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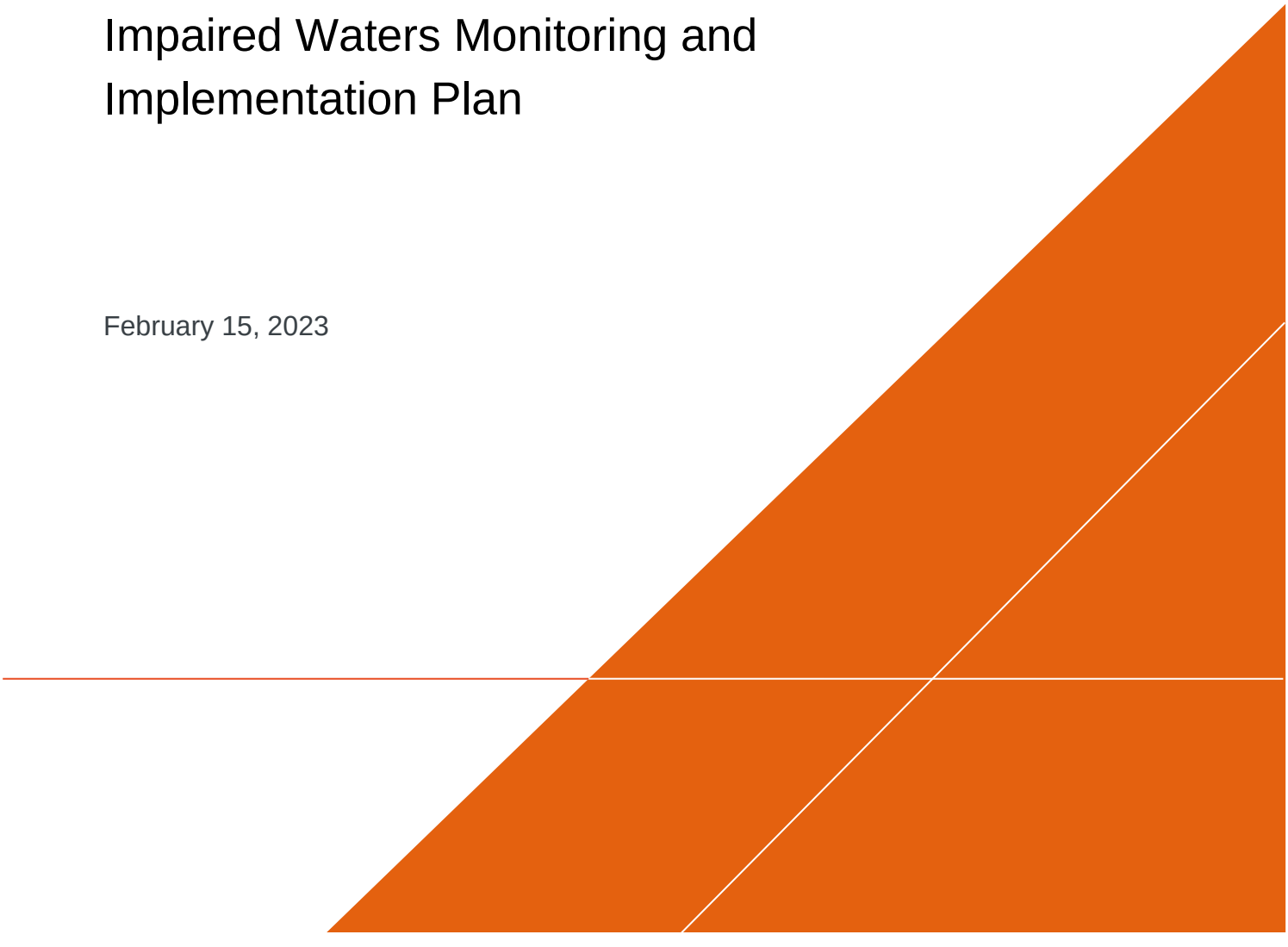
Athens-Clarke County, Georgia

2022 ANNUAL REPORT

Impaired Waters Monitoring and Implementation Plan

February 15, 2023



2022 ANNUAL REPORT

Impaired Waters Monitoring and Implementation Plan

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EXECUTIVE SUMMARY

Athens-Clarke County, Georgia developed and implemented an Impaired Waters Monitoring and Implementation Plan and Sampling Quality Assurance Plan in October 2015 as part of its Municipal Separate Storm Sewer System National Pollutant Discharge Elimination System permit requirements. As part of the Plan, fecal coliform bacteria (FC), total suspended solids (TSS), and pH are regularly measured at sampling stations representative of impaired reaches within the permit area.

On August 31, 2022, EPA approved an update to Georgia Environmental Protection Division's (EPD) water quality standards to include *Escherichia coli* (*E. coli)* rather than fecal coliform. Athens-Clarke County will discontinue FC sampling and begin *E. Coli* sampling in 2023. The change from fecal coliform to e. coli was approved by US EPA Region IV on August 31, 2022. This was adopted by the Georgia DNR Board of Natural Resources on January 28, 2022.

Data collected from initiation of monitoring efforts in October 2015 through fourth quarter 2016 were presented in the 2016 Annual Report. Data collected in 2017 were presented in the 2017 Annual Report, data collected in 2018 were presented in the 2018 Annual Report, data collected in 2019 were presented in the 2019 Annual Report, data collected in 2020 were presented in the 2020 Annual Report, and data collected in 2021 were presented in the 2021 Annual Report. This annual report includes sampling results from December 2021 for the November to April monitoring period and sampling results from three quarters of 2022: one from November to April, and two from May to October. This report also includes analyses of pollutant of concern (POC) trends since initiation of monitoring.

All pH levels for all stations met state standards.

Results for TSS at stations CA-1, CED-1, NC-1, and NC-2 were consistently between 3 and 11 mg/L. Results for MO-1 were consistent with other sampling locations in December 2021, then spiked through the spring and summer months, returning to normal levels in November 2022.

No rain was reported in Athens before or on the day that the highest TSS levels were measured in May 2022. August 16, 2022 results for TSS at station MO-1 may have been due to rain within the watershed at the time of sampling. Portions of the MO-1 watershed received about 0.1 to 0.25 inches of rain on August 16, 2022 (NWS NOAA 2022).

In some cases, the exceedances of state standards for FC were due in part to the lower geometric mean criteria. During the May – October season, the state standard for geometric mean is 200 CFU/100 mL. During the November – April season, the state standard for geometric mean is 1,000 CFU/100 mL. Geometric means met the state standard of 1,000 CFU/100 mL for all stations except CED-1 for the December 2021 sampling event. The geometric mean for BR-1, BR-2, CED-1, KB-3, MO-3, and MO-4 exceeded the standard for the March sampling event. Results from all other stations met the standard in March. In May 2022, results from all stations except MO-2, MO-3, and NO-2 exceeded the FC geometric mean standard of no greater than 200 CFU/100 mL. In August 2022, results from all stations exceeded the standard. In November 2022, all stations except BR-1, CED-1, TAN-2, and TR-3 met the standard of 1,000 CFU/100mL.

Seventeen of 24 of the largest reported concentrations (≥ 16,000 CFU/100 mL) were measured from samples collected in August 2022. Saturated soils from 0.5-1 inch of rainfall on August 21, 2022 likely

contributed to elevated fecal coliform concentrations in the August 22 and possibly August 24 samples. Samples on August 22 were collected between 8:33 and 11:02 AM and rainfall on August 21, 2022 totaled approximately 0.5-1 inch at all stations. All stations received up to 0.5 inch of rain on August 25 and up to 0.75 inch on August 31, which may have contributed to elevated concentrations on these days. Saturated conditions increase the possibility of leakage from septic drainage fields and sanitary sewers due to rainwater infiltration. Increased runoff contributes fecal coliform from wildlife and domestic animal sources.

The largest concentrations (≥16,000 CFU/100 mL) for the May geomean were measured on May 24 (BR-2) and May 25 (TAN-1, TAN-2). Rainfall total for the affected watersheds was up to 1.5 inches of rainfall on May 24, with an additional 0.25 inch on May 25. Because of the relatively high rainfall totals at BR-2, TAN-1, and TAN-2, it is likely that rainfall on May 24 and 25 contributed to elevated fecal coliform concentrations on these days.

The Middle Oconee River Watershed Management Plan (Arcadis-Tetra Tech April 2018b), including Kingswood Branch and Hunnicutt Creek, identified the following fecal coliform sources: pets, wild animals, farms, leaky sewer pipes, and septic systems. There may also be some contribution to fecal coliform levels in the Middle Oconee River Watershed from sources in the headwaters outside of the Athens-Clarke County boundary.

Athens-Clarke County Government (ACCGOV) has implemented best management practices, including initiatives in pet waste management, sewer evaluations, septic system management, and bacteria source tracking, to help reduce fecal coliform and sediment loads to receiving waters, as well as to maintain acceptable levels of pH. Best management practices are considered effective given that substantial progress has been made by ACCGOV over the reporting period. Examples of this progress include: millions of feet of sewer lines have been cleaned, sewer inflow and infiltration studies have been completed to detect areas of potential leaks, approximately 877 miles of roadways were swept as part of street sweeping programs (resulting in removal of 780 cubic yards of debris), construction sites were inspected for proper erosion and sediment controls, pet waste education materials were distributed, and septic system education and outreach programs continued to gain momentum. A bacterial source tracking study was also conducted from 2015 through 2017, and results are being used to target appropriate fecal coliform reduction strategies. Results from this study suggest that human sources of fecal coliform are a consistent contributor in Tanyard Creek, Brooklyn Creek, and Trail Creek, and are either not a contributor or are a negligible contributor of fecal coliform in Carr Creek, Cedar Creek, Hunnicut Creek, Kingswood Branch, and unnamed tributary to Middle Oconee River. In 2018, nine Watershed Management Plans (WMPs) were completed for Bear Creek, East Fork Trail Creek, Malcolm Branch, Middle Oconee River, North Oconee River, Sandy Creek, Sulphur Spring Branch, Turkey Creek, and Walton Creek.

