

## Contents

|  |    |
|--|----|
| Chapter 4 .....  | 2  |
| 4.1 General Description .....                                  | 2  |
| 4.2 Population and Land Use .....                              | 2  |
| 4.3 Permits .....  | 4  |
| 4.4 Biological Health .....                                    | 5  |
| 4.5 Ambient Water Quality .....                                | 8  |
| 4.6 Shellfish Growing Areas.....                               | 10 |
| 4.7 Nutrient Sensitive Waters .....                            | 10 |
| 4.8 Water Quality on the Watershed Scale (HUC 10) .....        | 12 |
| 4.8.1 Headwaters New River HUC 0302030201 .....                | 13 |
| 4.8.2 New River Watershed (HUC 0302030202) .....               | 22 |
| 4.8.3 New River Inlet (HUC 0302030203).....                    | 32 |
| 4.8.4 Topsail Beach (HUC 0302030204) .....                     | 33 |
| 4.8.5 Masonboro Inlet – Mason Inlet (HUC 0302030205) .....     | 36 |
| 4.9 Onslow Water Quality Monitoring Program .....              | 37 |
| 4.10 Protecting Water Resources in the New River Subbasin..... | 38 |
| 4.11 References .....  | 41 |

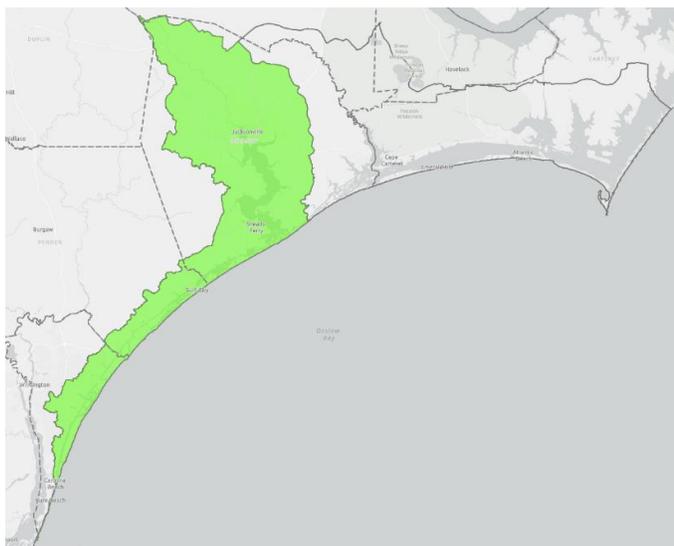
# Chapter 4

## New River (Southwest) Subbasin

Hydrologic Unit Code (HUC): 03020302

### 4.1 General Description

The New River (Southwest) subbasin is on the western end of the White Oak River basin. Most of the subbasin lies within Onslow County, but portions of Pender and New Hanover counties are also located in the subbasin. Those portions of the subbasin that lie within Pender and New Hanover counties were previously assigned to the Cape Fear River basin. In 2009, the Division of Water Resources (DWR) moved away from the previous subbasin boundaries and adopted the national Watershed Boundary Dataset (WBD). This changed the delineation of a handful of watersheds, not only in the Cape



Fear River basin, but also the Chowan, Pasquotank, and Tar-Pamlico river basins. Where applicable, historical information about streams located in this portion of the New River subbasin can be found in previous Cape Fear River basin plans. Municipalities within the subbasin include Jacksonville, Richlands, Sneads Ferry, Surf City, Topsail, and portions of Wrightsville and Carolina Beach. Marine Corps Base Camp Lejeune is also located in the subbasin, and rural residential properties and communities are scattered throughout the area.

The New River subbasin is located in [EPA IV ecoregions](#) designated as Nonriverine Swamps and Wetlands, Carolina Flatwoods, and Carolina Barrier Islands and Coastal Marshes (Griffith et al., 2002). More than half of the watershed is estuarine with estuarine waters in the mainstem of the New River reaching as far upstream as Jacksonville. Major tributaries to the New River include Harris Creek, Brinson Creek, and Northeast Creek. Hewletts Creek and Pages Creek are located further west/southwest in New Hanover County and drain to the Intercoastal Waterway.

Much of the water located in the subbasin is designated as High Quality Waters (HQW) or Outstanding Resource Waters (ORW) due to the shellfish growing area designations. The New River itself and many of its tributaries are designated as Nutrient Sensitive Waters (NSW). More information about the NSW designation can be found in Section 4.7.

### 4.2 Population and Land Use

Based on 2010 Census data, the population in the New River subbasin was estimated to be 246,492 with an estimated 70,145 people inhabiting the City of Jacksonville. In 2019, the North Carolina Office of State Budget and Management (OSBM), estimated that the population of Jacksonville was 80,328, a 14.5% increase in population compared to 2010 ([OSBM](#), September 2020) (Table 4-1).

Table 4-1: Estimated population on the watershed boundary scale (HUC 10) (2010 Census) (OSBM, 2014)

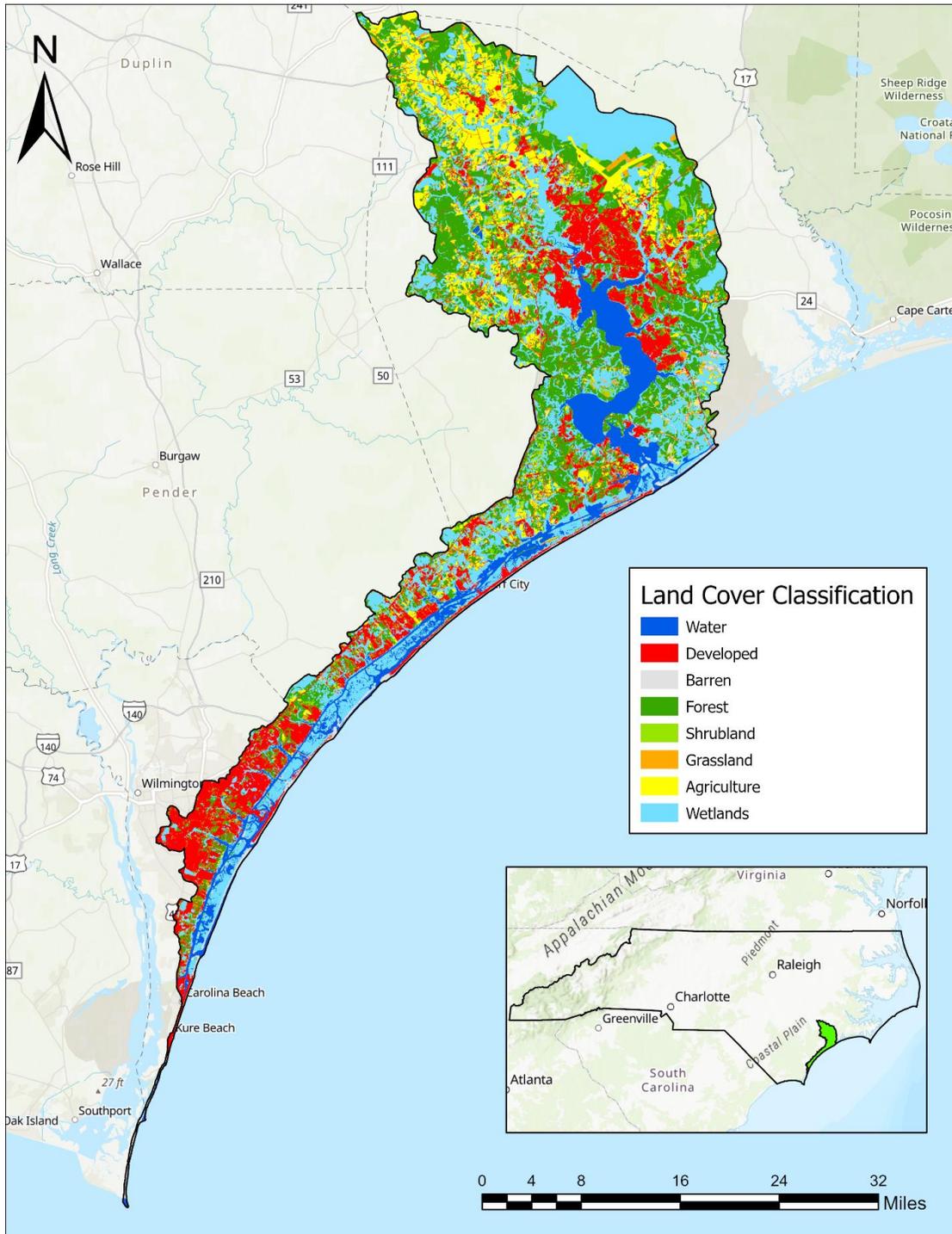
| Watershed Name<br>HUC10    | HUC 10     | Land Area<br>(mi <sup>2</sup> ) | Population<br>2010 | Population<br>2020 | Population<br>2030 |
|----------------------------|------------|---------------------------------|--------------------|--------------------|--------------------|
| Headwaters New River       | 0302030201 | 161.1                           | 56,774             | 59,625             | 61,477             |
| New River                  | 0302030202 | 254.8                           | 82,567             | 86,711             | 89,400             |
| Headwaters New River Inlet | 0302030203 | 81.2                            | 10,527             | 11,260             | 11,818             |
| Topsail Beach              | 0302030204 | 63.6                            | 17,536             | 21,631             | 25,582             |
| Masonboro Inlet            | 0302030205 | 63.5                            | 76,360             | 91,469             | 106,000            |

The New River subbasin drains approximately 624 mi<sup>2</sup>. In 2016, land cover was predominantly wetlands (28%) and forest (26%) with developed/urban areas (19%) and agriculture (10%) making up much of the remaining land use (Table 4-2; Figure 4-1).

Table 4-2: Land cover in the New River subbasin (NLCD, 2016)

| Land Cover  | 2001<br>(mi <sup>2</sup> ) | % Land<br>Cover<br>2001 | 2006<br>(mi <sup>2</sup> ) | % Land<br>cover<br>2006 | 2011<br>(mi <sup>2</sup> ) | % Land<br>Cover<br>2011 | 2016<br>(mi <sup>2</sup> ) | % Land<br>Cover<br>2016 |
|-------------|----------------------------|-------------------------|----------------------------|-------------------------|----------------------------|-------------------------|----------------------------|-------------------------|
| Agriculture | 65.90                      | 10.6%                   | 63.87                      | 10.2%                   | 62.27                      | 10.0%                   | 62.03                      | 9.9%                    |
| Barren Land | 9.25                       | 1.5%                    | 9.12                       | 1.5%                    | 9.02                       | 1.5%                    | 8.82                       | 1.4%                    |
| Developed   | 94.95                      | 15.2%                   | 103.78                     | 16.6%                   | 111.15                     | 17.8%                   | 115.33                     | 18.5%                   |
| Forest      | 166.53                     | 26.7%                   | 162.01                     | 26.0%                   | 157.65                     | 25.3%                   | 162.20                     | 26.0%                   |
| Grassland   | 16.54                      | 2.7%                    | 19.05                      | 3.1%                    | 17.48                      | 2.8%                    | 14.26                      | 2.3%                    |
| Open Water  | 62.02                      | 9.9%                    | 62.17                      | 10.0%                   | 62.77                      | 10.1%                   | 62.48                      | 10.0%                   |
| Scrub/Shrub | 29.93                      | 4.8%                    | 25.74                      | 4.1%                    | 26.36                      | 4.2%                    | 21.65                      | 3.5%                    |
| Wetlands    | 179.12                     | 28.7%                   | 178.50                     | 28.6%                   | 177.52                     | 28.4%                   | 177.46                     | 28.4%                   |

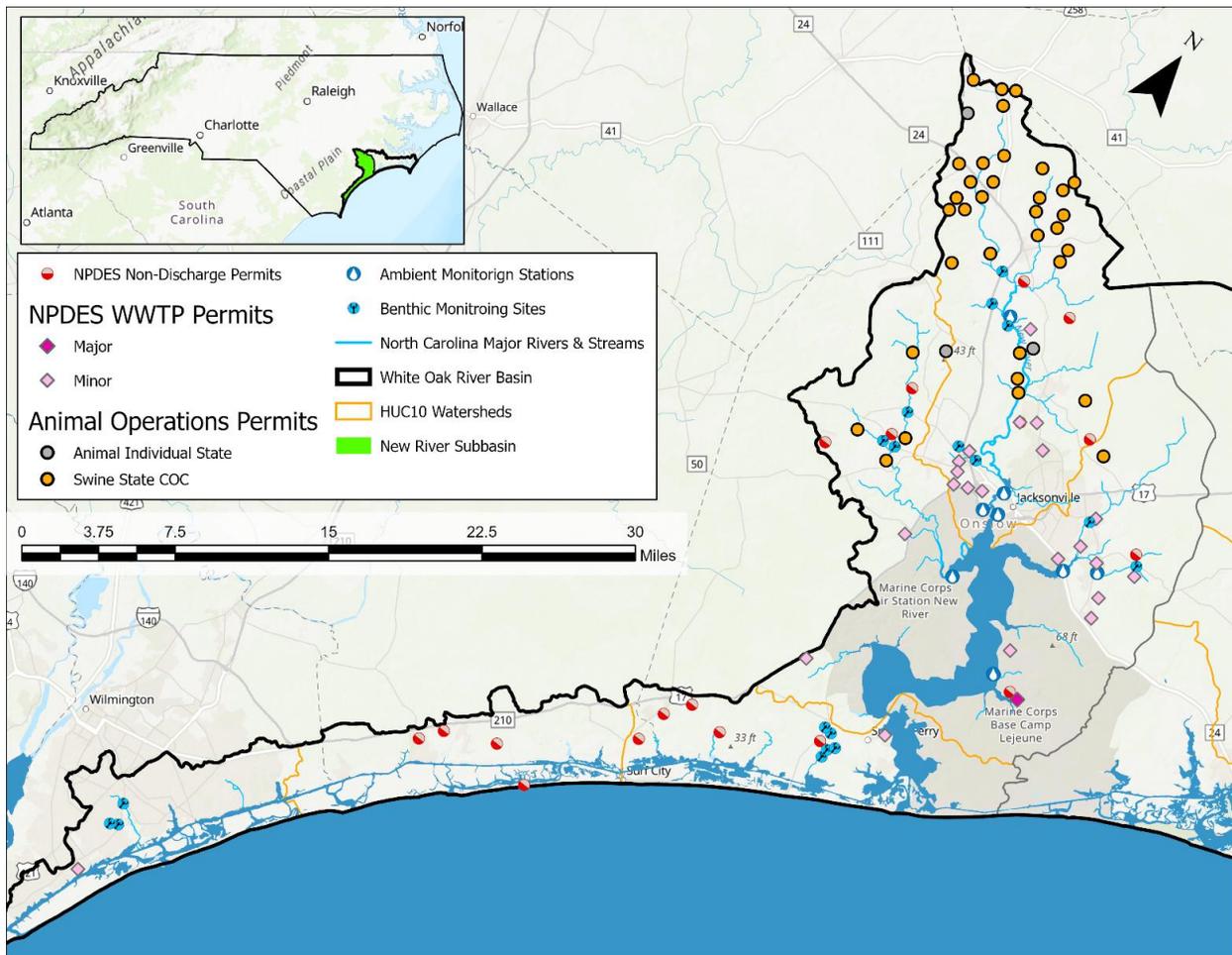
Figure 4-1: Land Cover in the New River Subbasin (NLCD, 2016)



### 4.3 Permits

There are 24 National Pollutant Discharge Elimination System (NPDES) wastewater permits, 18 non-discharge permits, 66 stormwater permits, and 36 permitted animal operations in the subbasin. All 36 permitted animal operations are in Onslow County. A list of permitted facilities can be found in Appendix IV, New River Subbasin Permits. Figure 4-2 shows the location of the permitted facilities.

Figure 4-2: NPDES Wastewater, NPDES Non-Discharge, and Animal Operations permits in the New River subbasin



#### 4.4 Biological Health

Benthic macroinvertebrate communities (also referred to as aquatic benthic communities) are composed of aquatic insects and crustacean species such as crayfish, mollusk-like mussels, clams, snails, and aquatic worms. They respond to a wide array of potential pollutants, and their sedentary nature helps identify and accurately capture local conditions, exposure to a pollutant, and/or stress in the environment. Benthic communities allow for the comparison of sites over time and changes in water quality.

Biologists in DWR's Biological Assessment Branch (BAB) incorporate species richness, abundance, composition, and pollution indicator species into the benthic biocriteria used to calculate Index of Biological Integrity (IBI) scores and bioclassification ratings. Certain species of benthos, like mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), referred to in combination as EPT, are typically sensitive to pollution and their presence or absence can be an indicator of water quality condition. Biocriteria, bioclassification assignment, and sampling methodology can vary with region and stream conditions. In the New River subbasin, three assessment methodologies were used: Swamp, Full Scale, and EPT as described in the [Biological Assessment Branch Standard Operating Procedures for the Collection and Analysis of Benthic Macroinvertebrates](#) (NCDEQ, 2016) (Table 4-3).

