

Environmental Assessment of the Lower Cape Fear River System, 2005



By

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Executive Summary

Multiparameter water sampling for the Lower Cape Fear River Program (LCFRP) has been ongoing since June 1995. Scientists from the University of North Carolina Wilmington (UNCW) perform the sampling effort. The LCFRP currently encompasses 36 water sampling stations throughout the Cape Fear, Black, and Northeast Cape Fear River watersheds. The LCFRP sampling program includes physical, chemical, and biological water quality measurements and analyses of the benthic and epibenthic macroinvertebrate communities, and has in the past included assessment of the fish communities. Principal conclusions of the UNCW researchers conducting these analyses are presented below, with emphasis on the period January - December 2005. The opinions expressed are those of UNCW scientists and do not necessarily reflect viewpoints of individual contributors to the Lower Cape Fear River Program.

The mainstem lower Cape Fear River is characterized by reasonably turbid water containing moderate to high levels of inorganic nutrients. It is fed by two large blackwater rivers (the Black and Northeast Cape Fear Rivers) that have low levels of turbidity, but highly colored water with less inorganic nutrient content than the mainstem. While nutrients are reasonably high in the river channels, algal blooms are rare because light is attenuated by water color or turbidity, and flushing is high. Periodic algal blooms are seen in the tributary stream stations, some of which are impacted by point source discharges. Below some point sources, nutrient loading can be high and fecal coliform contamination occurs. Other stream stations drain blackwater swamps or agricultural areas, some of which periodically show elevated pollutant loads or effects.

Annual mean salinity for 2005 was higher than the nine-year average for 1996-2004 at all stations. River discharge for 2005 continued a three-year decrease from the high discharge period of 2003. This influenced salinity and also appeared to lead to a reduction in concentration of certain nutrients and other parameters (suspended solids and turbidity) in the main channel and estuary stations.

Average annual dissolved oxygen (DO) levels at the river channel stations for 2005 were slightly higher than the average for 1996-2004, possibly due to the lack of major hurricane activity in the watershed last year. Dissolved oxygen levels were lowest during the summer, often falling below the state standard of 5.0 mg/L at several river and upper estuary stations. There is a dissolved oxygen sag in the main river channel that begins at Station DP below a paper mill discharge and near the Black River input, and persists into the mesohaline portion of the estuary. Mean oxygen levels were highest at the upper river stations NC11 and AC and in the middle to lower estuary at station M23. Lowest mainstem mean 2005 DO levels occurred at the lower river and upper estuary stations NAV and HB (7.1 mg/L). As the water reaches the lower estuary higher algal productivity, mixing and ocean dilution help alleviate oxygen problems.

The Northeast Cape Fear and Black Rivers generally have lower DO levels than the mainstem Cape Fear River. These rivers are classified as blackwater systems because of their tea colored water. The Northeast Cape Fear River in general seems to be more

oxygen stressed than the Black River; in 2005 Station NCF117 had DO concentrations below 4.0 mg/L 33% of the time sampled, while during that same period Station B210 had DO below 4.0 mg/L 0% of the occasions sampled. Several stream stations were severely stressed in terms of low dissolved oxygen during the year 2005. Station ANC had DO levels below 4.0 mg/L 50% of the occasions sampled, NC403 33%, GS 67%, BCRR 42% and SR 58%. Smith Creek had DO levels below the tidal water standard of 5.0 mg/L 42% of the time.

Annual mean turbidity levels for 2005 were considerably lower than the long-term average, probably a result of low rainfall. Highest mean turbidities were at the upper river sites N11, AC and DP (17-19 NTU) with turbidities gradually decreasing downstream through the estuary. Turbidity was lower in the blackwater tributaries (Northeast Cape Fear River and Black River) than in the mainstem river.