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Water Quality Trends (October 2015 – December 2022)

ACRONYMS AND ABBREVIATIONS

ACC	Athens-Clarke County, Georgia
ACCGOV	Athens-Clarke County Government
BioF	biota - fish communities
BioM	biota - macroinvertebrates
BMP	best management practice
BST	bacteria source tracking
CFU	colony forming units
EPA	U.S. Environmental Protection Agency
EPD	Georgia Environmental Protection Division
FC	fecal coliform bacteria
GIS	geographic information system
IWMIP	Impaired Waters Monitoring and Implementation Plan
mg	milligrams
mL	milliliter
MPN	most probable number
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
POC	pollutant of concern
PUD	Public Utilities Department
QA/QC	quality assurance/quality control
RDII	rainfall-dependent inflow and infiltration
SQAP	Sampling Quality Assurance Plan
SSES	sanitary sewer field evaluations and survey
TSS	total suspended solids
WMP	Watershed Management Plan

1 INTRODUCTION

Athens-Clarke County (ACC) is classified as a small Municipal Separate Storm Sewer System (MS4) community with a population greater than 10,000 and is permitted under the General National Pollutant Discharge Elimination System (NPDES) Stormwater Permit No. GAG610000. For monitoring year 2022, monitoring was conducted under the 2017 General Permit (Georgia Department of Natural Resources 2017). The 2017 General Permit expired on December 5, 2022 and the 2022 General Permit became effective on December 6, 2022. The General NPDES Stormwater Permit for small MS4s (Permit) requires MS4 communities such as ACC to develop and implement an Impaired Waters Monitoring and Implementation Plan (IWMIP) for impaired waters within the permitted area. Permittees must identify impaired waters located within its permitted area using the latest approved 305(b)/303(d) List of Waters, which contains MS4 outfalls or waters within 1 linear mile downstream of MS4 outfalls. Permittees are also required to identify POCs, which are the water quality parameter(s) for which the identified impaired waters are listed as not meeting its designated uses, such as fishing or drinking water.

Athens-Clarke County Government (ACCGOV) identified a total of 19 impaired reaches in the ACC Permit area (i.e., ACC jurisdictional area). According to the 2022 305(b)/303(d) List of Waters, seventeen of the 19 reaches are listed as impaired for fecal coliform bacteria (FC), three reaches are listed as impaired for sediment impacts to fish biota (BioF), two reaches are listed and impaired for sediment impacts to macroinvertebrate biota, and three reaches are listed as impaired for pH (Table 1; Georgia Department of Natural Resources 2022). Thus, the POCs identified for the ACC MS4 Permit area are FC, pH, and sediment (BioF and BioM). The reach names, locations, designated uses, impairment parameters (or POCs), extent (length of impaired reach), and potential causes are listed in Table 1.

On August 31, 2022, EPA approved EPD's new water quality standards using *E. coli* instead of FC as the impairment parameter (EPA 2022). This report discusses and references monitoring data using FC as the impairment parameter and the FC water quality standard. Beginning in 2023, ACCGOV will begin monitoring for *E.coli* and future monitoring reports will use the *E. coli* water quality standard.

Table 1. Impaired Stream Reaches with MS4 Outfalls within 1 Linear Mile in Athens-Clarke County, Georgia

Reach Name	Location	Designated Use	Impairment Parameter(s)	Extent (miles)	Potential Causes
Brooklyn Creek	Headwaters to Middle Oconee River, Athens	Fishing	FC	2	Urban runoff
Carr Creek	Headwaters to North Oconee River, Athens	Fishing	BioF, Bio M, FC, pH	2	Industrial facility, urban runoff
Cedar Creek	Headwaters to Oconee River, Athens	Fishing	FC, Bio F	5	Urban runoff
Cloverhurst Branch	Headwaters to Tanyard Branch (Athens)	Fishing	FC	2	Urban runoff
East Fork Trail Creek	Headwaters to West Fork Trail Creek, Athens	Fishing	FC	4	Urban runoff

Reach Name	Location	Designated Use	Impairment Parameter(s)	Extent (miles)	Potential Causes
East Sandy Creek	Long Branch to Sandy Creek	Fishing	pH	4	Non-point sources
Hunnicutt Creek	Headwaters to Middle Oconee River, Athens	Fishing	FC	2	Urban runoff
Kingswood Branch	Tributary to McNutt Creek, Athens	Fishing	FC	1	Urban runoff
McNutt Creek	Headwaters at GA 316 and Dials Mill Road to Middle Oconee River	Fishing	FC	12	Non-point sources, urban runoff
Middle Oconee River	Big Bear Creek to McNutt Creek	Fishing	FC, BioM*	12	Non-point sources
Middle Oconee River	McNutt Creek to North Oconee River	Fishing	FC	4	Urban runoff
Noketchee Creek	Headwaters to Sandy Creek	Fishing	pH, BioF	5	Non-point sources, urban runoff
North Oconee River	Sandy Creek to Trail Creek	Drinking Water, Fishing	FC	2	Non-point sources
North Oconee River	Trail Creek to Oconee River	Fishing	FC	8	Municipal facility, urban runoff
Oconee River	Confluence of North and Middle Oconee Rivers, Athens to Barnett Shoals Dam	Fishing	FC	4	Urban runoff
Tanyard Creek	Upstream North Oconee River, Athens	Fishing	FC	1	Urban runoff
Trail Creek	East Fork Trail Creek to North Oconee River, Athens	Fishing	FC	2	Urban runoff
Tributary to Middle Oconee River	Downstream closed UGA Botanical Gardens Landfill (Milledgeville Ave. Site), Athens	Fishing	FC	1	Non-point sources, urban runoff
West Fork Trail Creek	Athens	Fishing	FC	3	Urban runoff

*BioM impairment was removed in the 2022 list.
Source: Georgia Department of Natural Resources 2022

In 2015, ACCGOV developed and implemented an IWMIP and Sampling and Quality Assurance Plan (SQAP), referred to collectively as the Plan, to monitor and track POCs and to select initial best management practices (BMPs) to help reduce concentrations of the identified POCs. The Georgia Environmental Protection Division (EPD) approved the final IWMIP and SQAP in January 2016. ACCGOV began implementation of the Plan in October 2015, and implementation is ongoing. Combined with ACCGOV's ongoing Watershed Improvement Program, the Plan ultimately helps improve water quality and monitors progress toward removing the impaired waters from the 303(d) List.

In addition to satisfying MS4 Permit requirements, impaired water monitoring data are being collected in accordance with the SQAP component of the Plan (January 2016) to be submitted to EPD for consideration in 305(b)/303(d) listing decisions. Impaired waters monitoring data will be evaluated annually to help identify potential concentration trends and sources of POCs. Furthermore, the monitoring data are being used to help assess current watershed conditions and develop Watershed Management Plans (WMPs), as well as to help guide appropriate stormwater public education and outreach efforts. Results will be evaluated regularly to monitor progress toward delisting the streams from the Georgia 303(d) list.

2 METHODS

Impaired waters were sampled and tested for identified POCs according to the detailed methods described in the ACC IWMIP and SQAP (Arcadis-Tetra Tech January 2016). Data collection began in October 2015 and is ongoing. As mentioned in the Executive Summary, the 2022 Annual Report includes detailed results from November 2021 to November 2022 but also includes an analysis of POC trends since initiation of data collection.

The data collected and evaluated as part of this annual report extends from November 2021 to November 2022. Sampling results were compared to applicable Georgia numeric criteria to determine compliance with water quality standards. In addition to sampling data collection and evaluation, ACCGOV implemented BMPs designed to improve water quality for the identified POCs and impaired reaches.

2.1 Impaired Waters Sampling

2.1.1 Study Area

The study area includes the following 19 impaired reaches within the ACC permitted area (Figure 1):

1. Brooklyn Creek
2. Carr Creek
3. Cedar Creek
4. East Fork Trail Creek
5. East Sandy Creek
6. Hunnicutt Creek
7. Kingswood Branch
8. McNutt Creek
9. Middle Oconee River (section one)
10. Middle Oconee River (section two)
11. Noketchee Creek
12. North Oconee River (section one)
13. North Oconee River (section two)
14. Oconee River
15. Tanyard Creek
16. Cloverhurst Branch
17. Trail Creek
18. West Fork Trail Creek
19. Unnamed tributary to Middle Oconee River.

