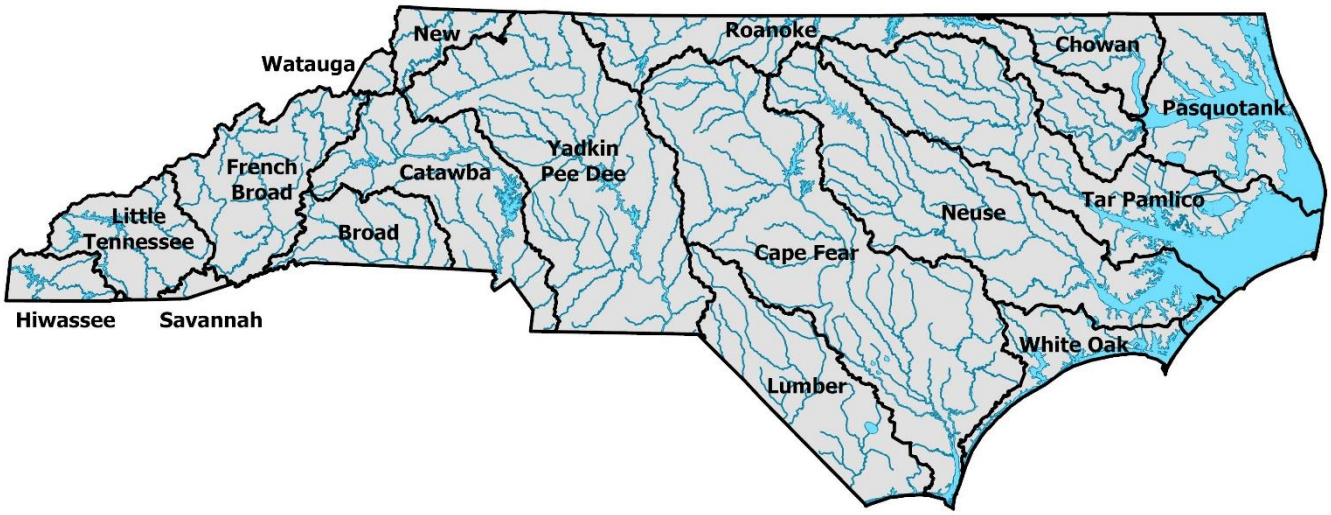
Annual Report to the General Assembly

Environmental Review Commission

Basinwide Water Resource Management Plans

July 2019 to June 2020



Environmental Management Commission

North Carolina Department of Environmental Quality

Division of Water Resources

This report is submitted to meet the requirements of G.S. 143-215.8B(d) and 143-355(p), which requires annual reporting on the development of basinwide water quality management plans and hydrologic models.

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Introduction

Basinwide water management plans (basin plans) are developed by the Basin Planning Branch (BPB) in the Division of Water Resources (DWR) in the North Carolina Department of Environmental Quality (Department or DEQ). Basin plans are prepared for each of the 17 major river basins and are used to communicate with government officials, entities required to adhere to water quality standards (wastewater managers and operators, stormwater engineers, contractors and developers, etc.), and the public on water resource issues across the state. When applicable, basin plans include recommendations for protecting water quality and explanations as to why there are long-term management strategies in place for rivers designated as nutrient sensitive waters (NSW) as well as measures in place to protect areas identified as having significant or outstanding water quality. Numerous federal, state and local agencies, watershed groups, universities, and the public are contacted throughout the basin planning process.

Implementation of recommendations, action plans or strategies presented in the basin plan is coordinated with various resource agencies and local communities. Often, regional voluntary measures or regulatory actions may be used to address water quality concerns identified in the basin plan. Information presented in each basin plan also aids local watershed groups in developing and prioritizing site-specific restoration and protection strategies. Basin plans are not a rule, are circulated to local agencies and the public for review and comment and are approved by the North Carolina Environmental Management Commission (EMC) at least every 10 years.

General Statue (G.S.) 143-215.8B(d) states that the Environmental Management Commission (Commission) and the Department shall each report on an annual basis to the Environmental Review Commission (ERC) on "the progress in developing and implementing basinwide water quality management plans and on increasing public involvement and public education in connection with basinwide water quality management planning. The report to the Environmental Review Commission by the Department shall include a written statement as to all concentrations of heavy metals and other pollutants in the surface waters of the State that are identified in the course of preparing or revising the basinwide water quality management plans." This year's ERC Annual Report covers the July 1, 2019 to June 30, 2020 timeframe. The DWR laboratory and field staff have both experienced limitations and delays during the COVID-19 emergency which will ultimately reduce the number of samples collected and analyzed during this timeframe. Specific details are described in the following sections.

In October 2017, G.S. 143-355(p) directed the Department to also include progress on developing basinwide hydrologic models in the annual report submitted to the ERC for basinwide water quality management plans. These models are often referred to as "water supply" models, and information on the status of hydrologic models is included in this report.

Basin Plan Development

Developing basin plans is a multi-year process built on reviewing available water quality data, discharge permits, and communicating with stakeholders prior to presenting the results. North Carolina has used an integrated, watershed-based approach to evaluate point and nonpoint sources of pollution from municipal wastewater facilities, industrial facilities, on-site wastewater collection systems and stormwater since 1983. The Tar-Pamlico River basin plan was approved by the EMC in 2015 and was the first plan to incorporate

water quality and quantity issues. The basin plan included in-depth water quality assessments and recommendations for improving water quality, as well as information made available through the hydrologic model. For basins that do not have a hydrologic model, information about future water demands, projections and groundwater use will be based on best available data collected by DWR.

In October 2018, the EMC approved the Watauga River Basin Plan. In addition to the in-depth water quality and quantity analysis, the plan incorporated online tools such as ArcGIS Online (AGOL) interactive maps and a summary story map (Watauga Story Map). These online, interactive tools will allow the basin plans to remain linked to maps and reference information that are frequently updated, allowing users access to the most currently available data. The draft Chowan River Basin Plan is scheduled to be presented to the Water Quality Committee in September 2020. Currently, the Cape Fear, Chowan, Neuse, Pasquotank, White Oak and Yadkin-Pee Dee river basin plans are being developed.

Progress on Developing Hydrologic Models

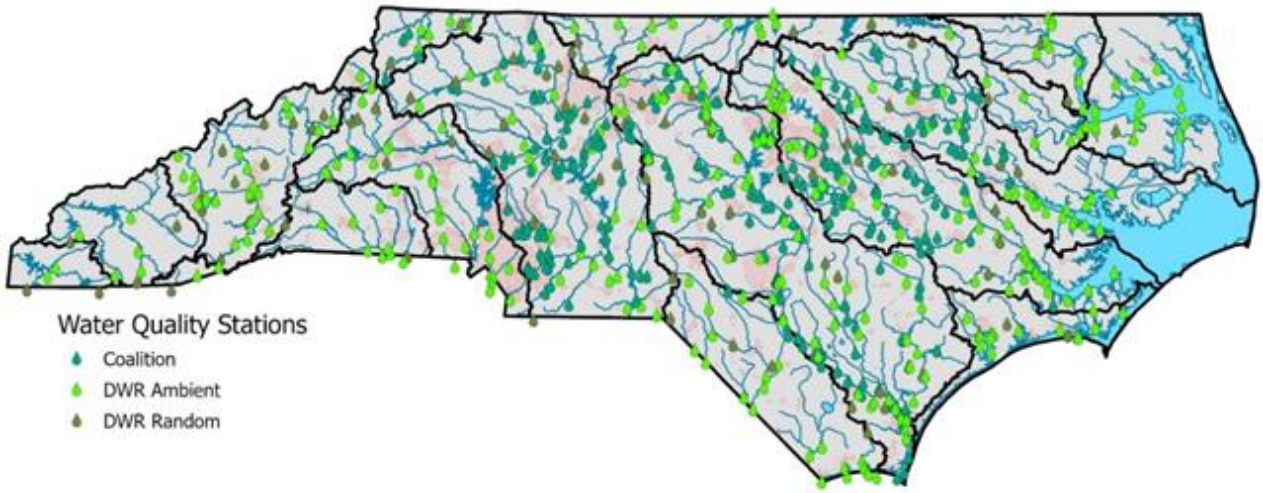
Hydrologic models are based on historic stream flow data and capture the effects of current management protocols (i.e., regulated releases from dams), surface water withdrawals, and wastewater discharges. The models can be used to evaluate the potential effects on surface water availability produced by anticipated changes in water demands and management regimes. Although not as precise as a site-specific study for accessing impacts, the models can be used to evaluate potential impacts of permit decisions. Examples include the approval of water supply allocations from lakes and reservoirs or approval of surface water transfers. The models are available to anyone who requests access and can be used to evaluate potential flow impacts from proposed projects and identify flow conditions, the reoccurrence of which, could produce water shortages limiting the ability to meet expected demand. The models also evaluate the possible magnitude of the water shortages. By statute, the models are subject to a 60-day comment period and must be resubmitted to the EMC if there are substantial comments and/or updates. Representatives from both the public and private sector participate in the development of the models and include DEQ, Wildlife Resources Commission (WRC), NC Department of Agriculture & Consumer Services (NCDA&CS), Soil & Water Conservation Districts (SWCD), municipalities, riverkeepers, and Duke Energy. DWR continues to review water use data that will be incorporated into the model and ensuring all water users are accounted for in the basins.

DWR hosts hydrologic models for the Tar-Pamlico, Roanoke, and Broad river basins along with the combined Cape Fear-Neuse River basin model through OASIS (Operational and Simulations of Integrated Systems). A hydrologic model through CHEOPS (Computerized Hydroelectric Operations Software) is also available for the Catawba-Wateree River basin. Two hydrologic models using the OASIS platform were completed for the French Broad, New, and Watauga river basins in 2019 with training provided for stakeholders in December. The New and Watauga river basins were combined into one model while the French Broad is an independent model that includes the Pigeon and Nolichucky rivers. These models will be available after technology updates are completed on the DEQ server. A hydrologic model, through OASIS, is currently being developed for Yadkin-Pee Dee and Lumber river basins. These basins will be combined into one model. This model is scheduled to be completed towards the end of 2020.

Water Quality Monitoring and Pollutant Concentrations

Chemical, physical and biological parameters are regularly assessed to determine how well waterbodies are meeting their best intended use. DWR's Ambient Monitoring System (AMS) and Random Ambient Monitoring System (RAMS), along with seven point source monitoring coalitions, collect physical and chemical data from ambient monitoring stations across the state. A monitoring coalition is a group of stakeholders that combine resources and expertise to collectively fund and perform an instream monitoring program (e.g., NPDES coalition, citizen science, watershed groups). Coalitions can be found in the Cape Fear, Neuse, New, Tar-Pamlico and Yadkin-Pee Dee river basins. Data collected from 329 AMS and RAMS stations as well as 291 coalition stations were used to assess water quality for the 2018 Integrated Report (IR) (Figure 1). The IR which is described further detail later in this section, fulfills the reporting requirements of Section 303(d) and 305(b) of the Federal Clean Water Act (CWA).

Figure 1: Water Quality Monitoring Stations (2018 Integrated Report)



AMS, RAMS and special studies for benthic macroinvertebrate and fish community were suspended between March 3rd and April 30th, 2020 due to a public health emergency (COVID-19). To avoid the spread of COVID-19, some laboratory support staff remained onsite to accommodate emergency samples collected for analysis and to continue analyzing PFAS, 1,4-dioxane and analyze backlogged metals samples. In May, DWR's Water Sciences Section (WSS) prioritized a limited set of sampling (some special studies and lakes samples) as the field scientists and the chemistry laboratory began to increase their capacity while adhering to COVID-19 safety protocols.

A second phase of increased sampling began in July 2020 with algal bloom samples being collected from several locations across the state and at 55 ambient stations, including stations in the Yadkin-Pee Dee, Lumber, Cape Fear, Roanoke, Chowan, and Pasquotank river basins. Phase II will continue through the end of August 2020. WSS will reassess existing and future monitoring needs based on current health and safety conditions as well as capacity.

Most of the coalitions have continued sampling throughout COVID-19 with no deviations from their regular schedule except for the Lower Cape Fear River Program (LCFRP) who were unable to access their labs on the University of North Carolina Wilmington campus until May 2020.