Regarding stream stations, chronic or periodic high nutrient levels were found at a number of sites, including BC117, 6RC, GS, GCO, NC403, PB and SAR. Algal blooms were rare in 2005, primarily occurring at Station PB, a nutrient-impacted stream site downstream of a point source, and Stations GS and BCRR. Several stream stations, particularly BCRR, BC117, PB, GS, and ANC showed high fecal coliform counts on a number of occasions. Biochemical oxygen demand (BOD) concentrations in several Northeast Cape Fear River watershed stream stations were considerably higher than BOD concentrations previously found in the neighboring Black River watershed stream stations. Water column metals concentrations were not problematic during 2005.

This report includes an in-depth look at each subbasin, comparing the results of the North Carolina Division of Water Quality's 2005 Basinwide Management Plan use support ratings with the UNCW-Aquatic Ecology Laboratory's (AEL) assessments of the 2005 sampling year. The UNCW-AEL utilized ratings that consider a water body to be of poor quality if the water quality standard for a given parameter is in violation > 25% of the time, of fair quality if the standard is in violation between 11 and 25% of the time, and good quality if the standard is violated no more than 10% of the time. UNCW also considers nutrient loading in water quality assessments, based on published experimental and field scientific findings.

For the 2005 period UNCW rated all stations as good in terms of chlorophyll *a*, except for Station PB, rated fair. For turbidity 100% of the sites were rated good. However, 22% of the stations had either fair or poor water quality in terms of fecal coliform bacterial contamination. Using the 5.0 mg/L DO standard for the Piedmont river stations, and the 4.0 mg/L "swamp water" DO standard for the stream stations and blackwater river stations, 41% of the sites were rated poor or fair for dissolved oxygen. In addition, UNCW considered 60% of the stream stations to be negatively impacted by excessive nitrate and 10% of the stream stations negatively affected by excessive total phosphorus concentrations.

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1.0 Introduction

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The Lower Cape Fear River Program is a unique science and education program that has a mission to develop an understanding of processes that control and influence the ecology of the Cape Fear River, and to provide a mechanism for information exchange and public education. This Program provides a forum for dialogue among the various Cape Fear River user groups and encourages interaction among them. Overall policy is set by an Advisory Board consisting of representatives from citizen's groups, local government, industries, academia, the business community, and regulatory agencies. This report represents the scientific conclusions of the UNCW researchers participating in this Program and does not necessarily reflect opinions of all other Program participants. This report focuses on the period January through December 2005.

The scientific basis of the Program consists of the implementation of an ongoing comprehensive physical, chemical, and biological monitoring program. Another part of the mission is to develop and maintain a data base on the Cape Fear basin and make use of this data to develop management plans. Presently the Program has amassed a ten-year (1995-2004) data base freely available to the public. Using this monitoring data as a framework the Program goals also include focused scientific projects and investigation of pollution episodes. The scientific aspects of the Program are carried out by investigators from the University of North Carolina Wilmington Center for Marine Science. The monitoring program was developed by the Lower Cape Fear River Program Technical Committee, which consists of representatives from UNCW, the North Carolina Division of Water Quality, The NC Division of Marine Fisheries, the US Army Corps of Engineers, technical representatives from streamside industries, the City of Wilmington Wastewater Treatment Plants, Cape Fear Community College, Cape Fear River Watch, the North Carolina Cooperative Extension Service, the US Geological Survey, forestry and agriculture organizations, and others. This integrated and cooperative program was the first of its kind in North Carolina.

Broad-scale monthly water quality sampling at 16 stations in the estuary and lower river system began in June 1995 (directed by Dr. Michael Mallin). Sampling was increased to 34 stations in February of 1996, 35 stations in February 1998, and 36 stations in 2005. The Lower Cape Fear River Program added another component concerned with studying the benthic macrofauna of the system in 1996. This component is directed by Dr. Martin Posey of the UNCW Biology Department and includes the benefit of additional data collected by the Benthic Ecology Laboratory under Sea Grant and NSF sponsored projects in the Cape Fear Estuary. The third major biotic component (added in January 1996) was an extensive fisheries program directed by Dr. Mary Moser of the UNCW Center for Marine Science Research, with subsequent (1999) overseeing by Mr. Michael Williams and Dr. Thomas Lankford of UNCW-CMS. This program involved

cooperative sampling with the North Carolina Division of Marine Fisheries and the North Carolina Wildlife Resources Commission. The fisheries program ended in December 1999, but was renewed with additional funds from the Z. Smith Reynolds Foundation from spring – winter 2000, and has been operational periodically for special projects since that period. The regular sampling that was conducted by UNCW biologists was assumed by the North Carolina Division of Marine Fisheries.

