North Carolina Area-Wide Optimization Program
2024 Annual Report

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NC Division of Water Resources
Public Water Supply Section

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NC Area Wide Optimization Program
2024 Annual Report

Maintaining the Program

The North Carolina Department of Environmental Quality (DEQ), Public Water Supply (PWS) Section has participated in the U.S. Environmental Protection Agency (EPA) Region 4 Multi-State Area Wide Optimization Program (AWOP) since 2000. The program's goal is to provide North Carolina's water utilities with needed training and tools that can assist in maximizing water system operations, thus improving public health. Optimization goals adopted by the North Carolina AWOP are in APPENDIX A.

Data from all surface water treatment facilities are evaluated annually to maintain a status component. Data evaluated include turbidity, microbial, and disinfection byproduct (DBP) performance information. In 2024, 149 surface water plants operated during the year. The following is a summary report of the 2024 NC AWOP findings and activities.

While North Carolina's AWOP team continues to engage in a number of beneficial activities that support the maintenance of its AWOP, the team also faces challenges.

Institutional Barriers
The NC AWOP is a volunteer effort for participating systems and PWS Section staff. Time dedicated to the implementation of the NC AWOP is limited because of necessary attention to regulatory requirements and other PWS Section activities. While compliance with drinking water regulations is our primary goal, the NC AWOP Team recognizes and operates with the understanding that optimization provides an additional level of public health protection and strives to meet the program goals.

Internal Support
Program support remains high on both the Division and Section levels. Our staff were not restricted from traveling to meetings or from conducting optimization activities in the State. Funding is available to purchase equipment needed for AWOP activities to grow the program.

The Drinking Water State Revolving Fund set-asides are the primary source of funding for the NC AWOP. Continued demonstration of the benefits of the NC AWOP will allow for future staff recruitment to ensure program maintenance and enable growth.

Core Team Structure and Capacity
In 2024, the NC AWOP Team consisted of ten staff participants from the PWS Section who worked to sustain the program by participating in varying activities, such as

evaluating system capabilities and providing technical training to systems (Table 1). Three members functioned as the core team and are responsible for ensuring the program's continued viability. The other members are in different stages of certification, technical knowledge, experience, and understanding of the AWOP philosophies, and provide expertise as opportunities present themselves.

Table 1

PWSS Staff	Program Activity	AWOP Certified
Eric Hudson	Core Team Member Program Manager	Yes
Rebecca Sadosky	Core Team Member CPE Technical Support Central Office Technical Advisor	Yes
Clif Whitfield	Core Team Member Regional Technical Advisor	Yes
Katherine Richardson	Central Office Technical Advisor	No (1 Microbial CPE)
Tommy Overby	Regional Technical Advisor	No
Emily Lester	Regional Technical Advisor	No (1 Microbial CPE)
Tim Appelboom	Regional Technical Advisor	No
Weston Johnson	Regional Technical Advisor	No
Omar Almazan	Central Office Technical Advisor	No
Nicole Hairston	Regional Technical Advisor	No

DS – Distribution System
DBP – Disinfection Byproducts
PBT – Performance Based Training
CPE – Comprehensive Performance Evaluation

Program Assessment

NC AWOP activities included: participation in the EPA Region 4 AWOP planning meetings, NC AWOP Team quarterly meetings, microbial performance based trainings (PBT), and evaluation of system data. These activities, along with previous DBP performance based trainings (PBTs) and microbial and DBP comprehensive performance evaluations (CPEs), have served as valuable training opportunities and have allowed key NC AWOP members to obtain their AWOP certification, while aiding others in their progress towards certification. The NC AWOP is currently comprised of both seasoned veterans as well as up-and-coming staff.

Plant Status and Rankings for Microbial Contaminants and DBPs

Microbial Status and Ranking Component

The PWS Section has maintained a plant status and ranking component for microbial contaminants since 2001. The microbial and turbidity plant ranking methodology was revised in 2014 to better reflect which systems receive more violations and have higher finished water turbidities (see APPENDIX B). Emphasis was placed on these two parameters because they most directly affect public health and, therefore, are of the greatest concern. To calculate the ranking scores, the average monthly finished water turbidity for a system is multiplied by 100, while the average settled turbidity is multiplied by 3.16, giving the finished water turbidity more weight than the settled water turbidity in the revised ranking scores. The lower the water plant's ranking score, the better their performance on turbidity and microbial indicators. Typically, water plants meeting AWOP finished water turbidity goals year-round have a ranking score of 200 or below.