DWR's Biological Assessment Branch (BAB), housed in WSS, evaluates the water quality of rivers and streams using the biological communities (benthic macroinvertebrates and fish) that live in them. Given the variety of life cycles these aquatic organisms exhibit, biological communities can often reflect both long- and short-term environmental conditions. Biocriteria have been developed for the major ecoregions using species diversity, abundance, and pollution sensitivity of the organisms. Data collected from 3,320 benthic macroinvertebrate stations and 960 fish community stations was used to assess water quality for the 2018 IR (Figure 2a and 2b). Of those, 716 benthic and 423 fish stations were sampled during the five-year assessment window (2012-2016) for the 2018 IR. Not all stations are resampled every assessment period due to staffing and resource limitations; therefore, data collected during previous assessment periods were carried forward and used for the remaining biological stations. Overall, resource limitations have restricted the ability of DWR staff to sample as many biological stations in recent years when compared to the previous five-year period. BAB had staff reduced by 30% between 2012-2014 (the equivalent to an entire field crew) which has not been replaced.

Biological monitoring was completed in the Savannah, Little Tennessee, Hiwassee, Roanoke, and White Oak river basins in 2019. Biological stations will be sampled in the Neuse and Lumber river basins in 2020. Sampling in the Chowan, Pasquotank, and Broad river basins have been postponed to 2021 due to COVID-19. Results from 2019 and 2020 will be assessed as part of the 2022 IR (2016-2020).

Figure 2a: Benthos Monitoring Stations – 2018 Integrated Report

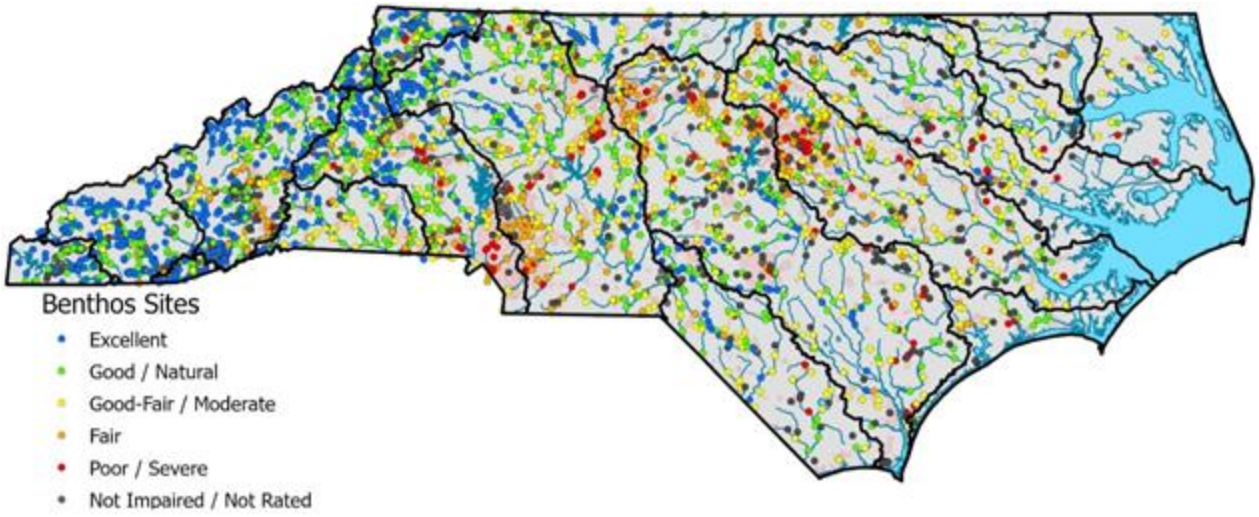
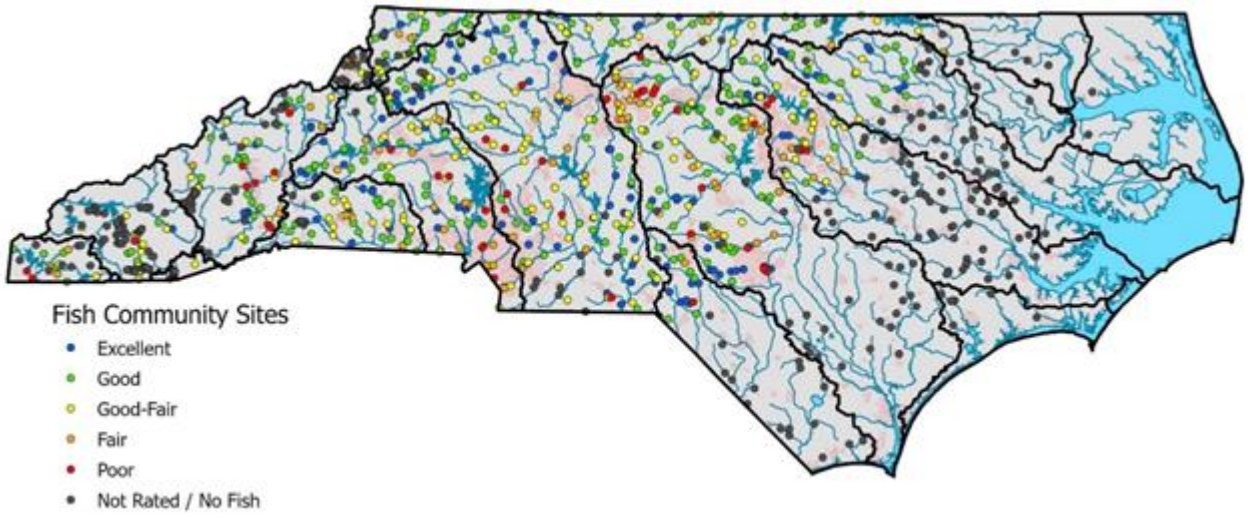


Figure 2b: Fish Community Monitoring Stations – 2018 Integrated Report



In North Carolina, all water quality parameters collected in a waterbody, or assessment unit (AU), are assessed independently and are based on the frequency of exceedances of the numeric or narrative water quality standard (Table 1). Waterbodies that are sampled for chemical, physical and biological parameters, along with the assessment criteria associated with that parameter and the EPA category the parameter is assigned are included in the IR (Table 2). The IR, as discussed, fulfills the reporting requirements of Section 303(d) and 305(b) of the Federal Clean Water Act (CWA). Waterbodies that exceed standards are reported on the 303(d) list and are submitted to the EPA for approval every two years and uses a five-year assessment period or dataset. Procedures used to evaluate water quality and assign categories are explained in detail in the IR methodology available on DWR's Modeling and Assessment Branch's (MAB) website. EPA approved North Carolina's 2018 303(d) list on May 22, 2019. Waterbodies assessed for the 2018 IR are shown in Figure 3.

There are currently 13,676 AUs, or stream segments, assessed in the state. Each AU varies in size based on the specific characteristics of the waterbody being evaluated. Because the characteristics of AUs vary, some units are only monitored for a subset of parameters. The results are based on a five-year compilation of data that has been quality assured and quality controlled (QA/QC). The 2016 and 2018 impairment assessments are based on data collected from 2010-2014 and 2012-2016, respectively. Figure 4 illustrates the number of AUs impaired for each assessment period based on the water quality parameters shown on the bottom of the graph and denotes an increase (red) or decrease (blue) in the number of AUs between the two periods. The DWR is in the process of preparing the 2020 Integrated report and hopes to release the draft for public review and comment in the fall of 2020.

Table 1: North Carolina Ambient Monitoring Program Water Quality Parameters+

Physical Parameters	Chemical Parameters	Biological Parameters
Dissolved Oxygen	Nutrients – NH_3, NO_2+NO_3, TKN, TP	Fecal Coliform Bacteria – Fresh & Saltwater
pH	Hardness	*Enterococcus* Bacteria – Saltwater
Specific Conductance	Chlorophyll *a* *	Biological Integrity – Benthic Macroinvertebrate Community
Water Temperature	Totals Metals ^ As, Hg, N, (in WS waters), Se	Biological Integrity – Fish Community
Turbidity	Dissolved Metals ^ As, Be, Cr, Cu, Zn, Ag, Cd, Ni, Pb	

+ Not all parameters listed are collected at each station or collected at the same sampling frequency. Generally, all stations are monitored monthly.

* Chlorophyll *a* is collected in lakes and estuaries or in areas of slower moving water such as behind a dam on flowing streams.

^ The standard for metals changed from total recoverable to dissolved metals (for most metal standards except Mercury and Selenium which remained total; Arsenic and nickel have standards for both fractions) as part of the 2015 Triennial review process. In 2007, DWR suspended sample collection for total recoverable metals due to the change in the proposed metals standard. In 2016, DWR started collecting dissolved metals for assessment purposes at select stations throughout the state.

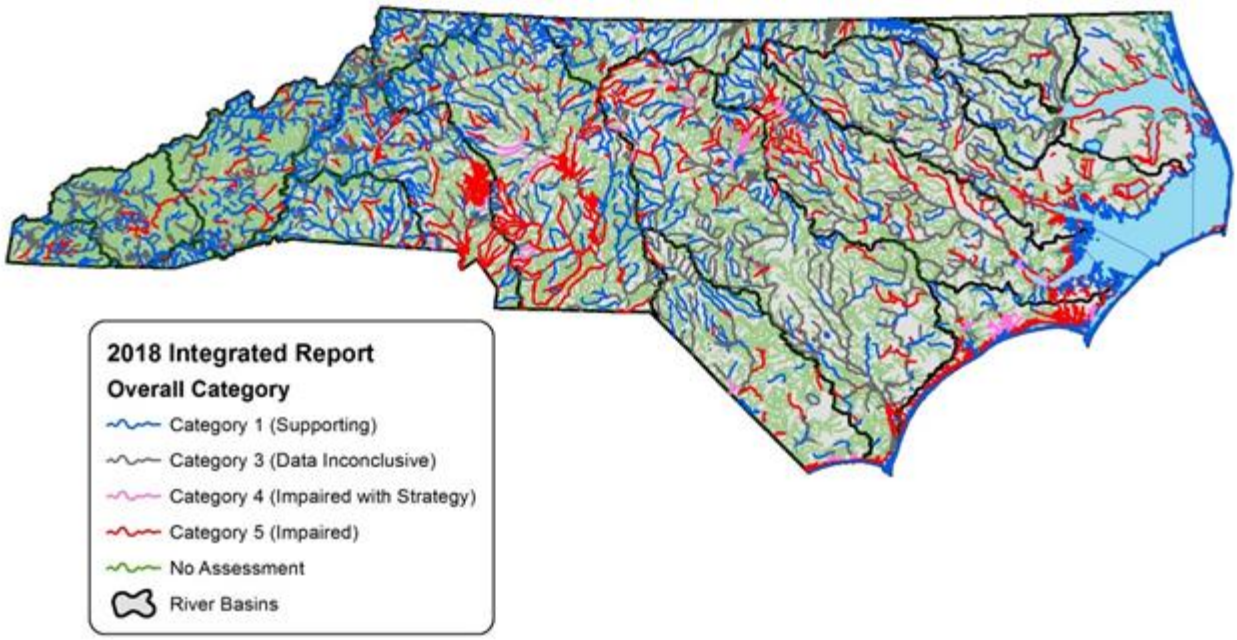
Table 2: North Carolina Assessment Criteria Based on North Carolina Numerical and/or Narrative Statements and Associated IR Categories

Water Quality Assessments	Water Quality Assessment Definitions	Integrated Report Category (EPA)
Meeting Criteria (MC) (Supporting)	Meeting water quality standard criteria for parameter of interest	Category 1 Category 2
Data Inconclusive (DI)	Data inconclusive to make an assessment for parameter of interest	Category 3
Exceeding Criteria (EC) (Impaired)	Exceeding standard criteria for parameter of interest	Category 4* Category 5**

*Category 4 is assigned when a parameter is exceeding criteria, but (1) the development of a total daily maximum load (TMDL) is not required, (2) a TMDL or management strategy is already in place, and/or (3) a variance is in place. The development of a TMDL includes a study of the watershed to identify the sources of the pollutant(s), calculations and modeling to identify the pollutant(s) contributing to the impairment and reductions needed from point and nonpoint sources of pollution.

**Category 5 is assigned when a parameter is exceeding criteria, and a TMDL or management strategy is required. Category 5 assessments are the 303(d) list, which is also referred to as the impaired waters list. Definitions and more detailed information about each category can be found in the 2018 listing and delisting methodology. The methodology is also referred to as the 2018 Water Quality Assessment Process.

