

## **Addressing Microbial Pollution in Coastal Waters A Reference for Local Governments**

### **Chapter 2. State & Federal Agencies & Microbial Contamination**

Being aware of federal and state agencies and their water quality related responsibilities can be a considerable help to local governments as they address microbial contamination in waters in their jurisdictions. This section will introduce the two primary state agencies that have responsibilities related to the management of microbes in to coastal waters from nonpoint sources of pollution. These agencies are the Division of Water Quality (DWQ) and the Division of Environmental Health (DEH) – both within the Department of Environment and Natural Resources. Table 1 identifies the major responsibilities of these two agencies, as well as the Division of Marine Fisheries, which regulates shellfish harvesting. Although there are other agencies involved with managing activities that could contribute to microbial contamination, since this document is focused on addressing “unknown” sources of microbes, this section will focus on the programs that are most directly involved with monitoring and managing microbial contamination along the coast. All of the state programs discussed in this section are required under federal legislation and programs, which are also briefly identified.

**Table 1. Microbial Related Responsibility and State Agency**

<b>Activity</b>	<b>Agency</b>
Microbial water quality monitoring	Division of Water Quality - Environmental Sciences Branch
Microbial water quality monitoring	Division of Environmental Health - Shellfish Sanitation & Recreational Water Quality Section
Shoreline Surveys of shellfish growing areas	Division of Environmental Health - Shellfish Sanitation & Recreational Water Quality Section
Regulating shellfish harvesting	Division of Marine Fisheries
Recommending and tracking shellfish growing area closings	Division of Environmental Health - Shellfish Sanitation & Recreational Water Quality Section
Assessing loss of use of swimming waters	Division of Water Quality - Planning Branch
Assessing loss of use of shellfish harvesting	Division of Water Quality - Planning Branch
TMDL development	Division of Water Quality - Planning Branch
Posting swimming advisories	Division of Environmental Health - Shellfish Sanitation & Recreational Water Quality Section

## Division of Water Quality

The Division of Water Quality's Environmental Sciences Branch has the responsibilities of testing/monitoring surface waters for bacterial content; assessing and reporting "use support" for these waters (Basinwide Planning Program); and developing "loading limits" of bacteria for waters that are exceeding NC water quality standards (Total Maximum Daily Load/ Modeling Program). These programs operate under mandates required by the federal Clean Water Act, administered through the US Environmental Protection Agency (EPA).

### *Environmental Sciences Branch*

The Environmental Sciences Branch provides the scientific and technical support required to regulate and manage water quality in the state. The four units and two teams of the branch, comprised of biologists, environmental specialists, and technical support staff, evaluate aquatic resources through a variety of specialized biological, chemical, and physical techniques to provide a basis for sound scientific decisions. This branch provides DWQ's Basinwide Planning Program with the majority of the data used to develop use support ratings across the state. From their Web site ([www.esb.enr.state.nc.us/](http://www.esb.enr.state.nc.us/)) you can: obtain or view reports and publications, including assessment reports of basinwide water quality for each river basin (these are used to develop basinwide water quality plans); see what research is in progress (either in similar geography or similar endeavor) and add research you are conducting; and review annual fish kill reports for the state.

This branch of DWQ conducts monthly ambient water quality monitoring at approximately 375 locations across the state, approximately 140 of these are in the twenty coastal CAMA counties. These monthly samplings include fecal coliform bacteria testing of selected lakes, rivers, streams and estuaries. On average 30% of the waters in each basin are routinely assessed. An annual screening review of all DWQ ambient fecal coliform data is conducted by DWQ to assess the need for additional monitoring or the need for immediate action by the local or state health agencies to protect public health. In most cases, management strategies to correct waters considered to be impaired due to elevated fecal coliform bacteria levels may require substantial resources and time. Therefore, impairment decisions for bacteria must be made using sound science and data.

