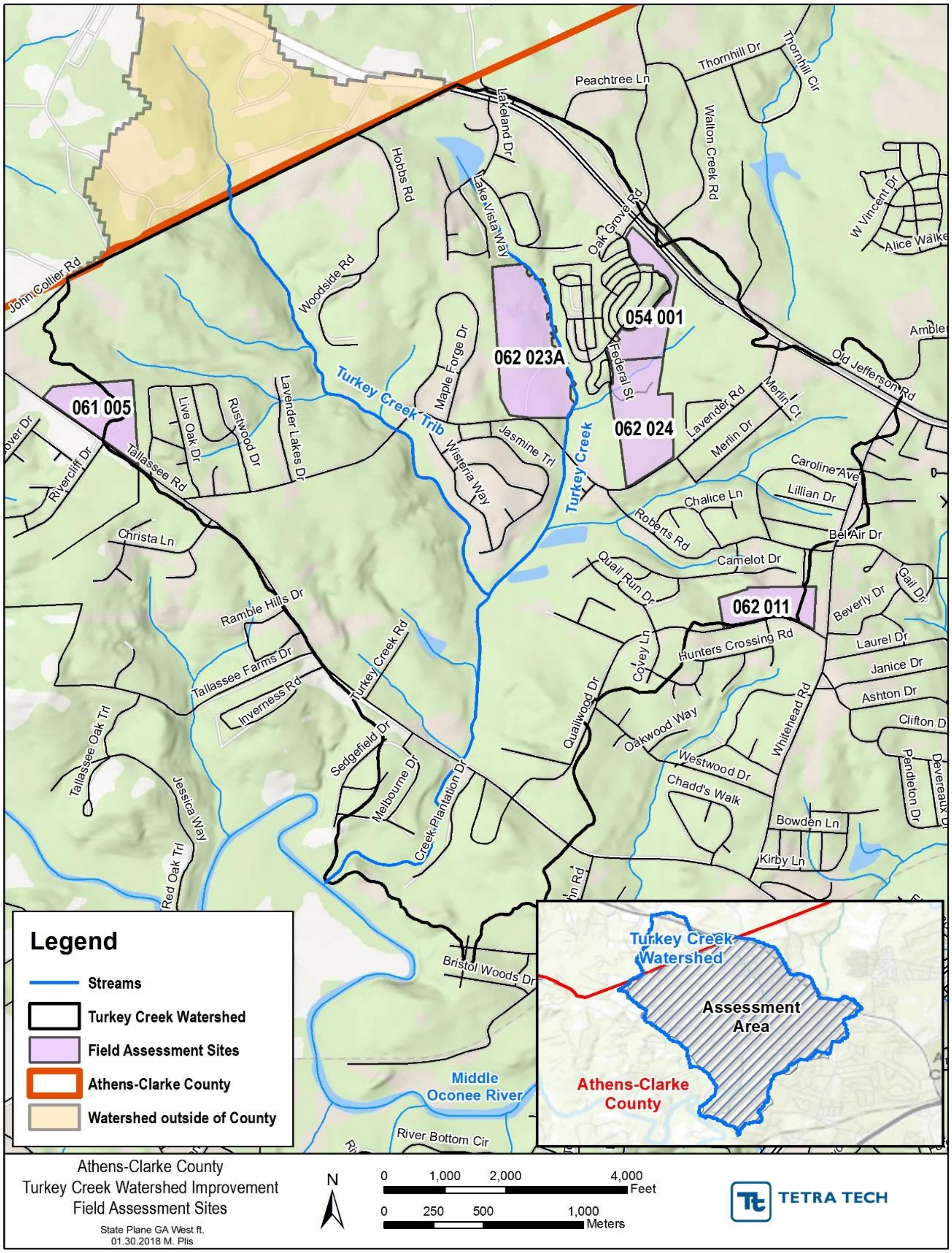


**Figure 3-2. Turkey Creek Field Assessment Sites**

### 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 E) 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. One site was identified in the Turkey Creek watershed. Parcel information and potential opportunity for the single parcel-specific candidate site is identified in Table 3-4 and the site location is 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). No stormwater control BMP opportunities were identified in the Turkey Creek watershed.

**Table 3-4. Candidate Sites for Watershed Improvement Opportunities**

| Watershed | Parcel Number | Owner | Description | Opportunity | BMP ID |
|---|---|---|---|---|---|
| Turkey Creek | 062 023A | Monsignor Walter J Dunovan Catholic High | Catholic High School | Erosion control | TC-Res-01 |