Figure 3: Overall Categories for Monitored Waters in North Carolina – 2018 Integrated Report

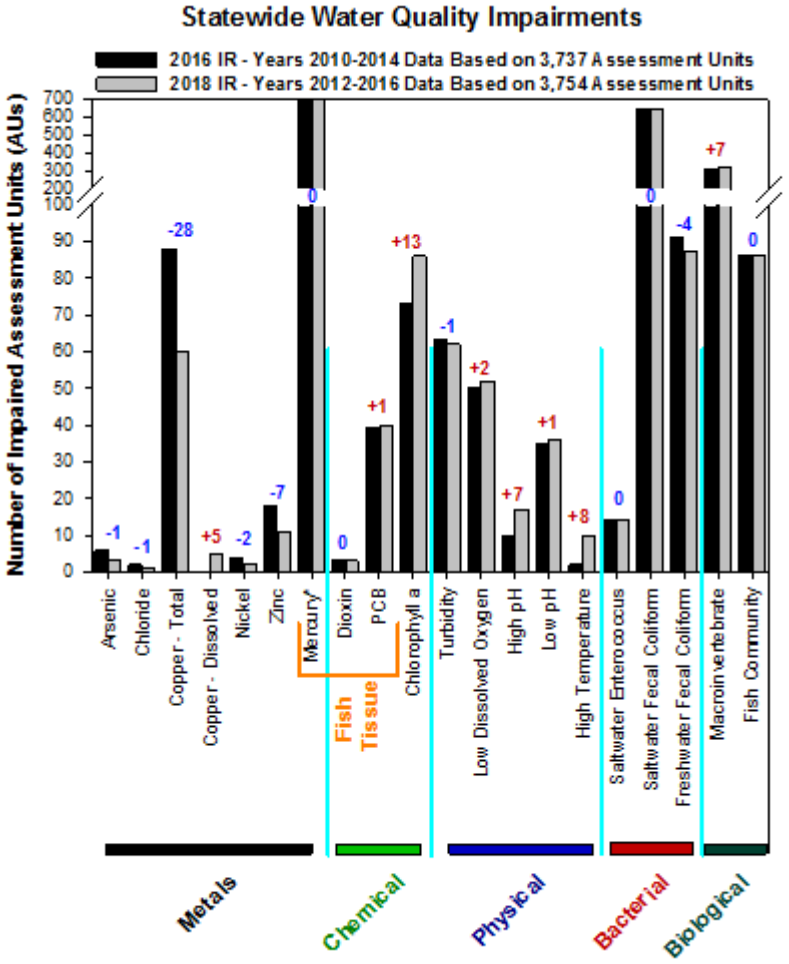


Water quality monitoring for total recoverable metals assessment was suspended in April 2007 to allow for evaluation and re-adoption of revised water quality standards using the most current science. In November 2014, as part of the Triennial Review process, the EMC approved new water quality standards for dissolved metals. EPA approved the water quality standards for dissolved metals for North Carolina in April 2016.

In 2016, DWR began monitoring for dissolved metals at "targeted stations." The targeted stations were located in stream segments EPA did not approve for delisting for metals during the 2016 IR assessment period. The stations required additional data to confirm that these waterbodies where compliant with the new instream metals water quality standard.

Based on the 2016 targeted study, DWR delisted 35 stream segments (AU's) for a total of 41 metal delistings as part of the 2018 IR assessment period (some stations had more than a single metal impairment). In addition, the targeted study confirmed that five AU's should remain on the 303(d) list for dissolved copper (one stream segment in the Cape Fear, Catawba and Roanoke river basins and two in the Yadkin-Pee Dee River basin).

Figure 4: Statewide Water Quality Impairments (Exceeding Criteria) for Integrated Reporting (IR) Years 2016 and 2018



DWR with the assistance from the LCFRP coalition have targeted a new set of stations for the next round of dissolved metals sampling. These stations are targeting waterbodies that are only exceeding for total recoverable metals. The metals impairments shown in Figure 4 includes the AU's listed based on the dissolved metals water quality standards and the remaining AU's listed for total recoverable metals that have not been resampled. DWR collected dissolved metals from 33 stations which included a few stations sampled during the previous dissolved metals pilot study that lacked enough samples for the 2018 IR. Dissolved metals sampling started in September 2019 but was stopped in March 2020 due COVID-19. This new set of dissolved metals data was to be used for the 2022 IR assessment, however, if sampling cannot resume in 2020, the majority of the 33 stations may lack enough samples for use in the 2022 IR. The LCFRP coalition has also postponed dissolved metals sampling due to COVID-19.

DWR, including BPB, uses the information from the statewide water quality assessment (IR) process to help guide our understanding of water quality concerns, where to focus efforts to restore water quality and identify areas for protection and preservation in order to maintain high quality waters. This information is also used to help understand possible sources of pollutants, where regulatory efforts may be needed to

improve protections, guide the need for additional special studies as well as where there is a need for management actions such as a TMDL (total maximum daily limit). The information is being incorporated into online, interactive mapping tools and basin plans for resource agencies and stakeholders to access easily.

Other Pollutants in Surface Waters

Basinwide water quality evaluations often go beyond the assessment of parameters with specific water quality standards such as those reported as part of the biennial IR assessment process. Basin plans must also address other pollutants which can result in nutrient over enrichment and algal blooms. As time permits, emerging issues and compounds, changes to water quality and stream flow over time, and climate resiliency are topics that will likely be incorporated into future basin plans.

Nutrients have been identified as a major water quality concern across most of North Carolina's river basins. Nutrients are introduced to an aquatic ecosystem through municipal and industrial treatment processes, runoff from urban or agricultural land, and inputs from groundwater and atmospheric deposition. The growth of algae and other plants can result in eutrophic conditions and increased biological productivity, or algal blooms.

A statistical analysis of nutrients in the Chowan, Neuse and Tar-Pamlico NSW watersheds found that while some nutrients have declined or remained steady, organic nitrogen has been increasing in these three basins since the early 2000's. This led to a statewide evaluation which indicated that organic nitrogen instream concentrations are increasing across all basins. Mechanisms driving this increase are not well understood. Changes in urban, agricultural and waste disposal activity, effects from groundwater and legacy sediments, changes in atmospheric deposition and rain pH levels, and changes to stream flow may be contributing to the increase in organic nitrogen. Changes in stream flow could also impact the amount of waste that can be discharged to a waterbody without changing existing conditions. Additional research and analytical tools are needed to help DWR understand the sources of increasing organic nitrogen and how to manage them.

Algae are responsive to the physical and chemical conditions in the aquatic environment. Algal blooms occur when favorable conditions exist, such as optimal temperatures, sufficient nutrients, and static or stable waterbodies. DWR's Algal Assessment Program uses phytoplankton unit densities of greater than 10,000 units/mL to define an algal bloom. In North Carolina, there is a growing concern about the number of cyanobacterial blooms (commonly called bluegreen algae) occurring across the state. Some species of cyanobacteria have the ability to produce toxins, which presents a potential health risk to humans and animals that come into contact with an affected waterbody. As such, blooms that are dominated by cyanobacteria are designated as harmful algal blooms (HABs). Algae are of most concern in drinking water supplies, reservoirs, impoundments and slow-moving/flushing estuaries. While some algae have the ability to produce toxins, many non-toxic blooms can also cause taste and odor problems, water discoloration, form large mats which can interfere with boating, swimming and fishing, and can be associated with fish kills and decreased biodiversity.

DWR now documents reported algal blooms on an online interactive map. In 2019, DWR investigated 43 algal blooms in nine different river basins. Of those, 30 blooms were categorized as HABs (cyanobacteria

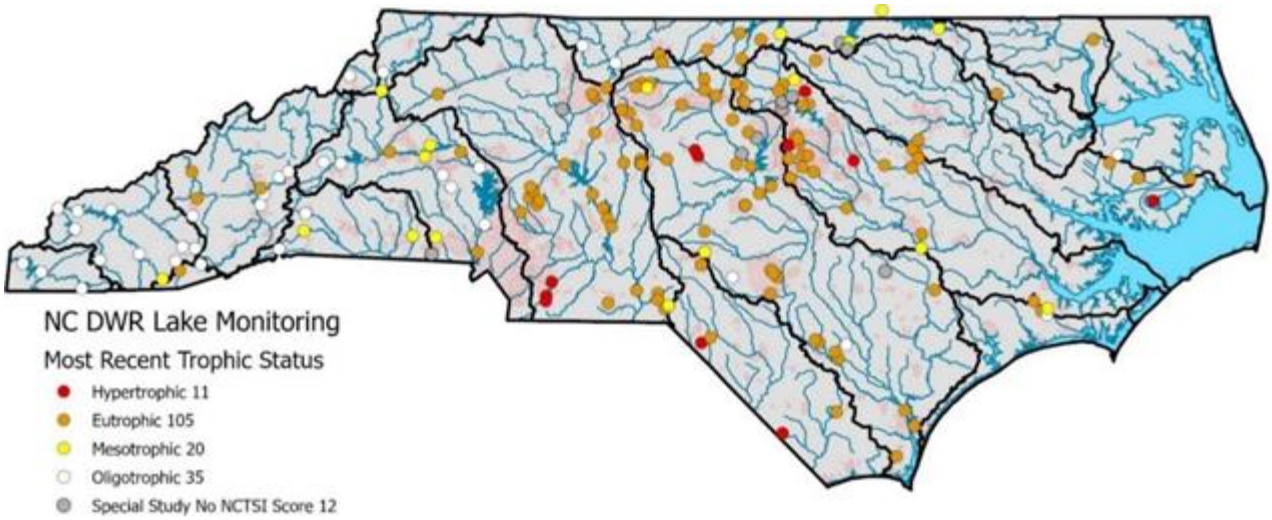
dominant). The 2019 HABs occurred in the Neuse, Cape Fear, Chowan, Catawba, Pasquotank, Tar-Pamlico and Yadkin-Pee Dee river basins.

In addition to episodic bloom evaluations, algal monitoring is done as part of the routine basinwide monitoring of North Carolina's lakes and reservoirs by the Intensive Survey Branch (ISB). Sites chosen are generally in areas likely to have favorable conditions for algal growth, so the numbers are not necessarily representative of what is happening in all waterbodies across the state. Overall, there were 134 routine samples collected from lakes and reservoirs in the Hiwassee, Little Tennessee, Roanoke and White Oak river basins in 2019. Of those, 40 (30%) met the algal bloom density criterion with 18 (45%) of those being categorized as HABs. Routine basinwide monitoring for 2020 is underway in the Neuse, Pasquotank and Chowan river basins. Monitoring in the Broad River has been postponed to 2021 due to overnight travel restrictions as well as health and safety concerns surrounding COVID-19.

ISB also collects and interprets biological, chemical, and physical data as part of their Ambient Lakes Monitoring Program (ALMP). Ambient monitoring data are used to calculate the state of nutrient enrichment (trophic state) and determine if the lake is meeting the designated use. The trophic state is a relative description of the biological productivity of a lake based on the calculated North Carolina Trophic State Index (NCTSI) value. The index accounts for nutrients along with chlorophyll *a* concentration and Secchi depth to calculate the lake's biological productivity. Trophic states may range from extremely productive (hypereutrophic) to very low productivity (oligotrophic).

Trophic states are not used in NC to determine the overall use support of a lake, but they are used as an indicator of how productive or over productive a system is. Trophic states are indicators of a potential need for watershed actions to limit the introduction of anthropogenic nutrient or for the need for conservation and enhancement measures. As off 2019, out of the 171 lakes assigned a trophic status in NC, 11 lakes were classified as hypereutrophic and 105 were eutrophic (Figure 5). Changing lake conditions are reported in the basin plans.

Figure 5: North Carolina Monitoring Lakes Trophic Status



Emerging compounds is a potential issue for all waters (surface and ground) of the state and come from a wide range of sources including pharmaceuticals, pesticides, disinfection by-products, wood preservatives, personal care products and industrial chemicals as well as their by-products. Potential sources include conventional wastewater treatments plants, individual on-site wastewater collection systems, and industrial and chemical manufacturing facilities. GenX and 1,4-dioxane are examples of contaminants recently identified in North Carolina surface waters. They often go undetected and untreated because facilities do not have the analytical tools, methods or treatment systems in place that can detect, eliminate or treat them.

While a contaminant may be unique to a specific source or river basin, many are widespread. The effects of emerging contaminants on aquatic ecosystems and on human health are mostly unknown, and the lack of appropriate analytical methods and monitoring techniques makes identification and management a challenge. The uncertainty of whether these contaminants are present, their effects on human health and their impacts to aquatic ecosystems is a growing public concern. Because emerging compounds are not fully understood, it limits the state's ability to protect water quality. It also limits the state's ability to regulate the contaminants or identify treatment options for public water supply systems to provide safe drinking water to the public and ensure that aquatic ecosystems are protected.