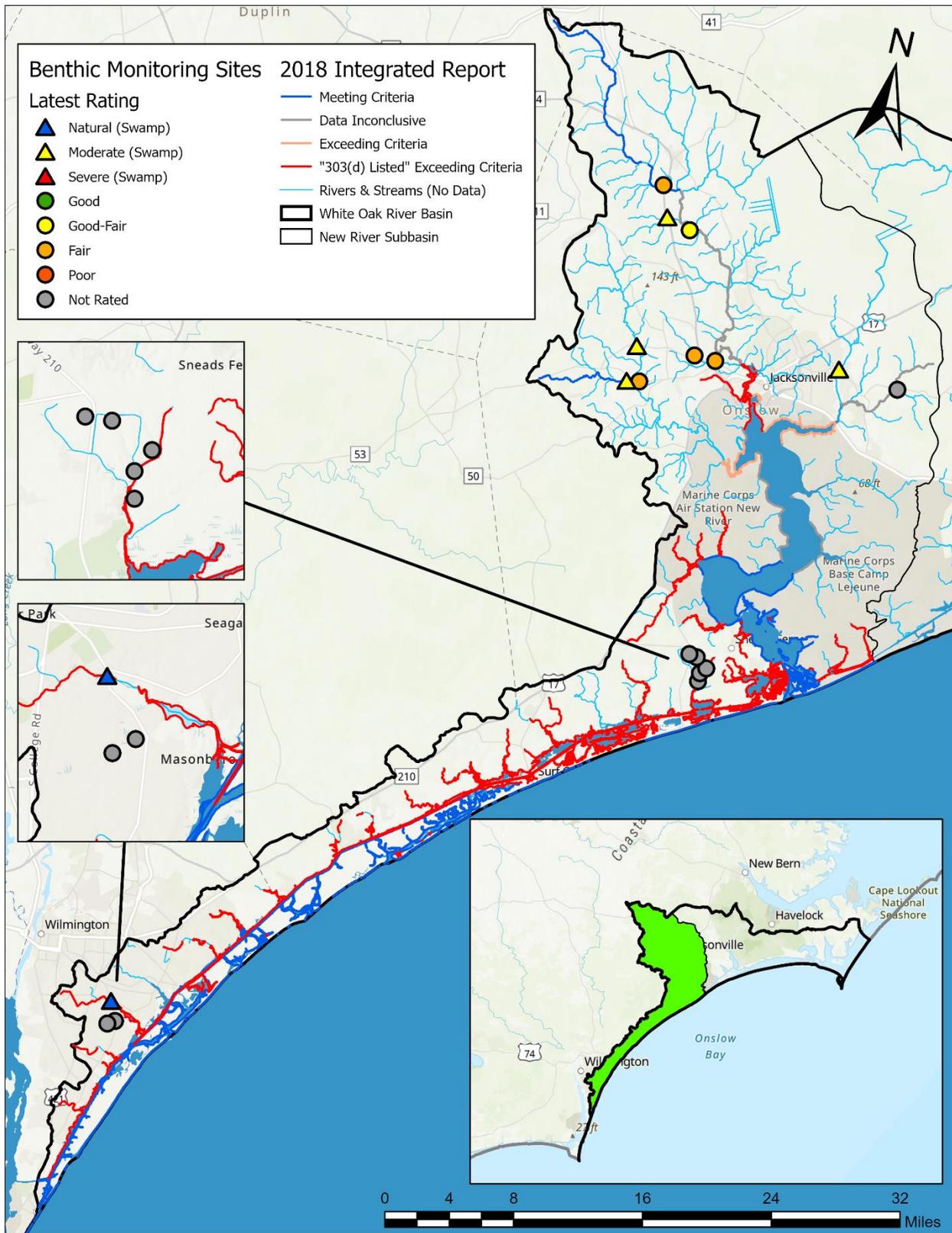
Waterbodies that have an Excellent, Good, Natural, or Moderate bioclassification rating consistently contain diverse, stable, and pollution-sensitive communities of aquatic benthic macroinvertebrates and are considered supporting their designated use for aquatic habitat. Waterbodies that have a Fair, Poor, or Severe bioclassification usually contain a number of pollution-tolerant species and are considered “impaired” and not meeting their designated use for aquatic habitat.

A total of 5 benthic sites were sampled in the New River subbasin between 2003 and 2010. Four sites were sampled between 2011 and 2015. Three sites were sampled between 2016 and 2019. Figure 4.3 shows the location and bioclassification of the most recent sampling event. Table 4-3 lists the most recent basinwide and special study sites and includes previous ratings for sites where multiple samples were collected.

Table 4-3: Biological monitoring stations in the New River subbasin

| Station ID  | Waterbody Name                | Assessment Unit # | Drainage Area (mi <sup>2</sup> ) | Assessment Method | Sampling Date | Bioclassification |
|---|-------------------------------|-------------------|----------------------------------|-------------------|---------------|-------------------|
| PB7   | Northwest Prong Newport River | 21-2              | 9.7                              | Swamp             | 3/2/2004      | Natural           |
|   |                               |                   |                                  |                   | 2/20/2008     | Natural           |
|   |                               |                   |                                  |                   | 2/27/2019     | Not Rated         |
| PB30*   | Unnamed Tributary             | -                 | 5.9                              | Swamp             | 3/6/2017      | Moderate          |
|   |                               |                   |                                  | EPT               | 6/26/2019     | Good-Fair         |
| PB4   | New River                     | 19-(1)            | 86.3                             | Full Scale        | 6/30/2004     | Good-Fair         |
|   |                               |                   |                                  |                   | 6/9/2010      | Good-Fair         |
|   |                               |                   |                                  |                   | 7/27/2015     | Good-Fair         |
| PB6   | Harris Creek                  | 19-17-3           | 9.5                              | Swamp             | 3/1/2004      | Moderate          |
|   |                               |                   |                                  |                   | 2/11/2008     | Moderate          |
|   |                               |                   |                                  |                   | 3/10/2015     | Moderate          |
| PB5   | Little Northeast Creek        | 19-16-(0.5)       | 8.3                              | Swamp             | 3/1/2004      | Moderate          |
|   |                               |                   |                                  |                   | 2/11/2008     | Moderate          |
|   |                               |                   |                                  |                   | 3/11/2015     | Not Rated         |
|   |                               |                   |                                  |                   | 2/27/2019     | Moderate          |
| BB299   | Hewletts Creek                | 18-87-26          | 4.46                             | Swamp             | 2/26/2003     | Moderate          |
|   |                               |                   |                                  | Swamp             | 3/13/2013     | Natural           |
| *Special Study monitoring not part of 5-year Basin Cycle Monitoring |                               |                   |                                  |                   |               |                   |

Figure 4-3: Benthic monitoring sites in the New River subbasin (HUC 03020301)



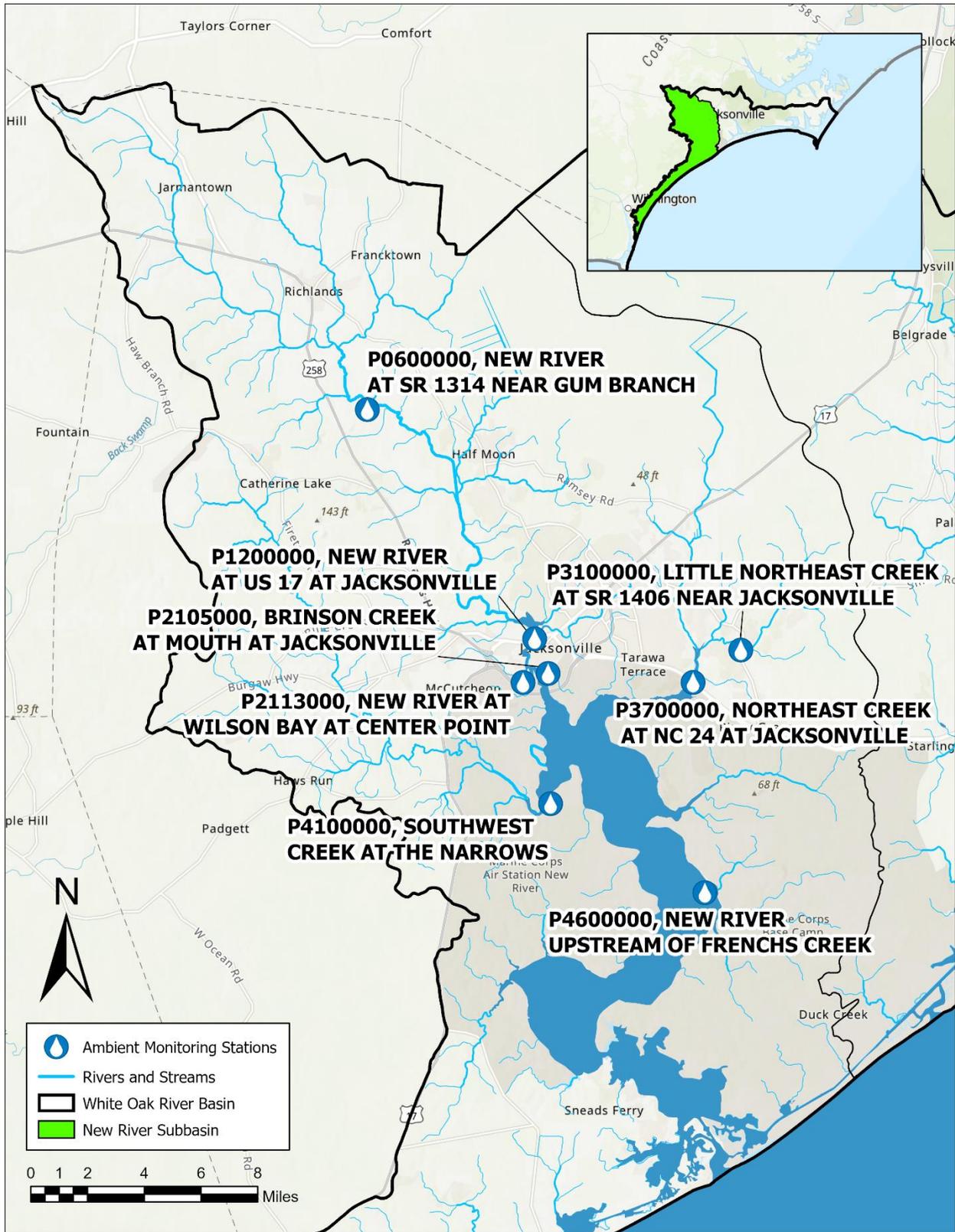
#### 4.5 Ambient Water Quality

Monthly chemical and physical samples are taken by DWR through the Ambient Monitoring System (AMS). Many of the ambient stations are associated with waterbody locations where potential pollution could occur from known land use activities in the subbasin. Parameters collected depend on the waterbody classification, but typically include conductivity, dissolved oxygen, pH, temperature, turbidity, nutrients, and fecal coliform. Each classification has an associated set of standards the parameters must meet in order to be considered supporting the waterbody’s designated uses. Ten sample results are required within the five-year data collection window to evaluate the water quality parameter and compare it to the water quality standards. There are eight ambient monitoring stations in the New River subbasin (Figure 4.4; Table 4-4).

Table 4-4: Ambient monitoring stations in the New River subbasin (HUC 03020302)

| Station ID | Waterbody Name/<br>Station Location                | County | Stream<br>Assessment<br>Unit Number<br>(AU#) | Stream<br>Classification | HUC 10     |
|------------|--|--------|--|--------------------------|------------|
| P0600000   | New River @ SR 1314<br>near Gum Branch             | Onslow | 19-(1)                                       | C, NSW                   | 0302030201 |
| P1200000   | New River US17 @<br>Jacksonville                   | Onslow | 19-(10.5)                                    | SB, HQW, NSW             | 0302030201 |
| P2105000   | Brinson Creek @ mouth<br>(Jacksonville)            | Onslow | 19-12  | SC, NSW                  | 0302030201 |
| P2113000   | New River @ Wilson Bay<br>Center Point             | Onslow | 19-14  | SC, HQW, NSW             | 0302030201 |
| P3100000   | Little Northeast Creek @<br>SR 1406 (Jacksonville) | Onslow | 19-16-2                                      | C, NSW                   | 0302030202 |
| P3700000   | Northeast Creek @ NC<br>24 (Jacksonville)          | Onslow | 19-16-(3.5)                                  | SC, HQW, NSW             | 0302030202 |
| P4100000   | Southwest Creek @ The<br>Narrows                   | Onslow | 19-17-(6.5)                                  | SC, HQW, NSW             | 0302030202 |
| P4600000   | New River Upstream of<br>Frenchs Creek             | Onslow | 19-(15.5)                                    | SC, NSW                  | 0302030202 |

Figure 4-4: Ambient monitoring stations in the New River subbasin (HUC 03020302)



#### 4.6 Shellfish Growing Areas

The [Shellfish Sanitation and Recreational Water Quality Section](#) of the DEQ's [Division of Marine Fisheries \(DMF\)](#) is responsible for monitoring and classifying coastal waters as to their suitability for shellfish harvesting for human consumption. Shellfish growing areas are classified as Approved, Conditionally Approved, Restricted, or Prohibited. Approved areas are consistently open, while Prohibited areas are permanently closed. Conditionally Approved areas can be open to harvest under certain conditions, such as dry weather when stormwater runoff is not having an impact on surrounding water quality. Restricted waters can be used for harvest at certain times as long as the shellfish are subjected to further cleansing before they are made available for consumption.

The Shellfish Sanitation Section completes a Sanitary Survey for each shellfish growing area every three years that includes a shoreline survey of all existing or potential pollution sources, a hydrographic and meteorological survey, and a bacteriological survey of the shellfish growing waters. Shoreline surveys assess the impacts of potential pollution sources – such as marinas, multi-slip docks, agricultural areas, subdivisions, septic tanks, wastewater treatment plants, and/or ditching - on surrounding water quality. The hydrographic and meteorological survey is used to evaluate the factors that may affect the distribution of pollutants within a growing area, such as prevailing winds, tidal amplitude and type, water circulation patterns, and the amount of freshwater. Rainfall patterns and intensity can also affect the distribution of pollutants by increasing volume and duration of pollutant delivery and flooding.

For water quality assessment purposes, shellfish growing areas that are conditionally approved (open or closed), restricted, or prohibited are considered impaired and not meeting their designated use. To target resources and the development of watershed action plans, conditionally approved (open) shellfish growing areas and the waterbodies associated with each are included in this subbasin chapter. For a complete list of water quality assessments for shellfish growing areas, refer to the Integrated Reports.

Stormwater, wastewater treatment plants, marinas, subdivisions, golf courses, and animals were identified as potential pollution sources in several of the shellfish growing areas in the New River subbasin. On-site wastewater management is also a potential pollution source identified throughout the subbasin. All the sanitary surveys conducted in the subbasin reported that the county health departments were notified prior to the surveys being conducted. Each county health department agreed to provide corrective action and follow-up for any malfunctioning septic systems or illegal on-site wastewater discharges discovered during the survey. Copies of the sanitary survey are available in the [NC Digital Collections Library](#). Current, or more recent, surveys are available upon request from DMF.

#### 4.7 Nutrient Sensitive Waters

Persistent water quality problems have been documented in the New River subbasin since the mid-1980's. In 1986, the frequency of algal blooms, fish kills, and low dissolved oxygen levels prompted a request for a special study by the former Department of Environment, Health, and Natural Resources (DEHNR) Wilmington Regional Office. In 1987, the then Department of Environmental Management (DEM) instituted a total phosphorus (TP) limit of 2.0 mg/L on new and expanding discharges in the upper New River watershed. Existing dischargers with a permitted flow greater than 50,000 gallons per day (0.05 MGD) were to receive the 2.0 mg/L TP limit upon permit renewal.

In 1990, the DEM released the results of a special study that was conducted from 1986 to 1989. The study documented high levels of total nitrogen (TN), TP, and chlorophyll *a*, along with high

phytoplankton biovolume and density levels in the upper New River Estuary, especially in the Jacksonville area. The conclusion of the study was that the estuary upstream of Hadnot Point was highly eutrophic, primarily due to substantial point source inputs. The study recommended that the Upper New River Estuary be designated as Nutrient Sensitive Waters (NSW). It also recommended a specific set of control strategies to address pollution sources (NCDEHNR, 1997).

The Environmental Management Commission (EMC) designated the Upper New River Estuary as a NSW in 1991. The designated area included all waters upstream of a line connecting Grey Point to a point of land approximately 2,200 yards downstream from the mouth of Duck Creek. The original strategy had five major objectives:

- (1) A total phosphorus (TP) limit of 2.0 mg/L on all existing facilities with a permitted capacity of 0.05 MGD or greater.
- (2) The option to apply more stringent TP and/or nitrogen (N) limits on existing facilities that make a significant contribution of nutrients to the system.
- (3) A TP limit of 0.5 mg/L applied to new or expanded discharges, regardless of design capacity.
- (4) Individuals considering a new discharge must demonstrate that non-discharge options or connection to an existing facility are not feasible.
- (5) Target the watershed for the implementation of agricultural best management practices (BMPs) under the Agricultural Cost Share Program (ACSP) in order to reduce nonpoint source inputs of phosphorus and nitrogen.

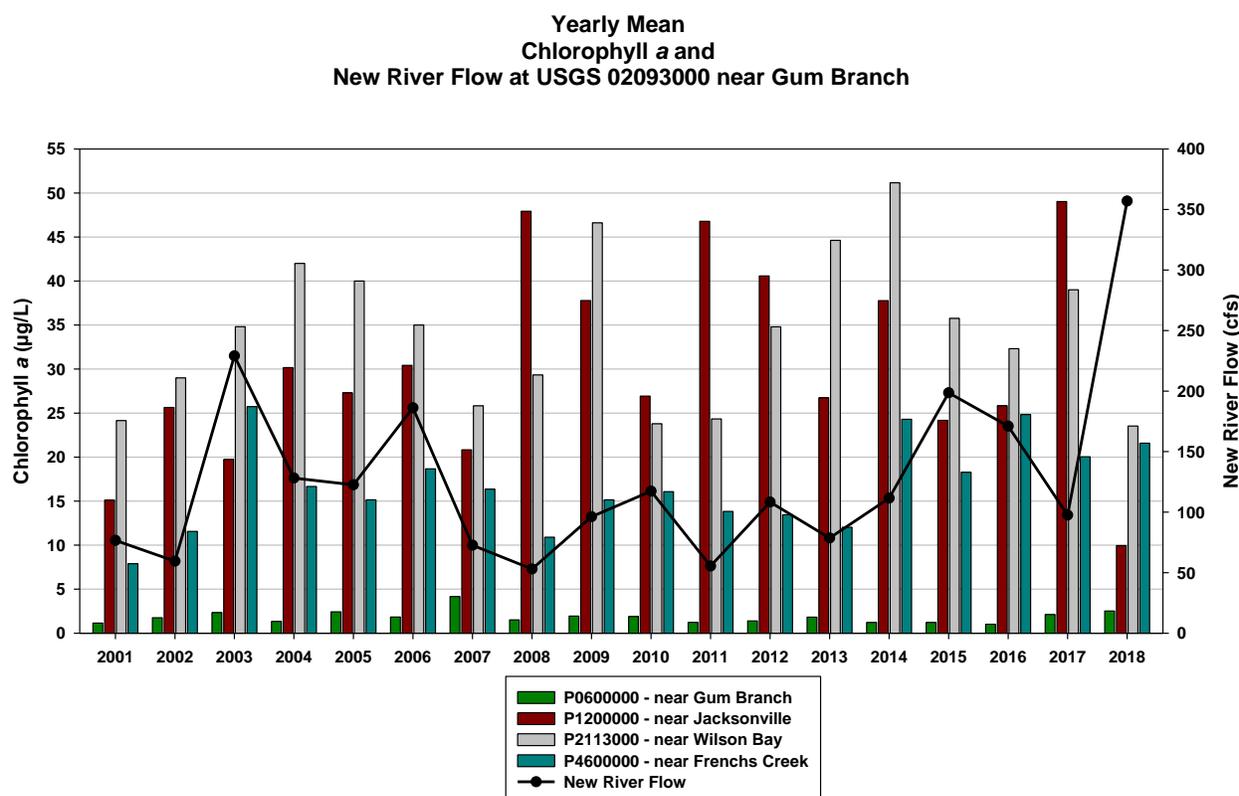
In addition to the five major objectives, it was recommended that all facilities without TN or TP limits be required to monitor TN and TP and that no new discharges be permitted. It was also recommended that expansions of existing facilities only be allowed if there is no increase in permitted loading of oxygen-consuming waste.