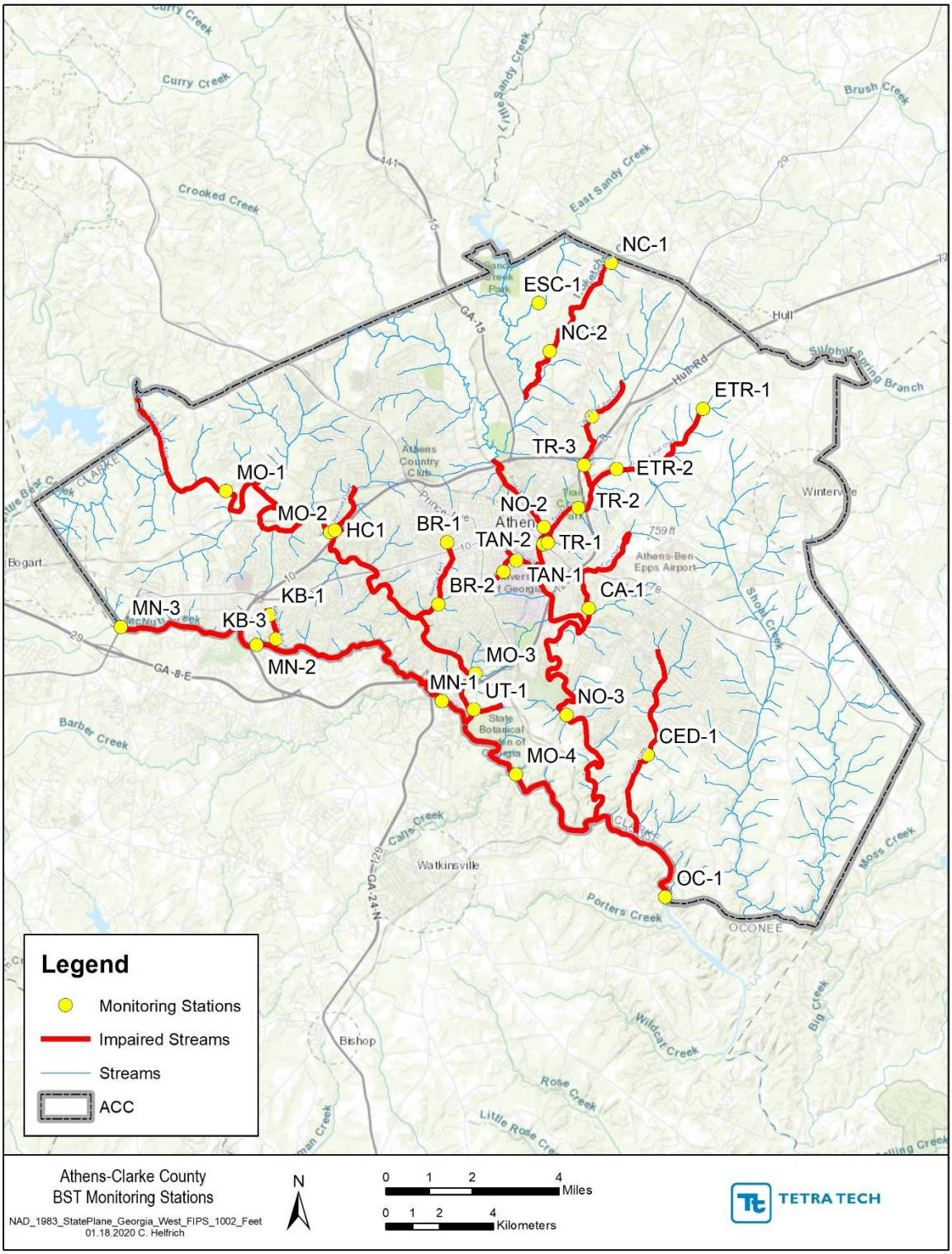

Figure 1. Impaired Stream Reaches within 1 Linear Mile of MS4 Outfalls and Sampling Stations in Athens-Clarke County, Georgia

2.1.2 Sampling Stations

The sampling station locations were selected to represent the 19 impaired reaches within 1 linear mile of MS4 outfalls and where water quality data were collected historically. The impaired streams were sampled at 29 stations. The sampling stations, along with their geographic coordinates, are listed in Table 2.

Table 2. Sampling Stations in Impaired Stream Reaches in Athens-Clarke County, Georgia

Station ID	Impaired Reach	Criterion Exceeded	Latitude	Longitude
BR-1	Brooklyn Creek	FC	33.9547	-83.3993
BR-2	Brooklyn Creek	FC	33.9376	-83.4021
CA-1	Carr Creek	BioF, FC, pH	33.9364	-83.3518
CED-1	Cedar Creek	FC, BioF	33.8958	-83.3321
ETR-1	East Fork Trail Creek	FC	33.9918	-83.3136
ETR-2	East Fork Trail Creek	FC	33.975	-83.3426
ESC-1	East Sandy Creek	pH	34.0211	-83.3686
HC-1	Hunnicutt Creek	FC	33.9581	-83.4367
KB-1	Kingswood Branch	FC	33.9347	-83.4584
KB-3	Kingswood Branch	FC	33.9279	-83.4565
MN-1	McNutt Creek	FC	33.9107	-83.401
MN-2	McNutt Creek	FC	33.9263	-83.463
MN-3	McNutt Creek	FC	33.9314	-83.5098
MO-1	Middle Oconee	FC, BioM	33.969	-83.4733
MO-2	Middle Oconee	FC	33.9576	-83.4383
MO-3	Middle Oconee	FC	33.9183	-83.3898
MO-4	Middle Oconee	FC	33.8904	-83.3763
NC-1	Noketchee Creek	BioF, pH	34.0322	-83.3444
NC-2	Noketchee Creek	BioF, pH	34.0077	-83.3649
NO-2	North Oconee River	FC	33.959	-83.3669
NO-3	North Oconee River	FC	33.9068	-83.3593
OC-1	Oconee River	FC	33.8563	-83.3263
TAN-1	Tanyard Creek	FC	33.9497	-83.3761
TAN-2	Cloverhurst Branch	FC	33.9466	-83.3804
TR-1	Trail Creek	FC	33.9642	-83.3553
TR-3	Trail Creek	FC	33.9542	-83.3671
WTR-1	West Fork Trail Creek	FC	33.9896	-83.3509
WTR-2	West Fork Trail Creek	FC	33.9761	-83.3534
UT-1	Unnamed tributary to Middle Oconee River	FC	33.908	-83.386

2.1.3 Sampling Parameters and Schedule

Sampling methods include in-situ pH measurements for stations NC-1, NC-2, CA-1, and ESC-1; grab sampling for FC analytical testing at all stations except NC-1, NC-2, and ESC-1; and sampling for total suspended solids (TSS) at stations CA-1, CED-1, NC-1, NC-2, and MO-1. Sample parameters, sample types, sampling stations, total number of stations sampled, and sampling schedule are listed in Table 3.

Table 3. Sampling Parameters and Schedule

Parameter	Sample Type	Stations Sampled	Total Number of Stations Sampled	Sampling Schedule
FC	Grab	BR-1, BR-2, CA-1, CED-1, ETR-1, ETR-2, HC-1, KB-1, KB-3, MN-1, MN-2, MN-3, MO-1, MO-2, MO-3, MO-4, NO-2, NO-3, OC-1, TAN-1, TAN-2, TR-1, TR-3, WTR-1, WTR-2, UT-1	26	4 geometric means/year = 16 grab samples = (4 grab samples/1 geometric mean) x (4 samples/year)
pH	In-situ	NC-1, NC-2, CA-1, ESC-1	4	20 samples per year
TSS	Grab	CA-1, CED-1, NC-1, NC-2, MO-1	4	4 samples per year (1 sample collected each calendar quarter)

Georgia water quality standards for the sampled parameters and impaired reaches designated uses are provided in Table 4. Sampling results are compared to the state standards to evaluate attainment of these criteria.

Table 4. Georgia Water Quality Standards for Sampled Parameters

Parameter	Standard	Source
Fecal Coliform Bacteria	May–Oct <200 colonies/100 mL as geometric mean and 4,000 colonies/100 mL as a single sample maximum	GA Water Quality Standards*
	Nov–Apr <1,000 colonies/100 mL and 4,000 as a single sample maximum	
pH	Between 6.0 and 8.5	GA Water Quality Standards
TSS	No quantitative standard in Georgia	NA

*Standard has changed to an *E. coli* water quality standard effective August 31, 2022

2.1.4 Sampling Methods

Sampling methods included in-situ water quality measurements for pH and grab samples for laboratory analyses of FC and TSS. Sampling protocols are described in detail in Section 3.1, Sampling Methods, of the ACC Plan (Arcadis-Tetra Tech January 2016) and adhere to the requirements of the Water Protection Branch Quality Assurance Manual (Georgia Department of Natural Resources 1999) and Title 40 of the Code of Federal Regulations, Part 136. Sampling included quality assurance/quality control (QA/QC) procedures such as the collection of blank and duplicate samples and the completion

of chain-of-custody forms for grab samples submitted to the laboratory for analysis. These QA/QC protocols are described in the SQAP (Section 3 of the IWMIP and SQAP).

Sampling personnel maintained field records during sampling events. Field records include completed field forms that provide information on sample location, date, time, weather conditions at the time of sampling, names of sampling personnel, observed field conditions, problems encountered, and any corrective actions taken as a result. Refer to Section 3.3.2, Field Records, of the Plan for additional details on the field records collected for each sampling event.

2.2 Best Management Practices

BMPs have been implemented in ACC to control and reduce POC concentrations. ACCGOV has many ongoing programmatic BMPs in place to reduce FC levels and prevent other POCs from entering streams in ACC. These BMPs and associated efforts are documented in the Unified Government of Athens-Clarke County Watershed Protection Plan 2020-2021 Annual Report (Jacobs 2021), ACC's NPDES Phase II 2021 Annual Report, and in the ACC Plan. In addition to ongoing programmatic BMPs, ACCGOV has conducted bacteria source tracking (BST) to assist in identifying the primary sources of FC measured in streams. Results will be used to focus management efforts in a cost-effective manner. BST commenced in November 2015 and was completed in October 2017.

The summaries below describe BMP progress made by ACCGOV in 2022. Progress made before 2022 is described in previous IWMIP Annual Reports.

2.2.1 Pet Waste Management Initiatives

This section discusses the activities ACC has undertaken to document, understand, and address pet waste management in ACC.

- During the reporting period, ACCGOV staff distributed brochures on pet waste/bag dispensers to promote public education on proper pet waste management. ACCGOV staff continues to actively monitor for pet waste "hot spots" in downtown Athens and beyond.
- The Stormwater Department passes out pet waste bag dispensers with bags for dog owners to clip to their leashes. They give these out at any tabling events they attend, and they supply animal shelters and hospitals with boxes of pet waste bags for dog adoption goody bags.
- The Leisure Services Department installs pet waste stations in public parks and at public trailheads. They maintain approximately 20 stations weekly.

2.2.2 Sanitary Sewer Evaluation

Due to the high levels of FC in ACC, a key source control measure for 303(d)-listed streams identified in the ACCGOV Public Utilities' Department (PUD) Watershed Protection Plan was maintenance and evaluation of sanitary sewer lines. Consequently, the following activities were undertaken to maintain and evaluate sanitary sewer lines in ACC.

