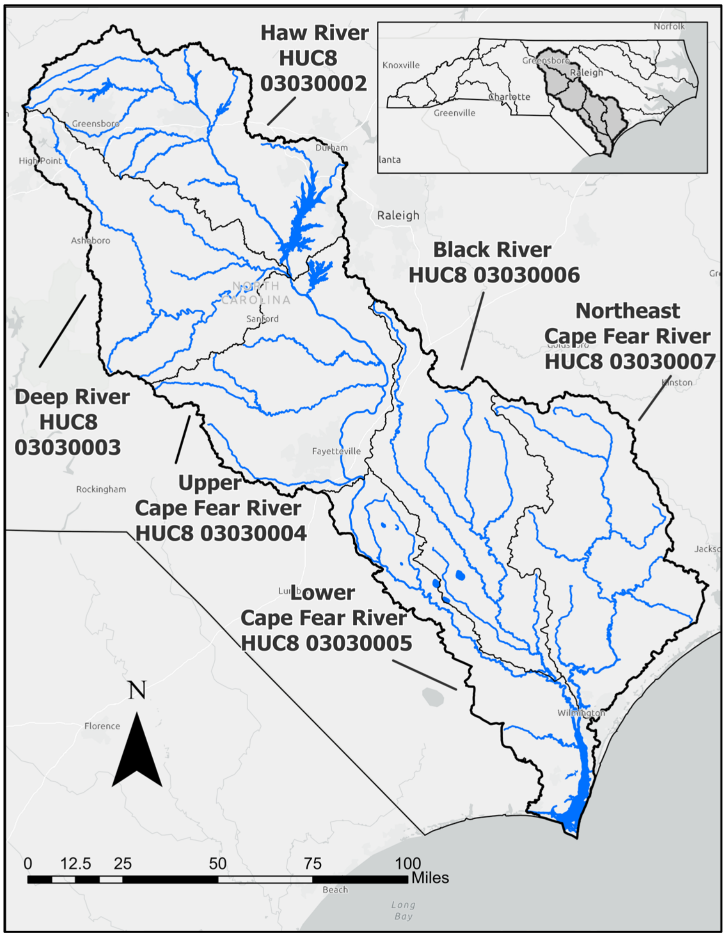


DRAFT
Cape Fear River Basin
Executive Summary

BASINWIDE WATER RESOURCES MANAGEMENT PLAN

CYCLE 4 –
CAPE FEAR RIVER BASIN 2026

North Carolina
Department of Environmental Quality
Division of Water Resources
Basin Planning Branch

Executive Summary

North Carolina's Basinwide Water Resources Management Plans (basin plans) are part of a nonregulatory, watershed-based approach to restoring and protecting North Carolina's water resources. Basin plans provide information on water-quality-and-water-quantity-related issues and identify areas that need additional protection, restoration or preservation to ensure the waters of the state are meeting their designated uses.

Basin plans are required under North Carolina General Statute 143-215.8B and are approved by the Environmental Management Commission (EMC) every 10 years (Session Law 2012-200). The 2026 Cape Fear River Basin Plan is the fourth plan to be developed for the Cape Fear River Basin by the North Carolina Department of Environmental Quality (DEQ) Division of Water Resources (DWR). The basin plan includes 13 chapters. It focuses on water quality and quantity data collected between 2000 and 2020 and reports specifically on the EPA-approved 2022 Integrated Report (IR). Chapters 1 through 5 are general chapters with information on basin characteristics, point and nonpoint sources of pollution, water quality assessments, permitted and registered activities, water supply and water resource planning and management through local and statewide initiatives, funding opportunities and recommendations to protect water resources. Chapters 6 through 11 focus on the six (HUC8) subbasins and provide specific water resource issues and recommendations for each of those subbasins. Chapter 12 focuses on how DEQ is addressing per- and polyfluoroalkyl substances, or PFAS, a group of man-made chemicals often called "forever chemicals". The chapter identifies studies that have been completed and how those studies are helping identify actions and strategies for reducing PFAS in air, groundwater and surface water across the state of NC. Chapter 13 focuses on how DEQ is addressing 1,4-dioxane, another "forever chemical" found mainly in the Cape Fear River Basin. The chapter identifies studies and actions taken to successfully reduce 1,4-dioxane surface water concentration in the basin and what additional permitting steps are necessary to further reduce 1,4-dioxane at the sources.

Basin Characteristics

The major tributaries making up the Cape Fear River Basin include the Haw, Deep, Cape Fear, Black and Northeast Cape Fear rivers. The headwaters of the Haw and Deep rivers start in the northwest portion of the basin above Greensboro and come together to form the Cape Fear River in Chatham County below the dam for Jordan Lake, the largest reservoir in the basin. From the confluence, the Cape Fear River flows south/southeast for 191 miles to the coast, transitioning to an estuary near Wilmington and draining to the Atlantic Ocean in Brunswick County. Other large tributaries in the basin include the Rocky River, Upper Little River, Lower Little River and Rockfish Creek in the midsection and the South River, Great Coharie Creek and Goshen Swamp in the lower section (*Figure 1*). There are three historic lock-and-dam (LD) structures in the lower half of the Cape Fear River. Built and operated by the U.S. Army Corps of Engineers (USACOE), these lock-and-dam structures were once used to pass commercial barge traffic between Wilmington and Fayetteville.

The Cape Fear River Basin is the largest of the 17 river basins in the state, encompassing 9,164 square miles (mi^2), and all, or portions of, 29 counties. The basin has a diverse landscape (*Figure 2*). Clear-water Piedmont streams feed the headwaters of the basin. These change to "brown water" streams that pass-through agricultural land and pine forests in the midsection. "Blackwater" rivers and creeks, many classified as swamp waters (Sw), drain the many low-lying wetlands of the Middle Atlantic Coastal Plain in the lower portion of the basin. Because of the diverse landscape, there are many rare animal and plant species throughout the basin, including the imperiled Cape Fear Shiner. In addition, there are several species of freshwater mussels and clams and two species of endangered sturgeon that migrate from the sea to freshwater to spawn.

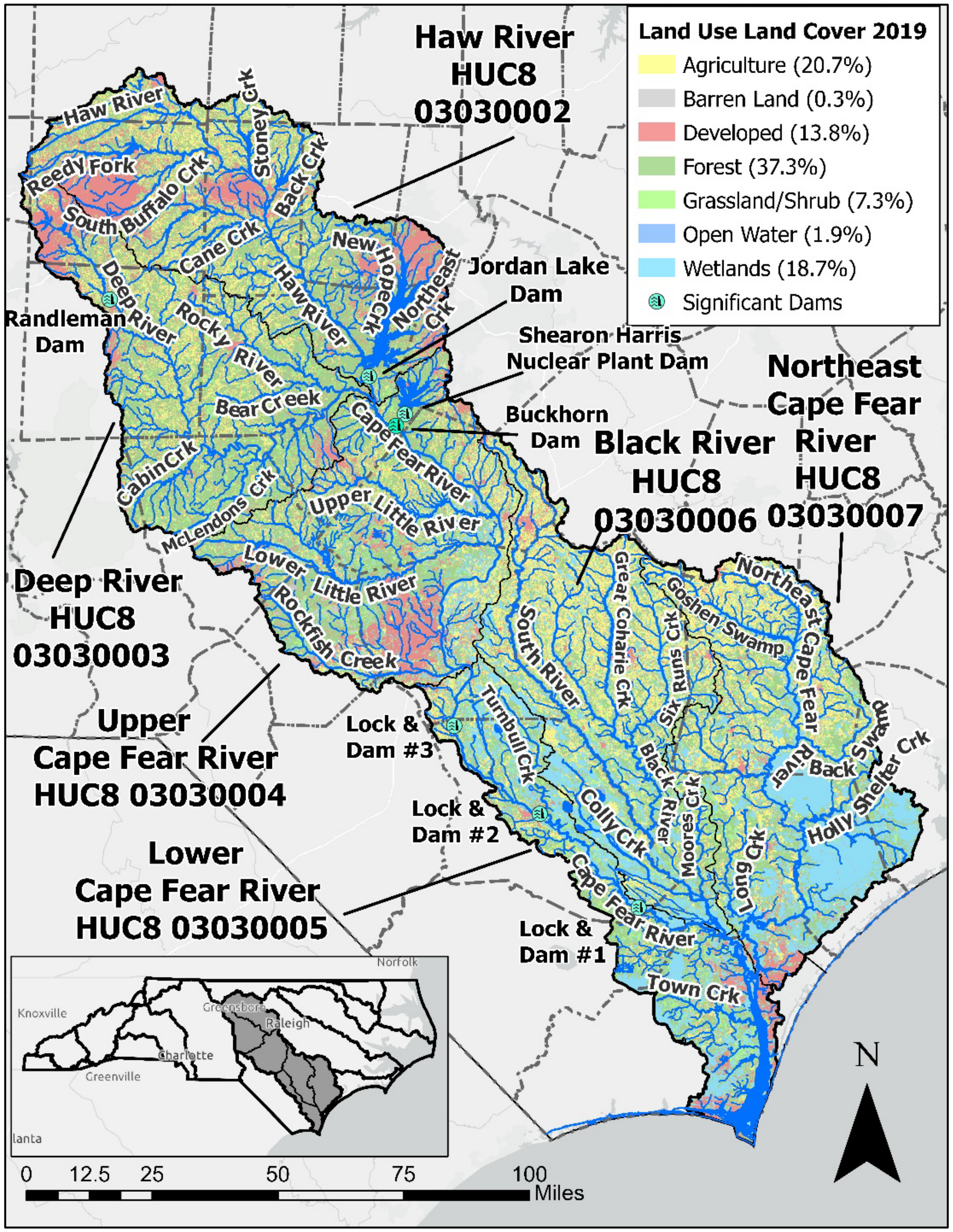


Figure 1 Cape Fear River Major Hydrology and Land Cover (NLCD 2019)