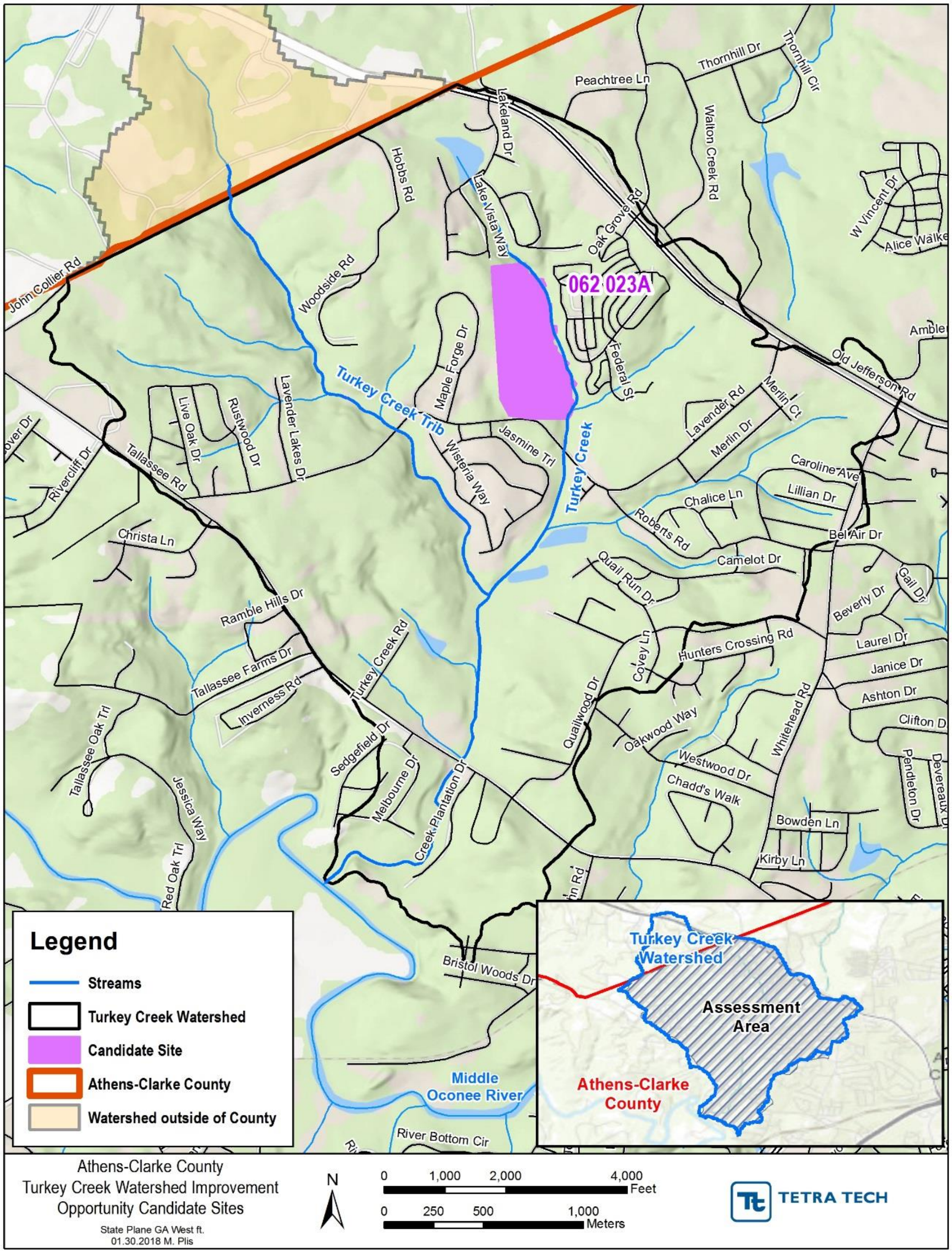


**Figure 3-3. Turkey Creek Watershed Improvement Opportunity Sites**

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 that are not parcel-specific is provided in Table 3-5.

**Table 3-5. Programmatic Watershed Improvement Opportunities (not parcel-specific)**

| 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.<br><br>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. |
| Coordination with Jackson County on Stormwater Management | Determine if stormwater management at the J&J Flea Market could improve hydrology in the tributary to Sandy Creek that runs along the southern edge of Sandy Creek Park. |

*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 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 3-6.

**Table 3-6. 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 F, including a detailed description of the scoring criteria for each BMP attribute. A prioritized list of stormwater control and restoration projects for the Turkey Creek watershed is provided in

Table 3-7.

**Table 3-7. Scoring and Prioritization for Stormwater Control and Restoration Projects in the Turkey Creek 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Attribute Score | | | | | | | | | | | |
| 062 023A | TC-Res-01 | 0 | 0 | 10 | 0 | 5 | 5 | N/A | N/A | 5 | 5 | 2.5 | 27.5 |

## 3.4 Recommended Management Measures

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 Restoration Management Recommendations

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 Turkey Creek watershed. One recommended project is identified in Table 3-8. A concept plan sheet for this project is provided in appendix G and a planning level cost estimate is provided in appendix H.

**Table 3-8. Recommended Restoration Measure**

| BMP ID | Project Description |
|---|---|
| TC-Res-01 | **Catholic High School Erosion Control**<br>This project involves the implementation of silviculture BMPs such as thinning to promote tree health and growth, the development of a duff layer, and the encouragement of herbaceous plants. Erosional areas may require regrading, seeding, and mulching. Benefits include reduced sediment transport and beautification. |

### 3.4.1 Programmatic Management Recommendations

General programmatic recommendations for watershed improvement are listed in Table 3-5. Concept plan sheets for two of the general programmatic measures (mowing maintenance practices and bank stabilization) are provided in appendix G. Pollutant load reductions are expected from the recommended programmatic measures, but cannot be accurately quantified.

# 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.<br>If the monitoring results indicate water quality degradation, ACC should:<br>o Try to identify point sources of any degradation;<br>o Attempt to identify the cause of the degradation;<br>o Evaluate the current BMPs established; and<br>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.

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