2.2.2.1 Sewer Maintenance

- From July 2021 through June 2022, PUD used Rodder trucks to clean 1,007,578 feet of sewer line, flush/vacuum trucks to clean 757,673 feet of sewer line, and camera trucks to inspect 204,438 feet of sewer line.
- PUD made condition and capacity upgrades to approximately 3,325 total linear feet of 8 inch, 12 inch, 18-inch, and 24-inch gravity sewer line and appurtenances within the Tanyard Creek watershed. This work included the relocation of two poor condition vitrified clay lines previously encroaching on Tanyard Creek. These lines were removed from private property and relocated to the adjacent public streets away from the creek eliminating the possibility of further impacts to the creek.
- PUD's on-call contractor installed new sewer in Rear Arch Street.
- PUD's on-call contractor installed upgrades to the sewer at Atlanta Highway Crossing at Ultimate Drive to realign and upsize approximately 1,200 linear feet of 10-inch line to improve condition and capacity in the area.
- PUD's on-call contractor replaced approximately 2,000 linear feet of 8-inch sewer in the vicinity of Academy sports on Timothy Road to improve these sewer line sections.
- PUD's contractor is digging a tunnel under the Loop between Alexander Street and Dairy Pac Road to upsize and realign the Upper North Oconee sewer main.
- PUD is finalizing construction plans for the Brooklyn Creek Interceptor Improvements. This project includes replacing the sewer interceptor from the trunk line at the Middle Oconee River up to King Street and increasing pipe size to provide greater capacity based on population projections for the future.
- PUD is under design on plans for the Middle Oconee Interceptor Improvements. This project includes replacing approximately 8,400 linear feet of the sewer interceptor from the treatment plant up to the vicinity of Dogwood Drive and increasing pipe size to provide greater capacity based on population projections for the future.

2.2.2.2 Sewer Evaluation Studies

- In 2015, PUD conducted a Flow Monitoring Study to identify rainfall-dependent inflow and infiltration (RDII) within the wastewater collection system.
- In 2015 and 2016, PUD performed detailed field as-built surveys of critical portions of the wastewater collection system. This information was used to update PUD's geographic information system (GIS) with accurate pipe locations, pipe materials, pipe diameters, and pipe slopes and depths.
- In 2015 and 2016, PUD updated and calibrated dynamic dry-weather and wet-weather models for most of the wastewater collection system. The entire wastewater collection system will be modeled in 2017. The results of the forecasting, flow monitoring, and modeling efforts have been used to identify both short- and long-term Service Delivery Plan Capital Improvement Projects to ensure that the wastewater collection system has adequate capacity.

- In 2016, PUD performed sanitary sewer field evaluations and surveys (SSESs) on that portion of the wastewater collection system that has the highest RDII for the purpose of identifying pipes that are in poor condition and need rehabilitation and/or replacement.
- In 2017, PUD continued to analyze results of SSES efforts to identify causes of inflow and infiltration and subsequent capital improvement projects to reduce inflow and infiltration. PUD continues to perform flow monitoring comparisons between pre-rehabilitation and post-construction activities to determine the effectiveness of the SSES program on the wastewater collection system.

2.2.3 Septic System Management

Another key source control measure for FC identified in the Watershed Protection Plan was septic system management. The following activities were undertaken to support proper management of septic systems in ACC.

- The ACC Planning Department is currently responsible for maintaining the GIS septic system inventory. This inventory is updated regularly with newly built septic systems.
- ACCGOV uses the Manual for On-Site Sewage Management Systems (Department of Human Resources, Public Health, Chapter 290-5-26, 2016) to regulate sewer management systems and septic tanks. This includes minimum design and construction standards and minimum volume requirements.
- ACCGOV continues to enforce Sections 8-6-6 and 8-6-7 of the Protected Environmental Areas Ordinance, which prohibit septic tanks in floodplains and riparian zones, respectively.
- ACC maintained a Septic System Education Program, which includes a website (http://www.accgov.com/5317/Septic-System-Education-Program) and a phone number for questions. ACC continued targeted septic tank education efforts, including continued distribution of informational materials, and a targeted social media campaign during the U.S. Environmental Protection Agency's 2021 Septic Smart Week in September.
- ACCGOV has adopted a General Sewer Use ordinance to regulate discharges to public sewers, septic tanks, and private wastewater systems. On October 5, 2018, ACC Mayor & Commission revised the Sewer Use Ordinance to include a recommendation from ACC PUD. Section 5-1-2 (b)(6) now reads "Athens-Clarke County recommends that septic tank disposal systems be inspected on intervals of not less than every five years, and maintenance performed as needed, at the owner's expense."

2.2.4 Street Sweeping

ACCGOV conducted the following street sweeping activities in 2022.

- ACCGOV contracts street sweeping services on major urban roadways and throughout the Central Business District. In 2022, approximately 877 miles of roadways were swept, resulting in removal of 780 cubic yards of debris from roadways.
- In addition to the normal monthly routes, street sweeping occurred after a fireworks show in the downtown area in July, and during the fall months of October and November.

2.2.5 Bacterial Source Tracking

- ACCGOV implemented BST in 2015 to determine the primary source(s) of fecal bacteria in streams that are impaired due to FC. BST analysis is being undertaken as a phased approach. Phase two of the BST work was completed in October 2017.
- Results from this study suggest that human sources of FC are a consistent contributor of FC in Tanyard Creek, Brooklyn Creek, and Trail Creek, and are either not a contributor or are a negligible contributor of FC in Carr Creek, Cedar Creek, Hunnicutt Creek, Kingswood Branch, and an unnamed tributary to Middle Oconee River.
- Results from all FC samples collected from Tanyard Creek, Brooklyn Creek, and Trail Creek as a part of the BST study exceeded the May-October state standard of 200 colony forming units (CFU)/100 milliliters (mL) of drinking water supply and recreational designated uses with the highest reporting limit (16,000 most probable number [MPN]/100 mL) for all three stations from the wet weather samples. However, the wet weather samples detected the same human gene biomarker levels as the dry weather samples. These results suggest that species other than humans are also contributing to the FC levels in Tanyard Creek, Brooklyn Creek, and Trail Creek.
- Because samples from Carr Creek, Hunnicutt Creek, Kingswood Branch, and an unnamed tributary to Middle Oconee River did not detect the human gene biomarker, species other than humans are contributing to the FC levels in those Creeks.
- Potential animal sources of FC were noted during stream walks and upland evaluations conducted in 2016 and 2017 as part of the Watershed Management Planning efforts and include dog, goose, and deer throughout most parts of ACC, and livestock in rural/agricultural areas.
- Based on the results of this study, next steps for consideration include:
    - Use data and analysis from the 2016/2017 Watershed Management Planning efforts to identify the most likely species and locations contributing to FC pollution in the listed streams.
    - Conduct BST to identify non-human species contributing to FC pollution. These may include species such as dog, goose, deer, and others as needed.

2.2.6 TSS Reduction BMPs

- Construction sites were inspected for watersheds with impairments for BioF to reduce sediment loads to receiving waters.
- ACCGOV is evaluating potential funding to increase the amount of street sweeping.

2.2.7 Watershed Management Plans

Before 2018, the Arcadis, Tetra Tech, and ACC partnership completed watershed management documents for Brooklyn Creek, Hunnicutt Creek, Trail Creek, Tanyard Creek, Cedar Creek, Shoal Creek, Big Creek, Carr Creek, and McNutt Creek in accordance with the overarching goals of the Watershed Improvement Program. In 2018, the partnership completed WMPs for nine more watersheds, including Bear Creek, East Fork Trail Creek, Malcolm Branch, Middle Oconee River, North Oconee River, Sandy Creek, Sulphur Spring Branch, Turkey Creek, and Walton Creek. These recently completed plans will likely lead to additional initiatives to improve water quality.

The WMPs discuss the impaired water monitoring and results as they relate to characterizing the existing watershed and discussing water quality. Some of the watershed management needs and recommended management measures are tied to known impairments and/or the water quality data collected under the impaired waters monitoring program. For instance, the Middle Oconee is impaired for FC. Sampling as of the timeframe during which the WMP was being prepared (2017, finalized early 2018) confirmed issues with this. A recommended management measure identified in the WMP was MO-Res-01, also known as the Ben Burton Park Pet Waste and Managed Access Project. The project involves the augmentation of pet waste collection measures through the installation of pet waste stations and additional signage to reduce FC 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. It would potentially deter park users from using unofficial access points through fencing and strategic vegetation. Benefits include nutrient uptake, runoff sediment reduction, and beautification.

3 RESULTS

Water quality monitoring data results collected during the study period are summarized below and are included in Appendix A.

3.1 Fecal Coliform

3.1.1 All Data

During the December 2021 to November 2022 period of record, a total of 617 grab samples (including duplicates and blanks) were tested for FC. Individual grab sample results were compiled and used to calculate five geometric means for 26 stations following sampling protocols (Table 5, Figure 2). Each geometric mean was computed based on results from four grab samples collected within a 30-day period, with no one grab sample collected less than 24 hours from the time of the previously collected sample. Grab samples used to compute geometric means did not overlap between the months of April and May or October and November to ensure that the results could be compared to Georgia FC water quality standards, which are presented as geometric mean criteria (Table 4).

Geometric means calculated for each station were plotted by date (Figure 2). The 2021 to 2022 data set does not support statistically sound trend analysis; however, analysis that incorporates all geomeans collected since 2015 will be discussed in Section 4.2.

In Table 5, the Exceedances of Standard column indicates whether a geometric mean exceeded the standard. Each tick mark corresponds to a geometric mean in chronological order from left to right. A red tick mark indicates an exceedance, and a green tick mark indicates no exceedance of the applicable standard. In Table 5, the red and green colors of the cells containing geometric mean results indicate whether sample results exceeded the water quality standard; red values indicate an exceedance, and green values indicate no exceedance.