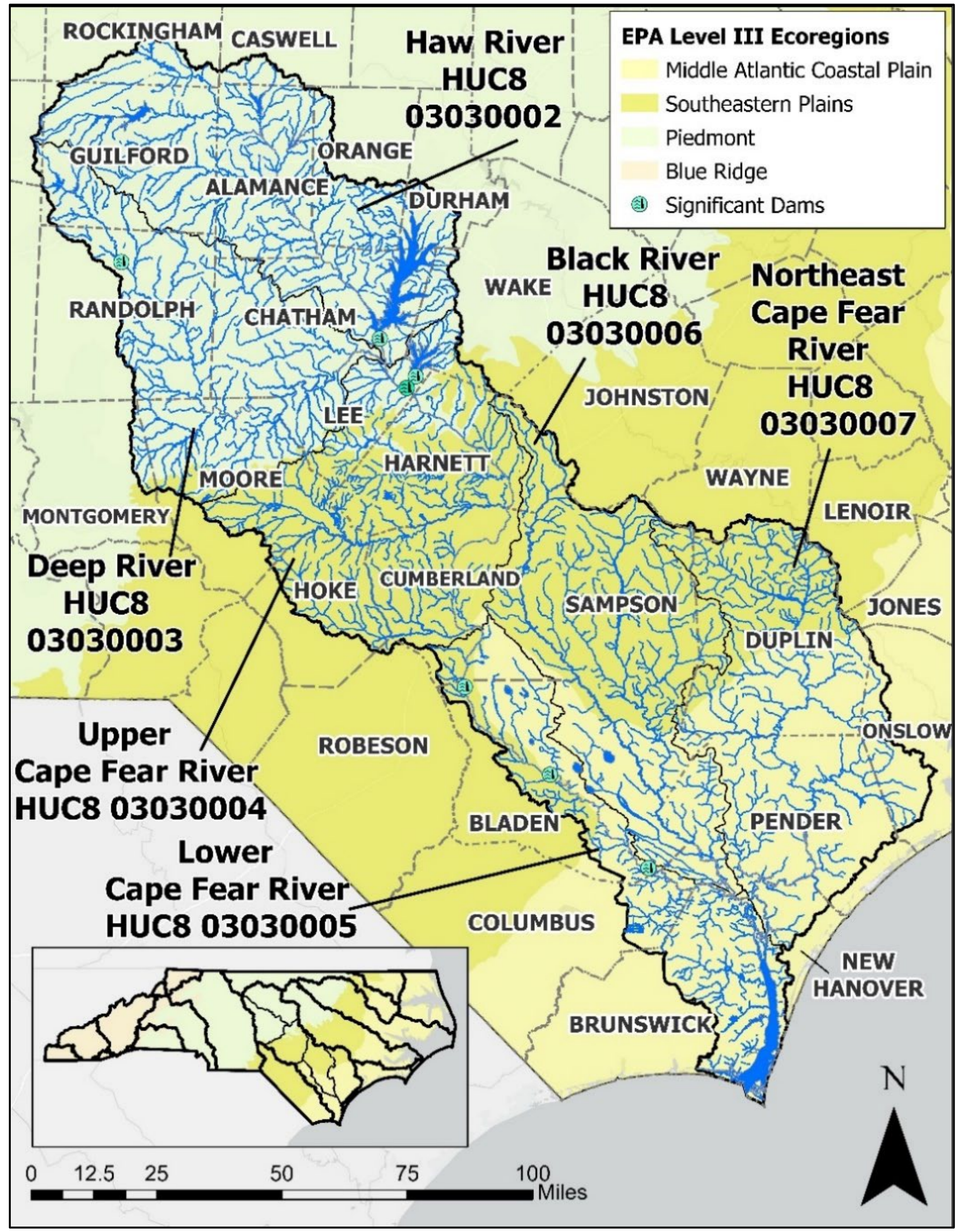


Figure 2 Cape Fear Counties and Ecoregions

Many of the man-made dams and structures within the river have caused a decline in sturgeon and other migratory fish populations (Striped bass, American eel, herring. shad, etc.). Concerted efforts by resource agencies and non-profit organizations are underway to improve fish passage throughout the basin.

Land use in the basin is a mix of forest (37%), agriculture (21%), wetlands (19%), developed/urban areas (14%) and grassland/shrub (7%) (*Figure 1*) (NLCD, 2019). The most populated urban centers are the Triad (Greensboro, Winston-Salem and High Point), portions of the Triangle (Raleigh, Durham and Chapel Hill), Fayetteville and Wilmington. Based on the 2020 U.S. Census, the population in the basin was estimated to be 2.3 million people, with just over 1 million (43%) residing in the Haw River subbasin alone.

Emerging Compounds

The Cape Fear River Basin is the most industrialized river basin in North Carolina and serves as a critical source of drinking water for numerous public water systems. The basin supports a wide range of activities, including power generation, manufacturing, wastewater treatment, landfill operations, and agriculture, all of which contribute potential sources of contaminants.

Emerging compounds (ECs) are contaminants that have only recently been detected or more fully understood in the environment. These compounds originate from diverse sources, including industrial processes and by-products, firefighting foams, pesticides, agricultural and lawn applications, disinfection by-products, wood preservatives, and pharmaceutical and personal care products.

In recent years, ECs have become a primary concern for communities relying on the Cape Fear River Basin for drinking water. Per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane are of particular concern due to their potential human health impacts. Their presence has been documented through sampling efforts conducted by DEQ, the NC Collaboratory, academic institutions, and public water and wastewater utilities.

Advancements in analytical methods continue to improve detection and understanding of these compounds. The basin plan addresses these contaminants in dedicated chapters, outlining DEQ's ongoing studies, management strategies, and actions to reduce their presence in the environment (PFAS in Chapter 12; 1,4-dioxane in Chapter 13).

Polyfluoroalkyl substances (PFAS)

PFAS, or per- and polyfluoroalkyl substances, are a group of human-made chemicals that includes PFOA (perfluorooctanoic acid), PFOS (perfluorooctane sulfonic acid) and GenX (hexafluoropropylene oxide dimer acid). There are thousands of different PFAS, some of which are more widely used and studied than others. Sources of PFAS to humans and the environment are from a wide array of sources including consumer products, industrial processes and firefighting foams resulting in PFAS found in landfills, wastewater and drinking water sources. Scientific studies indicate that exposure to PFAS can lead to significant health effects including reduced immune function, kidney and/or testicular cancer, ulcerative colitis, thyroid disease, high cholesterol, pregnancy complications and birth defects. Additional PFAS source and human health information is available on North Carolina Department of Health and Human Services (NCDHHS) PFAS website.

Researchers from North Carolina State University (NCSU) detected elevated levels of PFAS (including GenX) in the Cape Fear River in 2013-2015 (Sun et al., 2016; Kulikowski, 2018). In 2016, DEQ, along with NC Division of Health and Human Services (DHHS), began investigating PFAS in the basin to identify the potential source of contamination. Researchers traced the source of GenX to Chemours Fayetteville Works facility in Bladen County along the west bank of the Cape Fear River in the Lower Cape Fear River subbasin. PFAS was found to enter the environment through air emissions, discharged processed wastewater and groundwater. In the fall of 2017, DEQ required Chemours to halt the discharge of industrial process wastewater. Residual PFAS continued to enter the environment and mitigative steps were essential to protect the drinking water of downstream communities and surrounding residents (who had contaminated well water). Since 2017, DEQ has taken decisive action to require Chemours to significantly reduce the release of PFAS contamination into North Carolina's air, water and soil.

In February 2019, the Consent Order between DEQ, Cape Fear River Watch (a grass-roots, non-profit environmental organization) represented by the Southern Environmental Law Center, and Chemours was entered in Bladen County Superior Court. The court-enforceable order requires Chemours to address PFAS sources and contamination at the facility to prevent further impacts to air, soil, groundwater and surface waters, including:

- Sampling of private wells for PFAS and providing replacement drinking water supplies to impacted residents.
- Implementing multiple remedial strategies to significantly reduce Chemours' PFAS discharges to the Cape Fear River.
- Installation of a thermal oxidizer and reduction of GenX air emissions facility-wide by 99.9%.
- Conducting a comprehensive assessment of on and offsite groundwater contamination that complies with the requirements of the 15A NCAC 02L rules (North Carolina's regulations for maintaining groundwater quality).
- Other compliance measures to characterize and reduce PFAS pollution leaving the Fayetteville Works site.

In August 2020, DEQ ordered significant additional actions by Chemours to prevent PFAS pollution from entering the Cape Fear River in the Addendum to the Consent Order. These actions address more than 90 percent of the PFAS entering the Cape Fear River through groundwater from the residual contamination on the site.

To comply with the consent order, in 2019, Chemours installed a thermal oxidizer to reduce PFAS air emissions by 99.9%. In 2020, Chemours installed a wastewater treatment plant to remove 99% of PFAS from a tributary previously used for process wastewater discharge (Outfall 003). In 2022, an additional wastewater treatment plant was installed to treat contaminated groundwater seepage and well water that was extracted from behind the barrier wall (Outfall 004). Construction of the barrier wall was completed in June 2023. It was constructed to prevent the continued discharge of PFAS contaminated groundwater from the Chemours site to the Cape Fear River.

Along with the mitigation actions necessary to reduce additional contamination from the source, Chemours is required to sample residential drinking water wells in a significant portions of Cumberland, Bladen, Robeson, Sampson, Hoke and Harnett counties and provide replacement water supplies if concentrations exceeded a certain criteria (DEQ well sampling website). Between November 2018 and December 2024, Chemours has installed 3,312 Reverse Osmosis (RO) and 958 Granulated Activated Carbon (GAC) systems on properties within the six counties. An additional 382 properties have been connected to public water supply systems (2024 Fourth Quarter Consent Order Progress Report). These numbers continue to increase and can be found in reports on Chemours Facility Consent Order Compliance website.

In late 2021 and early 2022, based on several watershed studies, DEQ determined that Chemours was likely responsible for contamination of groundwater monitoring wells and water supply wells in four additional downstream counties: New Hanover, Pender, Columbus and Brunswick (DEQ well sampling website; March 2, 2022 Press Release). Contamination in these areas was likely the result of leaky municipal water supply and wastewater infrastructure as well as floodwater deposition. Residents in these areas are also eligible for private drinking water well testing and replacement supply. Between February 2022 and December 2024, Chemours has installed 950 Reverse Osmosis and 148 Granulated Activated Carbon systems on residential properties in these four counties. An additional 191 properties were connected to public water supply systems (2024 Fourth Quarter Consent Order Progress Report). The number of properties tested and receiving replacement drinking water systems throughout the Cape Fear River Basin continue to increase overtime. More information regarding well testing and water supply replacement eligibility can be found on DEQ's GenX Investigation website.

DEQ has conducted and continues to pursue and support comprehensive studies throughout the Cape Fear River Basin and statewide to evaluate the presence, concentrations and potential sources of PFAS in surface water, drinking water, groundwater, wastewater, biosolids and other environmental media.

Under DEQ's Action Strategy for PFAS, adopted in 2022, DEQ is taking a whole-of-department approach to protect communities by identifying, reducing and remediating PFAS pollution. DEQ's regulatory divisions are requiring PFAS information from new facilities and industries and adding permit conditions as appropriate to address PFAS wastewater discharges to require disclosure of data and additional monitoring. DEQ and our economic development partners work together to proactively address emerging contaminants early in the business recruitment and expansion efforts.

Data indicate that the cost of addressing PFAS contamination in publicly owned treatment facilities is much more expensive relative to addressing contamination at the industrial source. Reductions at the source reduce the burden of treatment costs to utility rate payers. DEQ strongly encourages proactive and vigilant action by public water and wastewater providers and pretreatment system operators to know the level of emerging contaminants in industrial waste constituents in order to protect the environment, downstream users of water resources and rate payers across the state.

In 2022 and 2023, DEQ also conducted a large-scale PFAS sampling project focusing on fish in the middle and lower Cape Fear River system [220 km (137 miles) from the Fayetteville boat ramp to mouth of Atlantic Ocean]. Fish and surface water samples were collected to better understand the potential bioaccumulation and determine if fish consumption-related PFAS exposure is occurring. Thirteen different PFAS compounds were detected in fish tissue across the 220 km (137 mile) length of the river with PFOS being the most concentrated compound detected is all fish species tested (see Chapter 12.4.6 for specific study details). Based on the results of this study, NCDHHS issued a fish consumption advisory for PFOS for a 160 km (99 mile) section of the Cape Fear River between the Fayetteville boat ramp near the I-95 overpass, to the bluffs on the Cape Fear River near the I-140 overpass in Wilmington (NCDHHS press release). NCDHHS recommends limiting consumption of certain freshwater fish in this section of the Cape

Fear River based on concerns about exposure to PFOS in fish tissue from that area. NCDHHS is currently (March 2026) assessing the saltwater fish tissue data to determine if there is a need for a fish consumption advisory for the lower 60 km (37 mile) saltwater section of the Cape Fear River. See the NC Fish Consumption Advisories website for updated fish consumption advisories for the Cape Fear River Basin as well as to understand which fish species are include in the consumption advisories.

As part of DEQs extensive PFAS source investigations occurring throughout NC, a pilot study was conducted in 2023 at 37 wastewater treatment facilities, a small subset of the 1,043 discharge facilities with a National Pollutant Discharge Elimination System (NPDES) permit in North Carolina. The project was conducted to survey PFAS concentrations in wastewater influent, effluent, biosolids, and also in soils from fields with repeated land application of biosolids (DEQ 2023 Biosolids study website) to gain a better understanding of the prevalence of PFAS in these systems and to inform future efforts to address these issues.