In 1997, the Upper New River Estuary continued to be impacted by algal blooms and was considered impaired for chlorophyll *a* and dissolved oxygen. High nutrient levels from the City of Jacksonville and Camp Lejeune were identified as the potential sources of pollution. In 1998, the City of Jacksonville removed its discharge from the Upper New River Estuary and Camp Lejeune consolidated its seven discharges into one tertiary treatment facility. The 2001 basin plan noted that moving and consolidating discharges resulted in a decrease in the frequency, extent, and severity of the algal blooms (NC DWQ, 2001). Subsequent recommendations in the 1997 and 2001 White Oak River basin plans included:

- (1) Continue implementing the total phosphorus (TP) limits of 2.0 mg/L on existing facilities with permitted capacity of 0.05 MGD or greater.
- (2) New and expanding facilities should continue to receive TP limits of 0.5 mg/L.
- (3) New and expanding facilities greater than 1.0 MGD should receive total nitrogen limits (TN) similar to Camp Lejeune TN limits which are 5.0 mg/L during the summer and 10.0 mg/L during the winter.
- (4) All facilities without TN and TP limits should be required to monitor TN and TP.

The basin plans also recommended that no new discharges be permitted and expansions of existing facilities only be allowed if there is no increase in permitted loading of oxygen-consuming waste.

Figure 4-5. Yearly mean concentration of chlorophyll *a* (upstream to downstream) as related to annual mean flow at New River USGS gage 02093000 near Gum Branch



Data collected between 2001 and 2018 show that chlorophyll *a* concentrations in the New River have remained relatively stable indicating that both point and nonpoint source conveyances may be contributing to the chlorophyll *a* exceedances in the river. Under high flow conditions in a nonpoint source driven system, physical and chemical parameters tend to be higher; however, in the New River, chlorophyll *a* does not appear to be strongly tied to higher flow events (Figure 4-5). Several factors may be contributing to this situation. For example, the land application of wastewater, discharge from minor wastewater treatment plants, and local stormwater runoff may be “overriding the expected hydrological controls” in the watershed (Christian, personal communication, Oct. 23, 2020). Shorter chlorophyll *a* residence times during high flow years, as seen in 2018, could also play a role with the stable concentrations seen at the most downstream site (P4600000). A list of permitted facilities as well as algal blooms reported in the subbasin since 2006 is available in Appendix IV. More information about chlorophyll *a* exceedances at each of the individual ambient monitoring stations is included in the local water quality information below (Section 4.8).

#### 4.8 Water Quality on the Watershed Scale (HUC 10)

To determine the source of pollutants in a watershed, it is useful to evaluate them on a smaller scale. Smaller-scale evaluations can also help identify where monitoring and restoration is needed or being conducted. North Carolina assigns numbers to surface waterbodies. For water quality assessment purposes, these numbers are referred to as assessment unit numbers (AU#). A letter attached to the end of the AU# indicates that the assessment unit has been segmented, or broken into smaller pieces, to target the water quality assessment and the data associated with it. AU#'s that have water quality data

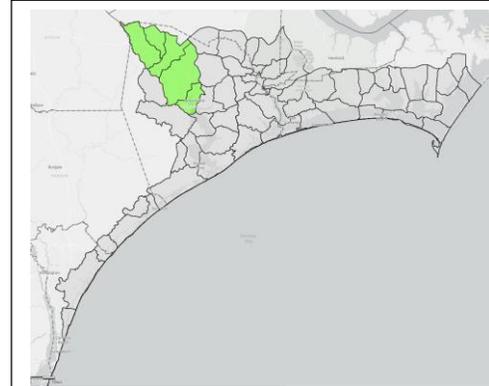
associated with them are discussed here on a watershed (HUC 10) scale. Not all stream segments are monitored by DWR. DWR does, however, value qualitative information from stakeholders throughout the basin to understand what is impacting water quality in a particular area. Information provided by stakeholders is incorporated into each watershed along with recommendations to protect and improve water resources in the watershed.

#### 4.8.1 Headwaters New River HUC 0302030201

The headwaters of the New River watershed encompass 103,078 acres (161 mi<sup>2</sup>) and had an estimated 2010 population of 56,770 people. Wetlands comprise most of the watershed (29%), followed by forests (25%), agriculture (22%), and developed land (17%) (NLCD, 2016). Thirty of the 36 permitted animal feeding operations in the subbasin are located in this watershed along with 11 wastewater, four non-discharge, and 13 stormwater permits.

##### *New River [AU# 19-(1)] (C, NSW)*

New River [AU# 19-(1)a], from its headwaters to Squires Run (14.5 miles), is supporting its designated use for benthic community. New River [AU# 19(1)b], from Squires Run to Blue Creek in Jacksonville (14.3 miles), is supporting its designated use for benthic community, but ambient water quality data collected from ambient monitoring station P0600000 (Gum Branch) indicated that this section of the river was being impacted by elevated levels of chloride, fluoride, and iron resulting in this segment being added to Category 3 (data inclusive) of the 2018 Integrated Report. Ambient water quality data for the draft 2020 Integrated Report, indicated that chloride, fluoride, and iron levels are within water quality standards, but fecal coliform data resulted in the segment from Squires Run to Blue Creek being added to Category 3 (data inclusive). Average chlorophyll *a* concentrations have seen a slight overall decline since 1983 (Figure 4-6). The highest concentrations of Total Kjeldahl Nitrogen (TKN), Total Nitrogen (TN), and Total Phosphorous (TP) in the subbasin are measured at ambient monitoring station P0600000 (Figure 4-7).



| Land Use (2016) | % Land Cover | Square Miles (mi <sup>2</sup> ) |
|-----------------|--------------|---------------------------------|
| Agriculture     | 21.9%        | 35.32                           |
| Barren Land     | 0.2%         | 0.28                            |
| Developed       | 16.5%        | 26.54                           |
| Forest          | 25.2%        | 40.56                           |
| Grassland/Shrub | 6.3%         | 10.08                           |
| Open Water      | 1.4%         | 2.22                            |
| Wetland         | 28.6%        | 46.06                           |

Figure 4-6: Chlorophyll a concentrations measured at ambient monitoring station P0600000 (Gum Branch) (1986-2019)

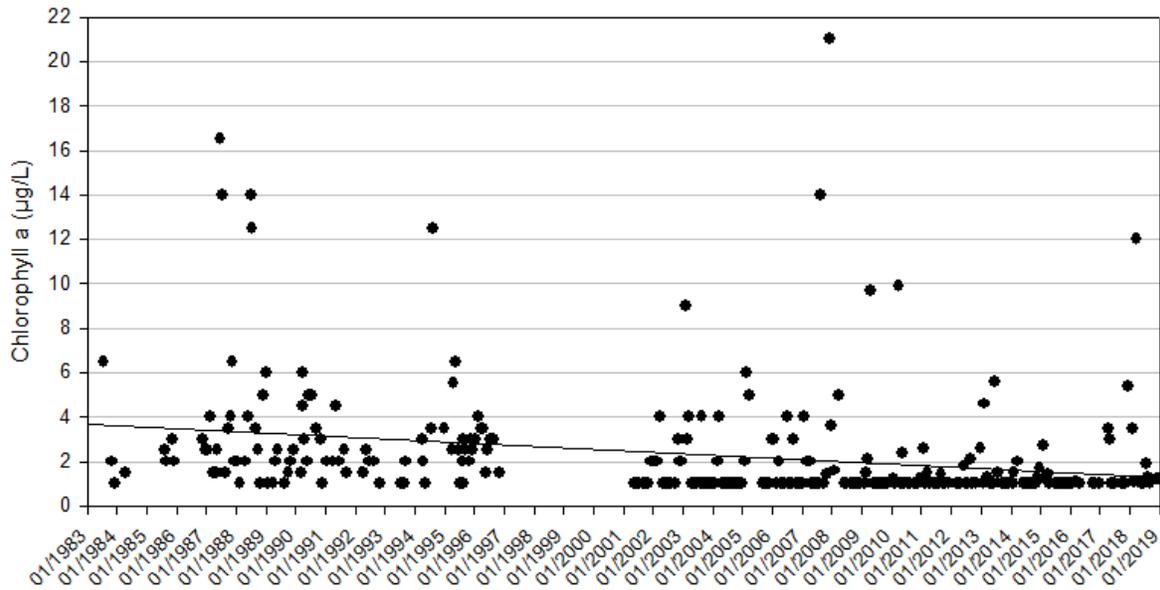
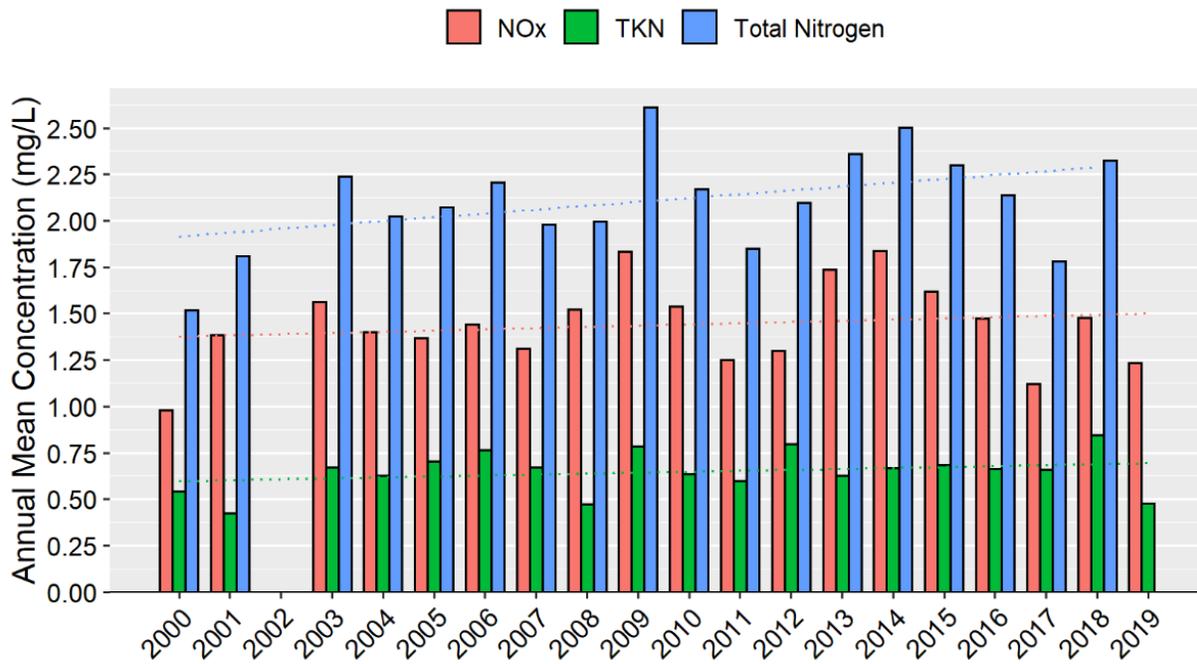
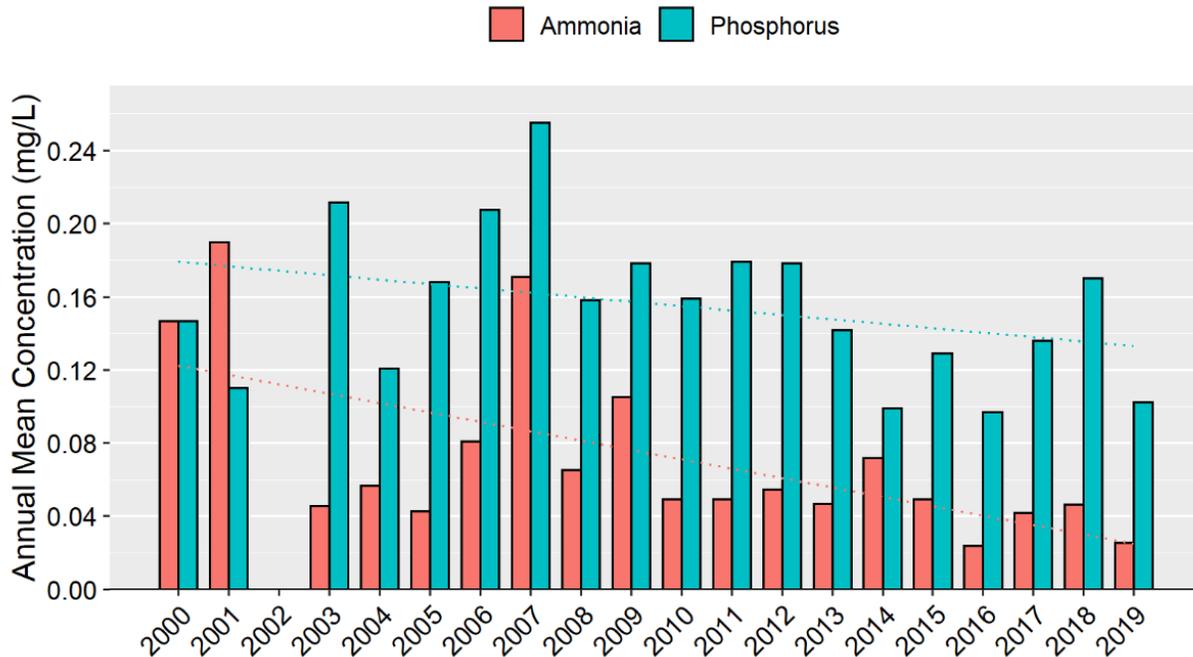


Figure 4-7: Calculated annual mean concentrations for nutrients P0600000 (Gum Branch) (2000-2019)





*New River [AU# 19-(7)] (SB; NSW)*

Moving downstream, New River from Blue Creek to the US Hwy 17 bridge (116 acres) continues to be considered impaired in the 2018 and draft 2020 integrated report for recreation due to high levels of enterococcus. It is also impaired for cooper.

*New River [AU# 19-(10.5)] (SB; HQW; NSW)*

From the US Hwy 17 bridge to the Atlantic Coast Line railroad trestle (49 acres), New River is listed as impaired on the 2018 and draft 2020 303(d) list for copper. Ambient data collected at ambient monitoring station P1200000 indicates that dissolved oxygen (DO) and pH continue to be an issue in this segment of the river. The ambient monitoring station (P1200000) is in the City of Jacksonville and downstream of the Jacksonville water treatment plant (WTP) (NPDES Permit NC0088455). The chlorophyll *a* water quality standard of 40 µg/L continues to be exceeded although the extent of those exceedances has declined slightly since a peak in the sampling period of 2008-2012 (Figure 4-8; Figure 4-10). Nonpoint sources of pollution from the surrounding urban landscape are likely driving the exceedances at this sampling point.

Comparing chlorophyll *a* concentrations to flow does not show a clear correlation to increases or decreases in concentrations related to increased or decreased flows (Figure 4-9). During periods of high flow, turbidity may be high, which can limit light penetration, consequently reducing biological productivity and chlorophyll *a* production, especially if those higher flows are during the warmer months (O’Driscoll, personal communication, Oct. 23, 2020). Because of historically high chlorophyll *a* measurements (Figure 4-8 to 4-10), this segment remains in Category 4b for chlorophyll *a*. Waters in Category 4b have an enforceable management strategy in place for the parameter of interest. Most of the waters in Category 4b were Category 5 (impaired) assessments prior to a management strategy being developed.

Figure 4-8: Chlorophyll a concentrations measured at ambient monitoring station P1200000 (Jacksonville) (1986-2019) (red line denotes the water quality standard of 40 µg/L).