Table 5. Fecal Coliform Bacteria Geometric Means (December 2021 - November 2022) and Comparison to State Standards

Date	Dec-21	Mar-22	May-22	Aug-22	Nov-22	
Station	FC Geometric Mean (#25) cfu/100 mL (Nov-Apr)	FC Geometric Mean (#26) cfu/100 mL (Nov-Apr)	FC Geometric Mean (#27) cfu/100 mL (May-Oct)	FC Geometric Mean (#28) cfu/100 mL (May-Oct)	FC Geometric Mean (#29) cfu/100mL (Nov-Apr)	**Exceedences of Standard***
BR-1	919.2	2038.9	2977.8	2258.3	1843.9	
BR-2	562.3	1139.0	1979.7	4015.9	369.4	
CA-1	519.1	262.8	469.6	1691.7	192.2	
CED-1	1945.3	1030.4	1090.5	1710.9	2734.2	
ETR-1	292.2	259.5	479.9	1361.1	243.6	
ETR-2	64.0	113.3	263.6	441.4	205.1	
HC-1	297.7	135.3	352.7	1333.3	167.8	
KB-1	181.3	188.0	310.5	2303.4	370.9	
KB-3	563.7	1205.5	3301.4	2885.9	963.5	
MN-1	252.4	505.9	494.2	720.2	535.9	
MN-2	279.1	340.5	397.6	644.5	444.0	
MN-3	150.0	259.8	270.4	534.5	125.3	
MO-1	361.6	221.2	400.0	630.9	203.5	
MO-2	259.4	226.2	161.9	1030.4	196.9	
MO-3	202.0	1153.1	146.6	1062.6	292.2	
MO-4	303.2	1218.3	237.2	545.3	439.9	
NO-2	207.4	287.8	162.3	957.3	199.7	
NO-3	167.4	632.5	403.1	640.2	393.3	
OC-1	383.3	778.4	294.1	428.6	583.1	
TAN-1	747.4	507.4	2243.7	17000.0	429.4	
TAN-2	253.0	210.0	2293.1	10360.1	1435.2	
TR-1	162.8	192.9	488.9	1090.5	133.7	
TR-3	184.2	906.0	511.2	8192.9	2837.2	
UT-1	64.2	83.8	434.3	436.1	36.4	
WTR-1	121.9	132.4	212.1	1019.4	435.6	
WTR-2	69.2	124.5	263.4	749.2	200.9	
State Standard	**1,000**	**1,000**	**200**	**200**	**200**	

*Standards used here refer to the former GA water quality standards based on FC bacteria. Standard changed to an *E. coli* water quality standard effective August 31, 2022.

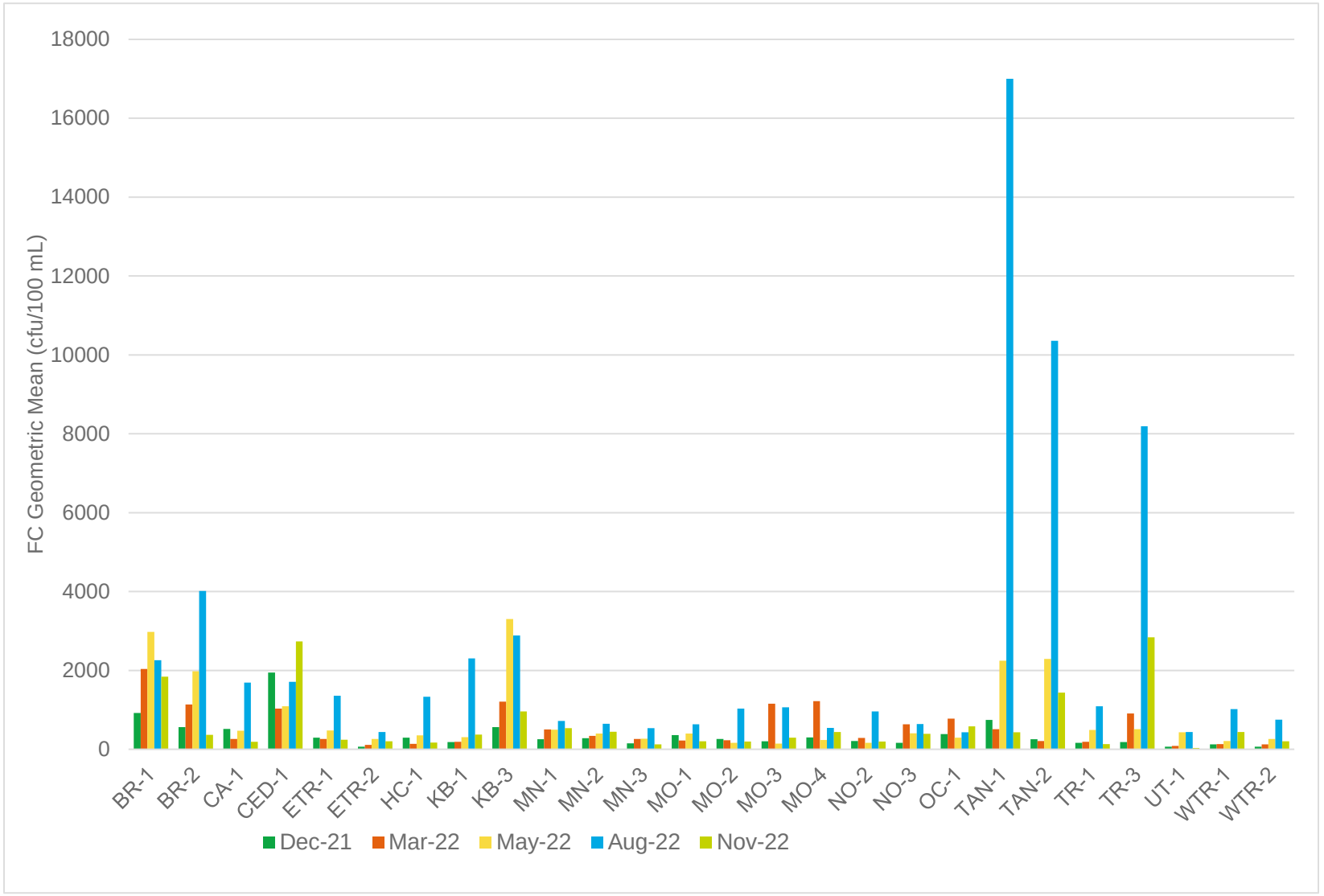

Figure 2. Fecal Coliform Geometric Means (December 2021 – November 2022)

The geometric mean for CED-1 exceeded the state standard of 1000 CFU/100mL for the December 2021 sampling event. The geometric mean for BR-1, BR-2, CED-1, KB-3, MO-3, and MO-4 exceeded the standard for the March sampling event. In May 2022, results from all stations except MO-2, MO-3, and NO-2 exceeded the FC geometric mean standard of no greater than 200 CFU/100 mL. In August 2022, results from all stations exceeded the standard. The geometric mean for BR-1, CED-1, TAN-2, and TR-3 exceeded the standard for the November 2022 sampling event.

FC results measured for individual grab samples were compared to the state water quality standard for FC single samples: <4,000 CFU/100 mL. The stations that exhibited exceedances, as well as the percentage of station samples that exceeded this standard, are listed below:

- 32% of samples for station TAN-1 exceeded the standard.
- 29% of samples for station TAN-2 exceeded the standard.
- 19% of samples for station CED-1 exceeded the standard.
- 15% of samples for station TR-3 exceeded the standard.
- 14% of samples for station KB-3 exceeded the standard.
- 12% of samples for station BR-1 exceeded the standard.
- 10% or less of samples for stations BR-2, CA-1, HC-1, KB-1, MN-1, MN-2, MO-2, MO-3, MO-4, NO-3, OC-1, and WTR-1 exceeded the standard.
- 0% of samples for stations ETR-1, ETR-2, MN-3, MO-1, NO-2, TR-1, UT-1, and WTR-2 exceeded the standard.

Individual grab sample FC data for the December 2021 - November 2022 study period is provided in Appendix A. Results exceeding the standard are highlighted in red in the appendix.

3.1.2 November–April Data

Geometric means computed for FC grab samples were differentiated by either November–April or May-October timeframes to evaluate POC trends in these seasons and to compare them to applicable Georgia water quality standards. Results for the November – April period, which include data collected in December 2021, March 2022 and November 2022, are presented in Table 6 and on Figure 3. In Table 6, the red and green colors of the cells containing geometric mean results indicate whether a sample exceeded the water quality standard; green values indicate no exceedance. Geometric means met the state standard of 1,000 CFU/100 mL for all but 1 of the 26 stations in December, all but 6 of the 26 stations in March, and all but 4 of the 26 stations in November.

