Clean water is essential to support the natural environment, public health and a vibrant economy.

North Carolina has a wide variety of waterways - from sparkling mountain streams to slow-moving swamp waters; diverse wetlands; lakes that support both water supply and recreation; and one of the nation's largest and most productive estuaries. Clean water is essential to support the natural environment, public health and a vibrant economy. Adequate supply of clean water continues to be a concern in the state and is a priority issue for the Department of Environment and Natural Resources.

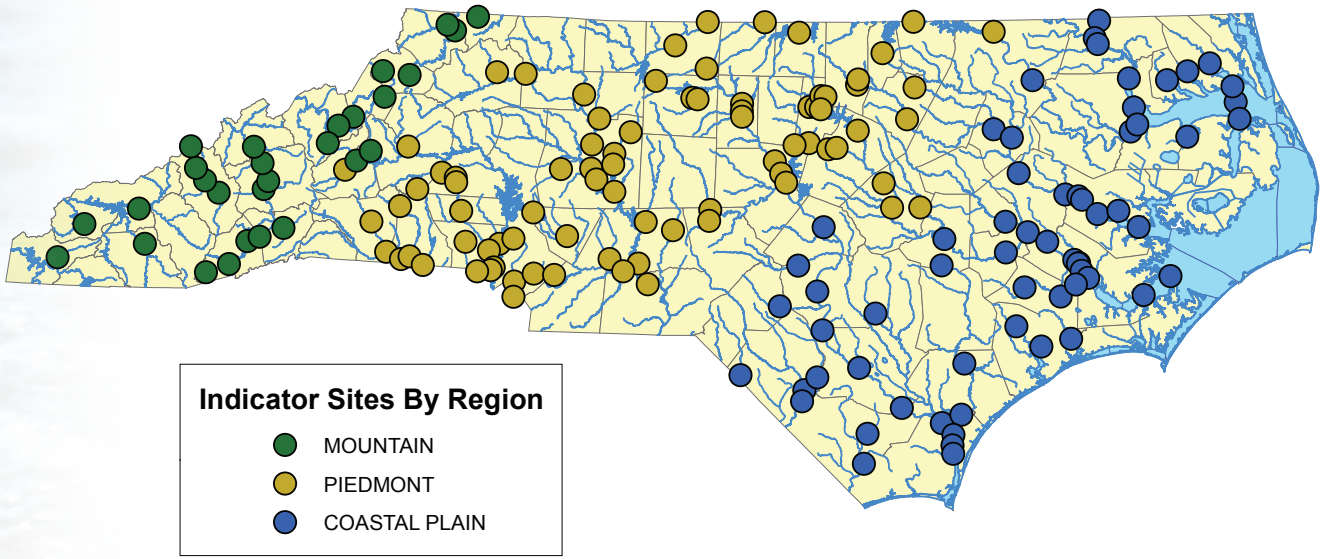
Surface Water

North Carolina evaluates the water quality of streams and rivers by examining the biological communities that live there and by collecting water quality data. The N.C. Division of Water Quality (DWQ) operates a statewide network of 323 monitoring stations for dissolved oxygen, turbidity, fecal coliform bacteria, pH and many other parameters. A general indication of water quality changes can be obtained by looking graphically at changes in dissolved oxygen, turbidity and fecal coliform data because these parameters have been measured with the same techniques for several decades. Table 1 indicates how many samples were taken for turbidity, fecal coliform and dissolved oxygen by region. The map depicts the locations of the monitoring stations.

Table 1: Environmental Indicators and Monitoring through 2010

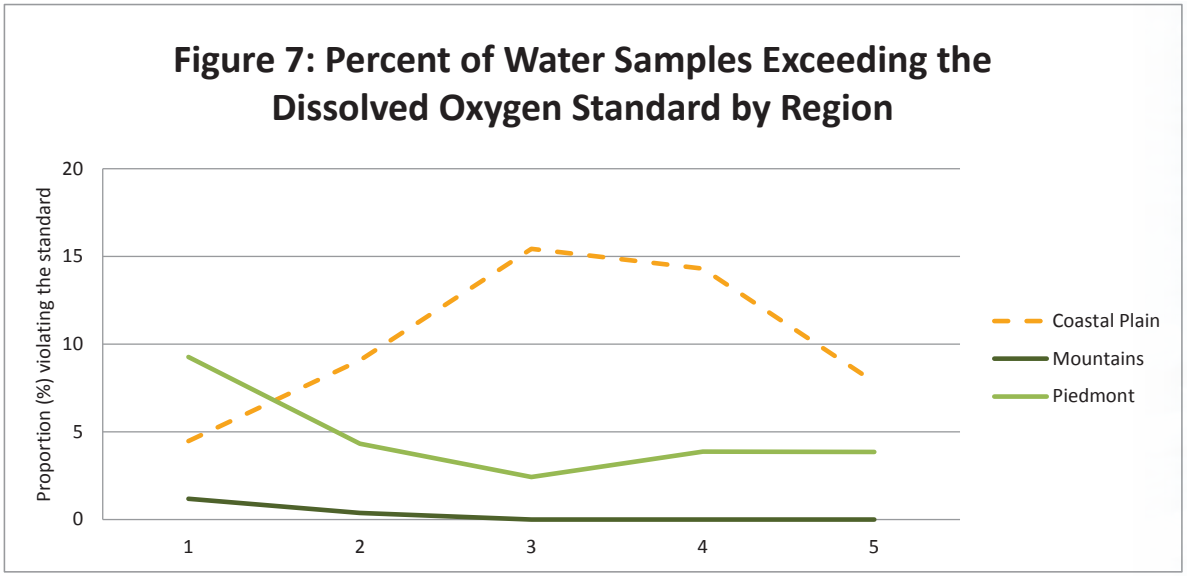
		Number of Results (Notes: Period: January 1970 through December 2010. Summer is defined as June, July, August and September and only surface results used (< 1m)).		
Region	**Number of Stations**	**Turbidity**	**Fecal Coliform Bacteria**	**Summer Dissolved Oxygen**
Coastal Plain	63	16,556	19,289	8,290
Mountains	28	8,395	9,531	3,429
Piedmont	80	21,346	25,339	10,426
Total	**171**	**46,297**	**54,159**	**22,145**

