

# **Appendix I**

## **DWQ Water Quality Monitoring Programs in the Chowan River Basin**



## DWQ Water Quality Monitoring Programs in the Chowan River Basin

Staff in the Environmental Sciences Section (ESS) and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Chowan River basin for that program. For more detailed information on sampling and assessment of streams in this basin, refer to the *Basinwide Assessment Report* for the Chowan River basin, available from the Environmental Sciences Section website at <http://www.esb.enr.state.nc.us/bar.html> or by calling (919) 733-9960.

### DWQ monitoring programs for the Chowan River Basin include:

- Benthic Macroinvertebrates
- Fish Assessments
- Aquatic Toxicity Monitoring
- Ambient Monitoring System

### Overview of Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since macroinvertebrates have life cycles of six months to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs. A Biotic Index (BI) value gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont, coastal plain and swamp) within North Carolina and bioclassifications fall into five categories: Excellent, Good, Good-Fair, Fair and Poor. Swamp stream bioclassifications fall into three categories: Natural, Moderate and Severe.

There were 14 benthic samples collected during this assessment period. The following table lists the total bioclassifications (by subbasin) for all benthos sites in the Chowan River basin. For detailed information regarding the samples collected during this assessment period, refer to the table following this section.

Summary of Bioclassifications for All Freshwater Benthic Macroinvertebrate Sites (using the most recent rating for each site) in the Chowan River Basin

| Subbasin | Bioclassifications |      |           |      |      |           | Swamp Bioclass. |          |               | Total |
|----------|--------------------|------|-----------|------|------|-----------|-----------------|----------|---------------|-------|
|          | Excellent          | Good | Good-Fair | Fair | Poor | Not Rated | Natural         | Moderate | Severe Stress |       |
| 03-01-01 |                    | 1    |           | 2    |      | 1         | 1               | 2        |               | 7     |
| 03-01-02 |                    |      | 1         |      |      | 1         |                 | 3        |               | 5     |
| 03-01-04 |                    | 1    |           |      |      |           |                 | 1        |               | 2     |

### Assessing Benthic Macroinvertebrate Communities in the Northeastern Coastal Plain

There are three types of streams in the Chowan River basin, in which biological criteria can be assessed and bioclassifications are assigned. Streams referred to as Coastal A have continuous flow throughout the year, Coastal B streams are deep non-wadeable rivers with minimal flow throughout the year and swamp streams typically only have flow between February to March.

The Biological Assessment Unit defines swamp streams, as those streams that are within the coastal plain ecoregion and that normally have no visible flow during a part of the year. This low flow period usually occurs during the summer, but flowing water should be present in swamp streams during the winter. Sampling during winter, high flow periods provides the best opportunity for detecting differences in communities from what is natural, and only winter (February to early March) benthos data can be used when evaluating swamp streams. The swamp stream must have visible flow in this winter period, with flow comparable to a coastal plain stream that would have acceptable flow for sampling in summer. No waterbodies in the Chowan River Basin have been given the supplemental “Swamp” classification by DWQ. However, for the purposes of biological assessments of waterbodies in the Chowan River basin, the Biological Assessment Unit uses a swamp criterion to assign a bioclassification to waterbodies that have visible flow in winter but stop flowing for some portion of the year.

The Biological Assessment Unit has limited data on Coastal B, thus, draft criteria have been developed based only on EPT taxa richness. However, biotic index values and total taxa richness values were also evaluated for between year and among site comparisons. These criteria will continue to be evaluated and any bioclassifications derived from them should be considered tentative and not used for use support decisions. Four Coastal B waterbody segments were Not Rated during this assessment period because of the draft Coastal B criteria.

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for flowing freshwater streams. The benthic macroinvertebrate database is being evaluated and a study to systematically look at reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in specific stream types. DWQ will continue to develop criteria to assess water quality in small streams.