Table 6. Fecal Coliform Bacteria Geometric Means (December 2021, March 2022, and November 2022) and Exceedance of State Standards

Date	Dec-21	Mar-22	Nov-22	Exceedences of Standard
Station	FC Geometric Mean (#25) cfu/100 mL (Nov-Apr)	FC Geometric Mean (#26) cfu/100 mL (Nov-Apr)	FC Geometric Mean (#26) cfu/100 mL (Nov-Apr)	
BR-1	919.2	2038.9	1843.9	
BR-2	562.3	1139.0	369.4	
CA-1	519.1	262.8	192.2	
CED-1	1945.3	1030.4	2734.2	
ETR-1	292.2	259.5	243.6	
ETR-2	64.0	113.3	205.1	
HC-1	297.7	135.3	167.8	
KB-1	181.3	188.0	370.9	
KB-3	563.7	1205.5	963.5	
MN-1	252.4	505.9	535.9	
MN-2	279.1	340.5	444.0	
MN-3	150.0	259.8	125.3	
MO-1	361.6	221.2	203.5	
MO-2	259.4	226.2	196.9	
MO-3	202.0	1153.1	292.2	
MO-4	303.2	1218.3	439.9	
NO-2	207.4	287.8	199.7	
NO-3	167.4	632.5	393.3	
OC-1	383.3	778.4	583.1	
TAN-1	747.4	507.4	429.4	
TAN-2	253.0	210.0	1435.2	
TR-1	162.8	192.9	133.7	
TR-3	184.2	906.0	2837.2	
UT-1	64.2	83.8	36.4	
WTR-1	121.9	132.4	435.6	
WTR-2	69.2	124.5	200.9	
State Standard	**1,000**	**1,000**		

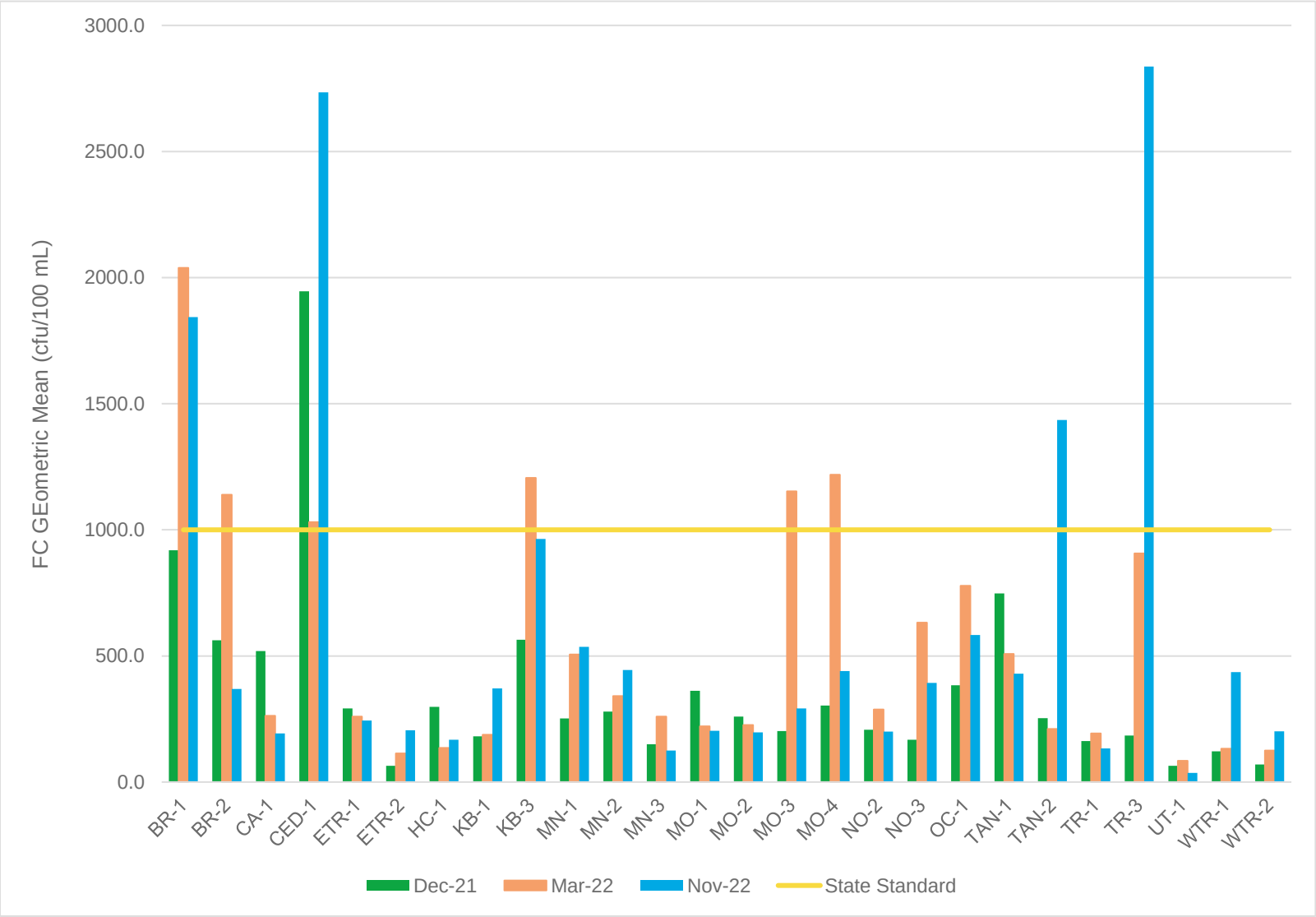

Figure 3. Fecal Coliform Geometric Means (December 2021, March 2022, and November 2022)

3.1.3 May–October Data

Results for the May–October period, which include data collected in May 2022 and August 2022, are presented in Table 7 and on Figure 4. In Table 7, the red and green colors of the cells containing geometric mean results indicate whether results from a sample exceeded the water quality standard; red values indicate an exceedance, and green values indicate no exceedance. Two FC geometric means were computed during May-October for the 2021 and 2022 study period. For the May sampling period, results from all stations but 3 exceeded the 200 CFU/100 mL state standard. For the August sampling period, results from all stations exceeded the state standard.

Table 7. Fecal Coliform Bacteria Geometric Means (May 2022 and August 2022) and Exceedance of State Standards

Date	May-22	Aug-22	Exceedences of Standard
Station	FC Geometric Mean (#27) cfu/100 mL (May-Oct)	FC Geometric Mean (#28) cfu/100 mL (May-Oct)	
BR-1	2977.8	2258.3	
BR-2	1979.7	4015.9	
CA-1	469.6	1691.7	
CED-1	1090.5	1710.9	
ETR-1	479.9	1361.1	
ETR-2	263.6	441.4	
HC-1	352.7	1333.3	
KB-1	310.5	2303.4	
KB-3	3301.4	2885.9	
MN-1	494.2	720.2	
MN-2	397.6	644.5	
MN-3	270.4	534.5	
MO-1	400.0	630.9	
MO-2	161.9	1030.4	
MO-3	146.6	1062.6	
MO-4	237.2	545.3	
NO-2	162.3	957.3	
NO-3	403.1	640.2	
OC-1	294.1	428.6	
TAN-1	2243.7	17000.0	
TAN-2	2293.1	10360.1	
TR-1	488.9	1090.5	
TR-3	511.2	8192.9	
UT-1	434.3	436.1	
WTR-1	212.1	1019.4	
WTR-2	263.4	749.2	
State Standard	**200**	**200**	

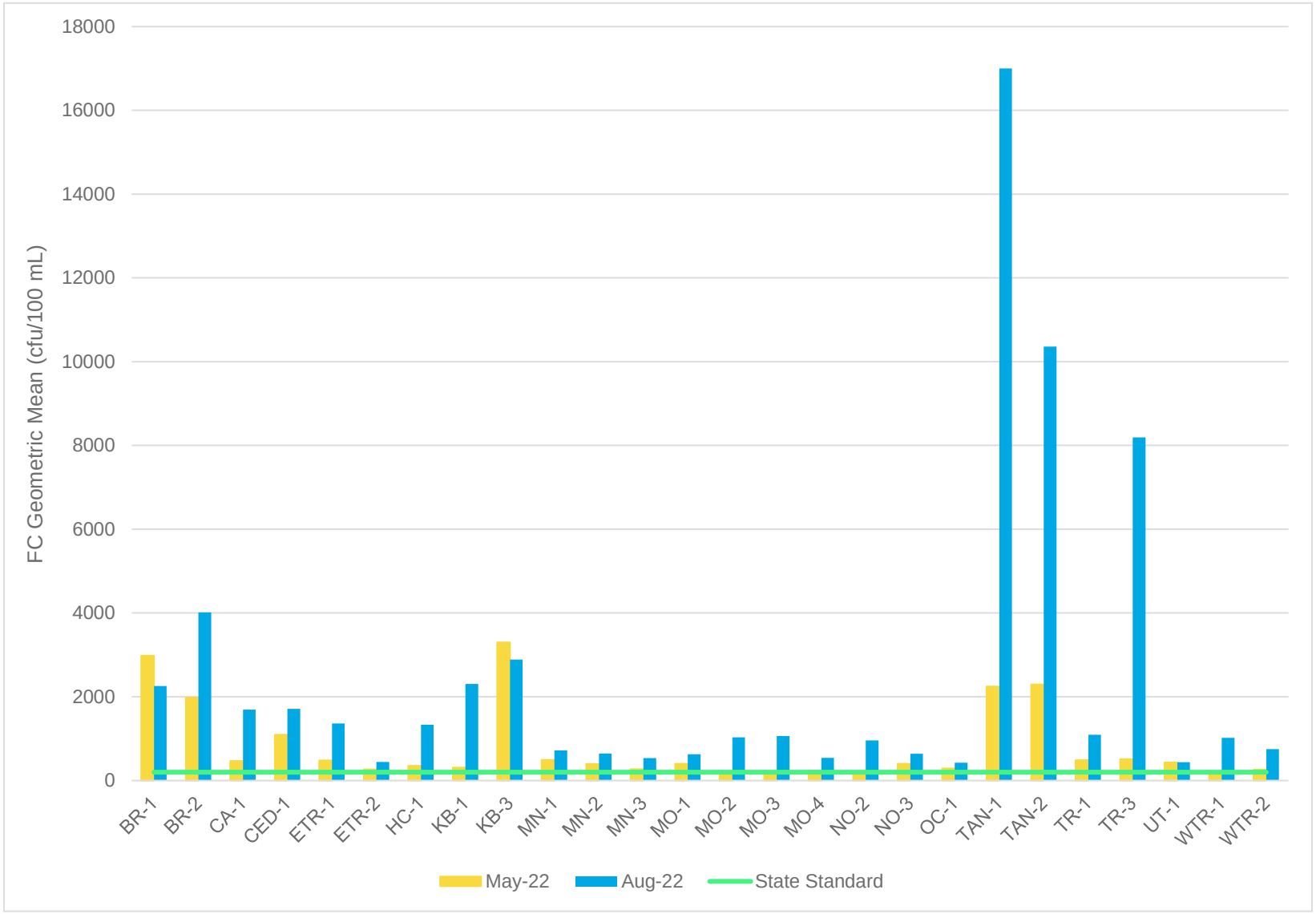

Figure 4. Fecal Coliform Geometric Means (May 2022 and August 2022)

3.2 pH

pH measurements collected for six stations during the study period are shown in Table 8 and Figure 5. Results in green represent measurements within the standard limit, while results in red represent measurements outside of standard limits of 6.0 to 8.5. All measurements for all stations met the standard range.