### *Basinwide Planning Program*

The DWQ manages all waters in the state using a basinwide approach – meaning streams, rivers, lakes and estuaries are evaluated within the river basin (major watershed) that contains them. NC has seventeen river basins, eight of which drain to the coast. Water quality management plans for each river basin are updated every five years based on extensive data from water quality sampling. Each plan describes monitoring and water quality activities in the basin and recommends management strategies to protect and restore water quality. To view the water quality plan for your river basin, visit the Basinwide Planning Program on the Web at: <http://h2o.enr.state.nc.us/basinwide>.

During the basinwide planning process, DWQ data, and other data meeting specified criteria are used to determine if the state's surface waters within the basin are supporting their best intended uses. NC's Surface Water Quality Classification system (Table 2) and water quality impairment assessments are explained below in more detail. You can refer to the basin plans for the complete use support assessment methods or refer to the 2002 NC Water Quality Assessment and Impaired Waters List, both can be found online. Use impairment due to microbial contamination is determined using DEH's information for waterbodies classified SA and SB. Bacterial data from the Environmental Sciences Branch are used to assess recreational use support in fresh water across the state. Decades of monitoring experience have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, a five-year time span in which data is collected and multiple sampling efforts are used to evaluate waters against the NC water quality standard for recreational use support.

The DWQ is currently assessing use support for shellfishing waters (class SA) based on an interim method using frequency of closure. This assessment approach began in 2000 with the second edition of the White Oak River Basinwide Water Quality Plan. The DWQ assesses class SA waters (shellfishing waters) designated by DEH-Shellfish Sanitation Section (SS) as Impaired when they are closed or prohibited/restricted. The SA waters classified by DEH-SS as conditionally approved (open or closed) that are closed less than 10% of the time during a five-year period, are considered supporting their use – and not impaired. If they are closed more than 10% of the time during a five-year assessment period, they are considered Impaired by DWQ. It is important to note that this method of use support assessments is anticipated to be further refined over the coming five years for identifying impairment.

For recreational water use support assessments in coastal waters, DWQ also depends on DEH-SS data. The DWQ attempts to determine if there are any inland swimming areas monitored by county or local health departments or estuarine (Class SA and SB) waters as assessed by

**Table 2. NC Division of Water Quality,  
Primary and Supplemental Surface Water Classifications**

<b>Primary Freshwater and Saltwater Classifications*</b>	
<b>Class</b>	<b>Best Uses</b>
<b>C and SC</b>	Aquatic life propagation/protection and secondary recreation.
<b>B and SB</b>	Primary recreation and Class C Best Uses.
<b>SA</b>	Waters classified for commercial shellfish harvesting.
<b>WS</b>	<i>Water Supply watershed.</i> There are five WS classes ranging from WS-I through WS-V. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. WS-I provides the highest level of protection and WS-IV provides the least protection. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located.
<b>Supplemental Classifications</b>	
<b>Class</b>	<b>Best Uses</b>
<b>SW</b>	<i>Swamp Waters:</i> Recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen.
<b>Tr</b>	<i>Trout Waters:</i> Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
<b>HQW</b>	<i>High Quality Waters:</i> Waters which are rated as excellent based on biological and physical/chemical characteristics through DWQ monitoring or special studies and watersheds classified as WS-I and WS-II water supplies.
<b>ORW</b>	<i>Outstanding Resource Waters:</i> Unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses.
<b>NSW</b>	<i>Nutrient Sensitive Waters:</i> Waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs.

\*Primary classifications beginning with an “S” are assigned to saltwaters.

DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year. When reviewing DEH fecal coliform data and local swimming advisories the five-year data window is used. If a water was posted with a swimming advisory for at least two months within the five-year data window, it is further evaluated for the persistence of elevated fecal coliform bacteria levels. Those waters posted with swimming advisories for more than two months in the five-year data window are rated Impaired unless county or state health agencies believe that the cause of the swimming advisory is not persistent. If data indicated there may be a problem, DWQ requests its regional office staff to take samples five times within 30 days in June during non-runoff events, if possible, to further examine fecal levels. If necessary samples are also taken in July and August to further examine fecal levels. The data is provided to DEH for consideration of posting swimming advisories. If DEH has no data on an estuarine water, that water will not be rated for recreational uses. For more information on the use assessment process, visit the Basinwide Planning Program Web site.