Standard wastewater treatment processes do not reduce or eliminate the PFAS compounds discharged to treatment plants from residential, commercial and industrial sources. The concentration of PFAS in biosolids has been found to be higher in treatment plants that serve significant industrial users (SIUs) (Sheets, 2021). In the DEQ study, the average concentration of total quantifiable PFAS compounds was lower in the influent and effluent of treatment plants that treated only domestic waste, compared with municipal and industrial treatment systems. PFOS was detected in a majority of the biosolids samples, at levels similar to those found in other states (DEQ 2023 Biosolids study website). Based on the NC pilot study, it is estimated that 87-98% of the total (quantifiable) PFAS entering wastewater treatment plants on an annual basis are discharged to surface water in effluent, while 2-13% are associated with biosolids (DEQ 2023 Biosolids study website).

On April 10, 2024, EPA established National Primary Drinking Water Regulations (NPDWR) maximum contaminant levels (MCLs) for PFAS compounds. These include MCLs for five individual PFAS compounds and an MCL set as a Hazard Index (HI) level for two or more of four PFAS compounds for PFAS mixtures (see chapter 12 for specifics). MCLs are legally forceable drinking water standards that apply to the treated drinking water produced by public drinking water systems. DWR's Public Water Supply Section (PWS) is responsible for implementing and enforcing public drinking water standards. On September 1, 2025, the NPDWR MCLs were incorporated by reference into NC water supply, Water Quality Section rules (15A NCAC 18C .1540). DEQ is working with public water systems across the state to provide technical assistance and funding where appropriate, as they prepare for compliance with the MCLs by 2029.

As of April 2026, North Carolina has not adopted surface water standards for any PFAS compounds. Drinking water standards, or MCLs, apply only to treated drinking water and are established by EPA under the authority of the Federal Safe Drinking Water Act (SDWA). Surface water quality standards apply only to surface waters and are established by states based on the requirements of the Federal Clean Water Act (CWA) and state laws. Surface water standards establish various protections for the many ways that we use surface waters. One of the ways surface waters are used is as a source of drinking water by public drinking water utilities. In North Carolina, these waters are referred to as water supplies and are classified as WS-I through WS-V. These WS classifications establish a goal that these waters should be of suitable quality so that approved treatment, as defined in 15A NCAC 02B .0202 (5), by public drinking water utilities will result in drinking water that meets federal MCLs. However, because these are two very different types of water quality standards that have very different regulatory requirements and goals, the establishment of MCLs by EPA does not necessarily result in the establishment of these MCLs as surface water standards for water supplies. These MCLs can, however, help to inform the development of future surface water quality standards to protect water supplies and, in some cases, as described 15A NCAC 02B .0208 (a)(2)(A)(ii), may even be adopted as surface water quality standards themselves to protect waterbody use designations.

Chapter 12 includes more information pertaining to how DEQ is addressing PFAS, describes studies that have been completed and how those studies are guiding specific actions and strategies for reducing PFAS in air, groundwater and surface water.

1,4-Dioxane

1,4-Dioxane is a clear liquid that is highly miscible in water. It has historically been used as a solvent stabilizer and is currently used for a wide variety of industrial and manufacturing purposes. The compound can be found in industrial solvents, antifreeze and aircraft deicing fluids, paint strippers, dyes and varnishes and is often produced as a by-product of chemical processes to manufacture soaps, plastics and other consumer products such as deodorants, shampoos and cosmetics. In 2024, EPA classified 1,4-dioxane as a likely human carcinogen (website).

From 2013 to 2015, EPA required all drinking water systems serving more than 10,000 people to sample for 1,4-dioxane as part of EPA's Third Unregulated Contaminant Monitoring Rule (UCMR3). After observing elevated concentrations reported as part of the UCMR3, DWR initiated a study of 1,4-dioxane in the Cape Fear River Basin in October 2014 with the objective of identifying potential sources, understanding changes in concentrations and documenting data that will help the state develop a regulatory strategy. During the study, elevated levels of 1,4-dioxane were identified downstream of the City of Greensboro, Reidsville and Asheboro's wastewater treatment plants (WWTP).

DWR is continually working with municipalities and permitted dischargers to identify potential sources of 1,4-dioxane and to address or eliminate the contamination at the source prior to discharge to the WWTP. For example, in March 2021, the City of Greensboro entered into a three year special order of consent (SOC) that required them to identify 1,4-dioxane sources and significantly reduce loadings to Publicly Owned Treatment Works (POTW). Greensboro complied with all targets in the SOC, significantly reducing 1,4-dioxane in downstream water supplies. Greensboro has reported a 97% reduction in their effluent concentration since 2015 (Greensboro's website, Oct 2025).

SIU's discharging to the City of Asheboro's WWTP remain the largest source of 1,4-dioxane to surface waters in the Cape Fear River Basin and in NC. The City of Asheboro's WWTP 1,4-dioxane effluent monitoring reported results have ranged between less than 1 to 3,520 µg/L, with a mean concentration of 96.9 µg/L and median concentration of 36.5 µg/L from 295 grab samples collected between January 2018 and October 2025. The maximum reported effluent concentration was recorded on January 24, 2025. To protect downstream water supplies and fish consumption uses, DWR issued a National Pollutant Discharge Elimination System (NPDES) permit to the City of Asheboro in August 2023 that included an effluent limit for 1,4-dioxane. On September 19, 2023, the City of Asheboro filed a petition for contested case hearing to the NC Office of Administrative Hearings (OAH). Asheboro's petition challenged various 1,4-dioxane effluent limitations and conditions contained in its NPDES renewal permit (NC0026123)(NC OAH 24 EHR 00862 Final Decision Sept. 12, 2024). This permit has been in litigation since September 2023. On February 5, 2026, the Wake County Superior Court upheld DEQs authority to set wastewater permit limits for 1,4-dioxane (DEQ Feb 12, 2026 press release). The court found that DEQ followed proper state and US EPA protocols in creating the 1,4-dioxane limits and "created the criteria for the purpose of protecting the health and wellbeing of North Carolinians". The City of Asheboro has appealed this decision to the Court of Appeals. Specific details regarding 1,4-dioxane effluent and instream concentrations as well as information about the ongoing litigation can be found in Chapter 13.

DWR continues to test for 1,4-dioxane across the different basins and while other sources of 1,4-dioxane from other media, such as residual application (non-discharge) fields and landfills have been identified as impacting state waters, the discharge from the City of Asheboro's POTW remains the most significant source in the Cape Fear.

As of 2025, DEQ has been working with the Environmental Management Commission to develop monitoring and minimization rules for 1,4-dioxane and three PFAS compounds. The goal of these rules are intended to achieve two key objectives: (1) characterize the presence of PFOS, PFOA, GenX and 1,4-dioxane in NPDES discharges (POTWs, Significant Industrial Users (SIUs) discharging to POTWs and industrial direct dischargers to surface waters), and (2) require affected entities to develop minimization plans that identify approaches to reduce these emerging compounds discharged directly or indirectly to surface waters (Fiscal note, April 23, 2025). The PFOS, PFOA, and GenX Monitoring and Minimization plan rules (15A NCAC 02B .0512 and 15A NCAC 02H .0923, March 2026 proposed version) and the 1,4-Dioxane Monitoring and Minimization plan rules (15A NCAC 02B .0513 and 15A NCAC 02H .0924, March 2026 proposed version) along with their OSBM approved Minimization Rules Fiscal Notes were presented to the EMC in January 2026 (EMC meeting link). The EMC approved the proposed PFAS and 1,4-dioxane rules with amendments, allowing the specific questions and associated fiscal notes to proceed to a public comment period. Three public hearings for each set of rules are being held with public comments accepted between March 16 and June 15, 2026. For specific details on the 2026 public hearings and submission of public comments, see the DEQ press release for PFAS and 1,4-dioxane.

Point and Nonpoint Sources of Pollution

Point sources of pollution are primarily associated with wastewater and stormwater discharges from municipal and industrial facilities. Nonpoint source (NPS) pollution can result from any number of activities and land uses, not all of which are permitted or registered, making it difficult to monitor and account for potential impacts. Construction and land clearing activities, agriculture, golf courses, mining operations, solid waste disposal sites, urban landscapes and on-site wastewater treatment systems (septic systems) all contribute to NPS pollution and can add sediment, nutrients, bacteria, heavy metals, oil and grease to waterbodies. DWR works with several state and local agencies to identify activities that may impact water quality as well as to identify potential point and nonpoint sources of pollution. However, data gaps exist. These unknowns include, but are not limited to, the amounts of fertilizers, pesticides, herbicides and animal waste applied to the land, as well as the level at which these same pollutants may be impacting groundwater and air quality and eventually reaching surface waters through baseflow or atmospheric deposition.

To minimize water quality impacts from point and nonpoint sources of pollution, the Clean Water Act (CWA) requires discharge permits for several pollution source types. *Figure 3* through *Figure 6* show the location of the permitted facilities in the Cape Fear River Basin including wastewater, stormwater, non-discharge and animal feeding operations as of May 2020 (BIMS, May 2020).

The majority of the wastewater and stormwater permits are concentrated in and around urban centers in the Haw, Deep, Upper and Lower Cape Fear River subbasins. There are 218 (50 major and 168 minor) National Pollutant Discharge Elimination System (NPDES) wastewater permits with a total permitted as-built flow of 425 million gallons per day (MGD) (*Figure 3*). More than one-third (146.8 MGD) of the total permitted as-built flow is associated with facilities draining to Jordan Lake in the Haw River subbasin.

Figure 3: Permitted NPDES Wastewater Discharge (Total: 218) and NPDES Stormwater (Total: 690) and State Stormwater (Total: 3,931)

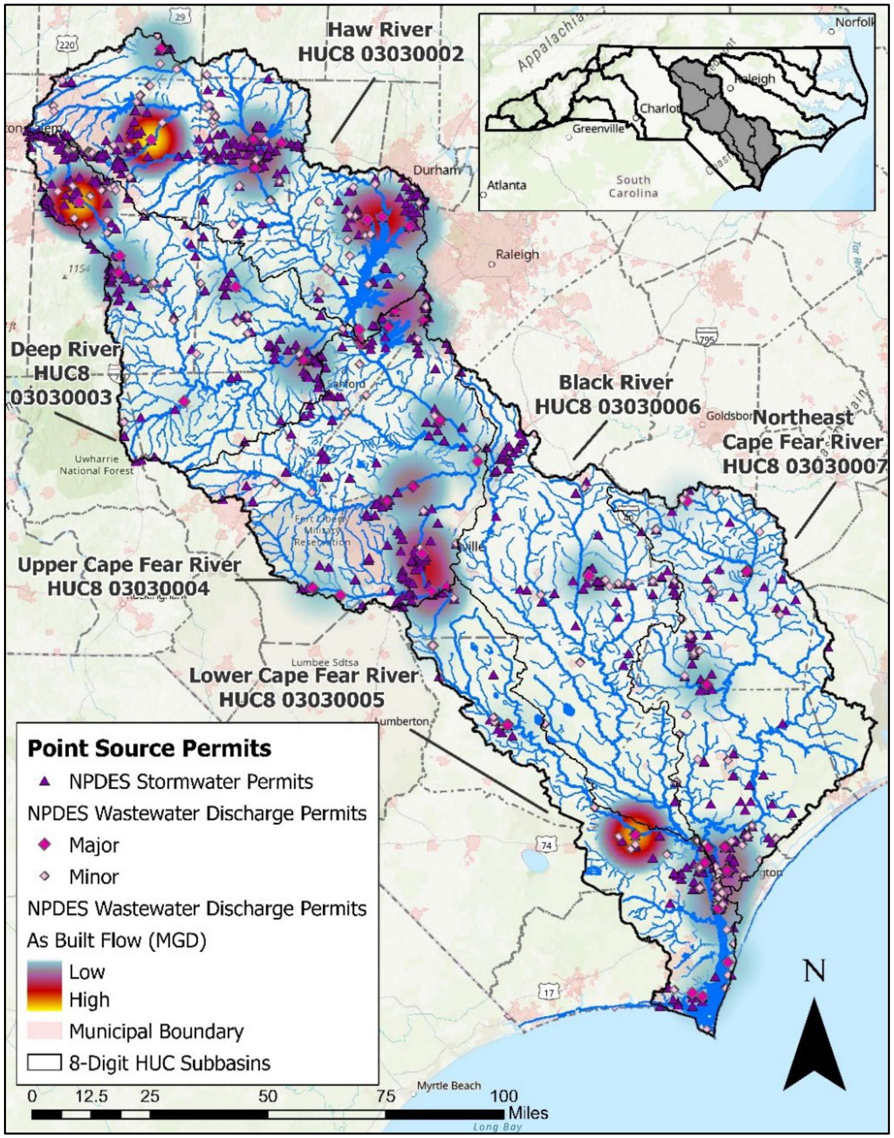


Figure 4: Permitted Single Family Wastewater Systems (Total: 252)