Benthic Macroinvertebrate Data Collected in the Chowan River Basin, (Current basinwide sampling sites are in bold print.)

| Waterbody       | Location         | County      | Map ID | Index No. | Date     | ST | EPTS | BI   | BIE PT | BioClass  |
|-----------------|------------------|-------------|--------|-----------|----------|----|------|------|--------|-----------|
| 03-01-01        |                  |             |        |           |          |    |      |      |        |           |
| Chowan R        | nr Riddicksville | Hertford    | DB5    | 25        | 09/28/05 | 71 | 9    | 7.11 | 5.61   | Good      |
|                 |                  |             |        |           | 07/31/00 | 46 | 7    | 7.33 | 5.84   | Good-Fair |
| Chowan R        | nr Gatesville    | Gates       | DB4    | 25        | 09/27/05 | 49 | 5    | 6.85 | 4.82   | Fair      |
|                 |                  |             |        |           | 08/01/00 | 62 | 9    | 7.22 | 4.70   | Good      |
| Cole Cr         | US 158*          | Gates       | DB6    | 25-12-7   | 02/05/05 | 46 | 3    | 7.43 | 7.7    | Moderate  |
|                 |                  |             |        |           | 02/10/00 | 47 | 4    | 7.60 | 7.00   | Moderate  |
| Wiccacon R      | SR 1433          | Hertford    | DB8    | 25-14     | 08/22/05 | 47 | 3    | 7.63 | 7.61   | Fair      |
|                 |                  |             |        |           | 08/01/00 | 66 | 6    | 7.88 | 6.80   | Fair      |
| Ahoskie Cr      | NC 42            | Hertford    | DB1    | 25-14-1   | 02/09/05 | 50 | 7    | 6.70 | 4.95   | Not Rated |
|                 |                  |             |        |           | 08/25/05 | 72 | 11   | 6.94 | 5.94   | Not Rated |
| Stony Cr        | SR 1235          | Bertie      | DB7    | 25-14-1-6 | 02/10/05 | 56 | 6    | 7.40 | 6.46   | Moderate  |
|                 |                  |             |        |           | 02/10/00 | 43 | 2    | 7.21 | 6.34   | Moderate  |
| Chinkapin Cr    | SR 1432          | Hertford    | DB3    | 25-14-3   | 02/10/05 | 56 | 6    | 7.40 | 6.46   | Natural   |
|                 |                  |             |        |           | 02/10/00 | 60 | 8    | 6.98 | 6.22   | Natural   |
| Bennetts Cr     | SR 1400          | Gates       | DB2    | 25-17     | 02/09/05 | 40 | 3    | 8.20 | 7.82   | Moderate  |
| 03-01-02        |                  |             |        |           |          |    |      |      |        |           |
| Kirbys Cr       | SR 1362          | Northampton | DB10   | 25-4-4    | 02/07/05 | 49 | 9    | 6.19 | 5.04   | Moderate  |
|                 |                  |             |        |           | 02/17/00 | 54 | 12   | 6.25 | 5.10   | Natural   |
| Meherrin R      | SR 1175          | Hertford    | DB11   | 25-4-(5)  | 09/27/05 | 45 | 8    | 7.42 | 5.9    | Good-Fair |
|                 |                  |             |        |           | 07/31/00 | 59 | 10   | 7.68 | 6.41   | Good      |
| Potecasi Cr     | SR 1504          | Northampton | DB12   | 25-4-8    | 02/07/05 | 44 | 1    | 7.31 | 6.40   | Moderate  |
|                 |                  |             |        |           | 02/09/00 | 24 | 1    | 6.97 | 7.78   | Not Rated |
| Urahaw Swp      | NC 35            | Northampton | DB13   | 25-4-8-4  | 02/07/05 | 52 | 5    | 7.19 | 6.31   | Moderate  |
|                 |                  |             |        |           | 02/09/00 | 20 | 0    | 6.83 | -      | Moderate  |
| Cutawhiskie Swp | SR 1141          | Hertford    | DB9    | 25-4-8-7  | 02/08/05 | 59 | 5    | 6.97 | 5.50   | Not Rated |
|                 |                  |             |        |           | 08/26/05 | 71 | 8    | 6.70 | 5.56   | Not Rated |
|                 |                  |             |        |           | 02/02/00 | 49 | 3    | 6.88 | 5.80   | Not Rated |
| 03-01-04        |                  |             |        |           |          |    |      |      |        |           |
| Chowan R        | US 17            | Chowan      | DB14   | 25        | 08/22/05 | 41 | 10   | 6.71 | 5.54   | Good      |
|                 |                  |             |        |           | 08/01/00 | 29 | 6    | 6.61 | 4.65   | Good-Fair |
| East most Swp   | SR 1361          | Bertie      | DB15   | 25-24-1   | 02/10/05 | 47 | 3    | 7.32 | 6.86   | Moderate  |
|                 |                  |             |        |           | 02/22/00 | 56 | 5    | 7.42 | 6.68   | Not Rated |

## Fish Kill Assessment

DWQ has systematically monitored and reported fish kill events across the state since 1996. From 2000 to 2005, field investigators reported seven kill events in the Chowan River basin. Stagnant water, shallow water, low dissolved oxygen, and possible chemical contamination may have contributed to these fish kill events. Annual fish kill reports can be found at DWQ's Environmental Sciences website <http://h2o.enr.state.nc.us/esb/Fishkill/fishkillmain.htm>.

## Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

The ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Two NPDES permits in the Chowan River basin currently require WET testing. Both facilities have a WET limit. Across the state, the number of facilities required to perform WET has increased steadily since 1987, the first year that WET limits were written into permits in North Carolina. Consequently, compliance rates have also risen. Since 1996, the compliance rate has stabilized at approximately 90 percent.

## Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina has more than 378 water chemistry monitoring stations statewide, where between 23 and 32 parameters are collected monthly at each station. During this assessment period (September 1, 2000 through August 31, 2005) chemical and physical measurements were obtained by DWQ from 14 stations located throughout the Chowan River Basin. The N.C. Recreational Water Quality Program monitors one additional location for bacterial issues. Information on the program can be found at [http://www.deh.enr.state.nc.us/shellfish/Water\\_Monitoring/RWQweb/home.htm](http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/home.htm). Of the 14 ambient monitoring stations are currently operating in the Chowan River basin, six are located on the Chowan River itself in North Carolina and an additional site in Virginia on the Nottoway River approximately three miles before the confluence with the Blackwater River (at which point they become the Chowan River). In the Chowan River basin, two ambient parameters commonly exceed water quality parameters, total iron and dissolved oxygen. The locations of these stations are shown on individual subbasin maps. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2006 Chowan River Basinwide Assessment Report* at <http://www.esb.enr.state.nc.us/bar.html> for more detailed analysis of ambient water quality monitoring data.

Many of the waterbodies in the Chowan River basin experience low dissolved oxygen concentrations in summer in violation of water quality standards. Also, pH measurements exceed water quality standards in some of these streams. The fact that many of these streams cease to flow or have low natural pH is not the result of any anthropogenic interference but due to their nature. This area of the Middle Atlantic Coastal Plain ecoregion is classified as Mid-Atlantic Flatwoods and Mid-Atlantic Floodplains, and Low Terraces. Low gradient, poor drainage and swamp conditions are common here.

Specific information on water quality standards and action levels can be found in 15A NCAC 2B.0200 (August 1, 2004) available at <http://h2o.enr.state.nc.us/csu/swstdsfaq.html>.

### Water Quality Parameters

#### Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important of all the chemical measurements. Dissolved oxygen provides valuable information about the ability of the water to support aquatic life and the capacity of water to assimilate point and nonpoint discharges. Water quality standards for dissolved oxygen vary depending on the classification of the body of water but generally results less than 4.0 mg/L can be problematic. Consistent patterns of low concentrations of dissolved oxygen can be subject to intense management review and corrective actions, although patterns of low dissolved oxygen can occur naturally in and near swamp waters, in estuarine waters under salt wedge conditions, or during droughts.

#### pH

The pH of natural waters can vary throughout the state. Low values ( $<< 7.0$  s.u.) can be found in waters rich in dissolved organic matter, such as swamp lands, whereas high values ( $>> 7.0$  s.u.) may be found during algal blooms. Point source dischargers can also influence the pH of a stream. The water quality standards for pH in freshwaters consider values less than 6.0 s.u. or greater than 9.0 s.u. to warrant attention; whereas in salt waters pH values less than 6.8 or greater than 8.5 warrant attention.

#### Turbidity

Turbidity data may denote episodic high values on particular dates or within narrow time periods. These can often be the result of intense or sustained rainfall events; however elevated values can occur at other times. Tidal surges can also disturb shallow estuarine sediments and naturally increase turbidity.

#### Nutrients

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as “nutrients.” Nitrogen compounds include ammonia-nitrogen ( $\text{NH}_3\text{-N}$ ), total Kjeldahl nitrogen (TKN) and nitrite+nitrate nitrogen ( $\text{NO}_2+\text{NO}_3\text{-N}$ ). Phosphorus is measured as total phosphorus. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes, or runoff from urban or agricultural land, the excessive growth of algae (algal blooms) and other plants may be accelerated. In addition to the possibility of causing algal blooms, ammonia-nitrogen may combine with high pH water to form  $\text{NH}_4\text{OH}$ , a form toxic to fish and other aquatic organisms.