Table 8. pH Measurements

Date	CA-1	ESC-1	NC-1	NC-2
12/6/2021	6.72	NC*	NC*	NC*
12/8-12/9/2021	NC*	6.70	6.82	7.01
12/13/2021	6.73	NC*	NC*	NC*
12/16/2021	6.76	NC*	NC*	NC*
3/2-3/3/2022	6.83	6.75	6.55	6.91
3/7-3/8/2022	6.90	6.87	6.71	6.90
3/14-3/15/2022	7.05	6.64	6.45	6.51
3/17-3/21/2022	7.14	6.88	6.65	6.85
4/8/2022	6.65	6.46	6.32	6.56
5/2-5/3/2022	6.44	6.51	6.53	6.85
5/4-5/5/2022	6.56	6.76	6.71	7.13
5/16/2022	NC*	NC*	NC*	NC*
5/23-5/24/2022	6.49	6.42	6.74	7.02
5/25/2022	6.55	6.84	6.68	6.91
8/5/2022	7.37	6.89	6.77	7.03
8/15-8/16/2022	7.34	6.92	6.83	6.99
8/17/2022	NC*	NC*	NC*	NC*
8/22-8/23/2022	7.31	6.76	6.77	7.03
8/24-8/25/2022	7.34	6.95	6.88	7.00
8/31/2022	7.30	7.02	6.92	6.92
10/13/2022	6.96	6.77	6.78	6.98
11/2-11/3/2022	6.99	6.63	6.59	6.93
11/7-11/10/2022	6.75	6.79	6.60	6.81
11/21-11/22/2022	6.86	6.82	6.65	6.99
11/28-11/29/2022	6.98	6.73	6.61	6.68
12/7/2022	6.95	6.57	6.25	6.70
Number of Samples	23	21	21	21
Min	6.44	6.42	6.25	6.51
Max	7.37	7.02	6.92	7.13
Median	6.90	6.76	6.68	6.92
Standard Deviation	0.288	0.161	0.172	0.160

*NC = not collected

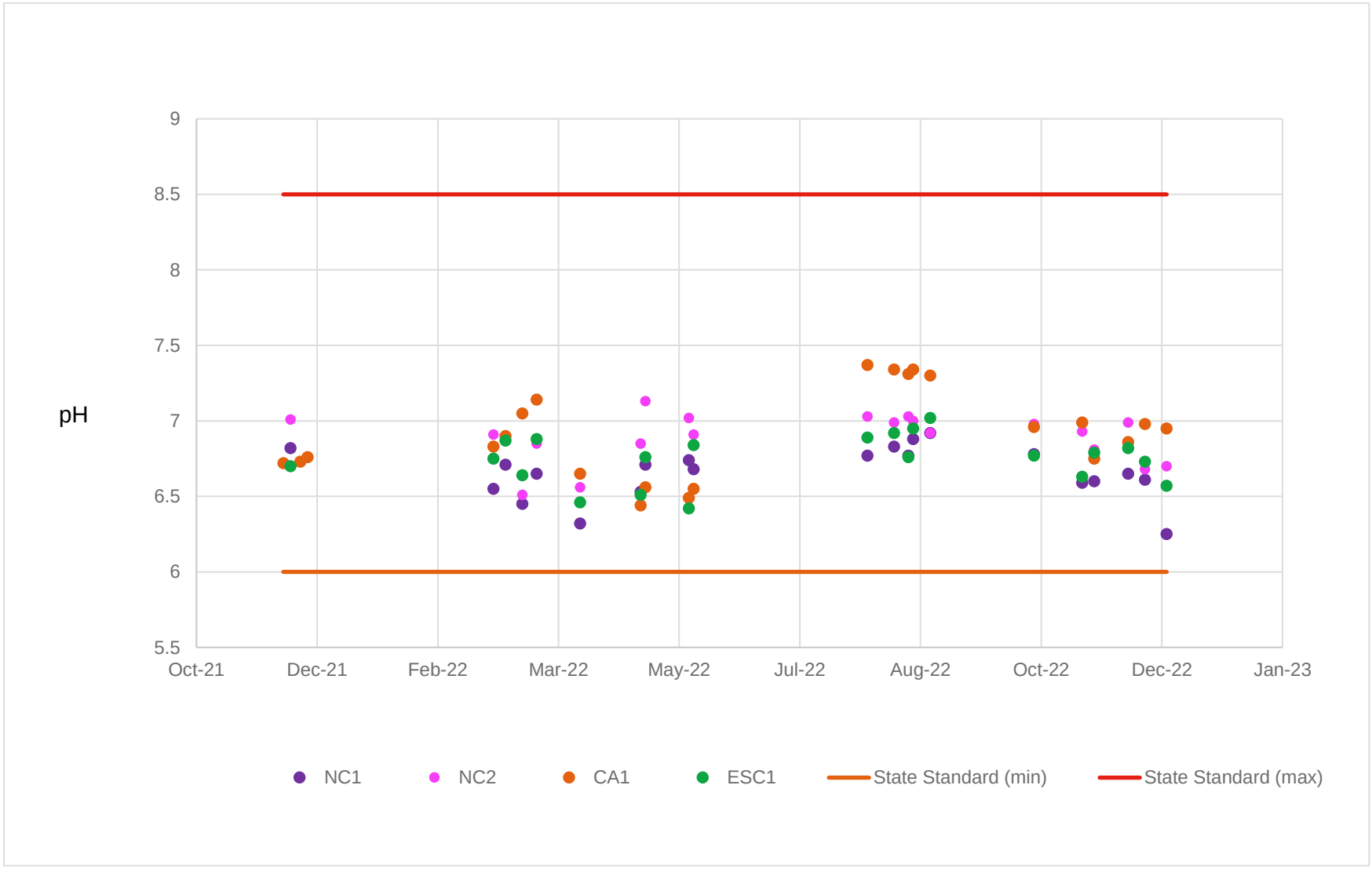

Figure 5. pH Measurements

3.3 Total Suspended Solids

TSS concentrations (milligrams [mg]/L) measured for CA-1, CED-1, NC-1, NC-2, and MO-1 for the study period are presented in Table 9 and on Figure 6. Results for stations CA-1, CED-1, NC-1, and NC-2 were consistently between 3 and 11 mg/L. Results for MO-1 were consistent with other sampling locations in December 2021, then spiked through the spring and summer months, returning to normal levels in November 2022.

Table 9. Total Suspended Solids (mg/L) Measured at CA-1, CED-1, NC-1, NC-2, MO-1

Date	CA-1	CED-1	MO-1	NC-1	NC-2
December-21	3	6	6.80	3.75	3.75
March-22	6.4	4.41	14.4	3.75	6.9
May-22	6	3.75	54	6	5
August-22	4.29	3.75	26	10.9	4.29
November-22	5	10	10.6	6.67	7.5

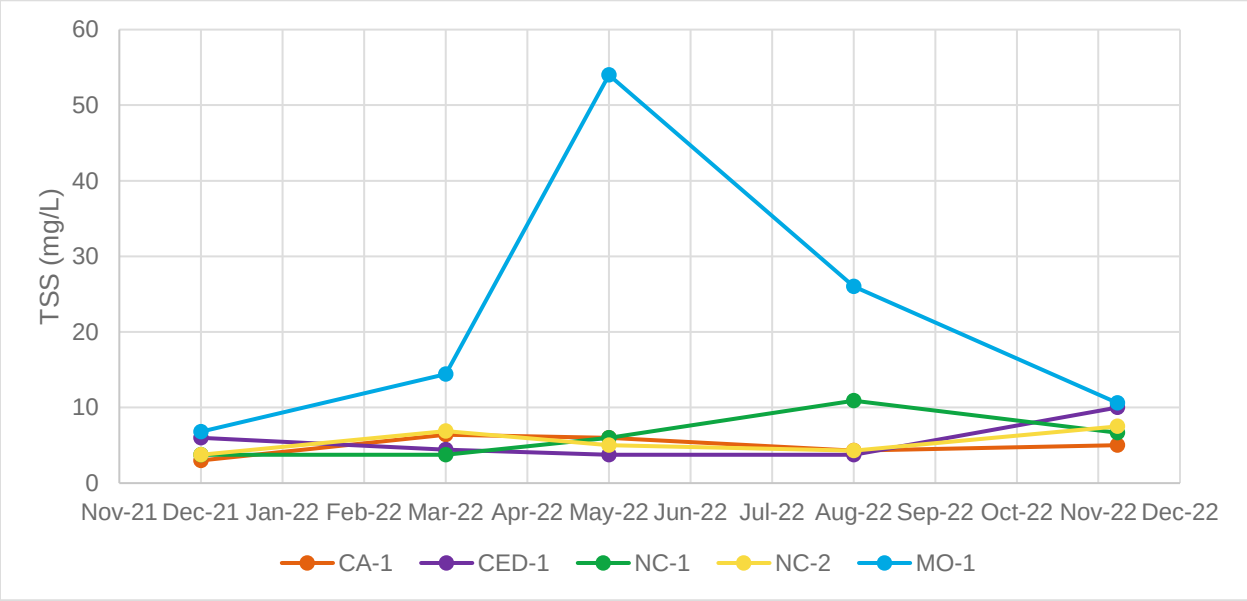

Figure 6. Total Suspended Solids Measured at CA-1, CED-1, MO-1, NC-1, and NC-2

3.4 Quality Assurance/Quality Control

QA/QC procedures were followed during the data collection, data entry, and data analysis components of the project according to the protocols described in the Plan (January 2016). The QA/QC procedures included the collection of blank and duplicate samples throughout the data collection period, completion of chain-of-custody forms for grab samples delivered to the laboratory for analyses, calibration of the

water quality meter used to measure pH in-situ before each pH sampling event, and data entry and data verification checks on the data entered into the master Excel spreadsheet. In total, 42 blank samples and 42 duplicate samples were collected and analyzed for fecal coliform during the study period of record.