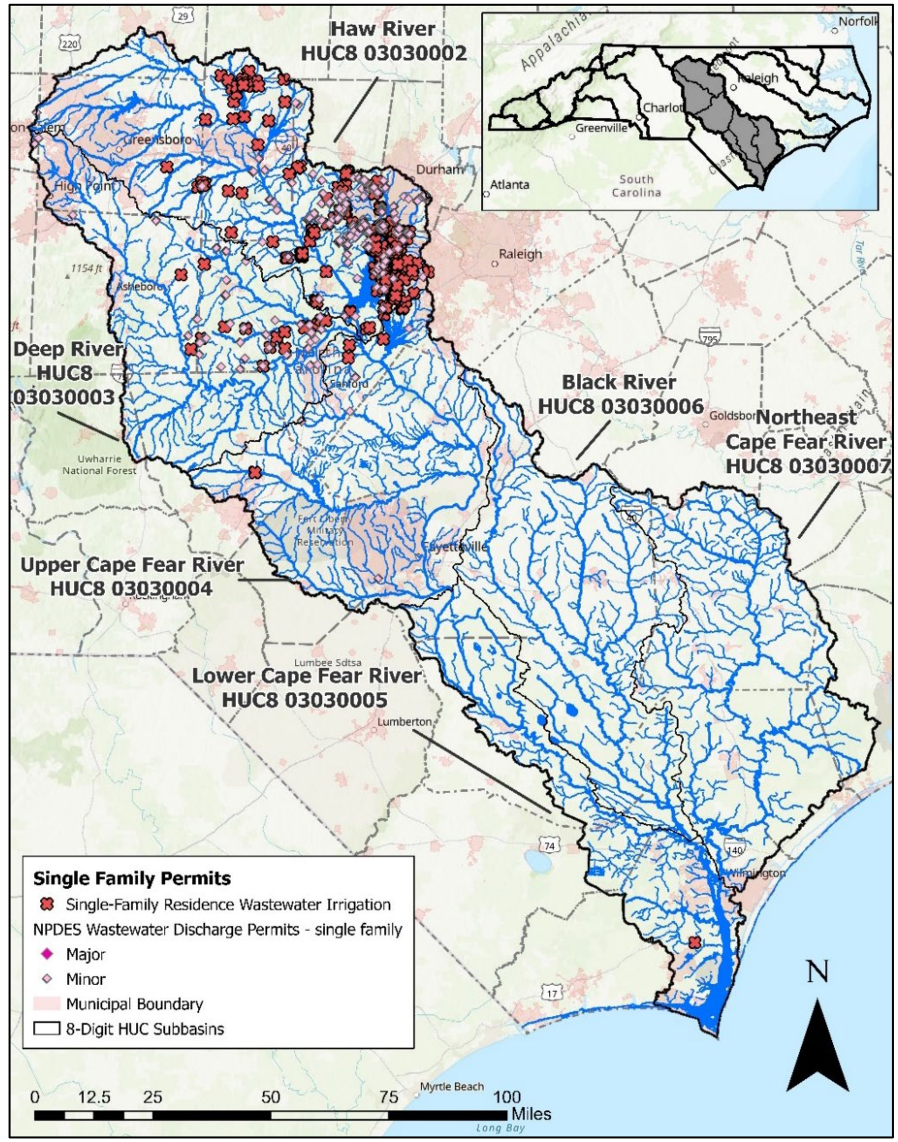


Figure 5: Permitted NPDES Non-Discharge (Total: 165)
(Total of 21,692 Acres of Wastewater Irrigation or Residual Solid Fields)

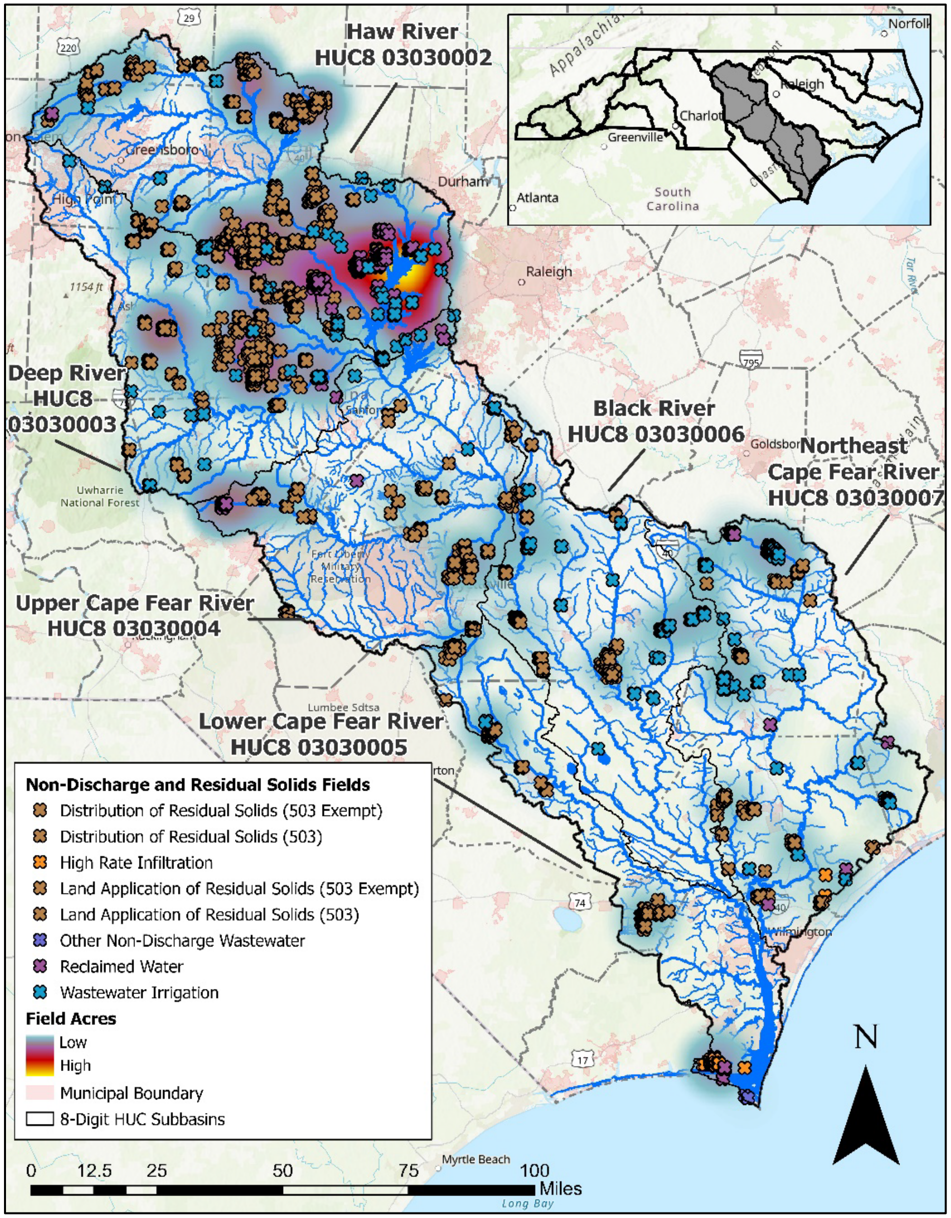
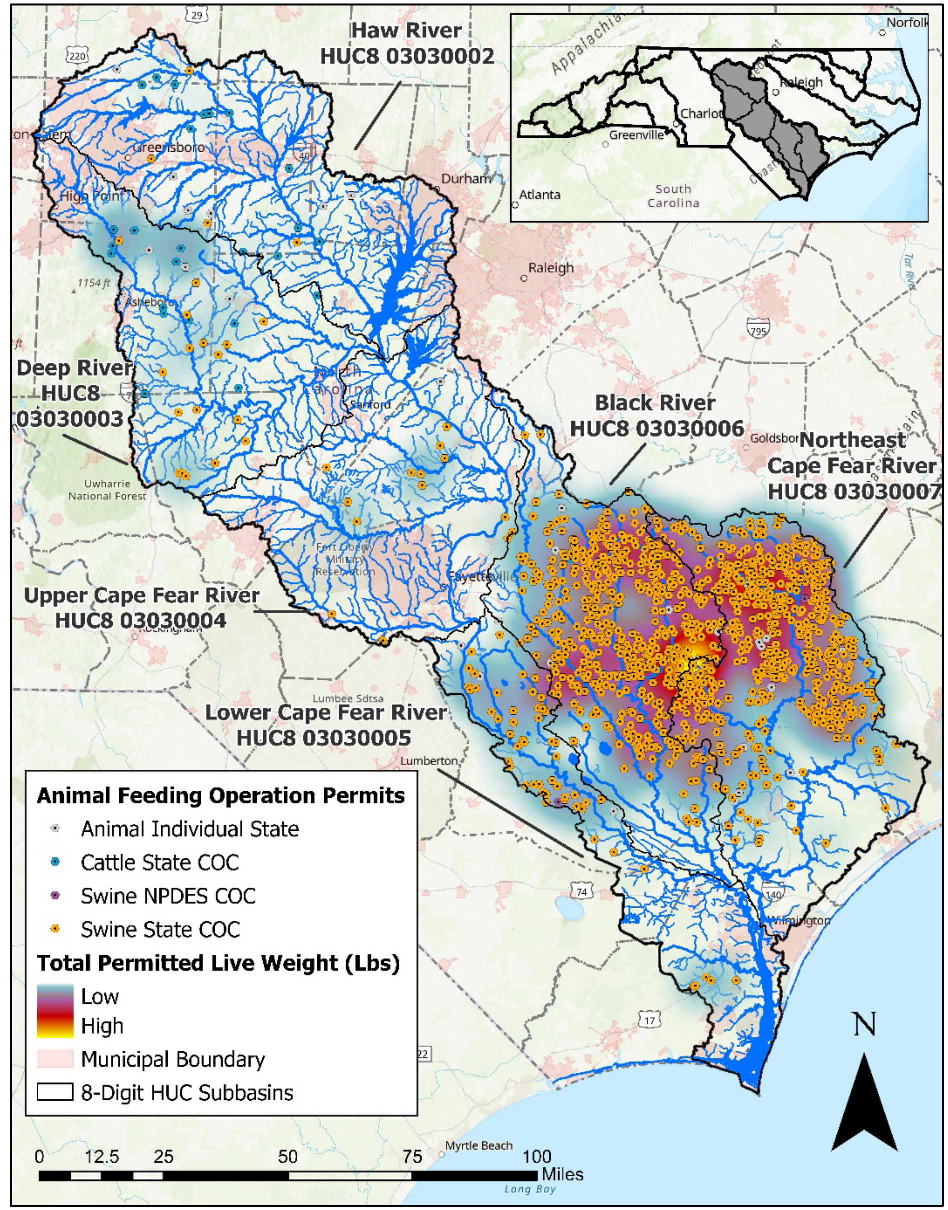


Figure 6: Permitted Animal Feeding Operations (Total: 1,188)



This does not include the 252 NPDES Single-Family Domestic Wastewater Treatment system permits (~0.078 MGD), that are also primarily concentrated in the upper portion of the basin in Chatham, Orange and Durham counties (*Figure 4*).