Specific emerging compounds and emerging issues identified within a basin will be discussed in detail as part of the basin plan document. Basin plans will incorporate as much information as possible on these subjects, however many of these issues are being assessed by several divisions within DEQ. A more comprehensive assessment will likely be available on the Department's Emerging Compounds website as reports are completed and science advisory boards complete their tasks (e.g. GenX Investigation website).

Additional data collected and reported in basin plans include special studies completed at the request of the legislature, EMC, DEQ, DWR, or as the result of natural or man-made impacts like hurricanes, droughts or coal ash spills. The results are generally summarized and posted on DWR's website. When appropriate, the results of these analysis are incorporated into our biennial statewide assessment (IR) process and into the basin plan updates.

River Basin Summaries

Broad River Basin

Aquatic habitat degradation (as indicated by impaired biological integrity) continues to be identified as a major water quality concern throughout the Broad River basin. Fecal coliform bacteria, turbidity and water temperature have also been identified as parameters of concern. Much of the aquatic habitat degradation and water temperature concerns are due to the cumulative effect of several stressors acting in concert. These stressors often originate in the upstream portions of the basin and may include runoff from impervious surface, sedimentation and stormwater from construction activities, general agricultural practices, and/or other land disturbing activities. Soils in the much of the basin are naturally erodible, making sedimentation and erosion a constant concern throughout the basin.

Stormwater, increased flow and velocity, erosion and sediment control, steep slope development, pesticide/herbicides and nutrient management from urban and agricultural land (crop, animal and

aquaculture facilities), animal access to streams, and damaged or aging wastewater collection systems have been identified as key contributors to water quality issues and habitat degradation in the basin in the past. It has been recognized that there are also several abandoned furniture manufacturing plants that are contributing large amounts of stormwater runoff due to unmaintained stormwater catch basins and/or impervious surface cover. It has been suggested that these abandoned structures could be marketed for economic redevelopment. Redevelopment could incorporate appropriate stormwater control measures that could reduce the flow and velocity of stormwater runoff, potentially improving downstream water quality.

New impairments were identified for benthic, fish, turbidity and water temperature during the 2018 water quality assessment period. The next basin plan will include additional information about water quality monitoring data, water resource concerns, and information about water quality violations in the basin.

Catawba River Basin

Aquatic habitat degradation has been identified as a major water quality concern and has resulted in many biological impairments throughout the Catawba River basin. Changes in land use, particularly an increase in developed and impervious surface areas in and around urban areas, has resulted in more stormwater runoff and an increase in flow and velocity even during small rain events. The sudden increase in volume and velocity can cause significant scouring and eroding along streambanks, eliminating aquatic habitat and increasing sedimentation. Additional studies are needed to determine where stormwater management practices could have the greatest impact on protecting aquatic habitats.

High levels of fecal coliform bacteria have been an ongoing issue in the upper portions of the basin. Sources of bacteria include failing septic systems, straight pipes and animal operations. For many years, the Wastewater Discharge Elimination (WaDE) Program provided financial assistance to repair failing systems in lower income areas. Progress was being made and fecal coliform bacteria levels were starting to decline but progress has slowed with the loss of the WaDE Program. Local efforts by the counties and the Western Piedmont Council of Government (COG) continues the efforts established by WaDE to provide financial assistance on a limited basis. These efforts, however, have resulted in the continuing decline in fecal coliform bacteria levels. Reinstatement of the WaDE Program would greatly decrease the rate at which fecal coliform bacteria is released in streams often used for recreational purposes.

Three of the eight reservoirs, Lake Rhodhiss, Lake Wylie, and Lookout Shoals Lake, were sampled by the ISB in 2017. All three lakes were identified as eutrophic (high biological productivity and low water transparency). Two of the reservoirs, Lake Rhodhiss and Lookout Shoals Lake, have historically been considered mesotrophic (moderate biological productivity and water transparency) indicating that the reservoirs could be receiving excess nutrients. Lake Wylie has remained eutrophic since monitoring began in 1981. More information and continued monitoring are needed to monitor potential changes to the trophic status of reservoirs in the basin.

Two algal blooms were reported in the Catawba River basin in 2019. The first bloom appeared September 11th in Lake Norman. *Microcystin* was detected. The second bloom was detected October 24th in the Catawba River. *Microcystin* was not detected and algal counts were low. Algal toxins were not confirmed in either bloom.

Based on results reported in the Catawba Nutrient Study (October 2018), DWR continued monitoring nutrients at existing ambient monitoring stations and four of the ten stations that were sampled during the special study. The study concluded that more information is needed to understand land use changes over time and how the number of animals and the types of agricultural operations have contributed to the amount of nutrients in the basin. The report also concluded that an in-depth analysis is needed to identify specific sources of nutrients and that continued maintenance and protection of existing riparian buffers is critical to reducing nutrient loads to the Catawba River. To help understand nutrients in the basin, additional analytical equipment, personnel and funding is needed.

Efforts are underway throughout the entire basin to protect source water watersheds. Stakeholders are continually identifying source water areas and learning how best to protect those areas. Protecting source water areas can help guide local decisions on water supply needs, economic development, agriculture, and land conservation.

Cape Fear River Basin

Nutrient enrichment was identified as a major water quality concern in the basin which led to the development of a TMDL and nutrient management strategies in portions of the basin. The basin is also experiencing many of the common water quality concerns seen throughout the state, including increased aquatic life impairments and aquatic habitat degradation due to excessive stormwater runoff. In addition to aquatic habitat degradation, excessive stormwater runoff also leads to increased sedimentation and often elevated fecal coliform concentrations. The lack of riparian buffer protections and requirements throughout the basin may be contributing to many of the water quality issues identified in the basin. The continual loss of riparian buffers will continue to exacerbate impacts to water quality.

A Jordan Lake TMDL was approved by EPA in 2007, and in May 2008, the EMC adopted a nutrient management strategy for the Jordan Lake watershed encompassing both the Haw and New Hope drainage areas. Implementation of certain rules within the strategy has been delayed as a result of multiple legislative mandates beginning in 2012, including the prohibition of local implementation of stormwater rules regarding new development and Stage 2 existing development.

S.L. 2016-94 Section 14.13(c) and S.L. 2018-5 Section 13.8 directed the NC Policy Collaboratory to undertake a nutrient management study for Jordan Lake, update a quantitative model of Jordan Lake and the Haw River subbasin, and evaluate the costs and benefits of nutrient strategies in other states. A final report was provided to the legislature in December 2019. The final report supports previous recommendations found in the nutrient strategy for Jordan Lake, provides additional supporting science, provides additional areas of improvement, and notes the need for nutrient reduction to sufficiently reduce algal growth to meet water quality standards in Jordan Lake has been exacerbated by the delay of the rules. The final report and associated research can be found online. The Environmental Management Commission, according to session law, has begun Jordan rules readoption upon receipt of the final NC Policy Collaboratory study.

The Jordan rules readoption process has begun with public outreach and participation needs met by Jordan Lake One Water (JLOW) a stakeholder driven process now supported by DWR. Results from the JLOW process will be used to develop a new nutrient strategy for the Jordan Lake watershed, with final rule readoption expected in 2023.

As a result of elevated nutrient loading, water quality issues can also be found in the Haw, Deep and Cape Fear rivers below Jordan Lake. In recent years, portions of the Cape Fear River have begun to experience algal blooms, some of which are potentially toxic and have resulted in human contact advisories. Research is occurring at the university level to determine the causes and potential solutions. In addition, DWR is in the beginning stages of developing nutrient and dissolved oxygen models for portions of the Cape Fear River basin. The model would provide tools to evaluate assimilative capacity and provide a mechanism to evaluate the relative impact of various sources on nutrient and dissolved oxygen conditions in the mainstem Cape Fear River. With support from DWR and the associated discharger monitoring coalitions, a two-year intensive monitoring study began in January 2019. The water quality model will be developed following the completion of the study.

Four episodic algal blooms where reported to DWR in the Cape Fear River basin in 2019. They were reported in Jordan Lake (7/2/2019), Greenfield Lake (7/16/2019), Northeast Cape Fear River (7/16/2019) and in a Wilmington stormwater pond (8/12/2019). The potentially harmful bluegreen alga was the dominate algal species present in all four blooms reported.

The Cape Fear River Classification Schedule [15A NCAC 02B .0311(u)] was amended effective November 1, 2019 with the reclassification of a portion of Sandy Creek in the Deep River watershed from WS-III to WS-III CA. The reclassification resulted in an updated representation of the water supply watershed for the Sandy Creek reservoir.

There is also a reclassification underway for a section of the lower Cape Fear River from the mouth of Toomers Creek near Wilmington to a line across the river between Lilliput Creek and Snows Cut from Class SC, Swamp to Class SC. The public hearing is scheduled for October, 2020.

A Cape Fear River Animal Feeding Operations Monitoring Study (CFRAFOMS) was initiated in April 2018 as part of a Title VI, Environmental Justice Agreement. This is an ongoing surface water quality monitoring study that evaluates water quality in watersheds adjacent to high concentration of permitted animal feeding operations utilizing lagoon and spray fields for waste management. A preliminary report presenting data from eleven monitoring stations in Duplin and Pender Counties from April 2018 to October 2019 is available here. The results to date, indicate that instream nutrient (nitrogen and phosphorus) and pathogen (fecal coliform bacteria) concentrations were significantly higher at stations located in the concentrated animal feeding operation (AFO) areas as compared to the reference station with no AFOs in the drainage area.

Emerging compounds have been identified as a major water quality concern throughout the Cape Fear River basin. There are several divisions within DEQ that are involved with the monitoring and regulations of these compounds. There is also a 16-member Secretary's Science Advisory Board which was established to help examine new and emerging chemicals and provide guidance on how to manage these compounds to better protect public health and the environment. There is additional information available on the departments websites: Emerging Compounds and GenX.

Water quality and quantity issues will be discussed in detail in the Cape Fear River basin plan. Due to the size of the Cape Fear River basin, the basin plan will be presented to the EMC as major watersheds as sections are completed.

Chowan River Basin

The Chowan River basin plan is scheduled to be presented to the Water Quality Committee in 2020. Nutrient loading continues to be a water quality issue throughout the basin. The 1982 Chowan River Water Quality Management Plan goals included nutrient reductions of 30 to 40 percent for phosphorus and 15 to 25 percent in nitrogen to achieve a reduction in chlorophyll *a* concentration with peak levels not to exceed 40 µg/L. The goals were established through the Nutrient Sensitive Waters (NSW) Water Quality Management Plan for the Chowan River Basin.

(Photo: Chowan River near Colerain, July 13, 2020; Steve Chesson)

The Chowan River and its tributaries have seen a steady increase in organic nitrogen concentrations since 2000 with significant algal blooms reported since 2015. Blooms appear to be occurring early in the season with algal blooms reported near Harrellsville as early as June 2019. The following year, local citizens noticed blooms as early as June 2020 on the Chowan River. DWR defines an algal bloom as having dissolved oxygen (DO) concentrations at or above 9 mg/L (110% saturation) and a pH higher than 8. An algal bloom is also defined by as algal concentrations at or above 10,000 units/mL (unit density). Fifteen algal bloom events were reported between this timeframe of July 2019 and June 2020 with four blooms in 2019 that exceeded the WHO recreational guideline of 10 µg/L microcystin toxin. These four events occurred on July 17th, 23rd, 29th, and August 13th in the Chowan River. These blooms had chlorophyll *a* concentrations ranging from 72 to 984 µg/L, and microcystin toxin concentrations ranging from 21 to 620 µg/L. The state's current chlorophyll *a* standard is 40 µg/L.

Other problem parameters in the Chowan River basin are turbidity, fecal coliform, and biological impairments suspected to be the result of nonpoint source runoff from agriculture and stormwater runoff. Dissolved oxygen levels in the upper Chowan River are also a concern to ecological health. These low levels are the result of water flowing from the two rivers in Virginia (Nottoway and Blackwater) that form the Chowan River near the Virginia-North Carolina state line, but these low levels progressively increase from the state line to the Albemarle Sound.

The ISB Ambient Lakes Monitoring Program visited Merchants Millpond as part of their 5-year lake sampling rotation beginning in May of 2020. The water quality data collected will be used to calculate the nutrient enrichment (trophic state) of the lake and determine if it is meeting its designated use.