### North Carolina Surface Water Classifications

All NC surface waters are classified according to their best intended uses, this is their “primary classification”. Determining how well a waterbody supports its uses (*use support ratings*) is an important method of interpreting water quality data and assessing water quality (Table 3). Surface waters are rated *supporting* and *impaired*. These ratings refer to whether the state standards are being met according to the classified uses of the water (such as water supply, aquatic life protection and recreation). This process of classifying waters was developed and is modified periodically to meet requirements of the Clean

Water Act. The system used by DWQ also consists of “supplemental” classifications that recognize special qualities of some waters. For example, trout streams may receive a supplemental “Trout Water” classification. For each classification, there are standards developed that establish the water quality that must be maintained in the waterbody so that the “best uses” for each classification will continue to be supported. Table 2 illustrates the components of the classification system. All

<b>Rating</b>	<b>Status</b>
Supporting	Supports best intended use. Example - approved shellfish growing areas in Class SA waters are supporting intended use
Impaired	Does not support use. Example - prohibited shellfish growing areas in Class SA waters are impaired for that use
Not Rated	Data are inconclusive
No Data	No data are available to make a use support determination

surface waters in NC, at a minimum, have been classified to protect for the propagation of aquatic life and for secondary recreation. Secondary recreation includes wading, boating, or other uses not involving human body contact with water, and activities involving human body contact with water where such activities take place on an infrequent, unorganized, or incidental basis. More information is available at: <http://h2o.enr.state.nc.us/csu/swc.html>.

Each classified waterbody has an established set of “quality” standards. If data indicates that a body of water is degraded – that these standards are not being met- it may no longer fully support its best use. When waters no longer support these uses, the water is then considered Impaired. During the use support assessment, the state tries to determine likely causes of impairment and pollution sources (agriculture, urban runoff, municipal or industrial discharge, etc.). For all waters that are identified as Impaired, a Total Maximum Daily Load or TMDL must be developed according to EPA requirements. These TMDLs or management strategies are intended to improve water quality such that their best uses are being met.

## Total Maximum Daily Load Program

The Division's Modeling & TMDL Unit has the overall purpose of developing water quality models and providing complex analyses to support TMDL development for impaired waterbodies. TMDL are developed for a specific waterbody and pollutant combination. Thus, a TMDL may be developed for Jarrett Bay for fecal coliform and not address sediment and erosion. Part of the TMDL development process is to identify potential contributors to the cause of impairment, including both point and nonpoint sources. Both point and nonpoint sources are allocated a portion of the load reduction needed in order to meet water quality standards. These reductions can appear in permits as actual loads or as required best management practices (BMPs).

This Unit, in cooperation with other DWQ programs, is actively studying waterbodies impaired due to excessive fecal coliform levels. Projects involving mountain, piedmont and coastal plain waterbodies are either underway or planned by 2008. Additional field monitoring and water quality modeling of the waterbody and the surrounding watershed will occur with each TMDL. The DWQ anticipates that by 2005, approximately 22 TMDLs will be developed for impaired shellfishing waters, most of which will be in the White Oak River basin (Table 4).

As discussed in Chapter 3, microbial source tracking (MST) can be very useful for developing TMDLs for waters that are not meeting their uses because of fecal bacteria contamination. The DWQ is investing in the antibiotic resistance techniques of source tracking. These methods are currently in use in piedmont freshwater bodies with plans to extend the work to coastal shellfish waterbodies. The results of the source tracking can be used to validate model predictions and to structure implementation appropriately. For more information on the TMDL Program visit the TMDL Web site at: <http://h2o.enr.state.nc.us/tmdl/index.htm>.