Prioritized List of Facilities - Microbial

The NC AWOP Microbial Ranking Score is used to identify and prioritize surface water facilities for technical assistance in optimizing microbial performance. The calculated ranking scores for the facilities with the highest 15 (top 10 percent) microbial rankings for 2024 are presented in Table 2 along with the system's 2023 ranking score.

Table 2

2024 Rank	System Name	2023 Rank
1	Tuckasegee Water & Sewer Authority (Tuckasegee WTP)	80
2	City of Asheville (North Fork WTP)	142
3	Harris Nuclear Plant Water System (Harris WTP)	141
4	Anson County Water System (Anson Co. WTP)	16
5	Town of Waynesville (Waynesville WTP)	134
6	Town of Carthage (Carthage WTP)	111
7	Town of Yanceyville (Yanceyville WTP)	4
8	City of High Point (Frank L. Ward WTP)	126
9	Town of Mount Pleasant (Mt. Pleasant WTP)	8
10	Town of Denton (Denton WTP)	2
11	Town of Ramseur (Ramseur WTP)	6
12	South Granville Water & Sewer Authority (Butner LA WTP)	10
13	City of Durham (Williams WTP)	35
14	City of Greensboro (Mitchell WTP)	20
15	City of Rocky Mount (Sunset Avenue WTP)	NA

The Tuckasegee Water & Sewer Authority Water Treatment Plant's ranking changed from 80 in 2023 to 1 in 2024. The primary reason for this change is because the water system received four violations in 2024. Two of the violations occurred in May. A Monitoring violation and a Treatment Technique violation, due to a pump failure that led to a failure to monitor entry point disinfectant residual and failure to maintain contact

time. The other two violations occurred in September. Hurricane Helene caused flooding and equipment failures. The plant failed to collect grab samples, combined filter effluent sample results were missing, and water was delivered to the distribution with 3.0 NTU turbidity.

The City of Asheville North Fork Water Treatment Plant's ranking changed from 142 in 2023 to 2 in 2024. The primary reason for this change is because the water system received a violation in 2024 related to the impacts of Hurricane Helene. The violations were for failure to operate water treatment process to reliably achieve 2-log removal of Cryptosporidium and a violation for exceeding the turbidity MCL.

The Harris Nuclear Plant Water System Water Treatment Plant's ranking changed from 141 in 2023 to 3 in 2024. The primary reason for this change is because the water system received two violations in 2024: one for failure to collect the residual disinfectant concentration sample required, and one for failure to calculate the CT ratio due to missing the data necessary for the calculation.

The Town of Waynesville Water Treatment Plant's ranking changed from 134 in 2023 to 5 in 2024. The primary reason for this change is because the water system received a violation in 2024 related to the impacts of Hurricane Helene. The system delivered water to the distribution on October 8, 2024, with two consecutive turbidity measurements above 1.0 NTU, exceeding the 1.0 NTU maximum threshold for CFE.

The Town of Carthage Water Treatment Plant's ranking changed from 111 in 2023 to 6 in 2024. The primary reason for this change is because the water system received a violation in 2024 for failure to resume continuous monitoring within 14 days after a failure in the continuous turbidity monitoring equipment.

The City of High Point Water Treatment Plant's ranking changed from 126 in 2023 to 8 in 2024. The primary reason for this change is because the water system's finished turbidity value was notably higher in 2024 than in 2023.

DBP Status and Ranking Component

The PWS Section has maintained a DBP status component since 2006. In 2021, the NC AWOP established a numerical ranking system for DBP that compares the difference of actual DBP values versus goal limits and generates a numerical ranking score (see APPENDIX C). The lower the water system's ranking score, the better their performance. Water systems meeting AWOP DBP goals for all four calendar year quarters have a ranking score of zero.

Prioritized List of Systems - DBPs

The NC AWOP DBP ranking score is used to identify and prioritize surface water facilities for technical assistance in optimizing DBP performance. The ranking can be used to separate systems previously grouped together in bins and can identify systems that have more serious Maximum Contaminant Limit (MCL) violations versus systems

that did not meet the goal. Our initial prioritization included surface water systems only; however, we expanded the ranking to include purchase and groundwater systems.

In 2024, there were 347 surface and surface water purchase systems on quarterly monitoring for DBPs. The calculated ranking scores for the facilities with the highest 15 (top 4 percent) DBP rankings for 2024 are presented in Table 3.