Because 75 percent of the river basin is in Virginia, the Albemarle-Pamlico National Estuary Partnership (APNEP) is working with natural resource agencies and stakeholders in Virginia and North Carolina to understand nutrient loading and its impact to water quality in North Carolina. The Albemarle Commission

(Region R Council of Governments) has obtained grants from the Clean Water Management Trust Fund (CWMTF) and US Fish and Wildlife Service (USFS) to study what is contributing to the algal blooms. These efforts include state agencies, universities and local, citizen-led environmental groups. A meeting was held in Edenton on February 5th of 2020 to share information on the possible causes and solutions to the algal blooms occurring the Albemarle region.

French Broad River Basin

Sediment, nutrients and bacteria are the most significant threats to water quality and aquatic habitats in the French Broad River basin. Several stream segments and waterbodies within the basin are classified for primary recreational use (Class B) and fecal coliform bacteria has been identified as a water quality concern in several recreational areas. Sources of bacteria include (but are not limited to) failing septic systems, straight pipes, sanitary sewer overflows and animal access to streams. Heavy storm events often result in increased levels of fecal coliform bacteria being delivered to waterbodies via nonpoint source runoff. Increased flows also resuspend or mix bottom sediment which can increase bacterial levels in the water during and after rain events.

Data collected by DWR's Asheville Regional Office (ARO) in the mainstem of the French Broad River during the recreational season (May to October 2019) indicate that the water quality standard for fecal coliform bacteria is not being met between Bent Creek and Woodfin Park. Further evaluation indicates that 46 percent of the calculated values for five of the stations exceeded the fecal coliform bacteria water quality standard for Class B waters. This stretch of river will be evaluated for potential inclusion on the 303(d) list of impaired waters (Category 5). Bacteria data collected near lower Hominy Creek also showed exceedances for fecal coliform bacteria as well. ARO continues to monitor the recreational corridor of the French Broad River and lower Hominy Creek on a weekly basis and is focusing on monitoring during storm events in order to collect data on different points of the hydrograph to better understand the source of the bacteria and how it correlates with precipitation events in the region. Results are being shared with local stakeholders to identify potential bacterial sources, projects and funding opportunities.

ARO continues to work with Duke Energy and Warren Wilson College to study chronic cyanobacterial blooms in Waterville Lake. Waterville Lake is an impoundment on the Pigeon River in Haywood County in the French Broad River basin that experienced some the highest concentrations of microcystin (580 µg/L) detected by DWR (August 2018) to date. To understand potential nutrient sources that could be contributing to the algal blooms in Waterville Lake, fourteen additional sampling locations were added to the six existing ambient monitoring stations in the Pigeon River watershed. Data is in the process of being analyzed to help identify and target areas in the watershed that may be contributing nutrients to the watershed.

Working with the DWR central office and ARO, the French Broad River Partnership is developing an online, interactive watershed action plan (WAP) for the upper Swannanoa River, Cane Creek and Richland Creek. Online and mobile apps will be used to identify potential sources and stormwater conveyances, potential project areas, where projects have already been implemented, existing land use, and potential partners to implement and install best management practices throughout these watersheds.

Hiwassee

Sediment, warmer temperatures in areas with inadequate riparian buffers, and unstable streambanks is a significant threat to aquatic habitat in the Hiwassee River basin. A combination of cattle access to streams, failing septic systems, year-round geese populations, and aging wastewater infrastructure continue to be associated with bacterial impairments throughout the basin.

Significant hydrologic modification in the basin from the Chatuge, Hiwassee, and Appalachia dams along the Hiwassee River have altered the natural flow regime and stream habitat in the basin. Generally, the water released from the dams is good quality, but the colder waters released from the dams have changed the fish community from historic records. There is limited information on what alterations to the benthic communities may have occurred. The magnitude and duration of the dam release have also caused some problems downstream. Streambank erosion from fast moving water and flooding of homes and agricultural fields were reported because of dam releases after heavy rain events in 2018.

Construction in the basin has increased impervious surface areas and altered natural hydrology by inhibiting stormwater infiltration. Building near steep and unstable streambanks has been particularly problematic for stream sediment inputs. Implementation of stormwater BMPs, riparian buffers, and cattle exclusion fencing is highly needed in some areas of the basin. Ambient water quality monitoring by DWR in the basin is also limited. Currently, there are only two permanent ambient monitoring stations in the entire 644 square mile basin.

Fish community, benthos, and lake sampling was conducted during the 2019 field season in the Hiwassee River basin. DWR also worked the Hiwassee River Watershed Coalition, now a part of Mountain True, to identify a benthos sampling location along Little Brasstown Creek and ambient special study sample locations along the Valley River in the vicinity of Andrews. The data is currently being processed.

Little Tennessee River Basin

Impairments on the 2018 303(d) report in the Little Tennessee Basin are fecal coliform bacteria and exceedances of both benthic macroinvertebrate and fish community ratings. Identified as key contributors to water quality concerns in the 2012 basin plan were steep-slope development, agricultural runoff, streambank erosion, reduced riparian areas, failing culverts and damaged or aging individual septic and municipal wastewater collection systems.

Two streams were delisted from the 303(d) impaired waters list in 2018. Iotla Creek was delisted for meeting criteria for fish community and Whiteoak Creek was delisted for benthos. Iotla Creek, however, remains on the 303(d) list of impaired waters for fecal coliform bacteria and the Tuckasegee-Little Tennessee rivers confluence at Fontana Reservoir was added to the list for exceeding water quality standards for fecal coliform bacteria.

Fontana Reservoir, a Tennessee Valley Authority (TVA) impoundment, is formed by a dam downstream of the confluence of the Little Tennessee, Tuckasegee and Nantahala rivers. Although the Tuckasegee arm of Fontana Lake had potentially harmful algal blooms (pHABs) during the summers of 2015 through 2017, no blooms have been documented since. Although previous water quality data collected at the ambient monitoring station just upstream of the impoundment indicate that nonpoint source runoff during rain

events may be adding excess nutrients to the river and contributing to the algal blooms, the exact source of the nutrients or the triggering conditions to create a noticeable algal bloom are unknown. Additional research and analytical tools would help DWR understand the cause of the algal blooms.

Nine reservoirs were sampled in 2019 (Nantahala, Bear Creek, Cedar Cliff, Thorpe, Sequoyah, Fontana, Cheoah, Calderwood and Santeetlah). All were rated as Oligotrophic except for Sequoyah which received a Mesotrophic rating.

DWR's Asheville Regional Office (ARO) has focused sampling efforts on the lower Cullasaja River with assistance from Mainspring Conservation Trust. The Cullasaja River exhibited a decline in benthic macroinvertebrate bioclassification in July 2018 changing from an Excellent at the upstream reference site to Good further downstream to Good-Fair just upstream of the confluence with the Little Tennessee River. This trend suggests possible water quality declines in the downstream reaches due to nonpoint source pollution. In addition to overall declines in benthic richness and abundance when comparing the reference to the downstream reaches, the increased biotic indices suggests fewer intolerant and more tolerant benthic fauna.

Fourteen macroinvertebrate stations were sampled in twelve streams in the basin during May, July and August 2019 for the five-year basin sampling (Caney and Bradley forks; Cullowhee, Deep, Noland, Deep, Forney, Eagle, and Turtle Pond creeks; and Tuckasegee, Cullasaja, and Oconaluftee rivers). All stations received an Excellent rating except for one of three sites on the Cullasaja River that received a rating of Good, which was a slight improvement for this station from 2018. Benthos special studies were completed in the Little Tennessee in 2019 including the Cullasaja River Special Monitoring, Coweeta Hydrologic Laboratory Climate Change Effects in Riparian Vegetation, and 2019 NARS: National Rivers and Streams Assessment studies. The Coweeta study is scheduled to continue into 2020 along with additional sampling for a minimum flow release study.

Thirteen streams were each sampled for fish in April and May 2019. Compared to previous samples reported in 2012 basin plan, four maintain a Good-Fair rating, three maintained a Good rating, two declined to Good-Fair, one improved to Excellent and two were Not Rated. Mainstream Conservation Trust sampled fish in 16 streams in the upper Little Tennessee River watershed in Swain and Macon counties, as well as two in Rabun County, Georgia, between May and September 2019. These data were not used to establish the present NCIBI ratings or for water quality assessments purposes.

A watershed action plan (WAP) was developed by Equinox Environmental for the Town of Sylva for the Scotts Creek watershed using a Clean Water Management Trust Fund (CWMTF) grant and local contributions. The creek is classified as C; Tr; passes through the towns of Sylva and Dillsboro; and is a tributary of the Tuckasegee River, with the confluence at a popular boating access site at Highway 23/441, just downstream of the site of the Dillsboro dam removal. Scotts Creek, as well as the Tuckasegee River, is on the 303(d) list of impaired waters for fecal coliform bacteria. Some of the recommendations in the WAP include a county-wide assistance program to repair failing septic systems, high-impact stormwater and riparian restoration projects at 17 locations identified within Sylva and an improvement plan for the town's Bridge Park. A 9-element plan has been submitted by the Watershed Association of the Tuckaseegee River (WATR) to DWR for approval and eligibility for 319 Grant funding.

The ARO and WATR are continuing to collect fecal coliform data in the Scotts and Savannah creek watersheds. WATR and ARO are working with DWR central office to develop an online WAP for Savannah Creek. Like the Scotts Creek 9-element plan, the goal is to submit a 9-element plan to DWR for approval and eligibility for 319 Grant funding. The Savannah Creek WAP will target two focus areas and will be a good example of an action plan to improve a watershed that is largely rural and agricultural.

The Final Decision Notice and Finding of No Significant Impact (FONSI) was issued by the U.S. Forest Service in May 2020, for the Buck Project, a 20,638-acre assessment unit in southeastern Clay County that includes the Buck Creek watershed, a tributary to the Nantahala River upstream of Nantahala Reservoir. The plan encompasses timber harvest, temporary road construction, invasive plant control, stand improvements, controlled burns, wildlife forage plantings and stream restorations. In the Buck Creek watershed, proposed restoration efforts include reintroducing brook trout to Little Buck Creek; removing dispersed campgrounds in the Glade Branch floodplain, stabilizing streambanks, removing trash dumps and eliminating off-road vehicle access and an old road in the Barnards (Branch) Creek riparian zone, removing a log crib fish barrier and stabilizing stream banks.

Lumber River Basin

Stormwater, rapid growth and development, damaged or aging wastewater infrastructure, and large agricultural operations were identified as water quality issues in the 2010 Lumber River basin. Elevated bacteria concentrations from stormwater runoff, leaking septic systems and/or municipal wastewater collection systems are impacting shellfish harvest areas with all shellfish waters impaired due to either permanently or frequently closed shellfish areas. In 2019, nearly 3,000 acres of shellfishing waters were closed indefinitely, leaving both commercial fisherman and seafood dealers concerned about their livelihoods.

Much of the stormwater runoff can be attributed to population growth in Brunswick County which is in the lower part of the basin. Efforts are underway to reduce stormwater runoff in the Lockwoods Folly River watershed along the Brunswick County coast. A Water Quality Management Plan became effective in 2014 and includes Lockwoods Folly River north from the Intracoastal Waterway to a line extending from Genoes Point to Mullet Creek to protect and improve water quality throughout the watershed. Proper planning including stormwater management programs, wastewater treatment plant upgrades, and land conservation are required to protect water quality as the area continues to grow. For activities, such as stormwater controls, proactive implementation prior to development can save considerable costs compared to retrofitting. Low dissolved oxygen, turbidity and low pH have also been identified as parameters of interest in the basin.

Over the past several years, hurricanes have had a devastating impact on the Lumber River Basin. In 2018, Governor Cooper's office published extensive studies of flooding concerns and possible solutions for flooding in the Neuse, Cape Fear and Lumber river basins. These studies looked at a range of flood prevention projects, including new dams, reservoirs and levees. The studies concluded that the most cost-effective approach is elevating flood-prone buildings or buying out the properties and demolishing buildings.

In March 2020, staff attended a kickoff meeting to discuss funds allocated by Congress for the "Additional Supplemental Appropriations for Disaster Relief Act (DRA) of 2019". The act provided money to "help Americans recover from the catastrophic disasters that have struck the Nation in the past three years". It authorized the United States Army Corps of Engineers (USACOE) to conduct studies with implementable solutions to address flooding in the Neuse, Tar-Pamlico and Lumber river basins. $3,000,000 was allocated to the Lumber River basin.

DWR is currently working on developing a hydrologic model for the Lumber and Yadkin-Pee Dee river basins which is scheduled to be completed later this year.