**Table 4. Waters Targeted for Fecal Coliform TMDL Development**

(Source: Michelle Woolfolk, NC DWQ Planning Branch)

River Basin	Stream Segment
Pasquotank	Callaghan Creek (H-2)
	Spencer Creek (H-2)
	Stumpy Point Bay (H-3)
Tar Pamilico	Chicod Creek
White Oak	Nelson Bay and tributaries (E-9)
	Jarrett Bay and tributaries (E-8)
	North River and tributaries (E-6)
	Newport River and tributaries (E-4)

## Division of Environmental Health

The other main state agency with microbial management responsibilities is the Division of Environmental Health (DEH), which primarily focuses on protecting human health but also has the responsibility of protecting the environment. The Shellfish Sanitation and Recreational Water Quality Section (SS) protects people from contaminated shellfish and exposure to pathogens in recreational waters, while the Onsite Wastewater Section (OSWS) is more regulatory and concentrates on controlling the siting and management of onsite wastewater systems to reduce contamination from human waste / pathogens.

## *Shellfish Sanitation Section and Recreational Water Quality*

One task of the SS Section is to monitor shellfish and shellfish harvesting waters in NC to evaluate the risk to public health from consuming shellfish meats, and make recommendations on whether harvesting should be allowed in certain areas. These activities are mandated by the Federal Food and Drug Administration to assure shellfish are safe for human consumption. All coastal waters that have the potential to support shellfish are monitored by this section through water testing. These waters are divided into “growing areas” and are assigned certain classifications by DEH which provide information on their general water quality status. DEH Classifications are based on DEH fecal coliform bacteria sampling, locations of pollution sources, and the availability of the shellfish resources. DEH samples these growing areas regularly and reevaluates the areas by conducting shellfish sanitation surveys every three years to determine if their classification is still applicable. These classifications (different from DWQ’s) are described below and are also listed in Table 5, along with criteria that determine their classification. The DWQ uses information obtained by DEH-SS to determine whether a body of water is “impaired.” Over the next few years DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a fully functional database with related georeferenced (GIS) shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to work together to better serve the public. DWQ proposes to use information generated by these new tools to do frequency of closure-based shellfish harvesting use support assessments in Class SA waters, starting with the 2005 Cape Fear River basin use support assessment.

The DEH-SS also monitors recreational beaches and posts advisories if those waters are not suitable for body contact. Beginning in the summer of 1997, the Division of Environmental Health (DEH) began testing coastal recreation waters (beaches) for fecal coliform bacteria levels to assess the relative safety of these waters for swimming. The Shellfish Sanitation Section of DEH routinely tests approximately 275 coastal sites once a week during the tourist recreational season (April to September), less often the rest of the year. These tests give researchers and the public a gauge of bacteria levels along the NC coast. If an area has elevated bacteria levels, health officials will advise that people not swim there by posting a swimming advisory in the area, and by notifying the local media and county health department.

### **NC DEH Shellfish Sanitation Growing Area Classifications**

#### **Approved**

These areas are always open to shellfish harvesting and close only after rare heavy rainfall events such as hurricanes.

#### **Conditionally Approved-Open Shellfish Areas**

This growing area classification allows for the utilization of valuable shellfish resources by permitting harvesting when environmental conditions result in fecal coliform bacteria levels lower than the state standard in areas that otherwise might be closed to harvesting. These areas are open to harvesting much of the year, but are immediately closed after certain rainfall events (refer to DEH Shellfish Sanitation growing area management plans for specific closure strategies). There are concerns that these areas may be closed more often and stay closed for longer periods as development proceeds in coastal areas adjacent to Class SA waters.