Table 3

2024 Rank	Water System	Score
1	Town of Mount Pleasant	217
2	Edgecombe Water & Sewer District	71
3	Pender County Utilities	68
4	Robbins Water System	60
5	Montgomery Count Water System	55
6	Town of Elm City	52
7	Woodrun Subdivision	48
8	Moore County Public Utilities – Robbins	46
9	Town of Candor	40
10	Town of Micro (County Line)	40
11	Carolina Forest Water System	39
12	Town of Kenly	38
13	Town of Star	38
14	Stanly County – Piney Point District	36
15	Lilesville Water System	32

In 2024, there were 54 groundwater and groundwater purchase systems on quarterly monitoring for DBPs. The calculated ranking scores for systems with the highest 15 (top 34 percent) DBP rankings for 2024 are presented in Table 4.

Table 4

2024 Rank	Water System	Score
1	Maple Hill Water District	34
2	Osprey Cove 2	18
3	USMC Lejeune – Rifle Range	16
4	Onslow Water and Sewer Authority	14
5	Southgate MHP	14
6	First Craven Sanitary District	7
7	Craven County Water System	7
8	The Cape Master System	6
9	Hertford Water System	5
10	City of Jacksonville – Springfield Apartments	5
11	Bertie County Regional Water	5
12	Colvard Farms Subdivision	4
13	Town of East Arcadia	3
14	Seagate I	3
15	Town of Sims	3

Targeted Performance Indicator (TPI) Implementation

Microbial Performance Based Training

In 2022-2024, the NC AWOP Team collaborated with the U.S. EPA and Process Applications, Inc. to host a Microbial Performance Based Training (PBT) series for surface water treatment plant operators. The PBT sessions consisted of classroom-style presentations and hands on workshops which focused on conducting special studies and using the data to make educated decisions on operational changes to improve optimization and performance at a surface water treatment plant. There were six training sessions over an 18-month period. At each session a trainer presented on a topic, a workshop was used to show participants how to implement what was taught, and the trainer provided a similar project/task (follow-up assignments) to the operators who then completed the task at their water plant and prepared a report/presentation for the next training session.

Some of the topics included:

- Optimized Performance goals
- Sampling, Testing and Data Development
- Optimization Skills Development – Developing and Implementing Special Studies
- Coagulation Control and Jar Testing
- Assessing Current Plant Performance and Applying Skills and Tools
- PBT Impacts and Sustaining Optimization

Six water treatment plants were invited to participate in the PBT. Each participating treatment plant provided two operators to attend the training sessions.

Rick Lieberman with the U.S. EPA and Jennifer Bunton with Process Applications, Inc. were the trainers for the PBT. NC AWOP Team members attended the training and served as facilitators to assist the water plant operators with their follow-up assignments and preparing presentations for the next training session.

PBT Sessions were held on the following dates:

- Session 1 – November 2, 2022
- Sessions 2 through 5 - February 7, May 10, September 12 and December 12, 2023
- Session 6 – March 26, 2024

Running List of Activities

The NC AWOP Team activities include quarterly meetings, participation in EPA Region 4 AWOP planning meetings, assimilating/evaluating system data and training/evaluation events. The following is a list of North Carolina activities for 2024 (Table 5).

Table 5

Date – 2024	Activity	Attendee(s)
Jan. 11	NC AWOP Team Meeting	NC AWOP Team
Mar. 26	Microbial PBT – Session 6	NC AWOP Team
Apr. 23-25	EPA Region 4 AWOP Planning Meeting - Cherokee, NC	Eric Hudson, Katie Richardson, Nicole Hairston
July 11	NC AWOP Team Meeting	NC AWOP Team
July 30-31	EPA Region 4 AWOP Planning Meeting - virtual	Eric Hudson
Aug. 19-23	EPA Region 4 AWOP CPE North Augusta, SC	Clif Whitfield, Katie Richardson
Oct. 11	NC AWOP Team Planning Meeting	NC AWOP Team
Nov. 19-21	EPA Region 4 AWOP Planning Meeting - Huntersville, NC	Eric Hudson, Weston Johnson, Rebecca Sadosky

Site Selection Process

Facilities are selected for CPEs and PBTs based on their priority rankings (microbial and DBP), their regional proximity, and by request. It is important that NC AWOP efforts are evenly distributed throughout the state. This approach allows for a more diverse program that still serves the most in-need facilities.

Building Awareness & Recognition

Participation in the NC Waterworks Operator Association and NC American Water Works Association and Water Environment Association activities has been instrumental in introducing AWOP tools and concepts into routine operator training. In conjunction with the NC AWOP events, these activities have contributed to the overall improvement in North Carolina's facilities.

Additional effort to facilitate and educate North Carolina's water system operators about the benefits of the AWOP has led to the production of NC AWOP flyers and posters. These flyers contain basic information about the program along with the AWOP goals. The flyers have been provided to water treatment facility staff and discussed during routine inspections. NC AWOP Team members distributed water resistant AWOP posters to each surface water plant. More work is needed to develop innovative approaches that will reach additional facilities and provide the necessary technical assistance to achieve their goals.