There are 32 NPDES Municipal Separate Stormwater Sewer System (MS4) permits issued for populated communities, and half are in the Haw River subbasin. There are also 690 NPDES stormwater permits (*Figure 3*) and 3,931 state stormwater permits in the basin (May 2022).

There are also several types of nonpoint source permits in the river basin, including 165 non-discharge permits (excluding single-family) which cover 21,692 acres of wastewater and reclaimed water non-discharge irrigation fields and residual/biosolid waste fields in the Cape Fear River Basin (*Figure 5*). The Haw and Deep River subbasins together account for nearly 50% of these permitted fields.

There are 1,188 permitted Animal Feeding Operations (AFOs) in the Cape Fear River Basin (*Table 1*). These account for nearly half of all permitted AFOs statewide (2,247 statewide AFO permits, BIMS, May 2022). The majority of the AFOs are in the Black and the Northeast Cape Fear river subbasins (498 and 558 total respectively; *Figure 6*). Across North Carolina, there are also deemed permitted operations. An example of a deemed permitted agricultural operation is a dry litter poultry operation. Per North Carolina statute, operations that are deemed permitted have fewer animals than what the state requires to obtain a permit, or they have a waste management system that does not require a state or federal permit. Under North Carolina Administrative Code (NCAC) 15A NCAC 02T .1303, "deemed permitted" is defined as "a facility that is considered to have a needed permit and to be in compliance with the permitting requirements of General Statute 143-215.1(a) even though it has not received an individual permit for its construction or operation."

Some dry litter poultry operations may rely on manure haulers to help remove waste. Manure haulers that annually carry or land-apply more than 100 tons of animal waste must register their manure hauling operation and submit annual reports to DWR. Manure haulers are defined in 15A NCAC 02T 1400 as "any person who accepts or purchases animal waste and land applies the animal waste on land not covered by the generator's permit." As of October 2022, there were a total of 75 manure hauler certificates (MHC) issued statewide by DWR, 19 (25%) are held by individual operators or companies in counties located in the Cape Fear River Basin.

While the location of AFOs with permits are known, the location of deemed permitted operations are not. This results in limited understanding of the total farm numbers, animal and waste concentrations and their potential impact to water resources in both the receiving watershed and the broader basin. Per statute, all animal AFOs, including poultry, are required to follow a waste utilization plan when applying animal fertilizer as a means for disposing of animal waste on their farms. DWR encourages operators of deemed permitted operations consult with certified technical specialists to develop or review waste utilization plans (WUP). A WUP ensures that the operation is meeting the requirement to apply waste at no greater than agronomic rates. DWR also encourages the use of waste management structures to store dry poultry litter. Uncovered waste piles on permeable surfaces can lead to concentrated nutrients and bacteria runoff to surface waters. Covered structures can reduce potential impacts to water quality by providing an impermeable surface and cover during weather events.

Table 1: Total Permitted Animal Feeding Operations in the Cape Fear River Basin (May 2022)

Permit Type	Permitted Facilities[1]	Allowable Count[2]	Number of Lagoons/ Waste Ponds
Animal Individual State	39	224,119	50
Cattle State COC	26	20,988	39
Swine NPDES COC	5	22,224	6
Swine State COC	1,118	5,249,690	2,155
Basinwide Total	**1,188**	**5,517,021**	**2,250**

Certificate of Coverage (COC)
[1]Permit data were queried from the DWR Basinwide Information Management System (BIMS) in May 2022.
[2]Allowable Count is the maximum number of individual animals allowed in the facility/farm at any one time.

To better understand the number and types of animal operations in the basin, data was obtained from the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) Quick Stats (USDA, 2024) for 15 counties located in the Cape Fear River Basin. Counties queried have greater than 45% land area in the Cape Fear River Basin. These include Alamance, Bladen, Brunswick, Chatham, Cumberland, Duplin, Guilford, Harnett, Lee, Moore, New Hanover, Orange, Pender, Randolph and Sampson counties. The basin plan presents USDA Census of Agriculture data for the last four census years (2007, 2012, 2017 and 2022). The USDA Census of Agriculture data captures a single point in time (Dec. 31st) and is representative of what is happening in the basin that year.

Per the 2022 USDA Census of Agriculture, a total of 9,362 farm operations consisting of a total of 1,593,062 acres (2,489 mi^2) are located in these counties. Sampson, Duplin, Bladen and Randolph counties contain more than half (51.7%) of the total number of acres in the 15 counties queried. In most cases, these same four counties contained the highest density of crop and animal numbers. The census highlighted a shift in the type of animal agriculture occurring throughout the basin, with a decline in swine/hog, turkey and cattle, and a significant increase in chicken (which includes broilers, pullets, layers and roosters) inventory and contract production numbers between 2007 and 2022 (*Table 2*).

The total swine inventory reported in the basin in 2022 was 4.9 million head. This is 62% of the statewide swine inventory total of 7.9 million but a decline of 16% from 2007 inventory numbers (5.9 million) (Table 2). Duplin and Sampson counties reported the highest number of swine inventory basinwide and statewide, with a combined total of 3.7 million head (76% of the basin total and 47% of the statewide total). There was a 42% increase in chicken inventory numbers between 2007 and 2022, with a total of almost 76 million chickens in inventory on December 31, 2022. The total number of chicken farm operations reporting inventory increased by 64% between 2007 (1,506) and 2022 (2,464). The number of chickens reported in inventory in the Cape Fear River Basin represents 36% (41.2 million) of the total statewide chicken inventory (209.6 million) and 24% of the total chicken farms reporting inventory in 2022. Duplin and Sampson counties combined have the highest total number of chickens and turkeys in the basin. Combined, they house 54% of the Cape Fear River Basin's total chicken inventory (41.2 million). Statewide animal numbers are reported in Chapter 1.

Table 2: Total number of operations, acres, crops, and animals for counties located in the Cape Fear River Basin (USDA, 2022)

Data Items	Number of Operations				Number of Acres			
	2007	2012	2017	2022	2007	2012	2017	2022
TOTAL FARM OPERATIONS	10,769	10,251	9,624	9,362	1,619,081	1,567,174	1,611,622	1,593,062
ANIMALS	**Number of Operations**				**Inventory**			
TOTAL CATTLE	4,074	4,097	3,906	3,316	208,810	208,128	183,993	174,225
TOTAL HOGS/SWINE	1,185	817	910	885	5,874,892	4,762,023	5,111,355	4,924,165
TOTAL TURKEYS	326	310	249	284	9,129,571	10,023,276	7,328,558	6,430,041
TOTAL CHICKENS[1]	1,506	1,727	2,086	2,464	53,361,938	47,429,276	54,286,271	75,983,865
CROP/COMMODITY	**Number of Operations**				**Number of Acres**			
TOTAL CORN	1,790	1,309	1,125	1,089	205,925	141,780	157,949	162,438
TOTAL COTTON	148	197	94	108	47,410	65,766	27,660	35,190
TOTAL HAY & HAYLAGE	3,855	3,830	3,658	3,236	161,363	144,670	143,715	139,216
TOTAL SOYBEANS	1,515	1,510	1,364	1,088	206,525	223,484	258,144	242,647
TOTAL TOBACCO	508	338	287	181	37,538	32,801	35,422	23,958
TOTAL WHEAT	594	886	458	430	69,293	119,416	55,168	65,414

[1] Poultry Inventory includes broilers, pullets, layers, and roosters.

Between January 2021 and July 2025, the Fayetteville Regional Office recorded a total of 98 complaints related to animal agriculture (BIMS July 2025). Many were related to improper waste management (i.e., disposing of dry litter waste on residential properties or leased properties with no record of origin, dry litter left uncovered for more than 15 days, stockpiled within 100 feet of a perennial waterbody or well, etc.). Not all complaints resulted in notices of violations being issued. Understanding the impacts from large-scale waste application on water quality, recreational opportunities and public health can be challenging due to minimal monitoring in the watersheds or counties in which the waste is generated and land applied.

As resources allow, water quality monitoring programs should evaluate and expand existing data collection (including bacteria source identification) to include watersheds dominated by agriculture land use as well as watersheds where treated municipal waste (or biosolids) is land applied. Data collected could be used by an interagency workgroup consisting of water resource professionals, the agricultural community, researchers (academia), database managers and interested community members to review the existing regulatory framework, identify which best management practices (BMPs) are most effective at reducing the amount of sediment, bacteria and nutrients leaving a site, and how best to manage and track waste generated at the source. Data collected could also be used to inform the rules readoption process as it relates to animal feeding operations and animal waste management.

Water Quality Assessments and Monitoring

DWR monitors instream ambient and biological stations located throughout the state to assess water quality conditions for the biennial Integrated Report (IR), as required by the Clean Water Act (CWA). Water quality standards vary by parameter and are dependent on the waterbody classification of freshwater (FW) or saltwater (SW) as well as for supplemental classification such as swamp (Sw). Biological data (fish and benthic macroinvertebrates) are collected by the Biological Assessment Branch, and lake samples are collected by the Intensive Survey Branch Ambient Lakes Monitoring Program. Both are collected on a five-year rotating cycle. Monthly ambient water quality data are collected by DWR's Ambient Monitoring System (AMS) program and by three monitoring coalitions through a voluntary ambient monitoring program composed of municipal and private industry NPDES wastewater permit holders. The three coalition monitoring programs in the Cape Fear River Basin are:

- Upper Cape Fear River Basin Association (UCFRBA) (40 stations)
- Middle Cape Fear Basin Association (MCFBA) (33 stations)
- Lower Cape Fear River Program (LCFRP) (31 stations)

As of 2020, there were 75 AMS and 104 coalition stations, with 12 being co-located with a DWR AMS station. Most ambient stations are in rivers and streams; however, several are also in the estuary, canals, lakes or reservoirs. DWR also collects algal and fish tissue samples, both for routine sampling and for episodic algal bloom or fish kill events (NC DWR Fish Kill & Bloom Report Dashboard). *Table 3* provides a summary of monitored waters in the Cape Fear River Basin as reported in the 2022 Integrated Report (IR). The impaired waters are listed in Categories 4 and 5. Waters in Category 4 have an approved management strategy in place (i.e., a total maximum daily load (TMDL), watershed management plan, nutrient management strategy, etc.). Waters in Category 5 comprise the list of impaired waters identified in Section 303(d) of the CWA.

Most of the impairments are located in the upper third of the basin in the Haw and Deep River subbasins (*Figure 7)*. Many of the impairments are in urban areas, although some can also be found in the more rural agricultural watersheds (*Figure 7*). The Haw River subbasin accounted for close to half (48%) of the impaired freshwater miles and over 90% of the impaired freshwater acres. The Deep River subbasin accounted for another quarter (25.5%) of the impaired freshwater miles.