Map 2: Water Quality Sampling Sites Across the State

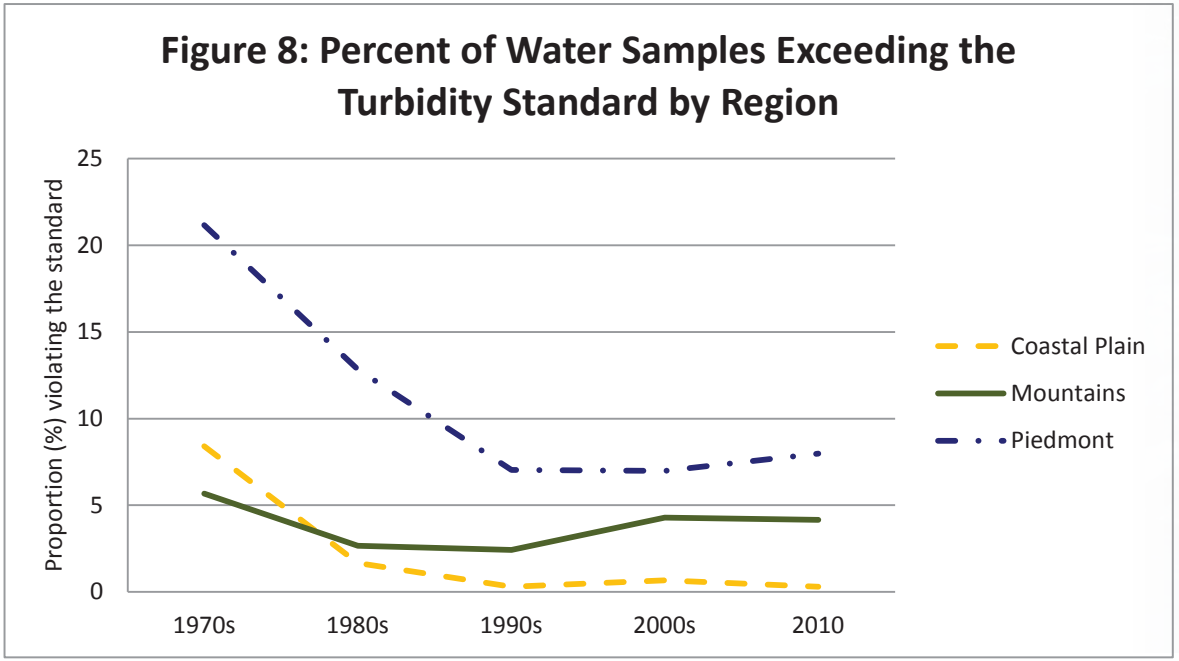


Results for dissolved oxygen, turbidity and fecal coliform bacteria were grouped by region (mountains, piedmont and coastal plain). The following graphs are based on the results from 172 currently active DWQ monitoring stations that were established before 1979. Since the data set is large and has been collected over many years, it can be used to show changes in dissolved oxygen, turbidity and fecal coliform bacteria over time. The differences in the three regions of the state point out the importance of location and geography when trying to determine trends in water quality.