The PWS Section issues annual certificates to facilities that meet the NC AWOP microbial optimization goals for settled and finished water turbidity. The award reflects the number of years that a plant has achieved optimized status and also includes special recognition for plants that have received the award for 10 or more consecutive years.

The PWS Section also issues a press release listing the facilities that received the annual certificates. In many communities the achievement of the AWOP goals and certificate award has been reported by the local media. DEQ has also posted pictures of the award presentations on Facebook and Twitter.

AWOP Impacts

The total number of systems that met the optimization goals for finished and settled water turbidity since 2002 and the population serviced by these systems are presented in Figure 1. In general, there has been an increase in the number of optimized plants and in the population served. In 2023, there were 79 optimized water treatment plants that served a population of 3,613,355. In 2024, there were 63 optimized water treatment plants that served a population of 2,856,781. This represents a 20% decrease in population from 2023. The primary reason for the change in the number of optimized plants may be attributed to the occurrence of severe weather. In 2023, water systems located in North Carolina were not affected by tropical storms or hurricanes. In 2024 severe weather from Hurricane Helene resulted in extensive flooding, landslides and damage to drinking water infrastructure located in western North Carolina.

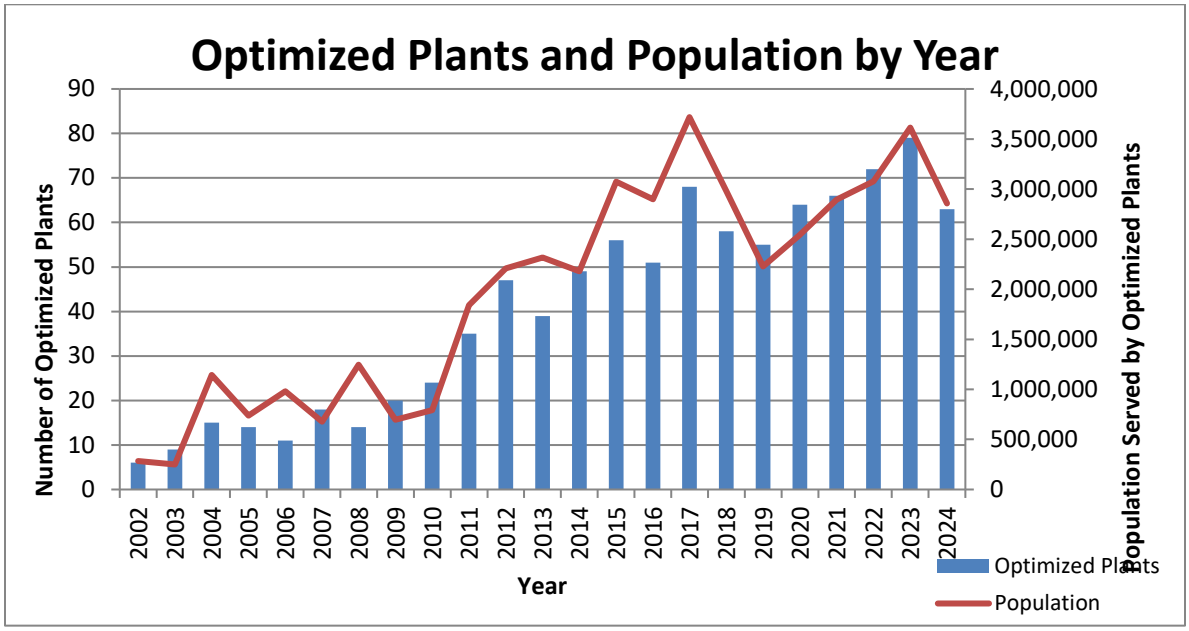

Figure 1

Finished Water Turbidity

The number of facilities that met the finished water turbidity goal of less than 0.10 NTU in 95% of daily maximum turbidity samples in each year from 2004 to 2024 is presented in Figure 2. The number of plants meeting this goal has fluctuated from a low of 65 plants in 2004 to a high of 100 plants in 2023. In 2024 there were 86 plants that met the goal.