Freshwater stream impairments were most often due to impaired benthic macroinvertebrate communities (390.6 freshwater miles). The most common impairment to freshwater acres was due to elevated chlorophyll *a* concentrations (11,724 FW acres), which is a response to nutrient over-enrichment. However, violations of the chlorophyll *a* water quality standard are likely underestimated since many lakes were not fully assessed due to lack of data (less than 10 samples) and chlorophyll *a* data is often not collected in rivers and streams due to the limited applicability and methodology available for flowing freshwater streams.

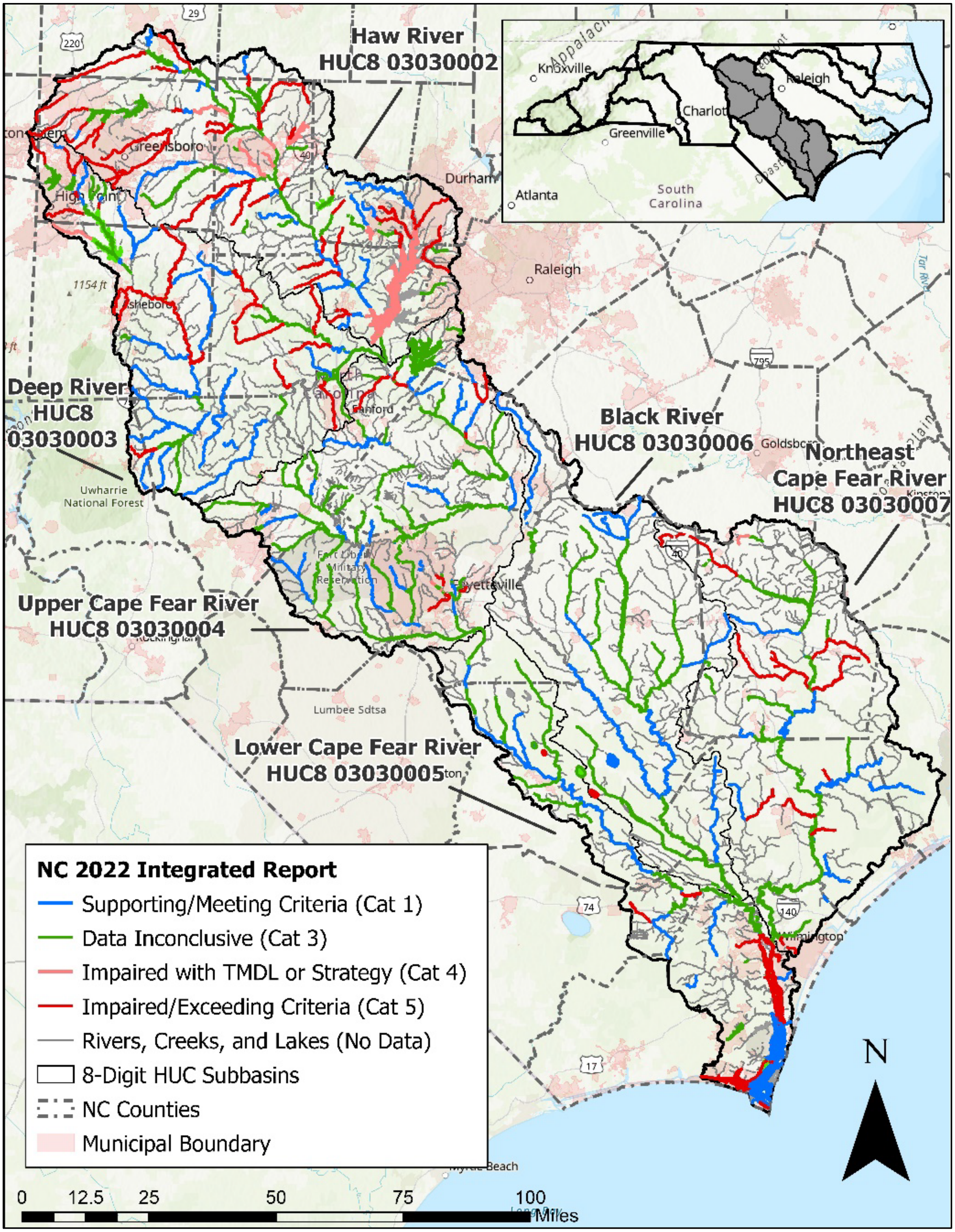
The most common impairment in the Cape Fear River Estuary (saltwater acres) is due to total copper (5,568 saltwater acres), closely followed by low dissolved oxygen (DO) and pH (5,026 SW acres). The total copper impairment needs to be reassessed using the 2014 approved dissolved metal standard to confirm the extent of this impairment. The low dissolved oxygen and pH are partially due to natural swamp drainage as well as the due to the amount of nutrients and bacteria from point and nonpoint sources in the watershed, resulting in increased biological demand in this system.

Table 3: Cape Fear River 2022 Integrated Report Summary

Assessment Unit[1]	Map Color	FW Miles[2]	FW Acres[2]	SW Acres[2,3]
Total	All Colors Combined	6,611.1	34,932.4	24,821.9
Total Monitored	Combined Blue, Gray, Red, Purple, Pink	2,649.4	28,492.1	24,235.7
Not Monitored	Green	3,961.7	6,440.3	586.2
Meeting Criteria (Category 1)	Blue	922.3	1,630.9	14,316.8
Data Inconclusive (Category 3)	Gray	1,083.0	14,432.1	375.6
Exceeding Criteria 303(D) (Category 5)[3]	Red	590.9	1,160.5	9,543.3
Exceeding Criteria with Watershed Action Plan (Category 5r)	Purple	7.4	0	0
Exceeding Criteria with TMDL (Category 4)	Pink	45.8	11,268.6	0
Exceeding Criteria (Combined Category 4, 5 and 5r)[3]	Combined Red, Purple, Pink	644.1	12,429.1	9,543.3
% Exceeding of Monitored Exceeding (Combined Category 4, 5 and 5r)	Combined Red, Purple, Pink / Total	24.3%	43.6%	39.4%

[1] All waterbodies in NC are impaired for Fish Tissue Mercury and are not included in the total numbers presented here.
[2] FW - Freshwater, SW -Saltwater
[3] Added Brunswick River's (18-77a and 18-77b) 743.7 SW acres not originally captured on 2022 IR category 5 list or total classified SW acres.

Figure 7: Cape Fear River Basin 2022 Integrated Report Map



A comprehensive water quality analysis was conducted for each subbasin to assess changes in water quality over the past 20 years and identify potential pollution sources. The findings aim to inform recommendations for mitigating these impacts. *Table 4* presents a simplified comparison of water quality conditions in the Cape Fear River HUC8 subbasins, based on mean ambient water quality data for nutrients, turbidity, and fecal coliform between 2016 and 2020.

Table 4: HUC8 Subbasin AMS & Coalition Water Quality Mean Concentrations for 2016-2020

Cape Fear River (CFR) HUC 030300_ _		**Number of Stations***	**NH_3 (mg/L)**	**TKN (mg/L)**	**NOx (mg/L)**	**TN (mg/L)**	**TP (mg/L)**	**Turbidity (NTU)**	**Fecal Coliform (CFU/100 mL)**
CPF Basin Mean 030300*		**140**	**0.06**	**0.77**	**0.84**	**1.61**	**0.13**	**14.52**	**668**
Haw River	**02**	35	0.06	0.77	1.34	2.10	0.13	20.19	749
Deep River	**03**	24	0.06	0.76	1.32	2.08	0.11	16.32	732
Upper CPF	**04**	20	0.03	0.65	0.35	1.00	0.07	13.08	360
Lower CPF	**05**	30	0.06	0.75	0.53	1.29	0.15	13.64	423
Black River	**06**	14	0.07	0.86	0.43	1.29	0.13	4.83	754
Northeast CPF	**07**	17	0.09	0.92	0.61	1.54	0.21	6.45	1,093
Healthy Piedmont Stream^			0.05	0.50	0.30	0.80	0.05		
EPA Nutrient Criteria - Piedmont+						0.70	0.038		
EPA Nutrient Criteria - Coastal Plain+						0.72	0.032		

*Ambient stations with a minimum of data collected for 5 years from 2016 to 2020 and 40 average day records were included in the analysis.
^DWQ ESS- ISU Special Study. March 24, 2004, Rocky River Survey (Chatham County) Subbasin 03-06-12.
+ USGS Circular #1350 – The Quality of Our Nation's Water – Nutrients in the Nation's Streams and Groundwater, 1992-2004. Neil Dubrovsky et al., 2010.

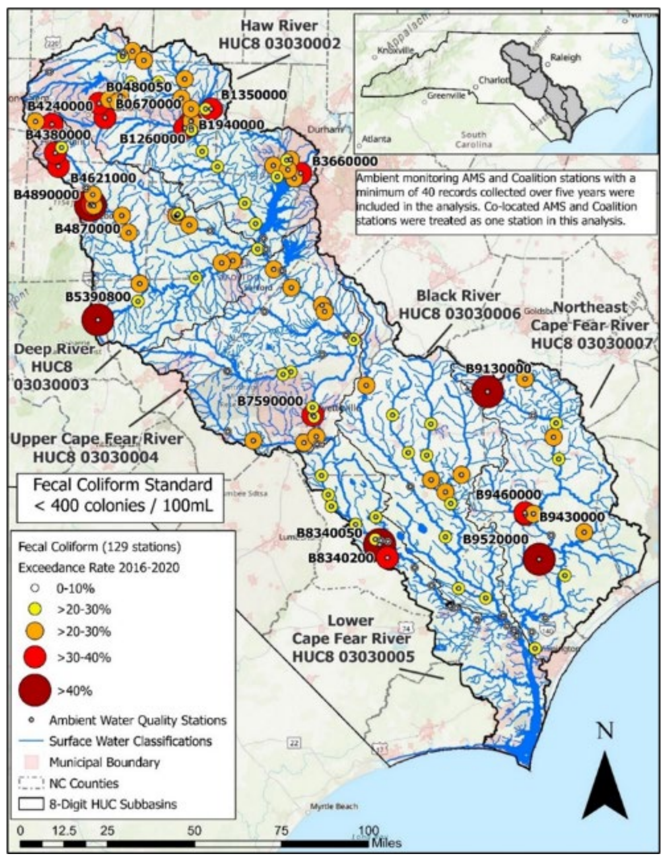
Orange highlighted values represent the highest mean instream concentration in comparison to the other HUC 8 watersheds.
Green highlighted row represents the overall basin watershed mean for each constituent for comparison purposes.

The Northeast Cape Fear River subbasin (HUC8 03030007) had the highest five-year mean concentration for fecal coliform, total phosphorus (TP), ammonia nitrogen (NH_3), and Total Kjeldahl Nitrogen [TKN] (organic nitrogen plus ammonia), while the Haw River subbasin (HUC8 03030002) had the highest five-year mean concentration for turbidity, total nitrogen (TN) and inorganic nitrogen (nitrite+nitrate [NOx]). As reported throughout the basin plan, these elevated concentrations correlate with the type of point and nonpoint sources of pollution identified in these watersheds.

Turbidity

The Cape Fear River is often described as a turbid system based on its often-opaque appearance, which can be orange/brown from the clay soils running off in the upper section of the basin. The lower section takes on a dark "black" or "brown" humic color from the expansive swamp forest drainage. Based on water quality data, the highest turbidity levels are found in the upper reaches of the Haw River and New Hope Creek watersheds. These are the areas with the highest population and densest development in the basin. Many streams, rivers and lakes in these areas are listed as impaired due to nonpoint source runoff directly contributing sediment to the system as well as the increased runoff volume resulting in stream bank erosion. There are 30.6 freshwater stream miles and 3,752 freshwater acres listed as impaired for turbidity on the 2022 [Integrated Report] (IR) in the Cape Fear River Basin.