1.1. Site Description

The mainstem of the Cape Fear River is formed by the merging of the Haw and the Deep Rivers in Chatham County in the North Carolina Piedmont. However, its drainage basin reaches as far upstream as the Greensboro area (Fig. 1.1). The mainstem of the river has been altered by the construction of several dams and water control structures. In the coastal plain, the river is joined by two major tributaries, the Black and the Northeast Cape Fear Rivers (Fig. 1.1). These 5th order blackwater streams drain extensive riverine swamp forests and add organic color to the mainstem. The watershed (about 9,149 square miles) is the most heavily industrialized in North Carolina with 244 permitted wastewater discharges and (as of 2000) over 1.83 million people residing in the basin (NCDENR 2005). Approximately 24% of the land use in the watershed is devoted to agriculture and livestock production (NCDENR 2005), with livestock production dominated by swine and poultry operations. Thus, the watershed receives considerable point and non-point source loading of pollutants.

Water quality is monitored by boat at ten stations in the Cape Fear Estuary (from Navassa to Southport) and one station in the Northeast Cape Fear Estuary (Table 1.1; Fig. 1.1). Riverine stations sampled by boat include NC11, AC, DP, IC, and BBT (Table 1.1; Fig. 1.1). NC11 is located upstream of any major point source discharges in the lower river and estuary system, and is considered to be representative of water quality entering the lower system. BBT is located on the Black River between Thoroughfare and the mainstem Cape Fear, and is influenced by both rivers. We consider B210 and NCF117 to represent water quality entering the lower Black and Northeast Cape Fear Rivers, respectively. Data has also been collected at stream and river stations throughout the Cape Fear, Northeast Cape Fear, and Black River watersheds (Table 1.1; Fig. 1.1). Data collection at a station in the Atlantic Intracoastal Waterway was initiated in February 1998 to obtain water quality information near the Southport Wastewater Treatment Plant discharge.

The LCFRP has a website that contains maps and an extensive amount of past water quality, benthos, and fisheries data gathered by the Program available at: www.uncwil.edu/cmsr/aquaticecology/lcfrp/

This report contains three sections assessing LCFRP data. Section 2 presents an overview of physical, chemical, and biological water quality data from the 36 individual stations, and provides tables of raw data as well as figures showing spatial or temporal trends. In Section 3 we analyze our data by sub-basin, compare our results with DWQ's 2005 Basinwide Plan, and make water quality ratings for dissolved oxygen, turbidity,

chlorophyll *a*, metals, and fecal coliform bacterial abundance. We also utilize other relevant parameters such as nutrient concentrations to aid in these assessments. This section is designed so that residents of a particular sub-basin can see what the water quality is like in his or her area based on LCFRP data collections.

1.2. References Cited

NCDENR. 2005. Cape Fear River Basinwide Water Quality Plan. North Carolina Department of Environment and Natural Resources, Division of Water Quality/Planning, Raleigh, NC, 27699-1617.

Table 1.1. Description of sampling locations in the Cape Fear Watershed, 2005, including UNCW designation and NCDWQ station designation number.