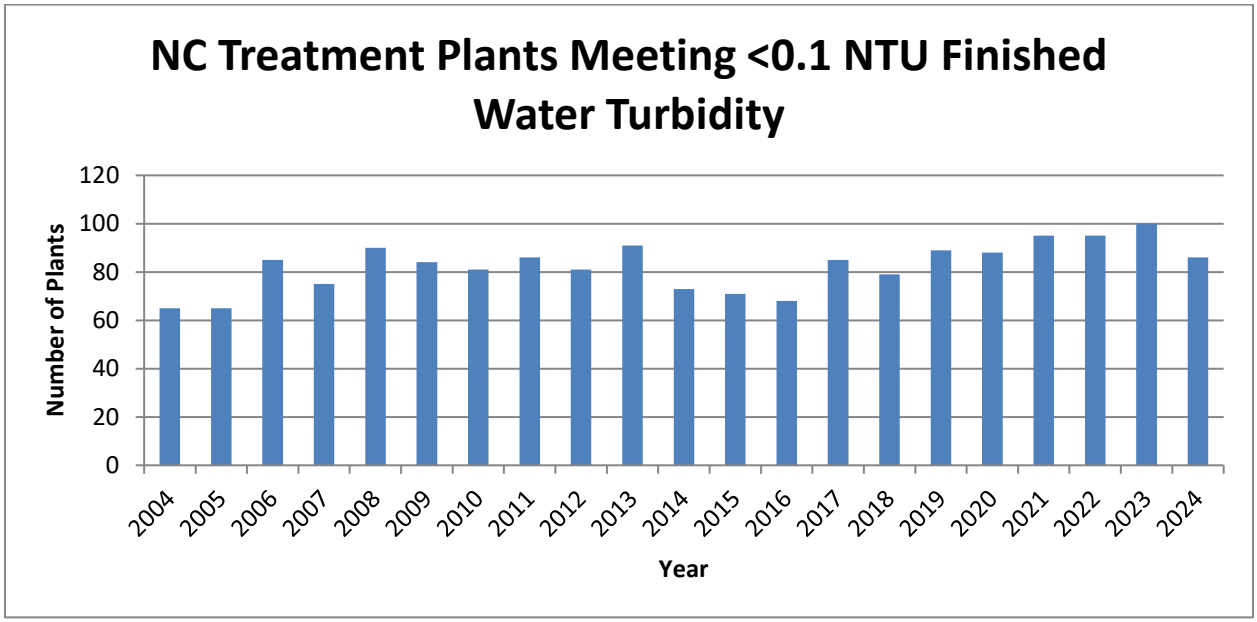

Figure 2

Figure 3 shows the decreasing average finished water turbidity rankings which demonstrates the continued improvements made by surface water facilities in North Carolina. The average finished water turbidity value is calculated from all of the water treatment plants' finished water turbidity values.