Bacteria



Fecal Coliform Bacteria (FCB) levels are elevated throughout much of Cape Fear River Basin and are generally stormwater driven. Instream concentrations tend to be higher in the smaller urban streams and in the highly agricultural areas in the Black and Northeast Cape Fear river subbasins (*Table 4*). The primary sources identified in urban watersheds are pet waste during wet conditions and leaky, exfiltrating sanitary sewer collection systems during dry conditions. There are 107.5 freshwater stream miles and 2,409 saltwater acres (based on shellfish growing area status) listed as impaired for fecal coliform bacteria on the 2022 [Integrated Report] (IR) in the Cape Fear River Basin. Based on monthly monitoring data, there are areas throughout the basin with high bacteria concentrations (> 400 cfu/100mL). Many of these are identified as data inclusive (Category 3) on the 2022 IR.

Nutrients

Collectively referred to as nutrients, nitrogen and phosphorus are major components of living organisms and are essential to maintain life. As of 2024, there are no surface water quality standards for nitrogen or phosphorus in North Carolina. When elevated levels of nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes or runoff from urban or agricultural land, the growth of algae and other plants can be accelerated creating eutrophic conditions. Accelerated or excessive plant and/or algal growth can be harmful or toxic to aquatic organisms and humans and have negative impacts on aquatic ecosystems, such as reducing dissolved oxygen throughout the water column.

Total Kjeldahl Nitrogen (TKN) and ammonia nitrogen (NH_3) were most concentrated in the agriculture-rich Northeast Cape Fear and Black river subbasins, while nitrite+nitrate nitrogen (NOx) and total nitrogen (TN) were at highest concentration in two of the more populated and developed subbasins (Haw and Deep river subbasins) (*Table 4*) where there is more point source wastewater discharge and urban runoff. The Northeast Cape Fear River also had the highest overall subbasin mean concentration for total phosphorus (TP). Animal waste is known to be high in phosphorus.

Nutrient Impacted Lakes

Biological productivity in a waterbody is often the result of nutrient enrichment. In lakes and reservoirs, biological productivity is measured by its trophic state and is based on the calculated North Carolina Trophic State Index (NCTSI) value. The index accounts for nutrients along with chlorophyll *a* concentrations and Secchi depth to calculate the lake's biological productivity. Trophic states can range from extremely productive (hypereutrophic) to very low productivity (oligotrophic). Several coastal Carolina Bay lakes in the Cape Fear River Basin are dystrophic, meaning that these lakes contain high amounts of humic substances and organic acids. Dystrophic lakes have characteristic tea-coloration naturally influenced by tannins and tend to have a low biological productivity level. NCTSI are not generated for dystrophic lakes.

In the 2018 lakes assessment, 26 of the 35 lakes monitored in the basin were documented as being biologically productive, with excess nutrients leading to the trophic status increasing over time. Two reservoirs in the Deep River subbasin (Upper Rocky River and Charles L. Turner reservoirs) were rated as hypereutrophic due to extremely elevated biological productivity. The unique Carolina Bay lakes in the Coastal Plain are generally classified as dystrophic, however, White Lake in the Lower Cape Fear River subbasin is an exception. Over the past several monitoring cycles, the water quality in the lake has declined, as seen by a shift from oligotrophic to eutrophic. Monitoring data indicate that the lake pH, nutrients, turbidity and chlorophyll *a* levels have increased and the algal community has shifted to a blue-green algal-dominated system.

Algal blooms in lakes and reservoirs can result in water taste and odor problems, which can impact water supplies. As of 2022, eight lakes and reservoirs are listed as impaired due to chlorophyll *a* water quality standard violations. These violations are due to elevated nutrients, resulting in algal blooms. These lakes include B. Everett Jordan Reservoir, Buckhorn Dam Lake (on the mainstem Cape Fear River), Graham-Mebane Reservoir, University Lake, Upper Rocky River Reservoir, Charles L. Turner Reservoir, Sand Creek Reservoir and Greenfield Lake. All are drinking water reservoirs, except for Greenfield Lake, a recreational lake in Wilmington. Additional lakes and drinking waters reservoirs in the basin are likely impacted as well but require additional monitoring to make an assessment.

Nutrient-Impacted Algal Blooms

Due to nutrient over-enrichment throughout the Cape Fear River Basin, algal blooms are occurring more frequently. There is a growing concern about the number of cyanobacterial blooms (commonly called blue-green algae) occurring not only in the basin but across the state. Under the right conditions, some species of cyanobacteria can produce toxins, which are a potential health risk to humans and animals. As such, blooms dominated by algae that can produce toxins or cause other negative water quality effects are designated as harmful algal blooms (HABs). The 2018 routine lakes algal sampling found that 23 of 32 lakes and reservoirs monitored had experienced a cyanobacterial bloom during at least one growing season, meaning the algal sample was dominated by HABs known to produce cyanotoxins.

Episodic algal blooms have been problematic in the lakes and reservoirs throughout the basin for many years, but they are also occurring in the Deep, Haw, Northeast Cape Fear and Black rivers. The unique lock and dam structures on the Cape Fear River cause large segments of impounded river to act more like slow-moving lakes rather than a swift-moving river. This creates an environment conducive to algal blooms when conditions are optimal (temperature, nutrients, clarity and flow). In 2009 between June and November, a Cape Fear River systemwide blue-green algal bloom occurred from above Buckhorn Dam to downstream of Riegelwood near Wilmington. The 2009 surface blue-green bloom was dominated by *Microcystis aeruginosa* and was found to produce the cyanotoxin Microcystis. The NC Department of Health and Human Services (DHHS) released several public health advisories cautioning the public to avoid contact with large accumulations of algae in the Cape Fear River and to take precautions to prevent children and pets from swimming or ingesting water in those areas. Major blooms persisted throughout the summer of 2011 and 2012. Between 2012 and 2019, 63 episodic blooms were reported in the Cape Fear River Basin. Of these, 40 (64%) were identified as potentially toxic blue-green algal blooms (HABs).

Because of the water quality concerns and overall impacts to the Cape Fear River Basin, DWR has recognized that much of the basin is nutrient-enriched or nutrient-sensitive. Steps to address these concerns include several modeling efforts, TMDLs, and/or site-specific rule development or regulatory actions were applied or are underway. Jordan Lake water supply protections were partially put in place in 2008, and are being readopted with guidance from extensive research studies and stakeholder process. Estuarine models were developed to understand portions of the estuary and potential influences draining to it, and DWR continues to work with EPA on models for the central portion of the Cape Fear River Basin. These models are needed to support permitting in the basin, inform the development of management strategies or TMDLs for impaired and impacted waters, provide information on conditions associated with algal bloom frequency and duration, and provide information on the sources of nutrients and biological oxygen demand (BOD) loading to the lower Cape Fear River Basin.

Water Use

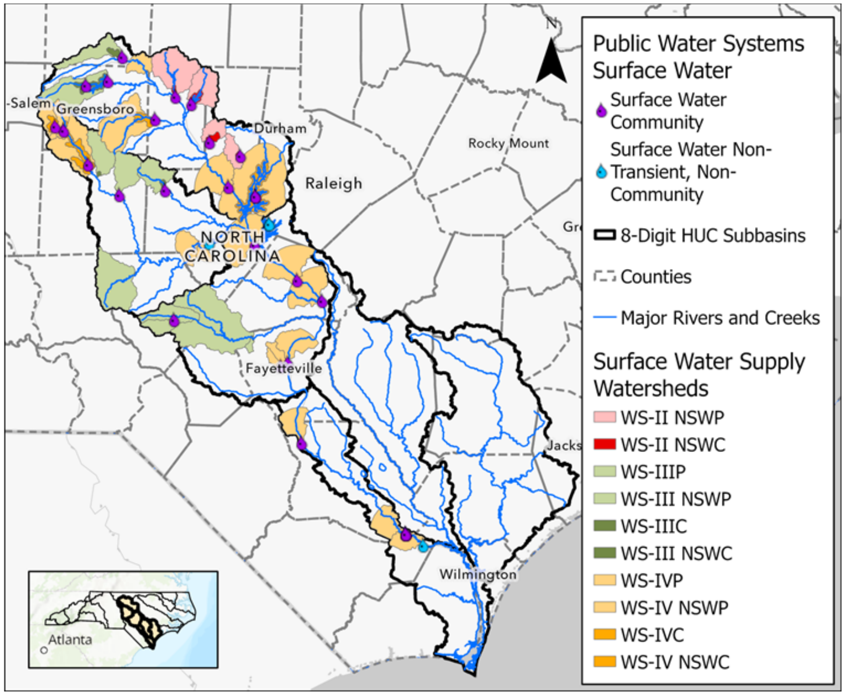
Several programs within DWR provide information about how much water is being used in North Carolina. These include the Water Withdrawal and Transfer Registration (WWATR) Program, the Local Water Supply Planning (LWSP) Program and the Interbasin Transfer (IBT) Certification Program. Several programs are also in place to protect drinking water sources, including the Source Water Assessment Program (SWAP), the Surface Water Protection Program (SWPP) and the Wellhead Protection Program (WHP). Additionally, DWR's Groundwater Resources Branch oversees the assessment, monitoring and management of the state's groundwater resources, including the Central Coastal Plain Capacity Use Area (CCPCUA) while the North Carolina Department of Agriculture & Consumer Services (NCDA&CS) plays a critical role in collecting statewide agricultural water use data.

Almost 60% of the waterways in the Haw, Deep, Upper Cape Fear and Lower Cape Fear (minus the estuary) subbasins are classified as water supply watersheds, or they drain to waterbodies designated as a water supply. It is estimated that in 2020, more than 1.3 million people receive drinking water from a public water supply (PWS) system that uses surface water as its source. This is based on proportioned service areas of PWS systems that submit Local Water Supply Plans. The most downstream of these PWS systems (Lower Cape Fear Water and Sewer Authority and Cape Fear Public Utility Authority) have a water supply intake behind LD1 near East Arcadia, NC (*Figure 8*). Eight miles downstream at Riegelwood, International Paper has the last water supply intake on the mainstem Cape Fear River for a non-transient/non-community PWS system.

Figure 8 shows the general location of PWS systems that use surface water or groundwater as well as water supply watershed boundaries. *Table 5* provides a summary of water use reported in the Cape Fear River Basin by the various programs who oversee permitted or registered water withdrawals. This includes the total water use reported to the LWSP, WWATR, CCPCUA, NCDA&CS Agriculture Water Use Survey, self-supplied domestic use and IBTs. While these programs all report water use, there is an overlap in reporting, and the numbers are not additive. Water use and availability data reported for all of these programs are presented in Chapter 5 of the Cape Fear River Basin plan. For local water supply plans, the basin plans include water use information for historic (2012-2017), current (2020) and projected (2030-2070) water demands.

The protection of these water supply watersheds is vital for the health and safety of all North Carolinians. They support economic development in areas of the state that are growing rapidly, but they also support the ecological goods and services of the region's rivers, streams and adjoining riparian zone.

Figure 8: Public water systems using surface water and groundwater sources and associated water supply watersheds as of 2021.