### Bacteria

Concentrations of fecal coliform bacteria can vary greatly. The descriptive statistics used to evaluate fecal coliform bacteria data include the geometric mean and the median depending on the classification of the waterbody. For all sites in the Chowan River Basin, the standard specified in Administrative Code 15A NCAC 02B.0211 (3)(e) (August 1, 2005) is applicable:

*"Organisms of the coliform group: fecal coliforms shall not exceed a geometric mean of 200/100ml (MF count) based upon at least five consecutive samples examined during any 30 day period, nor exceed 400/100ml in more than 20 percent of the samples examined during such period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution; all coliform concentrations are to be analyzed using the membrane filter technique unless high turbidity or other adverse conditions necessitate the tube dilution method; in case of controversy over results, the MPN 5-tube dilution technique shall be used as the reference method."*

### Metals

A number of metals are essential micronutrients for the support of aquatic life. However, there are threshold concentrations over which metals can be toxic. DWQ monitors total (not dissolved) concentrations for aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, manganese (Water Supply waters only), nickel, and zinc. Aluminum and iron are commonly found in North Carolina soils, therefore high aluminum and iron concentrations are typically correlated with high turbidity.

### Conductivity

Conductivity is a measure of the ability of water to conduct an electric current. The presence of ions and temperature are major factors in the ability of water to conduct a current. Clean freshwater has a low conductivity, whereas high conductivities may indicate polluted water or saline conditions. Measurements reported are corrected for temperature, thus the range of values reported over a period of time indicate the relative presence of ions in water. North Carolina freshwater streams have a natural conductance range of 17-65  $\mu\text{mhos/cm}$ , however (USGS 1992).

Conductivity can be used to evaluate variations in dissolved mineral concentrations (ions) among sites with varying degrees of impact resulting from point source discharges. Generally, impacted sites show elevated and widely ranging values for conductivity. However, water bodies that contain saltwater will also have high conductivities. Therefore those wishing to use conductivity as an indicator for problems must first account for salinity.

# Locations of DWQ Monitoring stations in the Chowan River Basin, 2000 - 2005.

| Subbasin/<br>Station ID | Map<br>ID | Location                                                     | Class        |
|-------------------------|-----------|--------------------------------------------------------------|--------------|
| <b>1</b>                |           | <b>Chowan River - Upper Section and Blackwater River</b>     |              |
| D0000050                | DA1       | Nottaway River at US 258 near Riverdale, Virginia            | II Estuarine |
| D0001200                | DA2       | Blackwater River at Horseshoe Bend at Cherry Grove, Virginia | II Estuarine |
| D0001800                | DA3       | Blackwater River .5 MI upstream of Mouth near Wyanoke        | B NSW        |
| D0010000                | DA4       | Chowan River near Riddicksville                              | B NSW        |
| D6250000                | DA7       | Chowan River at US 13 at Winton                              | B NSW        |
| D8356200                | DA8       | Chowan River at CM 16 near Gatesville                        | B NSW        |
| <b>2</b>                |           | <b>Meherrin River and Potecasi Creek</b>                     |              |
| D4150000                | DA5       | Potecasi Creek at NC 11 near Union                           | C NSW        |
| D5000000                | DA6       | Meherrin River at SR 1175 Parkers Ferry near Como            | B NSW        |
| <b>3</b>                |           | <b>Chowan River - Middle Section</b>                         |              |
| D8430000                | DA9       | Chowan River at CM 12 downstream of Holiday Island           | B NSW        |
| D8950000                | DA10      | Chowan River near CM 7 at Colerain                           | B NSW        |
| <b>4</b>                |           | <b>Chowan River - Lower Section and Albemarle Sound</b>      |              |
| D9490000                | DA11      | Chowan River at US 17 at Edenhause                           | B NSW        |
| D999500C                | DA12      | Albemarle Sound near Edenton Mid-Channel                     | B NSW        |
| D999500N                | DA13      | Albemarle Sound near Edenton North Shore                     | B NSW        |
| D999500S                | MA13      | Albemarle Sound near Edenton South Shore                     | SB           |