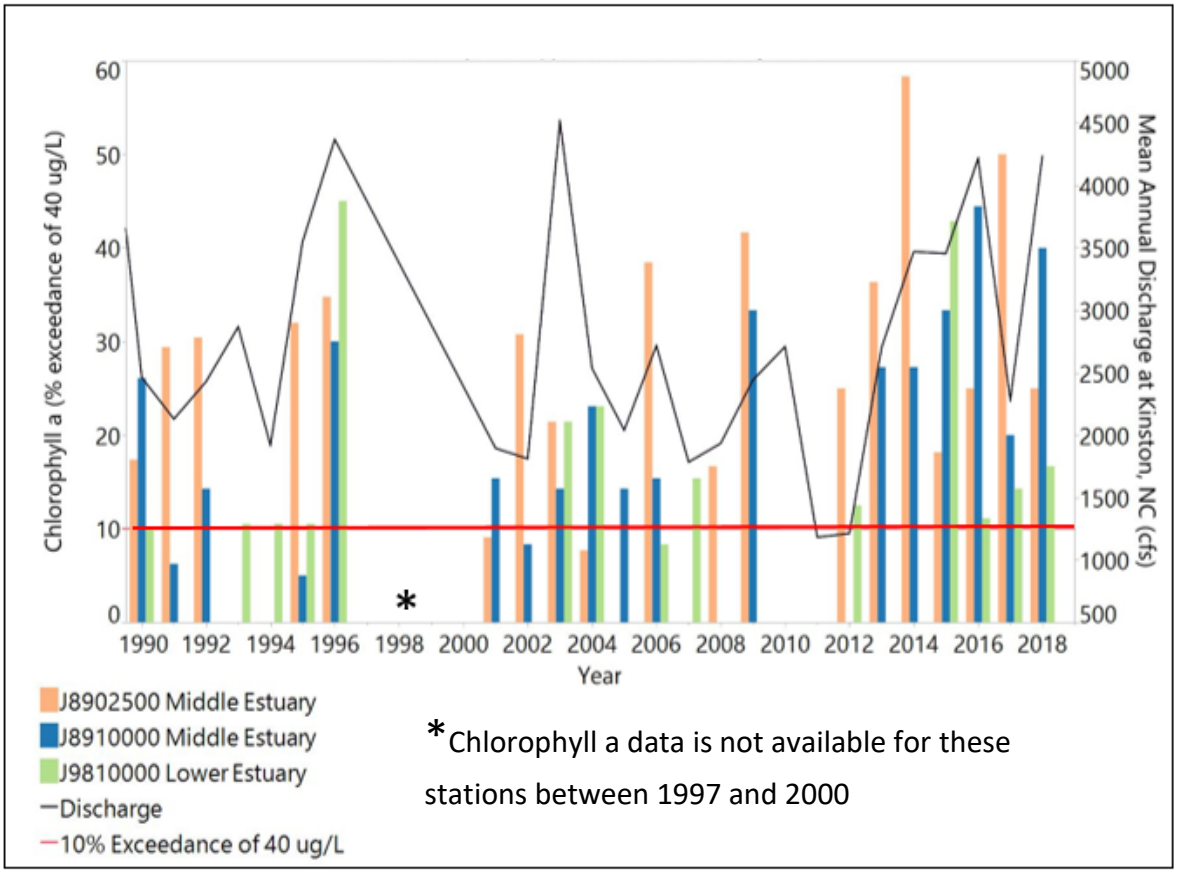
Neuse River Basin

Nutrient strategy implementation efforts are ongoing for the Neuse River Estuary and have been reported to the Water Quality Committee (WQC) and EMC over time as requested and through the annual agricultural report to the EMC. DWR resources and implementation activities in the Neuse River Basin have also focused heavily on the implementation of the Falls Lake Nutrient Strategy.

Water quality analysis of basinwide nitrogen loading in the Neuse River Estuary indicates that the overall nutrient strategy goal to reduce total nitrogen by 30 percent has not been achieved. Initial nutrient reduction efforts were successful in reducing loads from both municipal and agricultural sources, as well as mitigated nutrient loading from increased population growth within the Basin. The required riparian buffers have helped to limit additional nutrient-laden stormwater runoff from new and existing development throughout the basin. However, despite these efforts and reductions that have been made, DWR has identified an increase in the organic nitrogen load. This increase is currently offsetting the reductions made as result of the nutrient strategy rules.

The goal of limiting total nitrogen loading is to reduce exceedances of chlorophyll *a*, an indicator of algal growth. Because of this, changes in chlorophyll *a* in the estuary are also being assessed alongside trends in nutrient loading. The extent of the chlorophyll *a* impairment increased in the Neuse River Estuary between the 2016 and 2018 Integrated Reports. For the 2016 Integrated report, the lowest point in the estuary that exceeded criteria for chlorophyll *a* was Minnesott Beach. In the 2018 report, assessment units that exceed criteria stretch from the confluence of the Trent River at New Bern to the South River. DWR ambient data indicates that this is related to high mean annual flows in recent years (Figure 6). Greater flows through the Neuse River carry nutrients further into the estuary before conditions become favorable for algal growth. In wet years like 2015 and 2016, chlorophyll *a* exceeds the standard more frequently in the lower middle (station J8910000) and lower (J8910000) segments of the estuary, whereas dry years like 2017 exhibit higher algal growth in the upper middle (station J8902500) estuary (Figure 6). Because of the year to year changes in spatial extent of chlorophyll *a*, it is challenging to discern whether management actions have resulted in a reduction in algal growth.

Figure 6: Percent Chlorophyll a Standard Exceedances in the Neuse River Estuary and Mean Annual Discharge at Kinston, NC



As part of the required basin planning process in a designated NSW watershed, the success and limitations of the NSW rules are assessed. In the Neuse River basin, the last basin plan identified gaps in the existing nutrient management strategy and included recommendations or modifications to improve the strategy's efficacy. Some of these recommendations were proposed for inclusion in the readoption of the Neuse strategy rules that were readopted by the EMC pursuant to G.S. 150B-21.3A and went into effect in April 2020. The most significant changes made to the rules address the wastewater and new development sectors and nutrient offsets.

The Neuse wastewater rule was readopted with changes that better synchronized timing between offset requirements and new permitted loads providing potential cost savings under the offset credit option while still ensuring that new loads are effectively offset. The nutrient offset rule, which applies to all nutrient strategies, was also updated to improve the utility of nutrient offset credits. The readopted rule includes explicit recognition of NPDES permittee-generated offset options as well as a new pathway to generate permanent nutrient offset credits and revised the point to nonpoint trading ratio providing additional cost savings for new and expanding wastewater dischargers.

The readopted Neuse new development stormwater rule added fifteen jurisdictions to the rule, many of which have experienced significant population growth trends, addressing a growing gap that will help mitigate against further nutrient increases. Other revisions to the rule address an unintended gap in onsite treatment requirements, stipulating treatment when development reaches 24% built-upon area, which invokes minimum statewide MS4 rule requirements. Finally, through the Stormwater Nitrogen and Phosphorus (SNAP) tool, the rule incorporates the latest developments in stormwater science and expands the suite of stormwater control measures and design variations available to developers to reflect DEMLR rule changes and guidance

The DWR's Planning Section continues to develop and assess new information that can inform future Neuse nutrient strategy improvements. Recent internal efforts have focused on identifying potential sources of increasing organic loads to the Neuse River Estuary. Areas of inquiry include the potential influence of poultry operations, changes in acid rain deposition and soil pH resulting in increased export of organic nutrients, an evaluation of organic nitrogen trends in North Carolina and neighboring states, and an evaluation of laboratory methods over time. To date, no single source has been identified as the cause for increasing organic nitrogen trends.

In August 2020 the Department began the process to develop a Neuse watershed model in conformance with Session Law 2020-18. The resulting model will, at minimum, establish new transport/delivery factors for point source discharges and nutrient offset credits throughout the Neuse River Basin, and is also expected to provide new insights regarding nutrient loading to the Neuse River estuary. This modeling work will take place over the next several years and will be conducted in conjunction with affected parties in the basin. Once completed**,** the results of the modeling effort will be used by the EMC to adopt new transport/delivery factors through rulemaking.

Regarding the Falls nutrient rules, buffer and new development, and Stage I of agriculture and wastewater rules are fully implemented. Recent efforts have focused on implementing Stage I of the existing development rule. These efforts have included the development of credits for new nutrient reduction practices and establishment of local jurisdictional load reduction requirements. The Upper Neuse River Basin Association (UNRBA) continues its longstanding advancement of these rules by providing a forum for engagement and policy discussion among Falls Lake local governments. In 2019 the UNRBA, with collaborative input from DWR and other stakeholders, proposed advancing implementation through a combined compliance approach for Stage I of the Falls Existing Development Rule known as the Interim Alternative Implementation Approach (IAIA). DWR staff are currently working with the UNRBA membership as they finalize the IAIA proposal and plan to bring the Falls Stage I Existing Development Model Program to the EMC for approval by the end of 2020.

By recent session laws, Falls Stage II initiation is postponed and will presumably be supplanted by the results of Falls Lake rules readoption. The timeline for the Falls Lake nutrient strategy rules readoption was delayed by Session Law 2016-94 and S.L. 2018-5. According to the current timeline, the N.C. Policy Collaboratory will provide the final results and recommendations of its Falls Lake study by December 31, 2023. SL 2018-5 further requires the Environmental Management Commission begin Falls Lake rulemaking upon receipt of the Collaboratory's findings or by December 31, 2024, whichever comes first.

The UNRBA has collected five years of additional water quality monitoring data from the Falls watershed between August 2014 and October 2018 to be used along with the ongoing lake monitoring data DWR collects to remodel Falls Lake and its watershed to support the re-examination of the Stage II requirements. The UNRBA's modeling work is scheduled to be completed in 2023. The results of the re-examination effort will help guide the Falls rules readoption process and be made available for consideration by the Collaboratory to help guide any recommendations put forth in the final Falls Lake Study Report.

In 2019, there were five reported episodic algal blooms in the estuarine portion of the Neuse River Basin located between the confluence of Swift Creek down to the section near Fairfield Harbor. Two of the five where identified as potentially harmful bluegreen algae. The two additional episodic algal blooms were reported in a small ponds in Craven and Granville Counties. Both were identified as potentially harmful bluegreen algal blooms.

The Neuse River Basin Water Resource Plan will be updated with the goal of completing the plan in 2022. Planners are working on an evaluation of the Neuse River Estuary and NSW compliance point trend analysis. The Neuse River plan will follow and will include the Cape Fear–Neuse River basin hydrologic model and analysis along with the general water quality and quantity issues at the subbasin and basin level. Planners will work with the stakeholder in the basin as the plan progresses.

New River Basin

Aquatic habitat degradation (as indicated by impaired biological integrity and high turbidity) has been identified as a major water quality concern in the New River basin. In most cases, degradation is the result of the cumulative effect of several stressors acting in concert. The stressors often originate in the upstream portions of the basin and include runoff from impervious surface, sedimentation from construction runoff, general agricultural practices, and/or other land disturbing activities. The distribution of turbidity permit violations and standard exceedances at AMS stations make it difficult to isolate potential sources in the New River Basin. However, it appears that violations are highest in urban and agricultural areas. Violations are lowest in most headwater portions of the basin where land use is predominantly forested. This demonstrates the importance of protecting and conserving stream buffers and natural areas.

Pasquotank River Basin

Nutrients continue to be a water quality issue throughout the entire Pasquotank River basin. Since the early 1990s, monitoring data has shown a steady increase in phosphorus in the Little River. A steady increase in organic nitrogen has also been identified across all ambient monitoring stations since the mid-1990s. The steady increase in nutrients are likely contributing to the algal blooms that were reported in the Albemarle Sound, Little River and Perquimans River since 2015.

Between June 2019 and October of 2019, seven algal blooms were reported in the Pasquotank River, Little River, Perquimans River, and the Albemarle Sound. The blooms observed in these rivers and in the sound have been determined to contain dominant taxa of *Dolichospermum*, *Cylindrospermopsis*, and/or

Little River Algal Bloom July 2, 2019 (Photo by R. Johnson)

Pseudanabaena, which are cyanobacteria. These cyanobacteria blooms can cause discoloration of the water, odor problems and have the potential to produce cyanotoxins. Only one of the algal blooms reported in the Pasquotank river basin had detectable microcystin toxins at 0.44 µg/L. Chlorophyll *a* concentrations ranged from 19 - 131 µg/L. The Albemarle Commission (Region R Council of Governments) obtained grants from Clean Water Management Trust Fund (CWMTF) and US Fish and Wildlife Services to study the drivers of algal blooms in the Albemarle Sound. The Commission is collaborating with state agencies, universities and local citizen-led environmental groups. A meeting was held in Edenton on February 5th, 2020 to share information on the possible causes and solutions to the algal blooms occurring the Albemarle region. Research is currently focusing on the Little River Watershed in the Pasquotank River Basin.