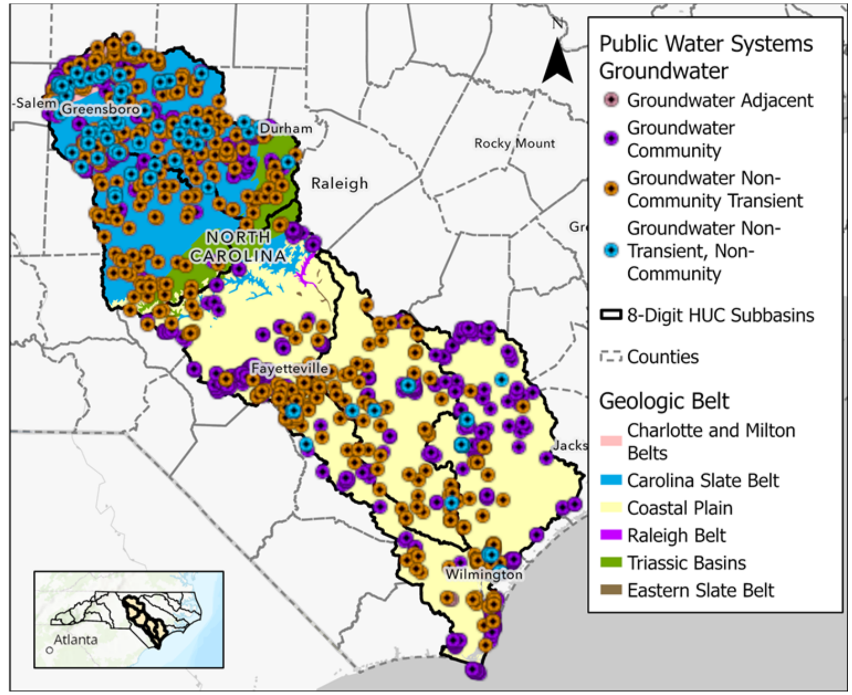


Table 5: Summary of the water use reported and estimated.

Category*	Total Annual Average Use (MGD)	Annual Average Groundwater (MGD)	Annual Average Surface Water (MGD)	Number of Facilities	Transferred out of the Basin (MGD)	Annual Average IBT Transfers out of the Basin (MGD)	Annual Average IBT Transfers within the Basin (MGD)
LWSP*	225.1	28.9	196.2	122	23.4	-	-
WWATR*	1,490.0	6.3	1483.7	169	-	-	-
WWATR – Agriculture*	8.0	0.6	7.4	4	-	-	-
CCPCUA[1]*	10.8	10.8	-	66	-	-	-
Agriculture Water Use[2]*	6.3	4.6	1.8	294	-	-	-
Self-Supplied[3,4]*	40.6	-	-	-	-	-	-
IBT[5]*	-	-	-	-	-	23.128	2.885

*Note: These numbers are **NOT** additive. Public Water Supply Systems may report to both the CCPCUA and LWSP programs. The agriculture water use survey information can overlap with the WWATR or CCPCUA records. Self-supplied is estimated using a desktop analysis and may not be accurate.

[1] For planning purposes, the total annual water use was divided by 365 days to align with annual reported average values from other water use programs in DEQ. This differs from the CCPCUA program which establishes maximum daily withdrawal limits. For compliance monitoring, average daily use reported on the public CCPCUA website is calculated as the total annual water use divided by # of days of use.

[2] non-disclosures associated with data

[3] desktop analysis based on spatial datasets available to DWR

[4] 70 gpd per capita estimate is based on the most recent 2015 water use report by the USGS (USGS, 2018)

[5] based on IBT Basin Boundaries

Protecting Water Resources in the Cape Fear River Basin

The long-term sustainability of water resources for all residents and aquatic life in the Cape Fear River Basin is essential, however, balancing economic growth with water resource protection is challenging. Water quality conditions throughout the basin are affected by both point and nonpoint source pollutants. Streamflow (or the amount of water flowing through a waterbody) also affects water quality conditions as well as aquatic habitat and availability. For example, low streamflow during drought-like conditions can cause pollutants from point sources to become more concentrated, while extreme rains and high streamflow can cause nonpoint pollutants that collect on the land to be quickly delivered to streams due to stormwater runoff. Local and regional activities that protect both surface and ground water may offer solutions for addressing environmental and health issues as well as future water and wastewater capacity needs in the basin.

The following recommendations are broken into general topics identified and discussed throughout the 2026 Cape Fear River Basin Plan. They are designed to address the water quality and quantity issues observed in the Cape Fear River Basin during plan development (2022-2025) and are meant to provide guidance to state and local water resource managers and watershed groups. More information on these general topics as well as subbasin specific recommendations can be found throughout the 2026 basin plan for the Cape Fear River Basin.

Point Source Pollution

- Continue to coordinate across basin planning, modeling, permitting, and monitoring programs to ensure collection and use of consistent effluent and instream data to inform nutrient management decisions.
- Permitting decisions should incorporate basin-scale and downstream impact evaluations, extending to or beyond natural or man-made features (e.g., reservoirs, dams, estuaries), to ensure protection of designated uses throughout the basin.
- Implement technology-based nutrient reduction requirements for new and expanding dischargers, as appropriate, while maintaining compliance with existing water quality-based standards (e.g., TMDLs, nutrient rules).
- Encourage pretreatment programs and targeted monitoring to identify and manage emerging contaminants in industrial discharges; incorporate permit conditions as needed.
- Promote nutrient optimization at existing wastewater treatment facilities, including operational improvements, infrastructure evaluation and development of standard operating procedures to ensure consistent performance.
- Expand operator training, technical assistance and oversight—particularly for smaller package plants—and promote proper maintenance of decentralized (on-site) wastewater systems, including connection to centralized systems where feasible.

Nonpoint Source (NPS) Pollution – Urban and Rural

- Encourage local governments to evaluate existing stormwater and development ordinances to reduce runoff and pollutant loading through watershed-specific best management practices (BMPs), including infiltration, erosion control, and protection of buffers, wetlands, and floodplains.
- Support implementation of the 2021-2025 North Carolina State Wetland Program Plan to prioritize restoration and protection of wetlands that provide water quality, flood mitigation, and habitat benefits.
- Expand outreach and education for landowners on nutrient management, BMP implementation and riparian buffer protection.

Nonpoint Source (NPS) Pollution – Agriculture and Forestry

- Promote collaboration with Soil and Water Conservation Districts to evaluate and implement BMPs that reduce nutrient, sediment, and bacterial runoff from agricultural operations.
- Encourage using certified technical specialists to develop or review Waste Utilization Plans (WUP) for deemed permitted animal operations and the use of covered or contained storage systems to store dry poultry litter or manure. Uncovered waste piles on permeable surfaces can lead to concentrated nutrients and bacteria runoff to surface waters.
- Expand monitoring and data collection in agricultural watersheds, particularly those with high concentrations of animal operations, to better assess impacts and inform management and regulatory decisions.
- Support increased funding and participation in state and federal cost-share programs to advance voluntary BMP implementation across agricultural and forestry sectors.
- Encourage forestry stakeholders to implement pre-harvest planning and BMPs to protect water resources and aquatic habitats.

Planning & Implementation

- Continue to support development of watershed models for nutrient management decisions and strategies for permitting and restoration efforts. This includes a no net increase or "hold the load" approach in the central portion of the basin where the goal is to limit additional nitrogen and phosphorus loading to already over enriched waterbodies.
- Collaborate with the Nutrient Criteria Development Plan (NCDP) Scientific Advisory Council (SAC) to develop defensible nutrient criteria and response indicators that support protection of designated uses and potential development of TMDLs or nutrient strategies.
- Improve assessment methodologies (e.g., chlorophyll a) to better characterize water quality conditions in flowing systems.
- Support watershed restoration planning, dam removal or modification where feasible, and habitat connectivity initiatives to improve ecosystem health.
- Incorporate updated hydrologic data (e.g., low-flow statistics) and support research on climate impacts, nutrient dynamics, and emerging contaminants to inform management decisions.

Water Quality Monitoring

- Strengthen and expand monitoring programs to address data gaps and provide consistent reliable data for water quality and trend analysis to inform modeling, permitting and restoration efforts.
- Periodically evaluate monitoring networks, parameters, and station locations to improve data quality and coverage.
- Increase resources for biological, algal bloom, fish tissue, and groundwater monitoring programs to better assess ecosystem and public health risks.
- Expand use of advanced tools (e.g., bacterial source tracking) to identify pollutant sources and guide targeted management actions.

Water Use & Demand

- Improve coordination and data sharing among agencies and stakeholders to better understand water use and support long-term planning, drought management, and resource protection.
- Maintain and expand streamflow and reservoir monitoring networks to improve understanding of water availability and watershed response to changing conditions.
- Support regionalization of water and wastewater infrastructure where appropriate to improve system efficiency and protect water resources, consistent with long-term planning efforts. The Regional Water and Wastewater Infrastructure Concept Plan offers concepts where regionalization could potentially address water and wastewater infrastructure concerns while also protecting our water resources.

Conclusions

The 2026 Cape Fear River Water Resources Management Plan (basin plan) is intended to serve as a guide and resource for local and state water resource managers and planners, local and state leaders who provide oversight and make decisions about funding water-based projects as well as the public on water resource issues and concerns in the basin. Conditions and circumstances are dynamic and have changed throughout plan development, but the basin plan is a starting point for further discussion, coordination and collaboration among interested stakeholders working in the basin. Continued monitoring and assessments are needed to accurately assess the health and protect this critically important resource as our state continues to grow.

References

Dubrovsky, N.M., Burow, K.R., Clark, G.M., Gronberg, J.M., Hamilton P.A., Hitt, K.J., Mueller, D.K., Munn, M.D., Nolan, B.T., Puckett, L.J., Rupert, M.G., Short, T.M., Spahr, N.E., Sprague, L.A. and Wilber, W.G. (2010). *The quality of our Nation's waters—Nutrients in the Nation's streams and groundwater, 1992–2004*: U.S. Geological Survey Circular 1350, 174 p. https://water.usgs.gov/nawqa/nutrients/pubs/circ1350/

Kulikowki, Mick. (2018) *Finding GenX.* NC State University News April 16, 2018.

NC DWQ – ESS - Intensive Survey Unit Special Study. (2004). *Rocky River Survey (Chatham County) Subbasin 03-06-12 – March 24, 2004*

NC DEQ Chemours Consent Order. https://edocs.deq.nc.gov/WasteManagement/Browse.aspx?id=1608103&dbid=0&repo=WasteManagement

NC DEQ (2022). 2022 Water and Fish Collection Project – Status Update. Presentation, Raleigh PowerPoint Presentation (nc.gov)

NC DEQ (2023) DEQ Study: PFAS in Wastewater and Biosolids. Website, data results and presentations. https://www.deq.nc.gov/deq-study-pfas-wastewater-and-biosolids#Howarewastewatertreatmentplantsregulated-20169

NCDHHS (Oct 2021). *Fish Consumption Advisories*. https://epi.dph.ncNCDHHS.gov/oee/fish/advisories.html#top.

NCDHHS (2023a) *Per- and Polyfluoroalkyl Substances* Fact Sheet. https://epi.dph.ncNCDHHS.gov/oee/pfas/PFAS_Factsheet.pdf

Sheets Johnathon (2021). *Addressing the Impacts of PFAS in Biosolids.* Wastewater Digest, September 10, 2021. https://www.wwdmag.com/sludge-biosolids/article/10940121/cdm-smith-addressing-the-impacts-of-pfas-in-biosolids

Sun, M., Arevalo, E., Strynar, M., Lindstrom, A., Richardson, M., Kearns, B., Pickett, A., Smith, C., and Knappe, D. (2016). *Legacy and Emerging Perfluoroalkyl Substances are Important Drinking Water Contaminants in the Cape Fear River Watershed of North Carolina*. Environ. Sci. Technol. Lett. 2016, 3, 12, 415-419. https://doi.org/10.1021/acs.estlett.6b00398