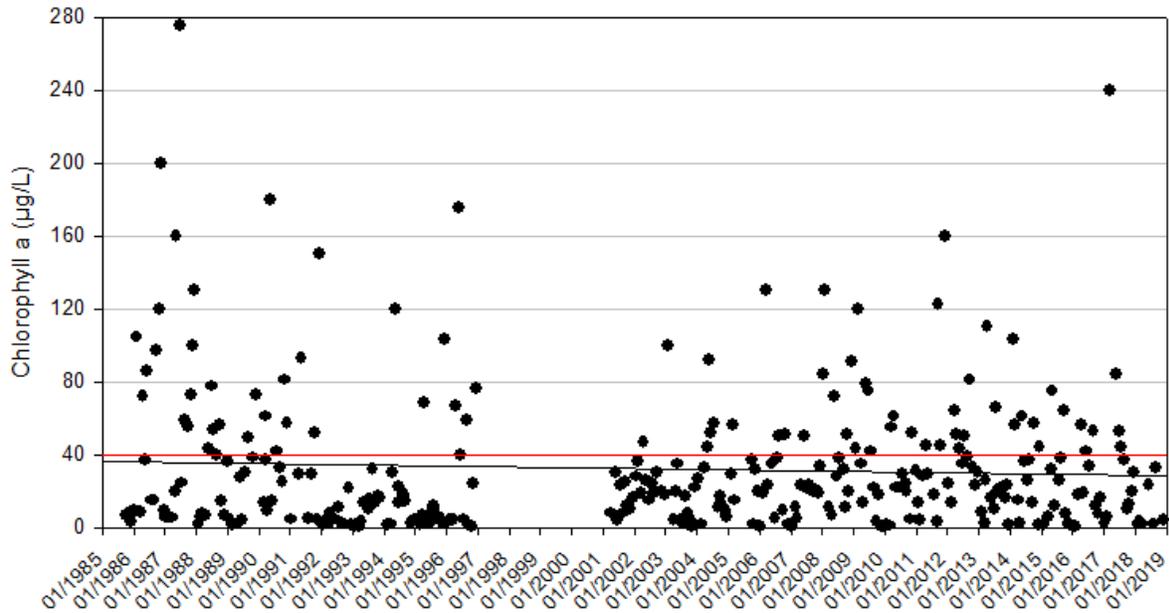


Figure 4-9: Chlorophyll a concentrations measured at ambient monitoring station P1200000 and annual mean streamflow (cfs)

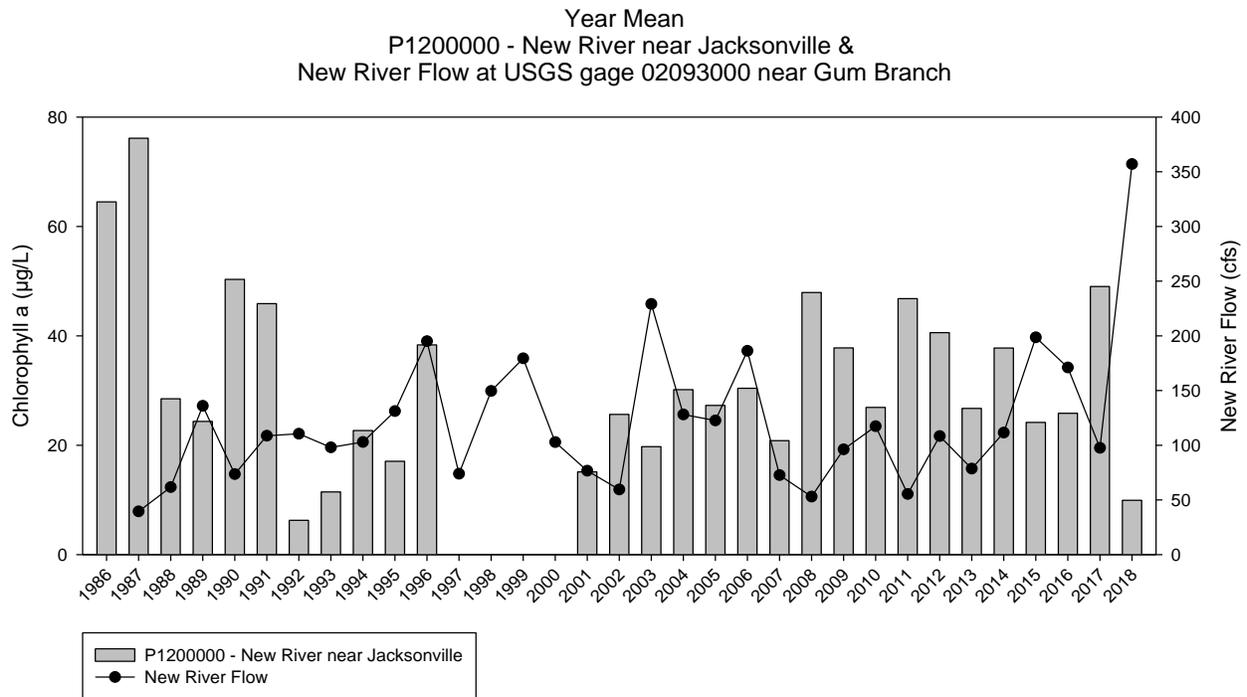
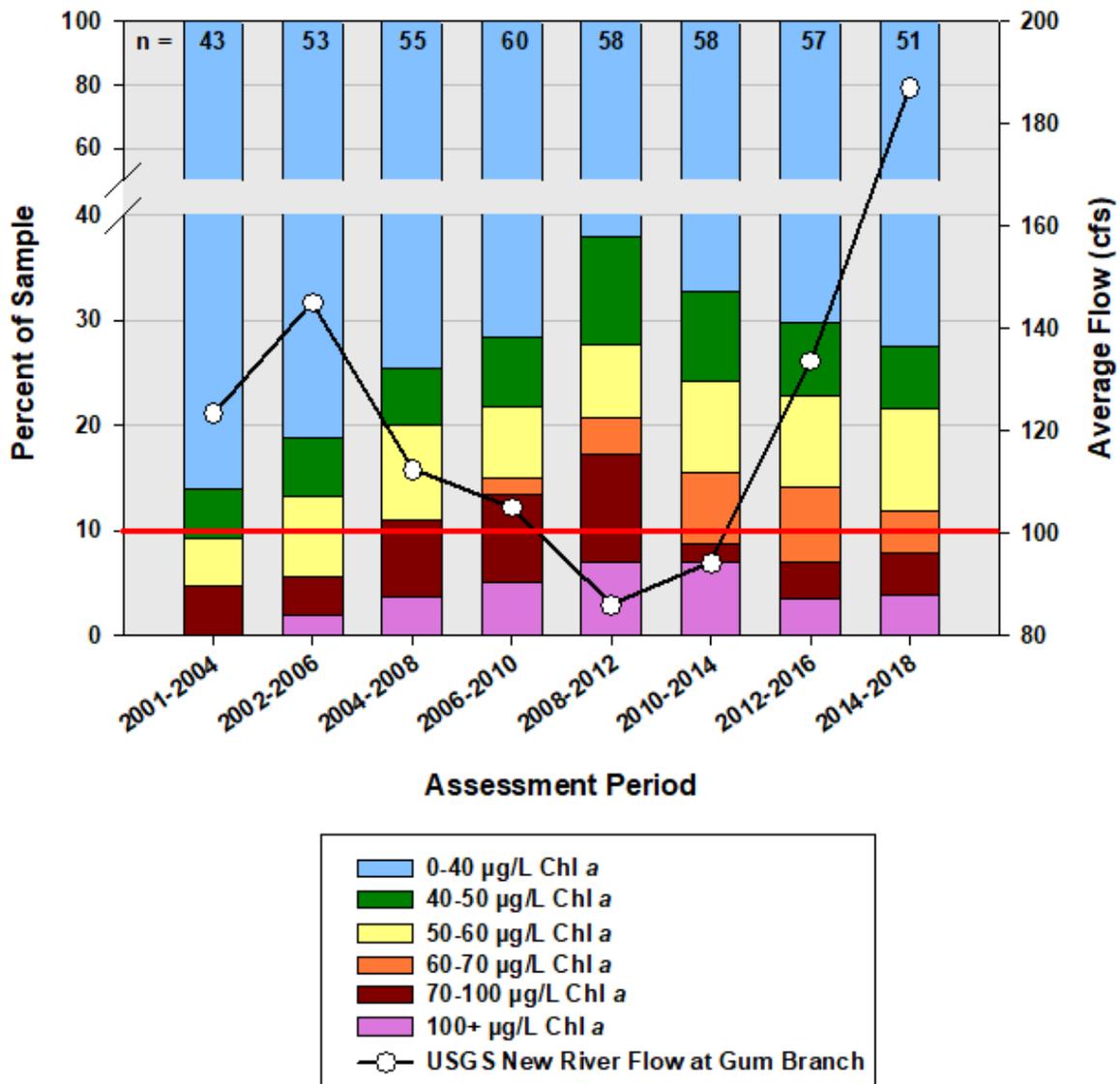


Figure 04-10: Percentage of chlorophyll *a* exceedances by concentration in total samples collected at ambient monitoring station P1200000 in each of the five-year assessment periods from 2001-2018 (red line denotes the 10% excursion level)



*Brinson Creek (AU#19-12) (SC; NSW)*

Brinson Creek, from its source to the New River (17.5 miles), continues to be impaired for chlorophyll *a* and copper. Brinson Creek was first identified as impaired in 2008. Data collected from ambient monitoring station P2105000 near the confluence with the New River indicates that the creek is also impacted by low DO and pH.

Overall, chlorophyll *a* concentrations and exceedance concentrations in Brinson Creek have decreased slightly since 2001, but percent exceedances are still high (Figure 4-11; Figure 4-12). While the Camp Geiger outfall was removed from Brinson Creek in 1998, the Osprey Cove Wastewater Treatment Plant (WWTP) (NPDES Permit NC0028215) is located upstream of the ambient monitoring station. Osprey Cove

has a permitted discharge of 0.10 MGD. TN is a composite sample collected from the effluent quarterly and TP is a composite sample collected weekly. There are currently no TN limits, but TP is limited to a quarterly average of 2.0 mg/L. In addition to Osprey Cove, there are three additional minor NPDES permitted facilities within the Brinson Creek watershed. Point and nonpoint source runoff from the surrounding land use may be contributing to the elevated chlorophyll *a* levels at this ambient monitoring station.

Figure 4-11: Chlorophyll *a* concentrations measured at ambient monitoring station P2105000 (Brinson Creek-Jacksonville) (2001-2019)

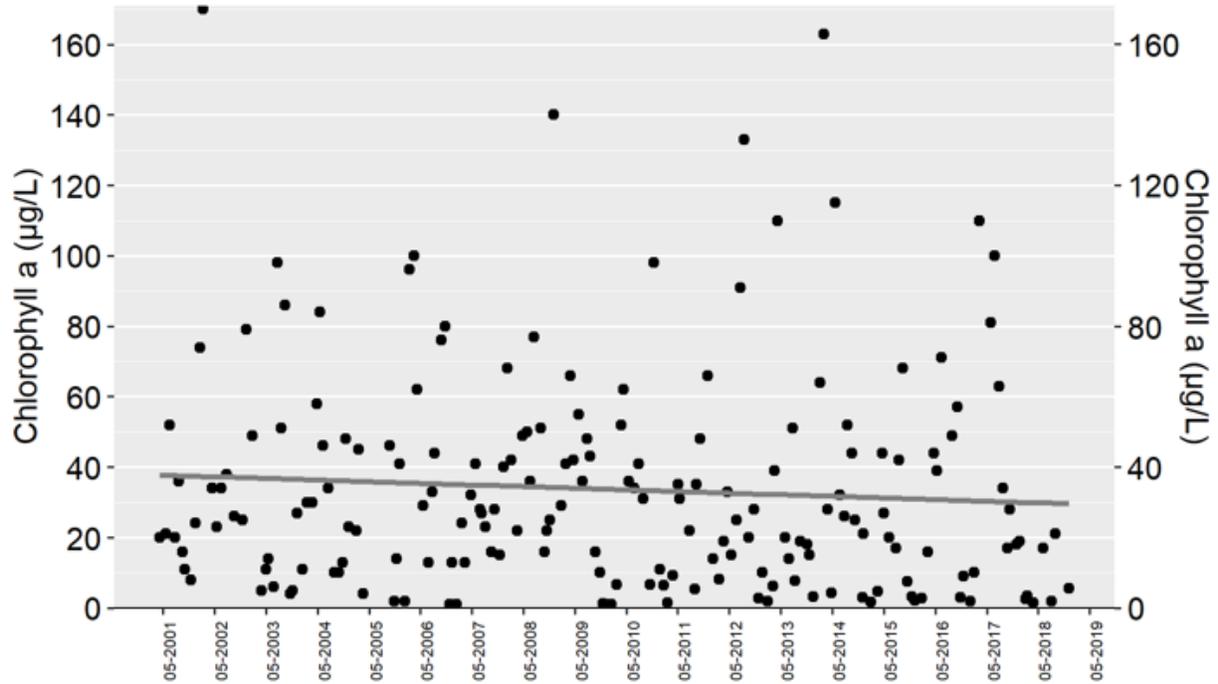
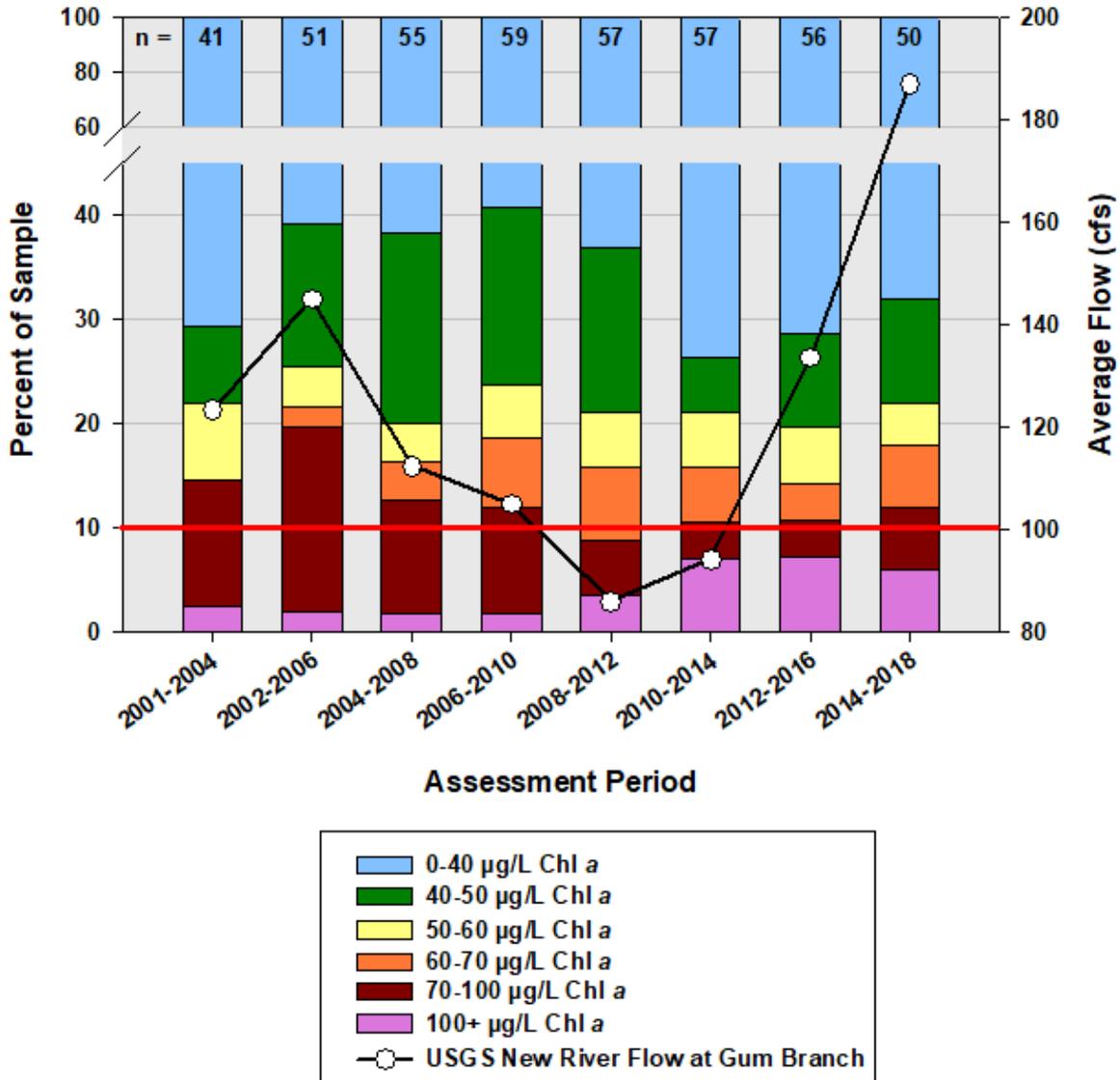


Figure 4-12: Percentage of chlorophyll *a* exceedances by concentration in total samples collected at ambient monitoring station P1205000 (Brinson Creek-Jacksonville) in each of the five-year assessment periods from 2001-2018 (red line denotes the 10% excursion level)



*Wilson Bay (AU# 19-14) (SC; HQW; NSW)*

The entirety of Wilson Bay (109 acres) is on the draft 2020 Integrated Report in Category 3 (data inconclusive) for DO and Category 4b for chlorophyll *a*. Ambient monitoring station P2113000 is located in Wilson Bay and data shows that chlorophyll *a* concentrations have consistently exceeded the water quality standard of 40 µg/L. The City of Jacksonville had a WWTP outfall in Wilson Bay which was found to be contributing greatly to nutrient exceedances in the bay. As part of complying with the NSW strategy, the outfall was removed in 1998 and effluent is now land applied. Since 2001, chlorophyll *a* concentrations at this station have consistently exceeded the water quality standard. Since

2012, those exceedances have grown (Figure 4-13; Figure 4-14). Algal densities have also remained relatively consistent (Appendix Table IV-5). As noted with the upstream ambient monitoring stations, nonpoint source pollution from existing land use may be contributing to the excess nutrients in Wilson Bay, but there is no clear correlation between increased flow and changes to nutrient or chlorophyll *a* concentrations. It is possible that excess nutrients in groundwater from land application sites are contributing, in part, to the chlorophyll *a* and nutrient exceedances in the watershed.