The Albemarle Resource Conservation and Development Council (RC&D) and the Albemarle Soil and Water Conservation District (a multi-county soil and water conservation district) along with eight counties surrounding the Sound have adopted and sent to legislators a resolution to strengthen critical drainage and water quality infrastructure. Drainage canals can carry sediments and nutrients to the river, and residential and commercial developments contribute to increased pollution from stormwater runoff.

The ISB Ambient Lakes Monitoring Program visited Phelps Lake as part of their five-year lake sampling rotation beginning in May of 2020. The water quality data collected is used to calculate the state of nutrient enrichment (trophic state) and determine if lakes meet their designated use. Data is currently being processed.

Roanoke River Basin

Declining dissolved oxygen levels as well as elevated water temperature, fecal coliform bacteria, chlorophyll *a* and turbidity concentrations, continue to be identified as water quality concerns throughout the entire basin. Marlowe Creek was listed on the 303(d) list of impaired waters in 2018 due to a dissolved metals pilot study that ran from 2015 to 2016. Habitat degradation is also a concern throughout the basin. Field biologists noted higher levels of precipitation during previous benthic sampling events, suggesting waterbodies are being impacted by increased nonpoint source pollutant runoff from upstream sources.

Water quality monitoring data of the Dan River show that levels of coal ash related constituents are similar to conditions measured upstream, indicating that the constituents are naturally occurring, or are background levels. Coal ash excavation from the onsite basins started in November 2015. DEQ approved the proposed Closure Plan by Excavation for Mayo Steam Station in Roxboro in April 2020. The decision is based on DEQ's finding that the Closure Plan "is protective of public health, safety, and welfare; the environment; and natural resources and otherwise complies with the requirements of Coal Ash

Management Act." The Roxboro Power Station and Belews Creek Steam Station also submitted closure by excavation plans in December 2019.

The Intensive Survey Branch (ISB) Ambient Lakes Monitoring Program visited the lakes of the Roanoke River basin as part of their five-year lake sampling rotation completed in 2019. The water quality data collected in lakes is used to calculate the state of nutrient enrichment (trophic state) and determine if lakes meet their designated use. Fish and benthos communities were also sampled in 2019 by the Biological Assessment Branch (BAB). Data is currently be processed and will be used for the 2022 IR.

Savannah River Basin

The federal government is the single largest landowner in the Savannah Basin. The U.S. Forest Service (USFS) is responsible for managing the land and resources. How these resources are managed, used and accessed can have ramifications to the quality of the streams that drain through these watersheds. The proposed Nantahala and Pisgah National Forests Land Management Plan was released in February 2020 for public comment. The plan includes forest-specific guidance to manage use of and access to terrestrial and aquatic resources in the two national forests. The existing management plan was first published in 1987. The final plan is expected in late 2020.

Several streams in the Savannah River basin have the supplemental classification of Trout (Tr) and Outstanding Resource Waters (ORW) with portions of two rivers (Horsepasture and Chattooga) being designated as a National Wild and Scenic River. Horsepasture River below N.C. 281 to Lake Jocassee is also designated as a NC Natural and Scenic River. Four benthic macroinvertebrate stations were sampled in July 2019 (Big, Indian, and East Fork Overflow creeks and the Chattooga River). All received Excellent ratings except for Indian Creek which was rated Good. No lakes or fish stations were sampled in 2019.

Tar-Pamlico River Basin

The 2015 Tar-Pamlico River basin plan identified stormwater, increased flow and velocity, erosion and sediment control, pesticide and nutrient management from urban and agricultural land (crop, animal and aquaculture facilities), and damaged or aging wastewater collection systems as key contributors to water quality issues in the basin. Several communities in the basin do not have or do not fall under a stormwater management program and additional research is needed to assess how uncontrolled stormwater runoff is impacting surface waters and nutrient loading to the estuary. Protecting existing riparian buffers can also play a critical role in stabilizing and protecting streambanks and reduce nutrients from overland flow.

Because nutrients have been a water quality concern for the basin, waters in the basin were designated as Nutrient Sensitive Waters (NSW) in 1989. Despite the apparent successful implementation in reducing nutrient loads from municipal wastewater facilities and several agricultural practices, the goal of reducing total nitrogen by 30 percent has not been met. Data collected over the last several years indicate that organic nitrogen is increasing. As described in the Neuse River Basin section, recent internal efforts have focused on identifying potential sources of increasing organic loads to North Carolina's estuarine waters.

The plan also notes there are likely nutrient sources beyond those regulated under the nutrient management strategy that may be contributing to the nutrient loads and that some nonpoint sources may not have been accounted for or are exceeding the original source (i.e., land use changes or changes to

agricultural operations). While the implementation efforts taken to date have not fully achieved compliance with the NSW strategy, the nutrient reductions achieved by point sources and agriculture have helped reduce the severity of fish kills in the Pamlico River and Estuary. DEQ is continuing to work with municipal wastewater facilities and the agricultural community to maintain their compliance with the strategy.

As part of the required basin planning process in a designated NSW watershed, the success and limitations of the NSW rules are assessed. In the Tar-Pamlico River basin, the assessment identified gaps in the existing nutrient management strategy and included recommendations or modifications to possibly improve the strategy in order to meet water quality standards in the estuary. As a result of the required rules review legislation (§150B-21.3A), the Tar-Pamlico River Basin Nutrient Sensitive Waters (NSW) Management Strategy rules found in 15 NCAC 02B .0255 - .0261 were readopted by the EMC and went into effect in April 2020.

The readopted Tar-Pamlico nutrient strategy rules address the recommendations identified during the basin planning process as well as the rules review and stakeholder input process. The most significant changes made to the rules address the wastewater and new development sectors and nutrient offsets.

The Tar-Pamlico wastewater rule was readopted with revisions providing all wastewater facilities in the basin a clear regulatory path to utilize both allocation trading and the existing nutrient offset credit market. This includes Tar-Pamlico Basin Association members, which are now provided with clear regulatory options for expansion, which do not exist within the Phase IV Tar-Pamlico Basin Agreement. The rule also includes new treatment efficiency standards for new and expanding non-association dischargers. This change is incorporated for several reasons including advancements in wastewater treatment technology since this rule was originally implemented in 1997, the fact that total nutrient loading to the estuary remains above TMDL levels, and the consideration that domestic expansions in this basin appear to be unlikely for twenty years or more.

The nutrient offset rule, which applies to all nutrient strategies, was also updated to improve the utility of nutrient offset credits. The readopted rule includes explicit recognition of NPDES permittee-generated offset options as well as a new pathway to generate permanent nutrient offset credits and revised the point to nonpoint trading ratio providing additional cost savings for new and expanding wastewater dischargers.

The readopted Tar-Pamlico new development stormwater rule was updated to add one additional jurisdiction to the rule. Fewer local governments were added to the rule in the Tar-Pam than the Neuse because of the lower population growth in the less urbanizing Tar-Pamlico Basin. Other revisions to the rule address an unintended gap in onsite treatment requirements, stipulating treatment when development reaches 24% built-upon area, which invokes minimum statewide MS4 rule requirements. Finally, through the Stormwater Nitrogen and Phosphorus (SNAP) tool, the rule incorporates the latest developments in stormwater science and expands the suite of stormwater control measures and design variations available to developers to reflect DEMLR rule changes and guidance

There were three episodic algal blooms reported in the Pamlico River estuary in the areas between Chocowinity Bay and Blounts Bay in Beaufort County in 2019. The July 17, 2019 bloom was associated with the pHAB *Cylindrospermopsis*. A non-HAB bloom in Blounts Bay on October 1, 2019 was associated with a

reported fish kill. Approximately 150,000 Menhaden were calculated to have died and all appeared to have visible sores. Water quality parameters measured at the time of the investigation were within normal ranges.

Located in the Tar-Pamlico River basin, Lake Mattamuskeet is the largest natural lake in NC and is part of the Mattamuskeet National Wildlife Refuge. The lake provides habitat for over 250,000 wintering waterfowl and other migratory birds. The entire lake was added to the 2016 impaired waters list due to elevated chlorophyll *a* concentrations and pH levels. USGS monitored the lake on four occasions between May and September 2017. DWR monitored the lake in May 2017 and found that the lake trophic status has increased from eutrophic to hypereutrophic. The chlorophyll *a* concentrations in June 2019 measured close to 200 µg/L (state standard is 40 µg/L). DWR is working with the US Fish and Wildlife Service (FWS) to better understand the water quality of this unique system and to understand the nutrient sources and algal bloom issues. Algal blooms have become a more frequent occurrence and contain harmful cyanotoxin concentrations leading the FWS to posted warning signs around the lake in 2019 about health risks associated with harmful algal bloom exposure.

A local watershed restoration planning effort began in 2016 and has involved many different stakeholders in order to identify the sources of the problems within the watershed as well as identify solutions. The North Carolina Coastal Federation is partnering with the US Fish and Wildlife Service, the NC Wildlife Resources Commission and Hyde County to develop the *Lake Mattamuskeet Watershed Restoration Plan*. Development of the plan has included many stakeholder and public meetings. The three main goals of the plan are:

1. Protect the way of life in Hyde County while supporting the lake's natural resources.
2. Reduce flooding by improving the ability to control lake levels.
3. Restore water quality by reducing nutrients and sedimentation, which will promote the growth of submerged aquatic grasses for waterfowl habitat and removing the lake from the state's impaired waters list.

The restoration plan was approved by DWR on August 7, 2019, making the Lake Matamuskeet watershed area eligible to receive EPA restoration funds. Research and restoration efforts identified in the plan are currently underway by several of the project partners.

Watauga River Basin

The Watauga River basin plan was approved by the EMC in October 2018. Stormwater, steep slope development, limited riparian areas, streambank erosion, individual onsite wastewater collection systems as well as damaged or aging public water supply (PWS) systems and municipal wastewater collection systems are impacting water quality and quantity throughout the basin. Water quality data collected at the ambient monitoring stations and by the Wildlife Resources Commission (WRC) indicates that water temperature is increasing in the mainstem of the Watauga River. Many of the streams in the basin support a rich and diverse trout population, but the numbers have been declining over recent years due to development, limited shade from riparian areas and increased stormwater runoff.

Beaverdam Creek is the only impaired water in the North Carolina portion of the basin. Several agricultural best management practices (BMPs) have been installed and continue to be installed throughout the

watershed in an effort to improve aquatic habitat with the goal of removing the stream from the impaired waters list.

Information about water supply and demand was included in the 2018 basin plan. Information about water quantity was obtained from various sources including programs managed by DWR's Water Supply Planning Branch (WSPB). One PWS system, the Town of Beech Mountain, was identified in the basin plan as a system that cannot meet its current water supply needs during low flow or drought conditions. DWR's Water Supply Development Program continues to work with the PWS to identify how best to meet current and future water supply needs.

White Oak River Basin

The White Oak River basin plan is currently being developed and is scheduled to be presented to the EMC for approval in 2021. Stormwater runoff, new development/construction, impervious surface areas, animal waste management, and damaged or aging wastewater collection systems are impacting water quality in the White Oak River basin. Coastal communities in the basin are constantly changing, and for decades, the traditional uses of waterfront property have been shifting to accommodate an increase in permanent residents, seasonal rental properties and new development. Residential development has moved inland along tidal creeks and rivers introducing more impervious surface area and increased stormwater runoff. As a result, many of the water dependent resources that people seek out from the coastal areas are diminishing. Public waterfront access is limited, high fecal coliform levels prevent shellfish harvesting and beach recreation, fish houses have closed, and overall fish harvests have continued to decline in the White Oak River basin. The Support Shellfish Aquaculture bill (S.L 2019-37), was passed in June 2019 during the General Assembly's long session. The bill establishes a shellfish enterprise area that will streamline the permitting and re-leasing processes, ensuring the sites growers are leasing won't interfere with other users of public trust waters.