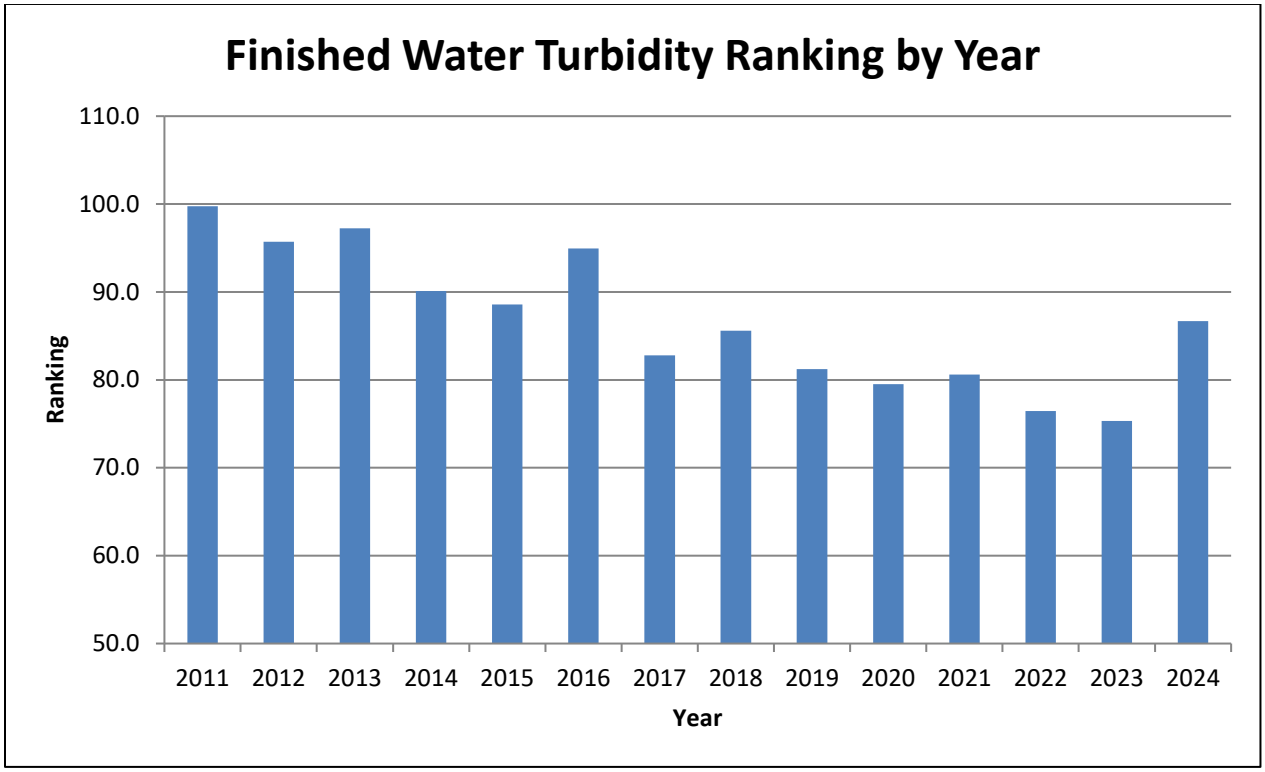

Figure 3

Maintaining compliance with disinfection byproduct regulations presents a significant challenge to water systems in North Carolina. Figures 4 and 5 below display the ten highest five Haloacetic acid (HAA5) and Total Trihalomethanes (TTHM) Locational Running Annual Averages (LRAAs) from 2024 for surface water systems.