Figure 4-0-13: Chlorophyll *a* concentrations measured at ambient monitoring station P2113000 (Wilson Bay) (2001-2019) (red line denotes water quality standard of 40 µg/L)

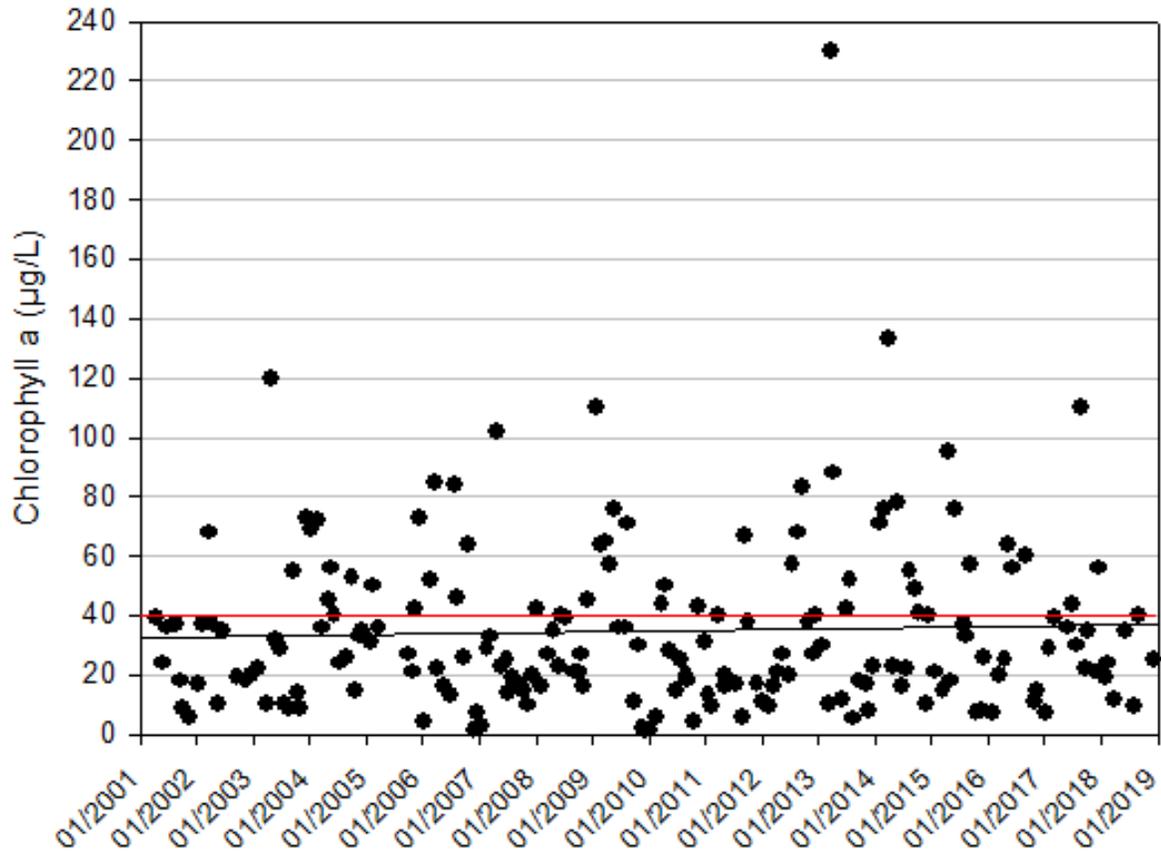
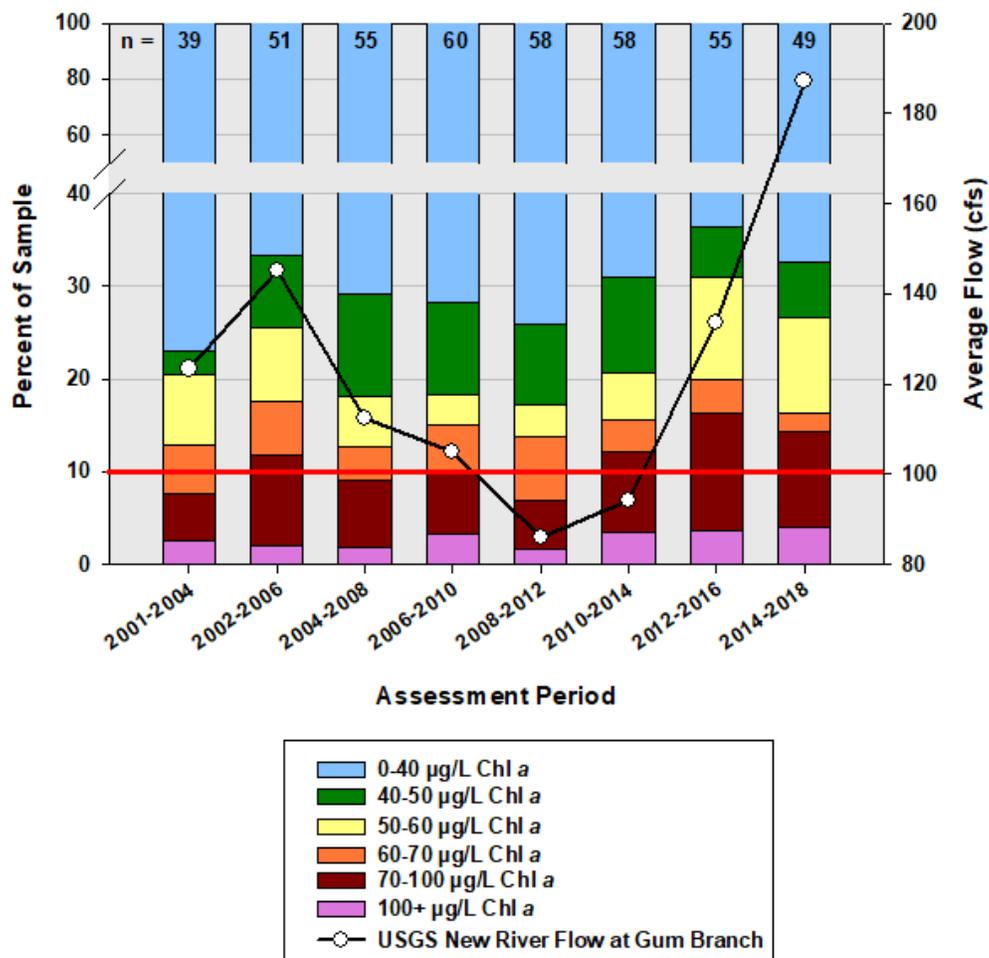


Figure 4-14: Percentage of chlorophyll *a* exceedances by concentration in total samples collected at ambient monitoring station P2113000 (Wilson Bay) in assessment periods from 2001-2018 (red line denotes the 10% excursion level)



Additional water quality assessments have been conducted by UNCW Center for Marine Science and sponsored by USMC-Camp Lejeune. UNCW collected water quality samples from 2008-2009 in Northeast Creek and the New River Estuary.

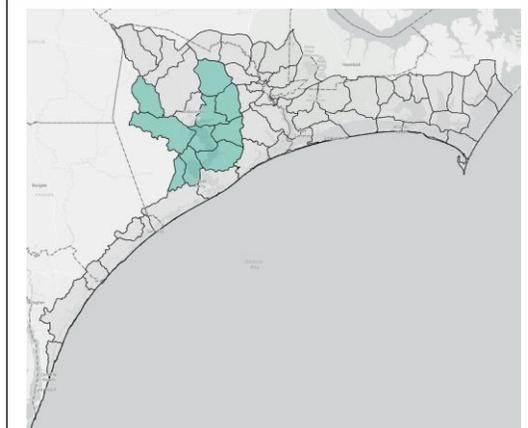
The UNCW assessment notes that overall water quality conditions have improved since the upgrade of City of Jacksonville and Camp Lejeune’s WWTPs in the late 1990s. However, algal blooms are still occurring in the upper estuary and are likely related to salinity stratification, slow flushing rate, and nitrate loads flushing out of Northeast Creek and upstream in the New River (Appendix IV). These algal blooms are contributing to the bottom hypoxic conditions.

*New River [AU# 19-(11)] (SC; HQW; NSW)*

The most downstream segment of the New River, located in the Headwaters of the New River watershed from the Atlantic Coast Line railroad trestle to Mumford Point (574 acres), is impaired for copper on the 2018 and draft 2020 Integrated Report and is in Category 4b for chlorophyll *a*.

#### 4.8.2 New River Watershed (HUC 0302030202)

The New River watershed encompasses 163,072 acres (255 mi<sup>2</sup>) and had an estimated 2010 population of 75,417 people. Forests comprise most of the watershed (35%), followed by wetlands (27%), developed (13%), and agriculture (8%). Just over 10% of the land area is identified as open water (NLCD, 2016). Six permitted animal feeding operations, five non-discharge, and 21 stormwater permits have been issued in this watershed.



#### *Little Northeast Creek (AU# 19-16-2) (C; NSW)*

Little Northeast Creek is a tributary to Northeast Creek. From its source to Northeast Creek, Little Northeast Creek is in Category 3 (data inconclusive) of the 2018 and draft 2020 Integrated Report for several chemical parameters that were collected as part of the Random Ambient Monitoring System (RAMS) at station P3100000 (State Route 1406). It is also in Category 3 due to routine monitoring for chloride, DO, fecal coliform bacteria, fluoride, and iron (Figure 4-15; Figure 4-16; Figure 4-17). The benthic community (PB5) was sampled in 2004, 2008, 2015, and 2019. In 2015, the macroinvertebrate community was listed as “Not Rated”, resulting in the stream being placed in Category 3 for benthic community. In 2019, the benthic community was listed as “Moderate”. The new rating will move Little Northeast Creek into Category 1 (or supporting its designated use for benthic macroinvertebrates) on the 2022 Integrated Report.

| Land Use (2016) | % Land Cover | Square Miles (mi <sup>2</sup> ) |
|-----------------|--------------|---------------------------------|
| Agriculture     | 7.7%         | 19.68                           |
| Barren Land     | 0.8%         | 2.09                            |
| Developed       | 13.0%        | 33.17                           |
| Forest          | 34.6%        | 88.12                           |
| Grassland/Shrub | 6.3%         | 16.13                           |
| Open Water      | 10.4%        | 26.01                           |
| Wetland         | 27.3%        | 69.60                           |

Figure 4-15: Calculated annual mean dissolved oxygen (DO) measurements P3100000 (Little Northeast Creek). Numbers on bars represent the number of samples collected in that year.

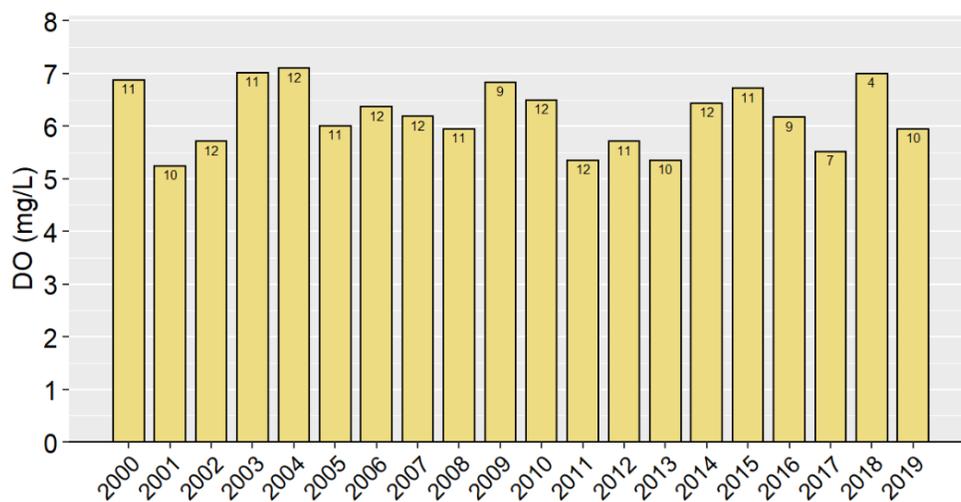


Figure 4-16: Calculated annual mean pH values P3100000 (Little Northeast Creek). Numbers on bars represent the number of samples collected in that year.

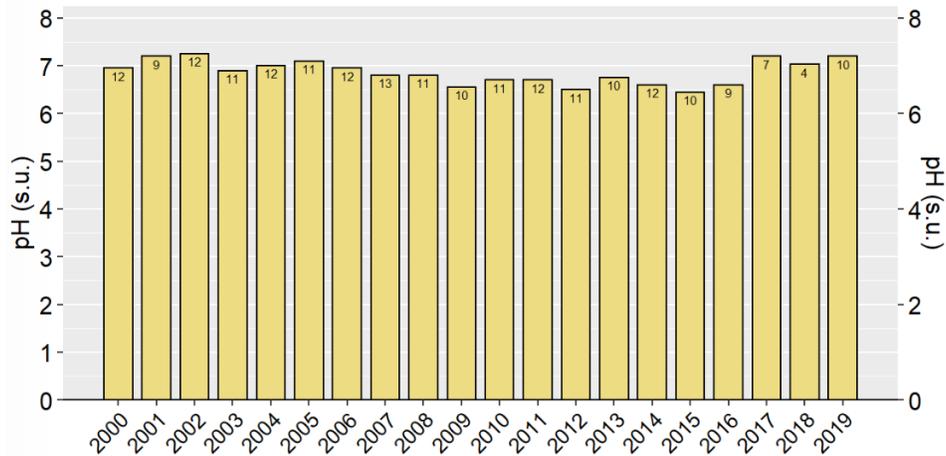
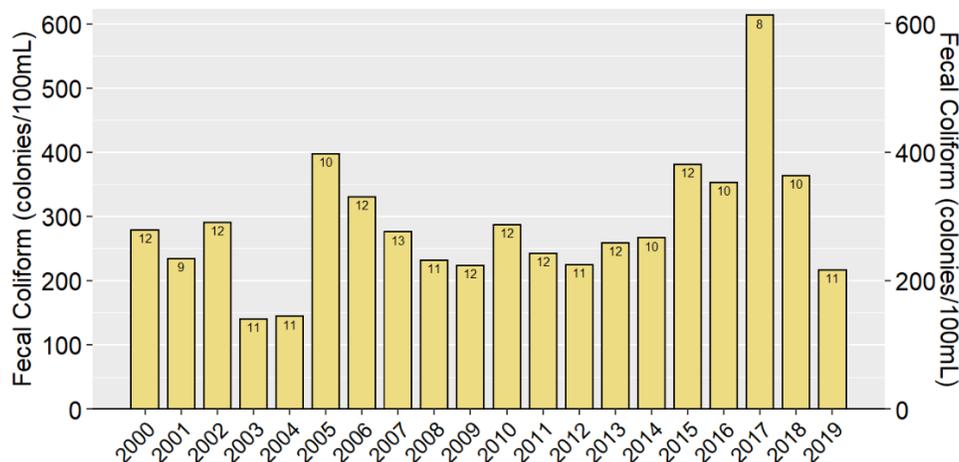


Figure 4-17: Calculated geomean for fecal coliform bacteria P3100000 (Little Northeast Creek). Numbers on bars represent the number of samples collected in that year.



*Northeast Creek (SC; HQW; NSW)*

Northeast Creek is a tributary to the New River. Much of Northeast Creek is in Category 4b for chlorophyll *a* (Table 4-5). Ambient monitoring station P3700000 is located in the upper most reach of AU# 19-16-(3.5)a. Chlorophyll *a* concentrations have measured as high as 200 µg/L (1986) and 190 µg/L (2013) and as low as 1 µg/L (Figure 4-18). Percent exceedances have changed over time, but Northeast Creek continues to be impacted by chlorophyll *a* (Figure 4-19). While ammonia and phosphorus levels have remained steady between 2000 and 2019, TN has increased (Figure 4-20). DO and pH are also parameters of interest. Both parameters were placed in Category 3a (data inconclusive) based on the most current ambient water quality assessment, a trend that can be seen for one or both parameters in the last four Integrated Reports (2014, 2016, 2018, and 2020).

Table 4-5: Assessment unit description, category and parameter(s) of interest for Northeast Creek

| AU#          | Classification | Description  | Category                  | Parameters of Interest  |
|--------------|----------------|--|---------------------------|-------------------------|
| 19-16-(0.5)  | SC; NSW        | From source to NC Hwy 24   | Category 1                |                         |
| 19-16-(3.5)a | SC; HQW; NSW   | From NC Hwy 24 to a line crossing Northeast Creek downstream of NC 24                                    | Category 3<br>Category 4b | DO, pH<br>Chlorophyll a |
| 19-16-(3.5)b | SC; HWQ; NSW   | From a line crossing Northeast Creek downstream of NC 24 to the downstream side of mouth of Scales Creek | Category 4b               | Chlorophyll a           |
| 19-16-(4.5)  | SC; NSW        | From downstream side of mouth of Scales Creek to New River   | Category 4b               | Chlorophyll a           |

Figure 4-18: Chlorophyll a concentrations from 1985 to 2019 at ambient monitoring station P3700000 in Northeast Creek (red line denotes water quality standard of 40 µg/L)

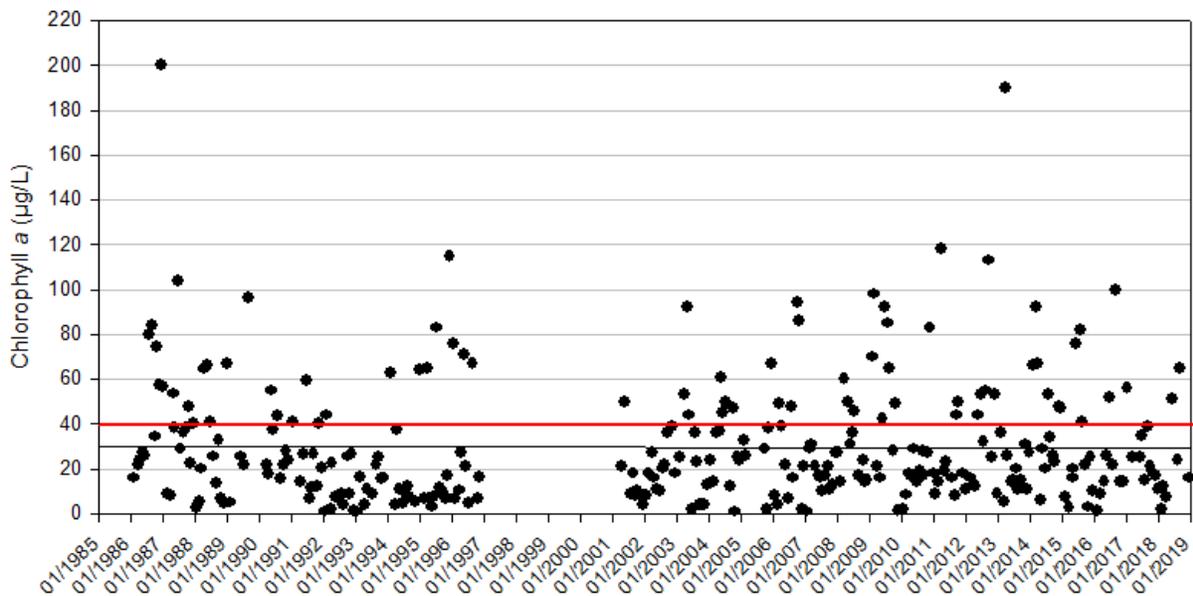


Figure 4-19. Percentage of chlorophyll a exceedances by concentration in total samples collected at ambient monitoring station P3700000 in assessment periods from 2001-2018 (red line denotes the 10 percent excursion level)