Several agencies, including DWR, Division of Coastal Management (DCM), Division of Energy, Mineral & Land Resources (DEMLR), Division of Marine Fisheries (DMF), the Soil and Water Conservation Districts (SWCDs), Parks and Recreation, and Environmental Health, are responsible for many coastal activities, policies, and education and outreach opportunities throughout the basin. These responsibilities include stormwater management, new development and retrofitting existing development, erosion control programs, agriculture and land preservation, shellfish protection and recreational monitoring. DMF's Coastal Habitat Protection Plan (CHPP) helps guide how to manage and restore aquatic habitats critical to North Carolina's commercial and recreational fisheries resources.

Benthic macroinvertebrates and lakes were monitored in the White Oak River basin during the 2019 field season. Ambient water quality data was also collected for a special study be conducted in Calico Creek. Data will continue to be collected into 2020 with field parameters only. An algal bloom was also detected in Calico Creek in July of 2019, but no algal toxins were confirmed. Data collected in 2019 will be used to assess water quality for the 2022 IR.

The five-year cycle benthos and lake sampling was conducted during the 2019 field season in the White Oak River basin. The ISB collected ambient water quality data for the Calico Creek study in 2019 and continued

into 2020 with just field parameters. An algal bloom was also detected in Calico Creek in July of 2019, no algal toxins were confirmed.

Yadkin-Pee Dee River Basin

Several streams in the Yadkin-Pee Dee River basin are impaired for aquatic life due to aquatic habitat degradation and the associated water quality impacts. This is occurring throughout the basin but largely in urban/suburban areas where increasing impervious surfaces result in greater stormwater runoff, higher peak flows (flashy stream) and lower baseflows. Streambank and instream habitat erosion along with elevated turbidity and pollutant loading concentrations are making it difficult to protect sustainable aquatic populations. Elevated fecal coliform bacteria due to stormwater runoff in urban and agricultural areas is also identified as a water quality concern in the basin. Protecting the existing riparian buffers can aid in the protecting and stabilizing streams, reducing impacts to water quality.

A TMDL alternative restoration plan was completed by the Piedmont Triad Region Council in October 2019 for the Swearing Creek watershed to address degraded water quality conditions that have harmed aquatic habitat. Swearing Creek is a 49-square mile watershed in central Davidson County that includes the western half of the City of Lexington and drains directly to High Rock Lake. Swearing Creek was first listed on the 303(d) list for Fish Community in 2004. Benthic samples over the years have also indicated biological conditions within the stream system are not representative of a healthy stream ecosystem. A watershed assessment for Swearing Creek was completed in 2017. It found that the degraded waters are a collective result of multiple nonpoint sources, including stormwater runoff, new development, existing land-uses, and agricultural practices. The Swearing Creek Restoration Plan coordinates the watershed needs identified during the assessment with the feasibility to create new projects or programs and outline a comprehensive strategy for their implementation. Some of the restoration goals are to update ordinances to address stormwater, strengthening design standards to better protect natural resources, retrofit existing development, restoring riparian buffers, promote infill development to conserve water resources and reduce stormwater runoff, protect rural land, encourage voluntary-agricultural BMPs, increase watershed education and outreach opportunities, and to continue water quality monitoring.

Local resource agencies and data collected through the US Department of Agriculture indicates there has been an overall total decrease for poultry inventory numbers from 67.4 million in 2007 to 62.6 million in 2017 and an overall decrease for poultry production contract numbers from 315.6 million in 2007 to 279.7 million in 2017 for counties with greater than 50 percent coverage in the Yadkin-Pee Dee River basin. However, some individual counties have reported an increase in poultry production numbers. Specific geographical spatial locations, numbers of birds and amount of dry litter waste production is not available making it difficult to evaluate water quality impacts from this potential nutrient source.

High Rock Lake is impaired for turbidity, chlorophyll *a*, and high pH. The lake is very turbid in the upper reaches, and for a large portion of the year, experiences algal blooms downstream of the location where the sediment settles out. Nutrient-related water quality criteria are being evaluated for High Rock Lake through the Science Advisory Council (SAC) in accordance with the Nutrient Criteria Development Plan (NCDP) facilitated by DWR. This process, to date, has been supported by extensive data analysis, ambient

monitoring studies, and a watershed and lake model. The data indicate that the lake's trophic status is eutrophic to hypereutrophic depending on the time of year.

The Science Advisory Council (SAC) has recommended site-specific pH and chlorophyll *a* standards for High Rock Lake. The SAC declined to recommend nitrogen or phosphorus criteria for the lake. Their findings have been documented in a report submitted to DWR in May 2020. DWR is currently facilitating review of those recommendations by the Criteria Implementation Committee (CIC). After CIC review is complete, DWR expects to present site-specific standards for High Rock Lake to the EMC for their consideration.

A regulatory approach to reducing nitrogen, phosphorous, and/or sediment is likely warranted for High Rock Lake to meet either existing or SAC-recommended nutrient-related standards. DWR has begun preliminary nutrient strategy development efforts in collaboration with stakeholders in the basin, including the Yadkin-Pee Dee River Basin Association (YPDRBA). These efforts include a series of educational presentations and internal evaluation of available permitting and environmental data. As the adoption of nutrient criteria moves forward, DWR intends to concurrently support the development and fiscal evaluation of multiple nutrient strategy options in consultation with key regional stakeholders. This approach seeks to minimize the time lag between the adoption of site-specific nutrient criteria and the implementation of a nutrient management strategy designed to achieve them.

DWR is currently working on developing a hydrologic model for the Lumber and Yadkin-Pee Dee river basins which is scheduled to be completed later this year. DWR has been working with the Yadkin-Pee Dee Water Management Group (YPDWMG) and other stakeholders through a technical review committee to develop a model that will be useful both DWR planning staff and local water managers. The model is being developed using the OASIS platform.

In July and August 2019, two algal blooms were detected due to discolored water in ponds located in Iredell County. Algal toxins were not confirmed at either location.

The Yadkin-Pee Dee River basin plan is scheduled to be completed in 2021.

Public Involvement and Education

Public involvement and education on a variety of water quality and quantity issues is an important component of the basin planning process. Examples include specific feedback on new rules and environmental protection measures, requests for data for watershed planning and assessment, and basin plan review and comments. Basin planners work with the public and resource agencies daily and act as a clearinghouse for basin related information. DWR continues to improve on data sharing capabilities to increase public access and enhance the public's ability to explore data on which basin plans are based.

While developing a basin plan, staff work directly with specific watershed stakeholders and resource agencies with the knowledge needed to understand and explain a concern or issue that has been identified in the basin. Stakeholders often provide information on local water quality issues, watershed activities, and issues affecting water availability. Site specific watershed restoration projects are included in each of the basin plans.

The number and amount of interaction with stakeholders and resource agencies varies depending on where the plan is in the development process. Over this annual reporting period, staff worked directly with several soil and water conservation districts (SWCD), local governments and resource agencies as well as several watershed groups. Planners have presented water quality and quantity information at several venues, science advisory committees and basin specific watershed groups and to DWR staff for cross-training purposes. Staff have also participated in several watershed meetings across the state.

In May 2018, the members of the Environmental Management Commission (EMC) agreed to work with the DWR Basinwide Planning Branch to develop an Adopt-A-Basin partnership. The EMC members will serve as an informal liaison between the two partners, which will enhance discussion and bring a greater depth of understanding of basin specific issues to the full EMC basin approval process. Seven new members were appointed to the commission in July 2019. Basin Planning staff worked with EMC Chairman and the Water Quality Committee Chair to assign members of the EMC who were interested in acting as a liaison (see the table in the appendix). Planners will work with members on basin specific issues, actions and goals. The Basin Planning Branch participated in an *Overview of DWR Planning Programs* presentation to the WAC in September 2019 and presented a *Basin Planning Basics* presentation to the WQC in March 2020.

North Carolina DWRs' educational programs are valuable tools to support ongoing statewide public engagement and K-12 educator training. Project WET and It's Our Water are complete water education programs providing hands-on activities and appropriate pedagogy for teachers. Both of these programs also feature online, virtual opportunities for educators and incorporate educational technology to enhance engagement and support digital competency. NC Stream Watch is an outreach tool providing a user-friendly platform for non-technical community members. It can be used to explore nearby streams and rivers while learning about water resources across North Carolina. The use of these programs continue to build momentum as they are applied to an evolving educational environment both in and outside the classroom. Each of these programs can be modified to suit the needs of the learners and the background knowledge of the teachers. Summative assessments of participants in these programs reveal increasing popularity for these water education programs. As a result, educators are excited to add their new knowledge about the hydrosphere to environmental educational opportunities in formal K-12 settings.

DEQ's Stream Watch program is undergoing renewed initiatives to incorporate hands-on and interactive technology for learners of all ages. The latest version of NC Stream Watch encourages an audience of potential stream watch participants to include even more schools and educational groups. Public involvement and citizen science programs, like NC Stream Watch, help connect local communities with state agencies like DWR. The latest development in this program is a consolidated survey to examine various aspects of stream health along with an interactive dashboard for participants to learn updated, real time data from other NC Stream Watchers. This network of active "stream watchers" benefits our environment while promoting relevant educational opportunities in their own community. Watershed groups and other stakeholders are able to utilize user-friendly surveys for stream monitoring on their mobile device. This program is designed for non-technical community members interested in learning about their stream and watershed. By completing the surveys, participants are taught to look at features of stream-bank and stream-bed habitat potential, macroinvertebrate presence, and other aspects that do not require instrumentation or extensive training. During their time in the stream, they can collect data on a range of

topics, depending on their interest and skill level. From scout groups to AP Earth and Environmental classes, the NC Stream Watch program allows stream monitoring to be relevant to communities as well as support formal education settings.

The NC Stream Watch program has been updated with surveys that allow community members with minimal technical training to still be involved with the program. In an effort to meet NC Department of Public Instruction's (POI) curriculum standards, these surveys can align with various grade level earth and environmental science standards. Teachers, students, and watershed networks will find the program useful because it creates a network of involved citizens while also creating awareness for water resource management issues. Councils of government, such as the Piedmont Triad Regional Council, plan on incorporating this program into their educational outreach initiatives. The City of Raleigh and other municipalities have also been working with NC Stream Watch to determine how to overlay collected Adopt-A-Stream data to the statewide NC Stream Watch map as well. As this program grows, citizens can access a GIS map that is populated with data collected by various educational groups across the state. Eventually, NC Stream Watch hopes to be a robust educational program that is commonly utilized to promote the importance of water resource management and water quality issues.

Along with NC Stream Watch, DWR also encourages local governments, the general public and watershed specific groups to organize stream cleanup projects in their waterways. Statewide, these initiatives have removed tons of trash and pollutants from our waterways. DWR held a volunteer stream clean-up on Earth Day for staff to do independently and submit pictures and locations.

In an effort to make the basin plans more easily accessible and user-friendly, BPB has spent the last few years working to develop online resources for the basin plans. Examples of new formats and mapping capabilities are available through the Department's Open Data website and on the 2018 Watauga River Basin Water Resources Plan webpage that includes an interactive StoryMap.

Appendix- EMC Liaison River Basin Assignments and Basin Planning Schedule

Table A1 – EMC Liaison River Basin Assignments

River Basin	Basin Planner(s)	EMC Basin Liaison
Chowan	Shepherd	Harris
White Oak	McMillan/Hoffman	Lazorick
Pasquotank	Raquet/Deamer (nutrients)	Arata
Cape Fear: Haw (HUC 03030002)	Deamer	McAdams
Yadkin	Baker	Yadkin - Meiburg Pee Dee - Davis
Cape Fear: Deep (HUC 03030003); Upper Cape Fear (HUC 0303004); Lower Cape Fear Above Lock & Dam #1 (HUC 030303005)	Deamer	McAdams
Neuse	Oggeri/Deamer (nutrients)	Upper - Anderson Lower - Keen
Broad	Raquet	Van der Vaart
Hiwassee	Baker	Deerhake
Little Tennessee	Tarver	Deerhake
Savannah	Tarver	Deerhake
Lumber	McMillan/Shepherd	Arata
Cape Fear: Black (HUC 0303006); Northeast Cape Fear (HUC 030303007)	Deamer	Bailey
Broad	Raquet	Van der Vaart
New River	Raquet	Monast
Cape Fear: Lower Cape Fear Below Lock & Dam #1 (HUC 030303005)	Deamer (estuary)	Bailey
Catawba	Oggeri	Gillespie
French Broad	Raquet	Solomon
Roanoke	Shepherd/Deamer	Carter
Tar-Pamlico	Deamer	Lazorick
Watauga	Raquet	Monast

Basinwide Planning Schedule

Please see the DWR Basin Planning Branch website located here for the current planning schedule.