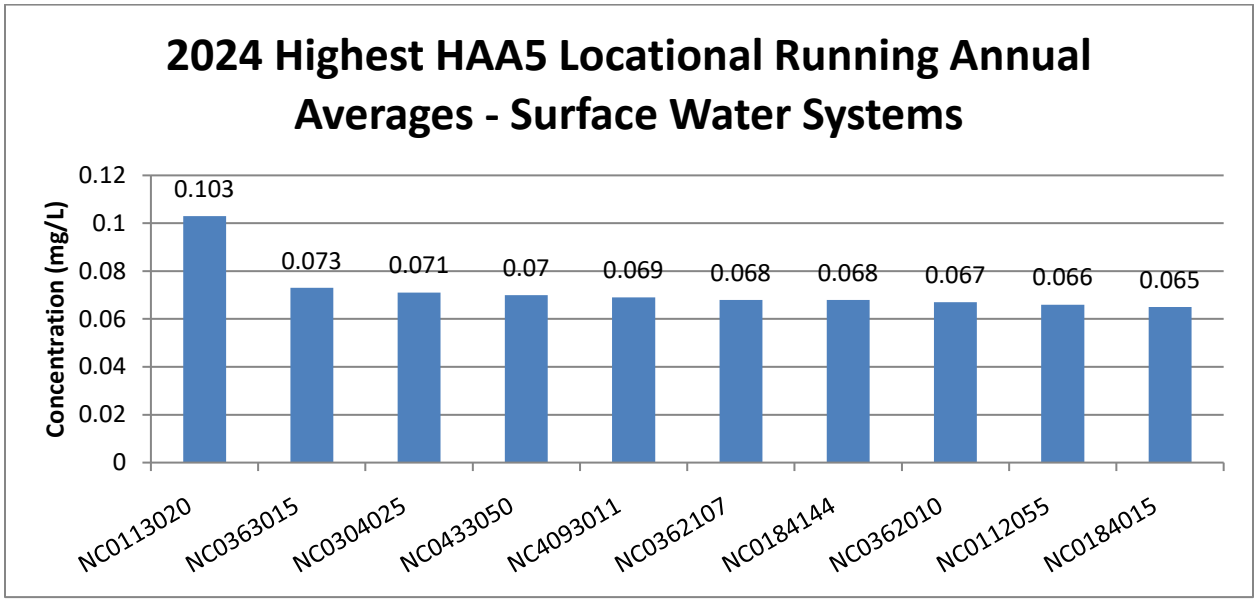

Figure 4

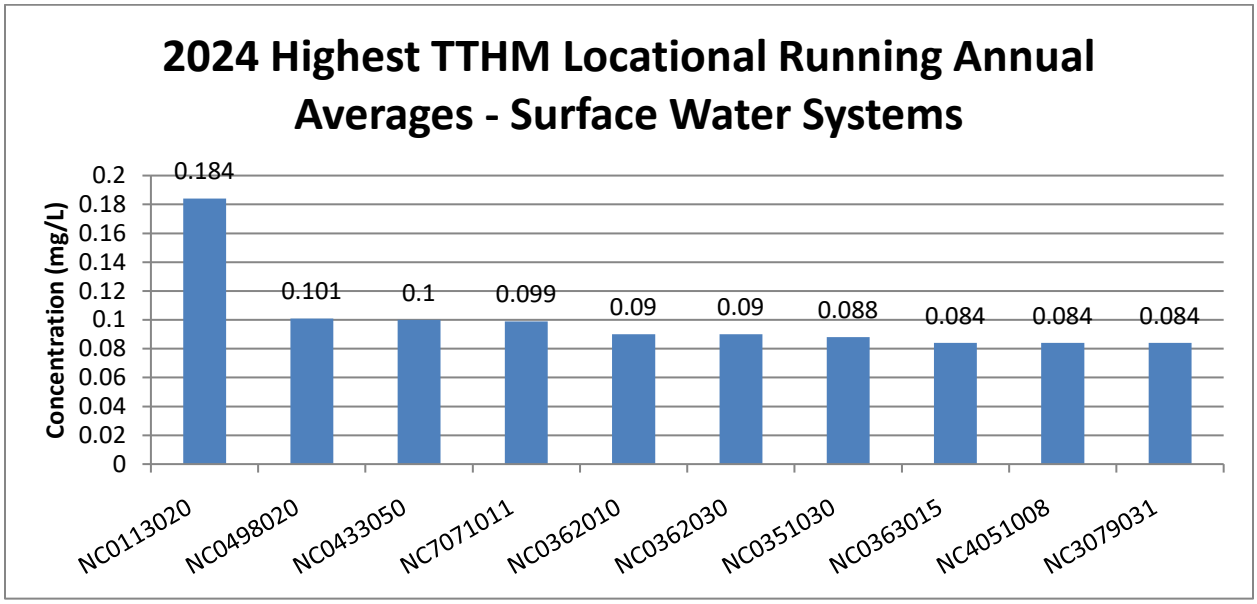

Figure 5

Figure 6 below displays the number of DBP MCL violations that have been issued to all water systems (surface water, surface water purchase, groundwater and groundwater purchase) since 2006. TTHM MCL violations account for approximately 65% of the total and HAA5 MCL violations account for approximately 35% of the total.

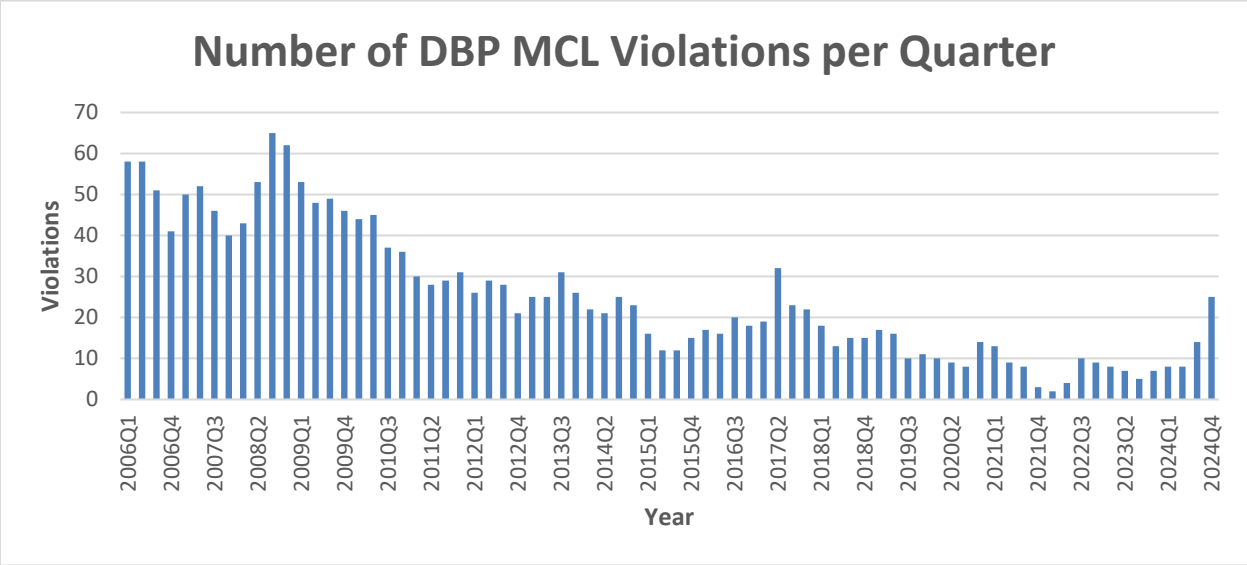

Figure 6

DBP concentration data were evaluated for all water systems required to sample for DBPs. The water system type, number of water systems that met NC DBP distribution goals (provided in APPENDIX A) and population served in 2023 are presented in Table 6.