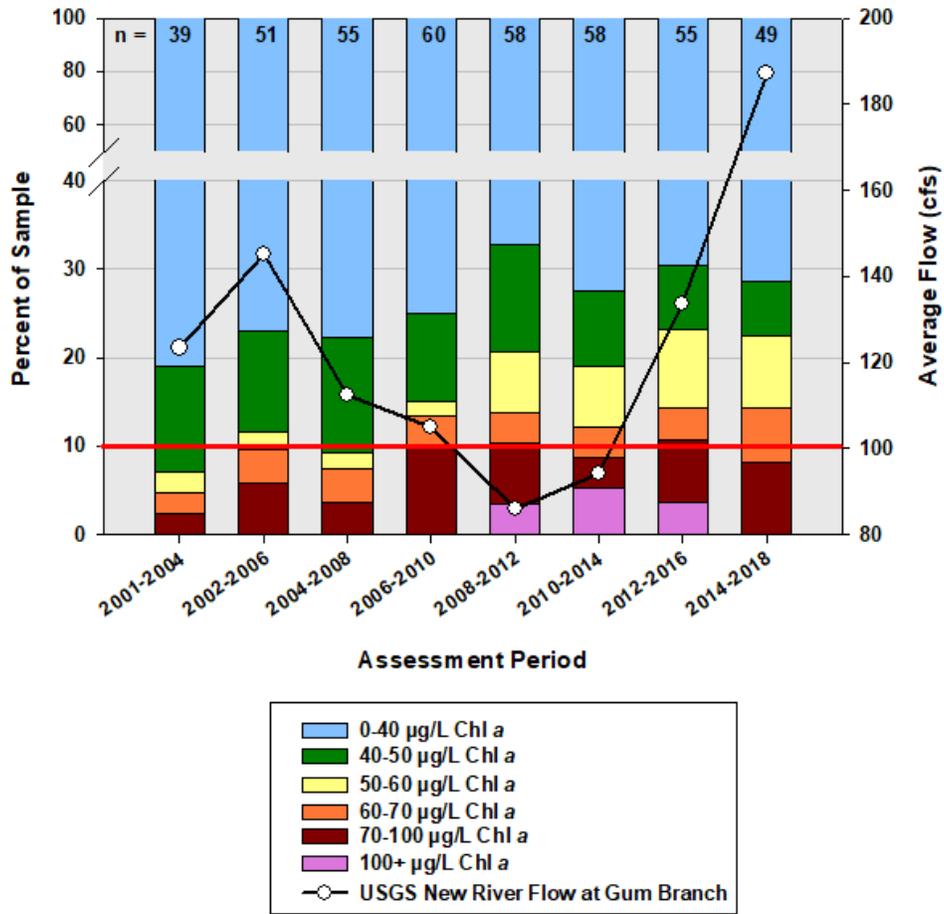
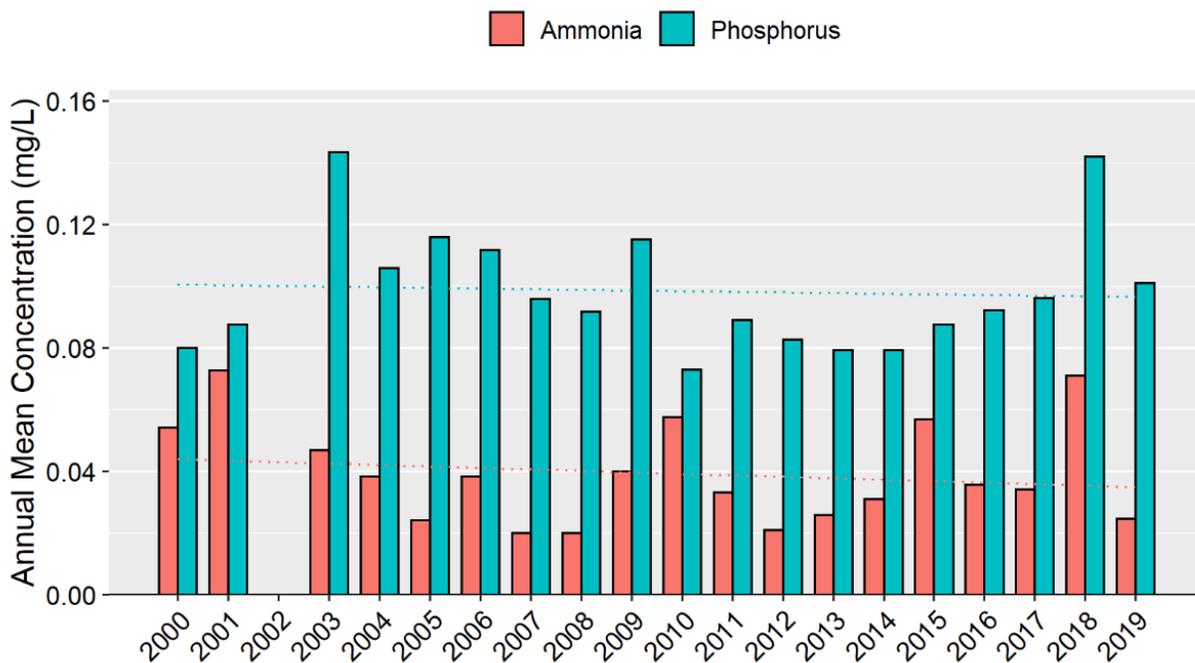
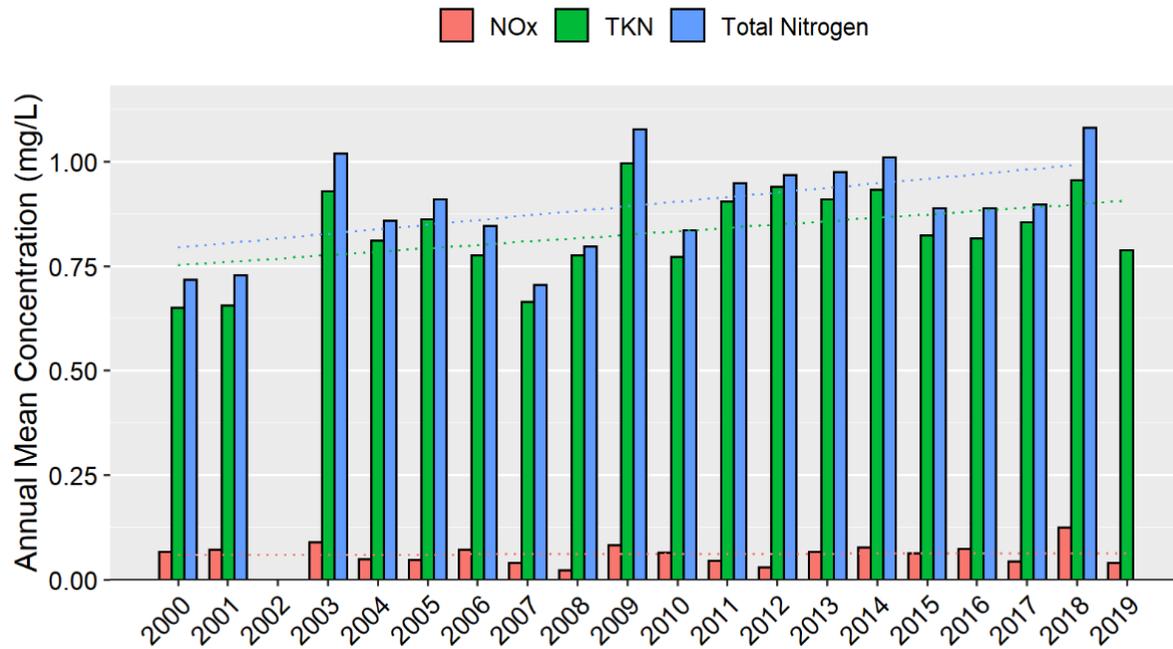


Figure 4-20: Calculated annual mean concentrations for nutrients P3700000 (Northeast Creek)



*Harris Creek (AU# 19-17-3) (C; NSW)*

Harris Creek is a tributary to Southwest Creek, and from its source to Southwest Creek (5.9 miles) is in Category 1 of the 2018 and draft 2020 Integrated Report. Benthic macroinvertebrates were sampled in 2008 and 2015, resulting in a Moderate swamp bioclassification during both events. Biologists noted that no major changes in water quality conditions have occurred since the initial 1999 assessment.

*Southwest Creek [AU# 19-17-(6.5)] (SC; HQW; NSW)*

Southwest Creek, from Mill Run to New River (595 acres), was in Category 4b for chlorophyll *a* on the 2018 Integrated Report but moved to Category 3 (data inconclusive) for the draft 2020 Integrated Report (Figure 4-21; Figure 4-22). Water quality data collected from ambient monitoring station P4100000 indicated that DO and pH were also parameters of concern during the last two assessment periods (Figure 4-23). One NPDES permit discharges to Southwest Creek (Permit NC0034339), and there is a large development in the watershed that may be contributing to nonpoint source of pollution.

Figure 4-21: Chlorophyll *a* concentrations at ambient monitoring station P4100000 (Southwest Creek) (1985-2019) (red line denotes water quality standard of 40 µg/L)

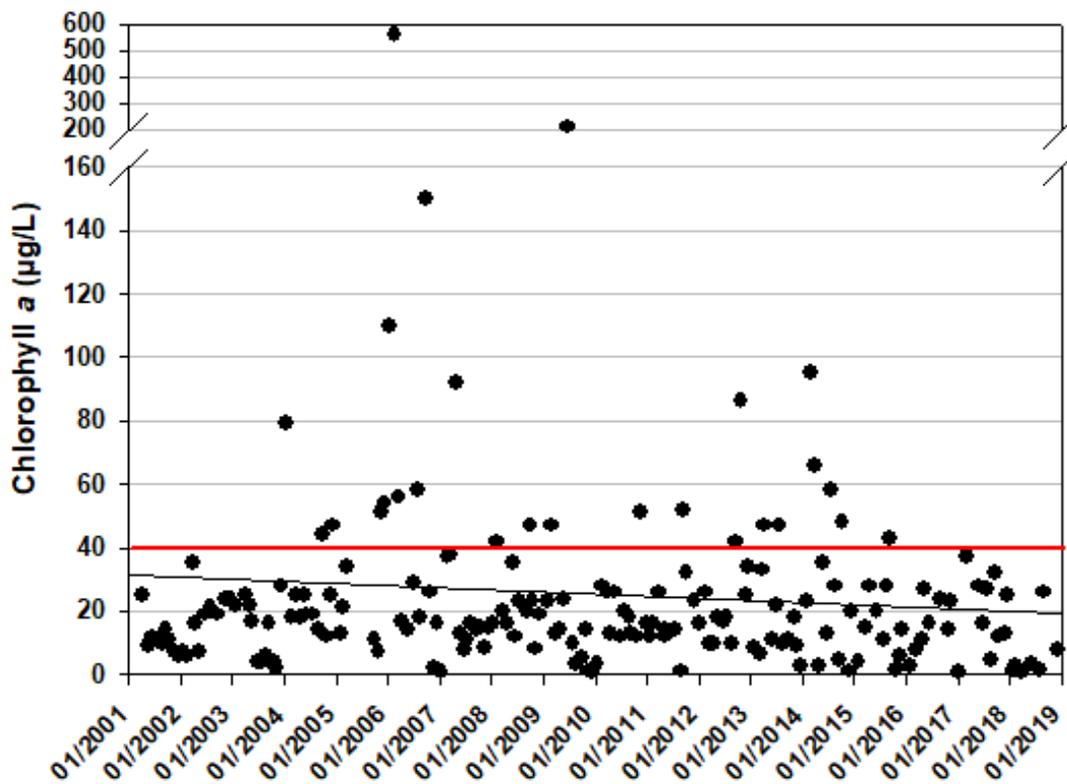


Figure 4-22: Percentage of chlorophyll a exceedances by concentration in total samples collected at ambient monitoring station P4100000 for assessment periods from 2001-2018 (red line denotes the 10 percent excursion level)

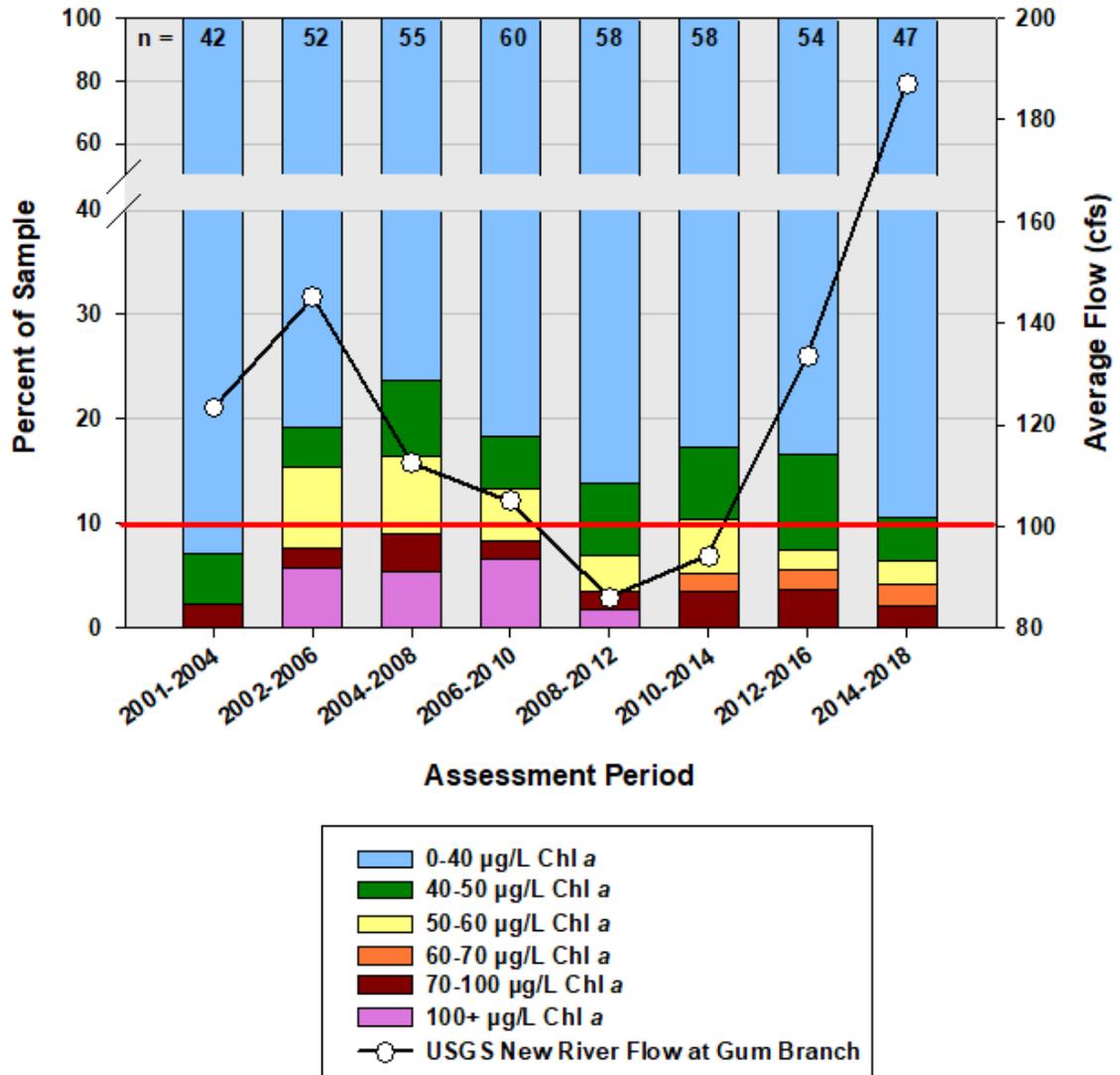
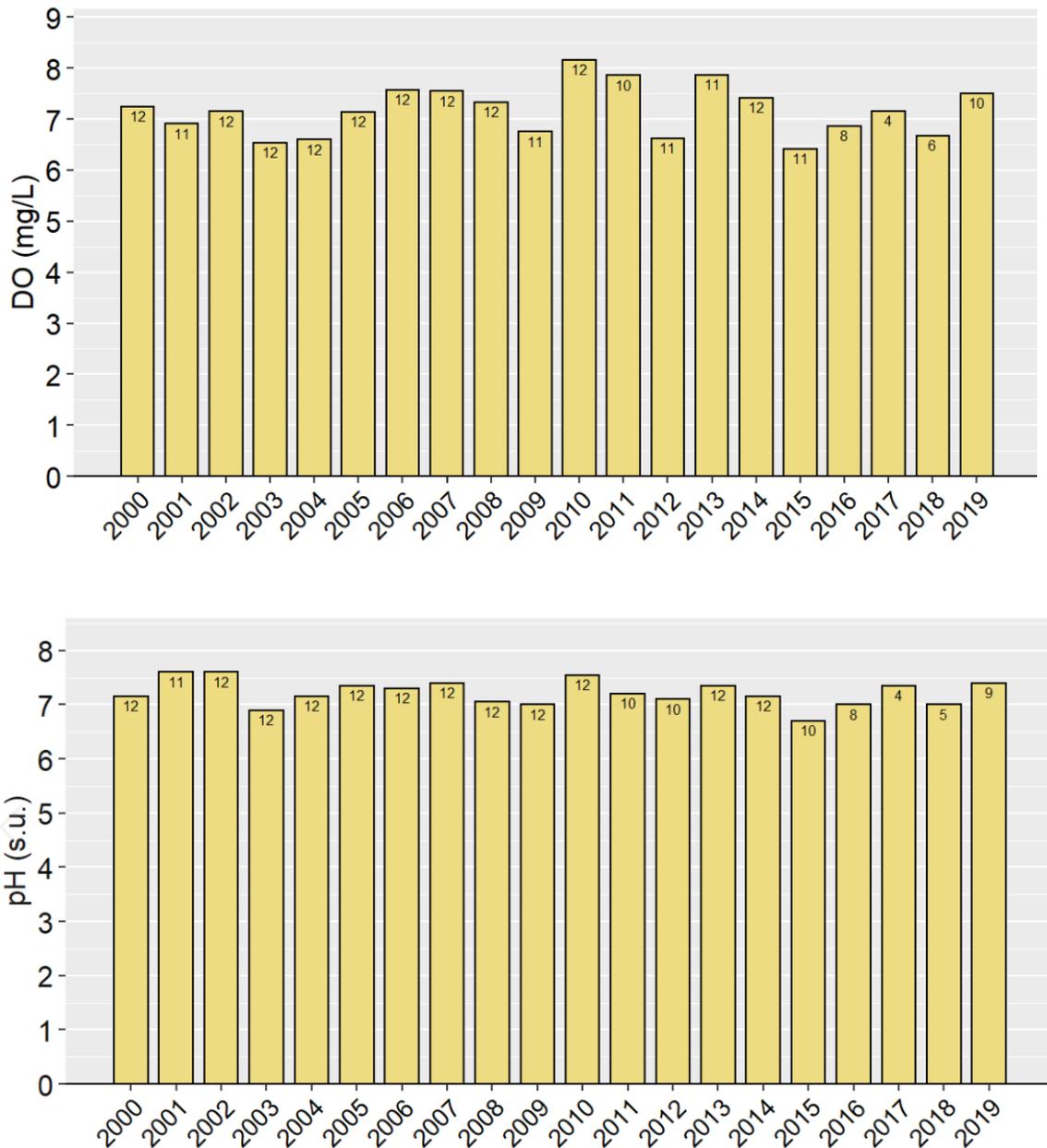


Figure 4-23: DO and pH calculated mean concentrations at ambient monitoring station P4100000 (Southwest Creek) (2000-2019). Numbers on bars represent the number of samples collected in that year.