| UNCW St. | DWQ No. | Location |
|---------------------------------------|----------|--|
| High order river and estuary stations | | |
| NC11 GPS | B8360000 | At NC 11 bridge on Cape Fear River (CFR) N 34.39663 W 78.26785 |
| LVC2 GPS | B8441000 | on Livingston Creek near Acme N 34.33530 W 78.2011 |
| AC GPS | B8450000 | 5 km downstream from International Paper on CFR N 34.35547 W 78.17942 |
| DP GPS | B8460000 | At Dupont Intake above Black River N 34.33595 W 78.05337 |
| IC GPS | B9030000 | Cluster of dischargers upstream of Indian Cr. on CFR N 34.30207 W 78.01372 |
| B210 GPS | B9000000 | Black River at Highway 210 bridge N 34.43138 W 78.14462 |
| BBT GPS | none | Black River between Thoroughfare and Cape Fear River N 34.35092 W 78.04857 |
| NCF117 GPS | B9580000 | Northeast Cape Fear River at Highway 117, Castle Hayne N 34.36342 W 77.89678 |
| NCF6 GPS | B9670000 | Northeast Cape Fear River near GE dock N 34.31710 W 77.95383 |
| NAV GPS | B9050000 | Railroad bridge over Cape Fear River at Navassa N 34.25943 W 77.98767 |
| HB GPS | B9050100 | Cape Fear River at Horseshoe Bend N 34.24372 W 77.96980 |
| BRR GPS | B9790000 | Brunswick River near new boat ramp in Belville N 34.22138 W 77.97868 |

| | | |
|------------|----------|---|
| M61 GPS | B9750000 | Channel Marker 61, downtown at N.C. State Port N 34.19377 W 77.95725 |
| M54 GPS | B7950000 | Channel Marker 54, 5 km downstream of Wilmington N 34.13933 W 77.94595 |
| M42 GPS | B9845100 | Channel Marker 42 near Keg Island N 34.09017 W 77.93355 |
| M35 GPS | B9850100 | Channel Marker 35 near Olde Brunswick Towne N 34.03408 W 77.93943 |
| M23 GPS | B9910000 | Channel Marker 23 near CP&L intake canal N 33.94560 W 77.96958 |
| M18 GPS | B9921000 | Channel Marker 18 near Southport N 33.91297 W 78.01697 |
| SPD GPS | B9980000 | 1000 ft W of Southport WWT plant discharge on ICW N 33.91708 W 78.03717 |

Tributary stations collected from land

| | | |
|------------|----------|---|
| SR GPS | B8470000 | South River at US 13, below Dunn runoff N 35.15600 W 78.64013 |
| GCO GPS | B8604000 | Great Coharie Creek at SR 1214 N 34.91857 W 78.38873 |
| LCO GPS | B8610001 | Little Coharie Creek at SR 1207 N 34.83473 W 78.37087 |
| 6RC GPS | B8740000 | Six Runs Creek at SR 1003 (Lisbon Rd.) N 34.79357 W 78.31192 |
| BRN GPS | B8340050 | Browns Creek at NC 87 N 34.61360 W 78.58462 |
| HAM GPS | B8340200 | Hammonds Creek at SR 1704 N 34.56853 W 78.55147 |
| COL GPS | B8981000 | Colly Creek at NC 53 N 34.46500 W 78.26553 |

| | | |
|--------------|----------|---|
| ANC GPS | B9490000 | Angola Creek at NC 53 N 34.65705 W 77.73485 |
| NC403 GPS | B9090000 | Northeast Cape Fear below Mt. Olive Pickle at NC403 N 35.17838 W 77.98028 |
| PB GPS | B9130000 | Panther Branch below Cates Pickle N 35.13445 W 78.13630 |
| GS GPS | B9191000 | Goshen Swamp at NC 11 N 35.02923 W 77.85143 |
| SAR GPS | B9191500 | Northeast Cape Fear River near Sarecta N 34.97970 W 77.86251 |
| LRC GPS | B9460000 | Little Rockfish Creek at NC 11 N 34.72247 W 77.98145 |
| ROC GPS | B9430000 | Rockfish Creek at US 117 N 34.71689 W 77.97961 |
| BCRR GPS | B9500000 | Burgaw Canal at Wright St., above WWTP N 34.56334 W 77.93481 |
| BC117 GPS | B9520000 | Burgaw Canal at US 117, below WWTP N 34.56391 W 77.92210 |
| SC-CH GPS | | Smith Creek at Castle Hayne Rd. N 34.25897 W 77.93872 |

Figure 1.1 Map of the Lower Cape Fear River system and the LCFRP sampling stations.

Lower Cape Fear River Program Monitoring Stations