4 DISCUSSION

4.1 Sampling Results

In some cases, the exceedance of state standards for FC were due in part to the lower geometric mean criteria. During the May – October season, the state standard for geometric mean is 200 CFU/100 mL. During the November – April season, the state standard for geometric mean is 1,000 CFU/100 mL. Geometric means exceeded the state standard of 1,000 CFU/100 mL for 1 of the 26 stations in December 2021, 6 of the 26 stations in March 2022, and 4 of the 26 stations in November 2022. In May 2022, results from all stations except MO-2, MO-3, and NO-2 exceeded the FC geometric mean standard of no greater than 200 CFU/100 mL. In August 2022, results from all stations exceeded the standard. However, several results for May and August 2022 also exceeded the higher standard of 1,000 CFU/100mL.

Seventeen of 24 of the largest reported concentrations (≥ 16,000 CFU/100 mL) were measured from samples collected in August 2022. Saturated soils from 0.5-1 inch of rainfall on August 21, 2022 likely contributed to elevated fecal coliform concentrations in the August 22 and possibly August 24 samples. Samples on August 22 were collected between 8:33 and 11:02 AM and rainfall on August 21, 2022 totaled approximately 0.5-1 inch at all stations. All stations received up to 0.5 inch of rain on August 25 and up to 0.75 inch on August 31, which may have contributed to elevated concentrations on these days. Saturated conditions increase the possibility of leakage from septic drainage fields and sanitary sewers due to rainwater infiltration. Increased runoff contributes fecal coliform from wildlife and domestic animal sources.

The largest concentrations (≥16,000 CFU/100 mL) for the May geomean were measured on May 24 (BR-2) and May 25 (TAN-1, TAN-2). Rainfall total for the affected watersheds was up to 1.5 inches of rainfall on May 24, with an additional 0.25 inch on May 25. Because of the relatively high rainfall totals at BR-2, TAN-1, and TAN-2, it is likely that rainfall on May 24 and 25 contributed to elevated fecal coliform concentrations on these days.

The Middle Oconee River Watershed Management Plan (Arcadis-Tetra Tech April 2018b), including Kingswood Branch and Hunnicutt Creek, identified the following fecal coliform sources: pets, wild animals, farms, leaky sewer pipes, and septic systems. There may also be some contribution to fecal coliform levels in the Middle Oconee River Watershed from sources in the headwaters outside of the Athens-Clarke County boundary.

Monthly total rainfall data in 2021 and 2022 compared with the 30-year average (1991 – 2020) are shown in Table 10.

Table 10. Monthly Rainfall Totals for Athens, Georgia (National Weather Service 2022)

	2021 Rainfall (in)	2022 Rainfall (in)	30-year Average (in)
December	3.45		4.43
March		5.60	4.37
May		2.17	3.28
August		3.18	4.55
November		5.97	3.77

In addition, much of the population continues to work from home, at least part time, as a result of the global COVID-19 pandemic. This results in an increased demand on sewer systems and septic systems serving residential dwellings. As these systems are often sources of fecal impairments, the increase loading on these systems might contribute to more exceedances of state standards as seen in the May and August results.

All pH measurements taken at all stations attained the standard range.

TSS levels for stations CA-1, CED-1, NC-1, and NC-2 were consistently between 3 and 11 mg/L. Results for MO-1 were consistent with other sampling locations in December 2021, then spiked through the spring and summer months, returning to normal levels in November 2022. No rain was reported in Athens before or on the day that the highest TSS levels were measured in May 2022. August 16, 2022 results for TSS at station MO-1 may have been due to rain within the watershed at the time of sampling. Portions of the MO-1 watershed received about 0.1 to 0.25 inches of rain on August 16, 2022 (NWS NOAA 2022). The Middle Oconee River Watershed Management Plan identified eroding streambanks and upland areas as well as legacy sediment from past land use practices as the major sources of sedimentation in the Middle Oconee River and MO-1 station (Arcadis-Tetra Tech April 2018b). Another potential source of excess sediment for the Middle Oconee River may be its tributary Bear Creek. The Bear Creek watershed can receive excess sediment from eroding upland areas and streambanks during rain events (Arcadis-Tetra Tech April 2018a).

4.2 BMP Effectiveness Evaluation

The effectiveness of the BMPs described in Section 2.2 was evaluated in relation to water quality monitoring results collected since implementation of the Plan in October 2015. A summary of the effectiveness evaluations completed for each BMP is provided in Table 10. In general, BMPs are considered to be successful because of the implementation progress made by ACCGOV during the reporting period. However, many variables regarding BMP effectiveness and associated uncertainties are unknown and unmeasured. As a result, the evaluation of BMP effectiveness summarized in Table 11 is considered preliminary and qualitative.

Table 11. Best Management Practices Effectiveness Evaluation

BMP Type	Targeted POCs	Implementation Status	Effectiveness Evaluation	Rationale
Pet waste stations	FC	Implemented, ongoing	Effective	ACC staff continues to actively monitor for pet waste "hot spots" and will install additional pet waste stations or move current stations based on needs.
Sewer evaluation	FC	Implemented, ongoing	Effective	About 1,765,251 feet of sewer lines cleaned by Rodder trucks and flash/vacuum trucks.
Septic system management	FC	Implemented, ongoing	Effective	ACC continued public education and outreach efforts for proper septic system management.
Street sweeping	FC and TSS	Implemented, ongoing	Effective	In 2022, approximately 877 miles of roadways were swept, resulting in removal of 780 cubic yards of debris from roadways.
TSS reduction: increased construction inspections in Noketchee Creek, Carr Creek, and Middle Oconee watersheds	TSS	Implemented, ongoing	Effective	In 2022, ACCGOV continued inspections in the Noketchee Creek and Carr Creek watersheds, as well as the Middle Oconee watershed. TSS results measured for NC-1 and NC-2 during the 2020-2021 reporting period were low. The results ranged from 3 mg/L to 6 mg/L.

Arcadis also looked at data trends over the entire monitoring period to assess general BMP effectiveness. Appendix B contains charts showing FC by stream, pH measurements, and TSS results since sampling began. Each dataset was fitted with a trendline. Table 12 contains statements concerning the trend of water quality in each stream. It is difficult to make statements about water quality trends based on these trendlines. The data are scattered, producing very low R-squared values. For FC, results at all stations fluctuate. For pH, results at all stations are consistently meeting standards. For TSS, measurements at all stations are fluctuating.

Table 12. Trends in Water Quality by Stream

Reach	FC	pH	TSS
Brooklyn Creek	Fluctuating		
Carr Creek	Fluctuating	Consistently meets standards	Fluctuating
Cedar Creek	Fluctuating		Fluctuating
East Fork Trail Creek	Fluctuating		
East Sandy Creek		Consistently meets standards	
Hunnicut Creek	Fluctuating		
Kingswood Branch	Fluctuating		
McNutt Creek	Fluctuating		
Middle Oconee River	Fluctuating		Fluctuating
Noketchee Creek	Fluctuating	Consistently meets standards	Fluctuating
North Oconee River	Fluctuating		
Oconee River	Fluctuating		
Tanyard Creek	Fluctuating		
Trail Creek	Fluctuating		
West Fork Trail Creek	Fluctuating		

Water quality related to FC and TSS in all stream reaches appears to be fluctuating. The pH levels in all streams appear to consistently meet standards. Sample measurements for all POCs are scattered around linear trendlines. Population growth, development, and aging infrastructure are possible explanations for fluctuating water quality.

5 CONCLUSIONS

It is difficult to evaluate BMP effectiveness and trends in water quality due to the limited and scattered data sets and many other unstudied variables and uncertainties. ACCGOV has made significant progress on BMP initiatives since the implementation of the Plan in October 2015. Water quality appears to be fluctuating, and ACCGOV plans to continue with significant BMP initiatives in 2023 to reduce the impacts of POCs and continue to make progress towards achieving water quality standards for receiving waters. It is possible that the fluctuating water quality improvement could be due to population growth; development; aging infrastructure; and an increase in the pet population, use of parks, and waste despite the pet waste management program. One project ACCGOV is implementing to address aging infrastructure and a growing population is the Brooklyn Creek Interceptor Improvements. The project includes replacing the sewer interceptor from the trunk line at the Middle Oconee River up to King Street, as well as increasing pipe size to provide greater capacity based on population projections for the future. Another project ACCGOV is considering is to retrofit an existing underground detention basin located on the Firefly Trail near the intersection with E. Broad Street. Runoff from Clayton Street between Pulaski

and Thomas Streets and surrounding areas would be directed here and treated with a proprietary water quality practice.

ACCGOV also plans to begin implementing projects suggested in the nine WMPs completed in 2018.

PUD's contractor will be replacing 8,715 linear feet of 15" sewer pipe with 24" pipe and 288 linear feet of 12" sewer pipe from Dairy Pac Road to the north side of Kathwood Drive on Newton Bridge Road to upsize and realign the Upper North Oconee sewer main. In addition, PUD's on-call contractor will replace the sewer line at Memorial Park to upsize and realign.

In addition, it should be noted that all of the pH samples at CA-1, ESC-1, NC-1, and NC-2 collected between December 2021 and November 2022 were within state standards. All pH samples for these stations since January 2021 have met the standard limit. Delisting these streams for pH impairment should be considered and discussed with GAEPD.

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APPENDIX A

Water Quality Sample Results (December 2021 – December 2022)

APPENDIX B

Water Quality Trends (October 2015 – December 2022)

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