*New River [AU# 19-(15.5)] (SC; NSW)*

New River, from Mumford Point to approximately 2,200 yards downstream from mouth of Duck Creek (6,581 acres), is in Category 3 (data inconclusive) on the draft 2020 Integrated Report for chlorophyll *a* and in Category 5 (impaired) for pH. Ambient monitoring station P4600000 is in the estuary, just upstream of Frenchs Creek. Chlorophyll *a* concentrations have been rising steadily at this station since 2000 and that rise may be partially attributed to nonpoint source pollution in the watershed (Figure 4-24). Housing and commercial development, including a golf course, parks, an urban center, and a military base, are all

located upstream of the monitoring station. There are also several NPDES outfalls upstream of the monitoring station. Comparing chlorophyll *a* concentrations to streamflow, there seems to be a correlation between higher flow measurements with higher concentrations and more extensive chlorophyll *a* exceedances in this portion of New River estuary (Figure 4-25).

Figure 4-24: Chlorophyll *a* concentrations at ambient monitoring station P4600000 (New River-Frenchs Creek) (2000-2019) (red line denotes water quality standard of 40 µg/L)

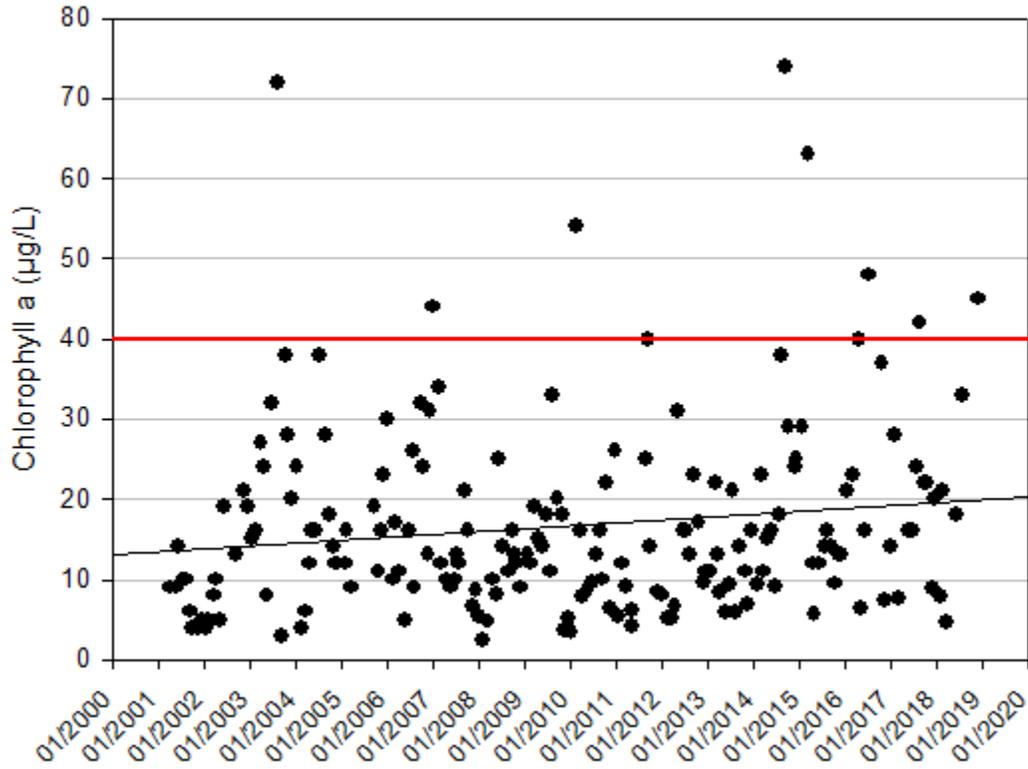
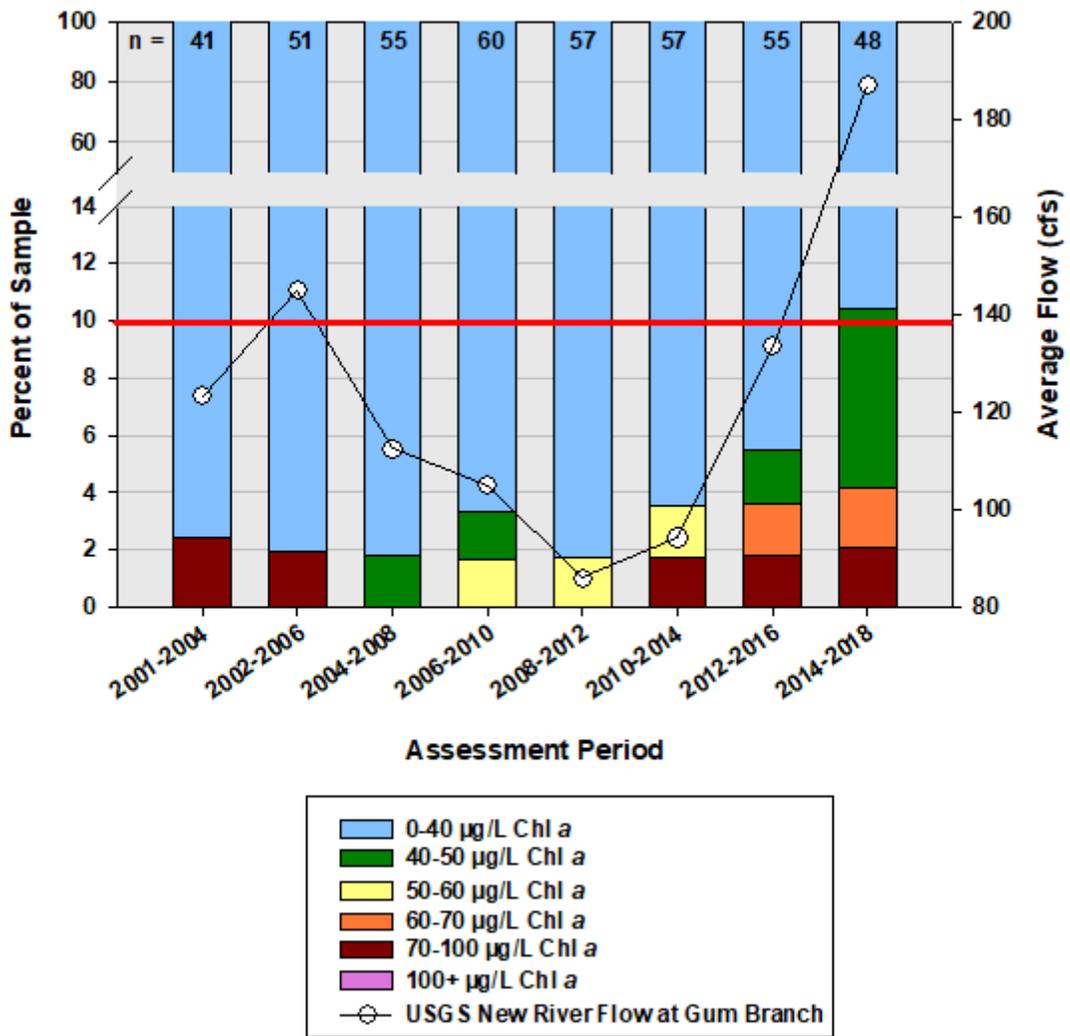


Figure 4-25: Percentage of chlorophyll a exceedances by concentration in total samples collected at ambient monitoring station P4600000 for assessment periods from 2001-2018 (red line denotes the 10 percent excursion level)



#### 4.8.3 New River Inlet (HUC 0302030203)

The New River Inlet (HUC 0302030203) encompasses 51,972 acres (81 mi<sup>2</sup>) and had an estimated 2010 population of 12,118 people. Wetlands comprise most of the land area (32%), followed by forest (22%), open water (18%), and developed/urban areas (13%) (NLCD, 2016). One NPDES discharge permit, five non-discharge permits, and 10 stormwater permits have been issued within the watershed.

Based on the most current shellfish sanitary surveys (2019), C-2 Sneads Ferry Area, C-1 Mill Creek Area, and B-9 Stump Sound Area are located in the watershed. Shellfish growing area C-2 includes all waters in New River between the Highway 172 Bridge and New River Inlet. It also includes growing areas found in Fannie Creek, Wheeler Creek, Courthouse Bay, Traps Bay, Mile Hammock Bay, and several smaller creeks and bays in the area. Most of the shoreline is owned by The United States Marine Corps Base Camp LeJeune. The community of Sneads Ferry is located along a small portion of the eastern shorelines. Overall, the area includes a total of approximately 4,630 water acres.

Shellfish growing area C-1 consists of all waters in Onslow County between Intracoastal Waterway Marker “76” near Hatch Point and the North Topsail High Rise Bridge, including Chadwick Bay, Fullard Creek, Charles Creek, Hell Gate Creek, Alligator Bay, Mill Creek, and a portion of the Intracoastal Waterway. The towns of Sneads Ferry and North Topsail Beach line the shores of the growing area. Overall, the area includes approximately 3,954 water acres.

Shellfish growing area B-9 consists of all waters in Stump Sound and its tributaries, bordered to the northeast by the North Topsail High Rise Bridge and the Intracoastal Waterway Beacon “71” near the new Surf City High Rise Bridge to the southwest. Portions of Holly Ridge, North Topsail Beach, and Surf City line the shores of the growing area. Overall, the area includes a total of approximately 5,771 water acres. A total maximum daily load (TMDL) allocation is currently being developed by DWR for Turkey Creek (AU# 18-87-1). The results will be incorporated into an alternative TMDL, or Watershed Action Plan (WAP), being developed by the North Carolina Coastal Federation (NCCF). The WAP is scheduled to be finished sometime in 2022. More information about TMDLs can be found on DWR’s Modeling and Assessment Branch (MAB) [website](#).

More information about the shellfish growing areas, new closures associated with the most current shellfish sanitary surveys, and potential pollution sources can be found in Chapter 5. Twenty-four waterbodies are located in conditionally approved open shellfish growing areas (Table 4-6).



| Land Use (2016) | % Land Cover | Square Miles (mi <sup>2</sup> ) |
|-----------------|--------------|---------------------------------|
| Agriculture     | 5.7%         | 4.65                            |
| Barren Land     | 3.0%         | 4.40                            |
| Developed       | 13.3%        | 10.77                           |
| Forest          | 21.5%        | 17.47                           |
| Grassland/Shrub | 6.2%         | 5.04                            |
| Open Water      | 18.3%        | 14.90                           |
| Wetland         | 32.0%        | 81.21                           |

Table 4-6: Conditionally approved open shellfish growing areas in the New River Inlet (HUC 0302030203)

| AU #          | Stream Name                     | Area (Saltwater Acres) | Growing Area Name | Growing Area ID | Growing Area (Acres) |
|---------------|---------------------------------|------------------------|-------------------|-----------------|----------------------|
| 18-87         | Intracoastal Waterway           | 76.2                   | Stump Sound Area  | B-9             | 1,662                |
| 18-87-(5.5)   | Intracoastal Waterway           | 159.6                  | Stump Sound Area  | B-9             | 1,018                |
| 18-87-0.5     | Stump Sound ORW Area            | 939.9                  | Stump Sound Area  | B-9             | 17,520               |
| 18-87-10b     | Topsail Sound                   | 56.2                   | Stump Sound Area  | B-9             | 1,393                |
| 18-87-10c     | Topsail Sound                   | 1144.5                 | Stump Sound Area  | B-9             | 3,816                |
| 18-87-10d     | Topsail Sound                   | 12.7                   | Stump Sound Area  | B-9             | 1,018                |
| 18-87-1a      | Turkey Creek                    | 79.5                   | Stump Sound Area  | B-9             | 1,126                |
| 18-87-1b      | Turkey Creek                    | 59.6                   | Stump Sound Area  | B-9             | 2,261                |
| 18-87-2       | Everett Bay                     | 240.6                  | Stump Sound Area  | B-9             | 3,521                |
| 18-87-3       | Stump Sound                     | 87.3                   | Stump Sound Area  | B-9             | 4,690                |
| 18-87-6       | Batts Mill Creek (Barlow Creek) | 40.8                   | Stump Sound Area  | B-9             | 535                  |
| 18-87-7       | Old Mill Creek                  | 0.1                    | Stump Sound Area  | B-9             | 1,160                |
| 19-39-1a      | Rogers Bay                      | 4.0                    | Stump Sound Area  | B-9             | 3                    |
| 19-(27)a1     | New River                       | 5738.8                 | Mill Creek Area   | C-1             | 73                   |
| 19-(27)a2     | New River                       | 49.1                   | Mill Creek Area   | C-1             | 84                   |
| 19-(27)a4     | New River                       | 5.6                    | Mill Creek Area   | C-1             | 7                    |
| 19-39-(0.5)   | Intracoastal Waterway           | 84.6                   | Mill Creek Area   | C-1             | 34                   |
| 19-39-(3.5)a1 | Intracoastal Waterway           | 81.3                   | Mill Creek Area   | C-1             | 5                    |
| 19-39-3a      | Alligator Bay                   | 260.2                  | Mill Creek Area   | C-1             | 63                   |
| 19-39-3c      | Alligator Bay                   | 305.5                  | Mill Creek Area   | C-1             | 751                  |
| 19-39-4a      | Chadwick Bay                    | 861.1                  | Mill Creek Area   | C-1             | 168                  |
| 19-41-(0.5)a2 | Intracoastal Waterway           | 19.3                   | Hurst Beach Area  | C-4             | 9                    |
| 19-41-(0.5)c2 | Intracoastal Waterway           | 16.3                   | Hurst Beach Area  | C-4             | 27                   |
| 19-41-3       | Salliers Bay                    | 60.2                   | Hurst Beach Area  | C-4             | 18                   |

#### 4.8.4 Topsail Beach (HUC 0302030204)

Topsail Beach (HUC 0302030204) encompasses 40,693 acres (64 mi<sup>2</sup>) and had an estimated 2010 population of 21,121 people. Wetlands comprise most of the land area (36%), followed by developed/urban areas (24%), open water (15%), and forest (15%) (NLCD, 2016). Four non-discharge and

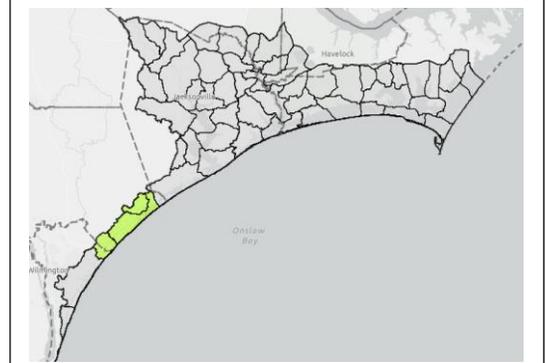
two stormwater permits have been issued in the watershed. No NPDES discharge permits are issued in the Topsail Beach watershed.

In 2011, a No Discharge Zone (NDZ) was established to prohibit the discharge of waste from marine toilets into surface waters. Currently, North Carolina has coastal NDZs in New Hanover, Brunswick, and Pender Counties. Within these three counties, any waterbody with a salt water classification (SA, SB, or SC) is a NDZ except for the Cape Fear River above Snow’s Cut. Additionally, the area extending three miles out into the ocean from these counties is also an NDZ. More information about NDZ is available on the Division of Coastal Management’s (DCM) [website](#) and on EPA’s Vessel Sewage NDZ [website](#).

Based on the most current shellfish sanitary surveys (2017-2019), B-7 Wrightsville Beach Area and B-8 Topsail Beach Area are located in the watershed. Shellfish growing area B-7 includes portions of Greenville Sound and Middle Sound, as well as Bradley Creek, Howe Creek, Pages Creek, and the Masonboro and Mason Inlet areas. The surrounding watershed is one of the most densely populated along the North Carolina coast, and includes portions of Wilmington, Wrightsville Beach, Ogden, and Figure Eight Island. Overall, the growing area includes a total of approximately 5,912 water acres.

Shellfish growing area B-8 consists of all waters in Topsail Sound between the Intracoastal Waterway Beacon “71” to the north and Intracoastal Waterway Beacon “118” in the south. It also includes Futch Creek, Mill Creek, Old Topsail Creek, Nixon Creek, Virginia Creek, and Beckys Creek. Portions of Hampstead, Topsail Beach, and Surf City line the shores of the growing area. Overall, the area includes a total of 12,307 water acres. A TMDL is being developed by DWR for Virginia Creek (AU# 18-87-9). The TMDL is scheduled to be complete by 2021. More information about TMDLs can be found on DWR’s Modeling and Assessment Branch (MAB) [website](#).

More information about the shellfish growing areas, new closures associated with the most current shellfish sanitary surveys, and potential pollution sources can be found in Chapter 5. More information about education and outreach as well as watershed projects in New Hanover County and the Wilmington area can be found in Chapter 6. Twelve waterbodies are located in conditionally approved open shellfish growing areas (Table 4-7).