Table 6

Type of Water System	Number of Systems That Met NC DBP Distribution Goals	Population Served
Surface Water	74 out of 127	4,702,265
Surface Water Purchase	249 out of 328	1,048,224
Groundwater	1,652 out of 1,664	1,392,824
Groundwater Purchase	49 out of 53	70,444
Total	2,024 out of 2,172	7,213,757

Lessons Learned

Participating water system management and staff have learned that notable change in performance will take both time and consistent effort. Significant improvement requires a concerted data collection effort, application of available tools, and dedicated individuals who are willing to explore new approaches to old processes. System management must be willing to allow the needed changes to be made as well as maintain adequate operational staff to accommodate data collection and evaluation. Basic understanding of AWOP concepts and approaches helps water operators and management make informed decisions to accomplish improvements in plant and system operations.

The experience, skills, and knowledge gained with the participation in the AWOP benefit both water system and state staff. It provides both insight into the functional aspects of water treatment as well as improved knowledge, skills, and abilities that allow staff to make more informed evaluations and provide valuable technical assistance, which further contributes to protecting public health in North Carolina.

Effort is needed by the NC AWOP Team members familiar with local facilities and the AWOP to maintain and increase the participation of drinking water facilities. Development of innovative training approaches and partnerships would promote the program and ultimately benefit additional systems.

APPENDIX A

North Carolina's Optimization Goals

Category	Goal	Description
Microbial	Minimum Data Monitoring Requirement	▪ Daily raw water turbidity. ▪ Settled water turbidity from sedimentation basins at four-hour increments. ▪ On-line, continuous turbidity from each filter.
Microbial	Individual Sedimentation Basin Performance Goals	▪ Settled water turbidity < 2 NTU in 95% of readings when the annual average raw turbidity is > 10 NTU. ▪ Settled water turbidity < 1 NTU in 95% of readings when the annual average raw turbidity is ≤ 10 NTU.
Microbial	Individual and Combined Filter Performance Criteria	▪ Filtered water turbidity of less than 0.10 NTU in 95 percent of the maximum turbidity samples recorded each day (excluding 15-minute period following filter backwash). ▪ Maximum individual filtered water turbidity of 0.3 NTU. ▪ Filter backwash initiated before effluent turbidity exceeds 0.1 NTU. ▪ Filter to waste until turbidity is less than 0.1 NTU. ▪ Maximum filtered water measurement of less than 10 particles (in the > 2 micron range) per milliliter (if particle counters are available).
Distribution System	Disinfection Byproducts Performance Goals	▪ Individual Site Goal: Quarterly Maximum Locational Running Annual Average TTHM/HAA5 values not to exceed 70/50 ppb. ▪ Long-Term System Goal: Average of Maximum Locational Running Annual Average TTHM/HAA5 values not to exceed 60/40 ppb (the average of the last 8 quarters cannot exceed 60/40 ppb).

APPENDIX B

NC AWOP Microbial/Turbidity Ranking Score Calculation

1000*Total Number of Tier 1 Acute MCL Violations per Year (Fecal)

+

750*Total Number of Tier 2 MCL Violations per Year (TC / Turb.)

+

500*Total Number of Tier 3 Monitoring and Treatment Technique Violations per Year (CT / Turb.)

+

100* Average Monthly Finished Water Turbidity

+

10*Max Monthly Finished Water Turbidity

+

3.16*Average Monthly Settled Water Turbidity

+

0.316*Max Monthly Settled Water Turbidity

+

0.1*Average Monthly Raw Water Turbidity

+

0.01*Max Monthly Raw Water Turbidity

=

Total Ranking Score

Note that raw water coliform is only considered in the rankings if two systems have the same score using the calculation above. The raw water coliform will be used as a "tiebreaker" in this case.

APPENDIX C

NC AWOP DBP Ranking Score Calculation

DBP Goals	Ranking Score
TTHM Individual Site Goal -quarterly max LRAA not to exceed 0.070 ppm	= IF (value > 0.07, (value – 0.07) x 1000, 0)
TTHM Long Term Goal -avg. of max LRAA not to exceed 0.060 ppm	= IF (value > 0.06, (value – 0.06) x 1000, 0)
HAA5 Individual Site Goal -quarterly max LRAA not to exceed 0.050 ppm	= IF (value > 0.05, (value – 0.05) x 1000, 0)
HAA5 Long Term Goal -avg. of max LRAA not to exceed 0.040 ppm	= IF (value > 0.04, (value – 0.04) x 1000, 0)
Total Ranking Score	= sum of the above values