#### **Conditionally Approved-Closed Shellfish Areas**

This growing area classification allows for the utilization of valuable shellfish resources by permitting harvesting when environmental conditions result in fecal coliform bacteria levels lower than state standards in areas that are typically closed to shellfish harvesting. These areas are regularly monitored to determine if temporary openings are possible. These waters are rarely opened to shellfish harvesting.

#### **Prohibited/Restricted Shellfish Harvest Areas**

Most of these areas receive runoff that consistently results in fecal coliform bacteria levels above the state standard. As noted above, the sources of fecal coliform bacteria may be many. DEH Shellfish Sanitation shoreline surveys attempt to identify possible sources. In many areas, the contamination may be from several different sources at different times of the year.

**Table 5. NC DEH Shellfish Sanitation Growing Area Classification Criteria**

<b>DEH Classification</b>	<b>DEH Criteria</b>
Approved	The median fecal coliform Most Probable Number (MPN) or geometric mean MPN of water shall not exceed 14 per 100 milliliters, and the estimated 90 <sup>th</sup> percentile shall not exceed an MPN of 43 per 100 milliliters for a five tube decimal dilution test.
Conditionally Approved-Open	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed with a plan.
Conditionally Approved-Closed	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed with a plan.
Restricted	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited	Sanitary Survey is not routinely conducted; area is closed as matter of regulation due to the presence of point source discharges or marinas; OR, previous sampling data did not meet criteria for Approved, Conditionally Approved or Restricted Classification.

### *Onsite Wastewater Treatment Section*

The Onsite Wastewater Section writes, oversees, and enforces the rules and laws regulating the design, siting and installation, repair, operation, and maintenance of onsite wastewater treatment systems for the protection of human and environmental health from microbial contamination. The actual implementation of these regulations (e.g., site evaluation, permitting of new systems) is conducted at the county level by authorized environmental health specialists in each county health department. All of the extensive rules and laws in NC including horizontal setbacks, depth to groundwater, soils requirements, loading rates, etc., have been based on scientific studies of microbial fate and transport. These rules are constructed to protect groundwater and surface water from microbial contamination (as well as other contaminants). Their onsite treatment regulations are devised to minimize migration of microbes and pathogens from the site of the treatment system.

## **Water Quality Standards**

Water quality standards have been established for “allowable” microbial content depending on a waterbody’s designated use. These standards are based on national criteria developed by the EPA and address risks to public health for body contact, water consumption, and shellfish consumption. Standards are developed to keep illnesses from microbial exposure to a minimal acceptable level. State agencies have the responsibility of monitoring for indicator organisms (see Chapter 1, Section 3) to determine if the standards are being met. Currently, the DEH-SS monitors recreational waters for *E. coli*, Enterococci, and fecal coliform bacteria and has been doing so since 1997 (per the Beaches Environmental Assessment and Coastal Health Act of 2000). Shellfishing waters are monitored for fecal coliform bacteria only. The

DWQ uses fecal coliform bacteria as an indicator for freshwater monitoring, and relies on DEH data and classifications to assess whether coastal waters are meeting their designated uses.

Microbial standards are established for water quality to protect human health. NC's DWQ uses coliform bacteria as an indicator of microbial contamination in surface waters. In freshwaters (waters classified as B and C), fecal coliform bacteria are used as the indicator and the standard is 200 MFFCC (membrane filter fecal coliform count per 100 milliliters of sample). For Water Supplies, a total coliform bacteria standard is used and is set at 50 MFTCC (membrane filter total coliform count per 100 milliliters of sample), and applies only to unfiltered water supplies.

For recreational waters, the EPA is using national criteria established in 1986, but has committed to updating the criteria, and appropriate indicator to allow a more accurate determination of human health risk, by 2005. The 1986 standards for freshwater bathing or full body contact indicate that the geometric mean for the indicated bacterial densities should not exceed: 12 per 100 milliliter sample for *E. coli* and for Enterococci, 33 per 100 milliliter sample. For marine waters, the geometric mean of the indicator species Enterococci should not exceed 35 per 100 milliliter sample.