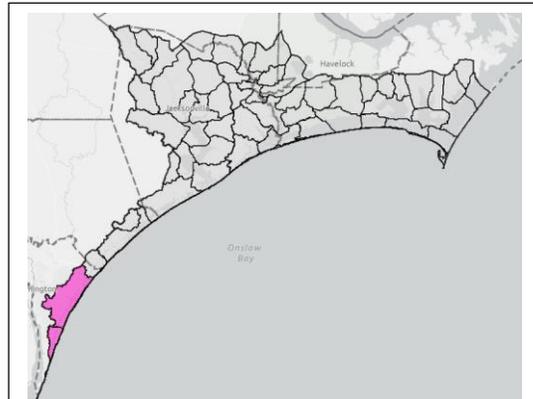
| Land Use (2016) | % Land Cover | Square Miles (mi <sup>2</sup> ) |
|-----------------|--------------|---------------------------------|
| Agriculture     | 3.3%         | 2.12                            |
| Barren Land     | 2.3%         | 1.48                            |
| Developed       | 23.8%        | 15.16                           |
| Forest          | 14.7%        | 9.36                            |
| Grassland/Shrub | 4.6%         | 2.92                            |
| Open Water      | 15.3%        | 9.75                            |
| Wetland         | 35.8%        | 22.79                           |

Table 4-7: Conditionally approved open shellfish growing areas in the Topsail Beach watershed (HUC 0302030204)

| <b>AU #</b>  | <b>Stream Name</b>                      | <b>Area<br/>(Saltwater<br/>Acres)</b> | <b>Growing Area<br/>Name</b> | <b>Growing<br/>Area ID</b> | <b>Growing<br/>Area<br/>(Acres)</b> |
|--------------|---|---------------------------------------|------------------------------|----------------------------|-------------------------------------|
| 18-87-11.7b  | Topsail Sound and Middle Sound ORW Area | 2.1                                   | Wrightsville Beach Area      | B-7                        | 3                                   |
| 18-87-11.7c  | Topsail Sound and Middle Sound ORW Area | 272.5                                 | Wrightsville Beach Area      | B-7                        | 81                                  |
| 18-87-(11.5) | Intracoastal Waterway                   | 112.9                                 | Topsail Sound Area           | B-8                        | 330                                 |
| 18-87-(5.5)  | Intracoastal Waterway                   | 159.6                                 | Topsail Sound Area           | B-8                        | 291                                 |
| 18-87-10c    | Topsail Sound                           | 1,144.5                               | Topsail Sound Area           | B-8                        | 389                                 |
| 18-87-11.7c  | Topsail Sound and Middle Sound ORW Area | 272.5                                 | Topsail Sound Area           | B-8                        | 532                                 |
| 18-87-11.7e  | Topsail Sound and Middle Sound ORW Area | 2.7                                   | Topsail Sound Area           | B-8                        | 291                                 |
| 18-87-12a    | Old Topsail Creek                       | 16.5                                  | Topsail Sound Area           | B-8                        | 631                                 |
| 18-87-12b    | Old Topsail Creek                       | 12.4                                  | Topsail Sound Area           | B-8                        | 736                                 |
| 18-87-19b    | Futch Creek                             | 14.3                                  | Topsail Sound Area           | B-8                        | 25                                  |
| 18-87-8b     | Beckys Creek (Bishops Creek)            | 66.4                                  | Topsail Sound Area           | B-8                        | 140                                 |
| 18-87-9b     | Virginia Creek                          | 73.6                                  | Topsail Sound Area           | B-8                        | 18                                  |

4.8.5 Masonboro Inlet – Mason Inlet (HUC 0302030205)

Masonboro Inlet - Mason Inlet (HUC 0302030205) encompasses 40,665 acres (64 mi<sup>2</sup>) and had an estimated 2010 population of 75,318 people. Nearly half of the land use is developed/urban areas (47%) followed by wetland (21%) and open water (15%) (NLCD, 2016). One NPDES wastewater and 12 stormwater permits have been issued in the watershed. No non-discharge permits have been issued in the Masonboro Inlet - Mason Inlet watershed.



To identify potential bacterial sources near Wrightsville Beach, the Town of Wrightsville Beach funded a Bacteria Source Tracking Study that was carried out by researchers at UNC-Wilmington. Water quality samples were collected between 2007 and 2009 and identified human and wildlife bacteria sources. The human sources were attributed to discharge from marinas and boat heads. This led the Town of Wrightsville Beach to enact a NDZ in 2010. The bacteria coming from wildlife were likely flushed into surface waters via stormwater. Continued implementation of the Town’s Stormwater Ordinance and the Coastal Stormwater rules should help reduce impacts from bacteria (i.e., swimming advisories, prohibited shellfish growing areas) (Mallin et al. 2009).

| Land Use (2016) | % Land Cover | Square Miles (mi <sup>2</sup> ) |
|-----------------|--------------|---------------------------------|
| Agriculture     | 0.5%         | 0.30                            |
| Barren Land     | 3.8%         | 4.43                            |
| Developed       | 47.2%        | 29.98                           |
| Forest          | 10.7%        | 6.78                            |
| Grassland/Shrub | 2.8%         | 1.79                            |
| Open Water      | 14.5%        | 9.19                            |
| Wetland         | 20.6%        | 13.06                           |

Based on the most current shellfish sanitary surveys (2017-2019), B-5 Myrtle Grove Sound, B-6 Masonboro Sound, and B-7 Wrightsville Beach Area are Conditionally Approved Open for shellfish harvesting. Shellfish growing area B-5 consists of all waters between the Cape Fear River and the Intracoastal Waterway Marker “141” near Peden Point, including Snows Cut, Myrtle Grove Sound, Carolina Beach Inlet, and Everett Creek. Portions of Carolina Beach, Myrtle Grove, and the uninhabited Masonboro Island line the shores of the growing area. Overall, the area includes a total of approximately 3,053 water acres.

Shellfish growing area B-6 includes all waters in Masonboro Sound between Masonboro Inlet and Intracoastal Waterway Marker “140”, as well as Whiskey Creek and Hewletts Creek. Portions of Wilmington, as well as the uninhabited Masonboro Island, line the shores of the growing area. Overall, the area includes a total of approximately 3,046 water acres.

Shellfish growing area B-7 includes portions of Greenville Sound and Middle Sound, as well as Bradley Creek, Howe Creek, Pages Creek, and the Masonboro and Mason Inlet areas. The surrounding watershed is one of the most densely populated along the North Carolina coast, and includes portions of Wilmington, Wrightsville Beach, Ogden, and Figure Eight Island. Overall, the growing area includes a total of approximately 5,912 water acres.

More information about the shellfish growing areas, new closures associated with the most current shellfish sanitary surveys, and potential pollution sources can be found in Chapter 5. More information

about education and outreach as well as watershed projects in New Hanover County and the Wilmington area can be found in Chapter 6. Twelve waterbodies are located in conditionally approved open shellfish growing areas (Table 4-8).

Table 4-8: Conditionally approved open shellfish growing areas in Masonboro Inlet (HUC 0302030205)

| AU #          | Stream Name                    | Area (Saltwater Acres) | Growing Area Name       | Growing Area ID | Growing Area (Acres) |
|---------------|--------------------------------|------------------------|-------------------------|-----------------|----------------------|
| 18-87-(25.5)  | Intracoastal Waterway          | 310.5                  | Myrtle Grove Sound Area | B-5             | 324                  |
| 18-87-(30.5)  | Intracoastal Waterway          | 26.8                   | Myrtle Grove Sound Area | B-5             | 112                  |
| 18-87-25.7b   | Masonboro Sound ORW Area       | 99.5                   | Myrtle Grove Sound Area | B-5             | 426                  |
| 18-87-31b     | Myrtle Sound Shellfishing Area | 65.1                   | Myrtle Grove Sound Area | B-5             | 788                  |
| 18-87-(25.5)  | Intracoastal Waterway          | 310.5                  | Masonboro Sound         | B-6             | 195                  |
| 18-87-25.7a   | Masonboro Sound ORW Area       | 285.3                  | Masonboro Sound         | B-6             | 32                   |
| 18-87-26b     | Hewletts Creek                 | 19.9                   | Masonboro Sound         | B-6             | 405                  |
| 18-87-(23.5)a | Intracoastal Waterway          | 52.8                   | Wrightsville Beach Area | B-7             | 10                   |
| 18-87-(23.5)c | Intracoastal Waterway          | 70.4                   | Wrightsville Beach Area | B-7             | 4                    |
| 18-87-21b     | Middle Sound                   | 139.9                  | Wrightsville Beach Area | B-7             | 62                   |
| 18-87-21c1    | Middle Sound                   | 32.1                   | Wrightsville Beach Area | B-7             | 62                   |
| 18-87-22b     | Pages Creek                    | 28.5                   | Wrightsville Beach Area | B-7             | 12                   |

#### 4.9 Onslow Water Quality Monitoring Program

In 1999, the [Onslow Board of Commissioners](#), with the aid of Senator Charlie Albertson, obtained funds to support an Onslow County Water Quality Study. The study was to establish a one-year water quality testing program in Onslow County to determine where fecal coliform, copper, arsenic, ammonia, and other pollutants are impacting the health, safety, and economic welfare of citizens in the county.

Today, there are 28 active monitoring sites in Onslow County in both the New and White Oak river subbasins. Samples are analyzed every two weeks for temperature, salinity, dissolved oxygen (DO), enterococcus bacteria, nitrate-nitrogen, ammonia-nitrogen, and ortho-phosphate. The data is reported to the Onslow County Board of Commissioners by the Onslow County Cooperative Extension Service (CES) on a regular basis. A March 2014 report available [online](#) included information about salinity, dissolved oxygen, and nitrogen collected between 2000 and 2013. Salinity was reported as being moderate in Kings Creek, Turkey Creek, Mill Creek, and the White Oak River (Stella Road) with higher levels observed during drought years (2004-2005, 2007-2008, 2010-2011). Halls Creek (Swansboro) saw a decline in DO (below 3 mg/L) whereas New River (Rag Lane) saw an increase in DO. The decline was attributed to beaver dams

and new urban development in the watershed. The improvement was attributed to debris removal and aquatic weed control just upstream of the monitoring site. Nitrate remained below 0.5 mg/L for most of the monitoring sites in the White Oak. In the New River, however, four locations sampled above Richlands have consistently shown nitrate levels between 0.3 mg/L to almost 5 mg/L. The report also indicated that samples collected in Brinson Creek (Hwy. 17) and New River (Rag Lane) can sporadically reach 4 mg/L, and that Blue Creek (Oakhurst Land Park) has seen a significant increase in nitrate since 2007. The cause of the increase in Blue Creek is unknown (Rashash, 2014). No other reports are available online.

To help understand where nutrients may be impacting water quality in the White Oak River basin and to understand where nutrients may be contributing to elevated chlorophyll *a* concentrations in the New River subbasin, DEQ and the Onslow County CES should work collaboratively to identify and supplement existing water quality monitoring data. Water quality results should be shared across state and local agencies to help meet the original objective of the county program which was to determine where pollutants may be impacting the health, safety, and economic welfare of citizens (and visitors) to the county.

#### 4.10 Protecting Water Resources in the New River Subbasin

The Basin Planning Branch (BPB) continually works with the Nonpoint Source Planning Branch (NPSPB), Soil and Water Conservation Districts (SWCD), Natural Resources Conservation Service (NRCS), and various stakeholders throughout the region to improve our understanding of point and nonpoint sources of pollution and encourage continued efforts to implement best management practices (BMPs) and restoration activities that reduce nutrients, sediment loads, and flow volume to the receiving waterbodies.

##### *Nutrient Sensitive Waters (NSW)*

In the New River subbasin, the original NSW strategy focused on point sources of pollution. Nonpoint source reductions were voluntary. Because an NSW strategy was put into place, the New River and its estuary were moved to Category 4b of the Integrated Report. Category 4b is assigned when a parameter exceeds criteria, but there is an enforceable management strategy in place for the parameter of interest. Waters included in Category 4b were in Category 5 (impaired waters) prior to the development of a management strategy. A TMDL is not required for parameters assessed in Category 4b, however the state is required to report on implementation activities every 2 years.

The majority of the New River remains in Category 4b for chlorophyll *a*, and an evaluation of water quality data indicates that chlorophyll *a*, nutrients, DO, pH, and bacteria continue to be parameters of concern for much of the subbasin. The existing nutrient management strategy should be revisited along with the recommendations made in previous basin plans to determine if the existing NSW strategy is protecting water resources in the New River subbasin. Options that could be explored as part of updating the current NSW strategy include:

- DWR, coordinating with local, state, and federal agencies, including the City of Jacksonville, Onslow County, Camp Lejeune, and other stakeholders to update the NSW strategy. The update should include and identify point and nonpoint source nutrient reduction opportunities. This approach would enable DEQ to keep the New River impairments in Category 4b with an updated and expanded NSW strategy.

- If required or directed by the EPA, moving or re-assigning waterbodies from Category 4b to Category 5. Placing these waters back in Category 5 would require DEQ to develop a TMDL or an alternative TMDL to address point and nonpoint source pollution in the watershed.

#### *Nonpoint Source Pollution and Shellfish Growing Areas*

Stormwater, wastewater treatment plants, on-site wastewater management systems (septic systems), marinas, subdivisions, golf courses, and animals were identified as potential pollution sources in several of the shellfish growing areas in the New River subbasin. Several agencies within DEQ have jurisdiction over water quality, marine fisheries, and coastal management. Representatives from these agencies, along with several agencies outside DEQ, develop and implement the Coastal Habitat Protection Plan (CHPP), with DMF as the lead agency. The CHPP is a guidance document that addresses habitat and water quality efforts needed to protect, enhance, and restore fish habitat along North Carolina's coasts. It aligns closely with the Albemarle-Pamlico National Estuary Program's (APNEP) [Comprehensive Conservation and Management Plan \(CCMP\)](#). More information about the CHPP can be found in Chapter 5.

Key recommendations for protecting water quality and the shellfish growing areas in the New River subbasin include:

- Continue to improve strategies to reduce nonpoint source pollution and minimize cumulative losses. This can be done through voluntary programs, actions, and assistance and improving methods to control stormwater runoff from agriculture, forestry, and urban areas.
- To prevent additional shellfish closures and swimming advisories, conduct targeted water quality restoration activities.
- Prohibit new or expanded stormwater outfalls to coastal beaches and shellfish growing areas except during times of emergency when public safety and health may be threatened. Continue to phase out existing outfalls by implementing alternative stormwater management strategies.
- Enhance coordination and provide financial and technical support to local governments to effectively manage and improve stormwater and wastewater infrastructure.
- Maintain effective regulatory strategies to reduce nonpoint pollution. This can include using vegetated buffers and established stormwater controls.
- Maintain adequate water quality conducive to the support of present and future mariculture in public trust waters.
- Reduce nonpoint source pollution from large-scale animal operations by ensuring proper oversight and management of animal waste management systems, and certified operator compliance with permit and operator requirements and management plan for animal waste management systems.
- Increase financial support for the implementation of voluntary BMPs throughout the basin. Several voluntary programs exist through the local Soil and Water Conservation District (SWCD) and Natural Resource Conservation Service (NRCS). The SWCD, NRCS and the Cooperative Extension Offices (CES)

can also provide guidance on managing agricultural lands, forests, riparian buffers, and stormwater runoff.

- Identify ways to work collaboratively with the Onslow County Cooperative Extension Service (CES) to utilize data collected through the Onslow County Water Quality Monitoring Program to understand where nutrients may be originating from in the New River watershed.
- Continue to work collaboratively with federal, state, and local resource agencies to understand water resource issues (quality and quantity).

#### 4.11 References

Environmental Protection Agency (EPA). Vessels, Marinas and Ports. Vessel Sewage No-Discharge Zone (NDZ). June 18, 2020. <https://www.epa.gov/vessels-marinas-and-ports/vessel-sewage-no-discharge-zones>. Accessed 5/25/2021.

Griffith, G.E., Omernik, J.M., Comstock, J.A., Schafale, M.P., McNab, W.H., Lenat, D.R., MacPherson, T.F., Glover, J.B., and Shelburne, V.B., 2002. Ecoregions of North Carolina and South Carolina, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000). [ftp://newftp.epa.gov/EPADDataCommons/ORD/Ecoregions/nc/nc\\_eco\\_pg.pdf](ftp://newftp.epa.gov/EPADDataCommons/ORD/Ecoregions/nc/nc_eco_pg.pdf). Accessed 3/23/21. Website last updated 2/9/2021. <https://www.epa.gov/eco-research/ecoregion-download-files-state-region-4#pane-31>.

North Carolina Department of Environment, Health and Natural Resources (DEHNR), Division of Water Quality. February 1997. White Oak River Basinwide Water Quality Management Plan.

North Carolina Department of Environmental Quality (DEQ), Division of Coastal Management (DCM). No Discharge Zones (NDZ). n.d. <https://deq.nc.gov/about/divisions/coastal-management/coastal-management-recognition/clean-marinas-program/no-discharge-zones>. Accessed 5/25/2021.

NC Department of Environmental Quality, Division of Water Resources, Biological Assessment Branch. February 2016. Standard Operating Procedures for the Collection and Analysis of Benthic Macroinvertebrates. [https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/BAU/NCDWRMacroinvertebrate-SOP-February%202016\\_final.pdf](https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/BAU/NCDWRMacroinvertebrate-SOP-February%202016_final.pdf). Accessed 6/22/2021.

NC Department of Environmental Quality. 2016. North Carolina Coastal Habitat Protection Plan (CHPP). [http://portal.ncdenr.org/c/document\\_library/get\\_file?p\\_l\\_id=1169848&folderId=28335811&name=DLE-127603.pdf](http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=28335811&name=DLE-127603.pdf). Accessed 5/27/2021.

NLCD, 2016. National Land Cover Database. USGS. Retrieved from [https://www.usgs.gov/centers/eros/science/national-land-cover-database?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/centers/eros/science/national-land-cover-database?qt-science_center_objects=0#qt-science_center_objects)

North Carolina Office of State Budget and Management (OSBM). Estimates of the Total Population of North Carolina Municipalities for July 1, 2019 by Municipality Name. [https://files.nc.gov/ncosbm/demog/muniestbymuni\\_2019.html](https://files.nc.gov/ncosbm/demog/muniestbymuni_2019.html). Accessed 4/1/2021.

Onslow County Board of Commissioners. Accessed 4/1/2021. <http://www.onslowcountync.gov/368/Board-of-Commissioners>.

Onslow County Cooperative Extension Services (CES). Onslow Water Quality Monitoring Program. Accessed 4/1/2021. Webpage last updated November 2020. <https://onslow.ces.ncsu.edu/onslowwq/>.

Rashash, Dr. Diana. March 2014. Onslow County CES. Onslow Water Quality Monitoring Program. Program Update – March 2014. Accessed 4/1/2021. <https://onslow.ces.ncsu.edu/wp-content/uploads/2014/08/BOCupdateMarch2014.pdf? fwd=no>.

Mallin, Michael; Haltom, Mary I.; Song, Bongkeun. 2009. Assessing Fecal Bacteria Sources in the Wrightsville Beach, N.C. Area: Final Report. Retrieved from:

<https://uncw.edu/cms/aelab/wrightsville%20beach/wbeach%20bacteria%20final%20report%202009.pdf>