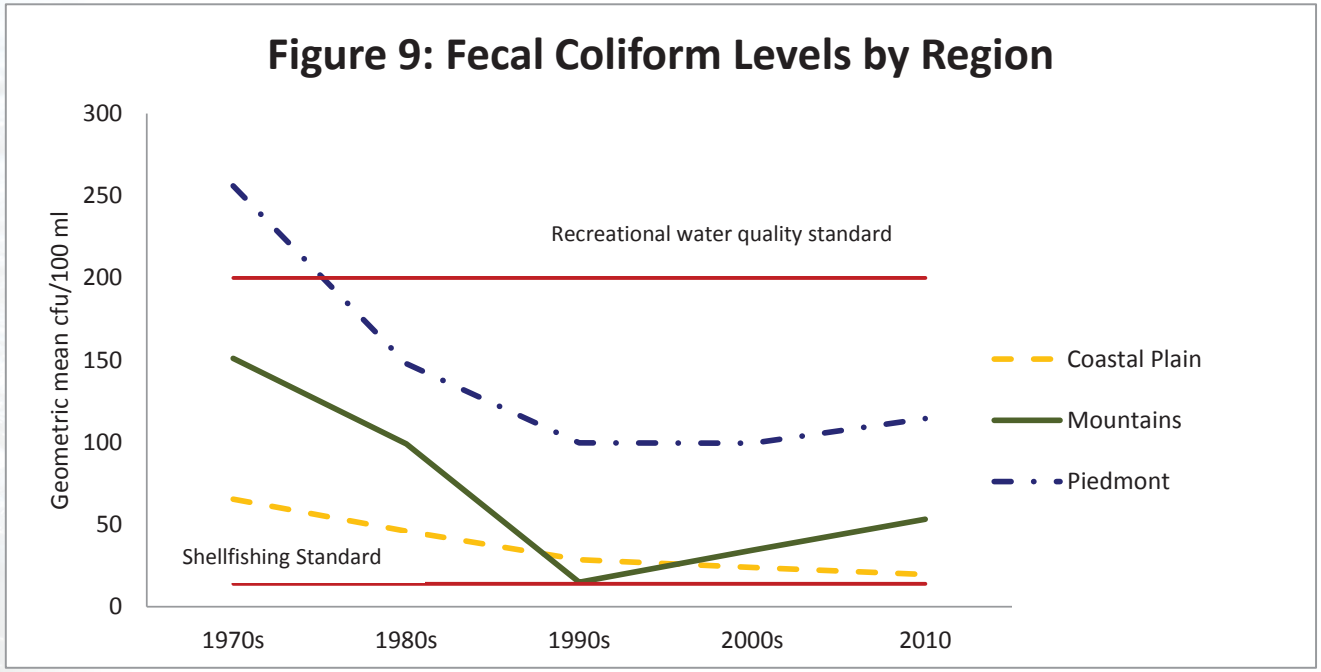
Dissolved oxygen (DO) in water is necessary for aquatic life, like fish and their food chain, to survive. Wastewater can contain contaminants, organisms and conditions that consume DO and take it from the oxygen available for aquatic life. Figure 7 shows that DO conditions have improved in the mountain and piedmont areas since the 1970s but that DO conditions in the coastal plain have declined.



Turbidity is a measure of the amount of suspended solids in the water. Turbidity affects water clarity, plant and animal growth and the usefulness of the water body as a drinking water source. Trout are particularly susceptible to turbidity because turbid conditions hinder the trout's ability to reproduce. High turbidity levels largely correspond to erosion and stormwater runoff from land-disturbing activity associated with development or agriculture. Figure 8 shows that turbidity standard violations across the state have declined since the 1970s. In more recent years, North Carolina has seen increased violations in the mountain and piedmont areas.



Fecal coliform and enterococcus bacteria indicate that water is polluted with human or animal waste. Increased levels of these microorganisms in waters usually indicate a source of pollution to the waterbody. Sources can include urban stormwater, animals (including wildlife, livestock and pets), improperly managed animal waste systems, wastewater discharges, failing or leaking septic systems and marina activities. Figure 9 shows that bacteria levels have decreased in every region of the state since the 1970s. However, there are individual water bodies within each region that do not meet the standards; those waters receive special attention, particularly in water bodies used for shellfishing and swimming.



Designated Uses and Use Support Ratings

Another indicator of water quality is the percentage of waters in the state that can support their designated uses. All rivers, streams and lakes have designated "best uses" and water quality standards to protect those uses. Designated uses are defined by classifications and standards associated with those classifications that are intended to protect and maintain the designated uses; Class C is the baseline classification that is applicable to all waters of the state. This classification maintains water quality that is good enough to support secondary recreation (wading, boating and other uses involving infrequent body contact with the water), fishing, wildlife, fish and aquatic life propagation and agriculture. Other primary classifications are assigned to protect waters for such uses as shellfishing (Class SA), drinking water supply (WS-I through WS-V), and primary recreation (Class B). In addition, North Carolina has many supplemental classifications to recognize other uses and characteristics, such as for Outstanding Resource Waters, Trout and Swamp waters.

The majority of monitored waters in North Carolina support their uses and are in good to excellent condition. However, almost 40 percent of all monitored waters are impaired. Table 2 depicts the number of the state's surface waters by level of impairment. North Carolina relies on biological, chemical and habitat assessments to indicate whether or not waters are supporting their designated uses.

Water quality impairments are identified every other year through the "use support" assessment process. These impairments are compiled and submitted to the U.S. EPA for review and approval pursuant to Section 303(d) of the Clean Water Act. An impairment designation may require development of total maximum daily loads (TMDLs) specific to those waters. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards.

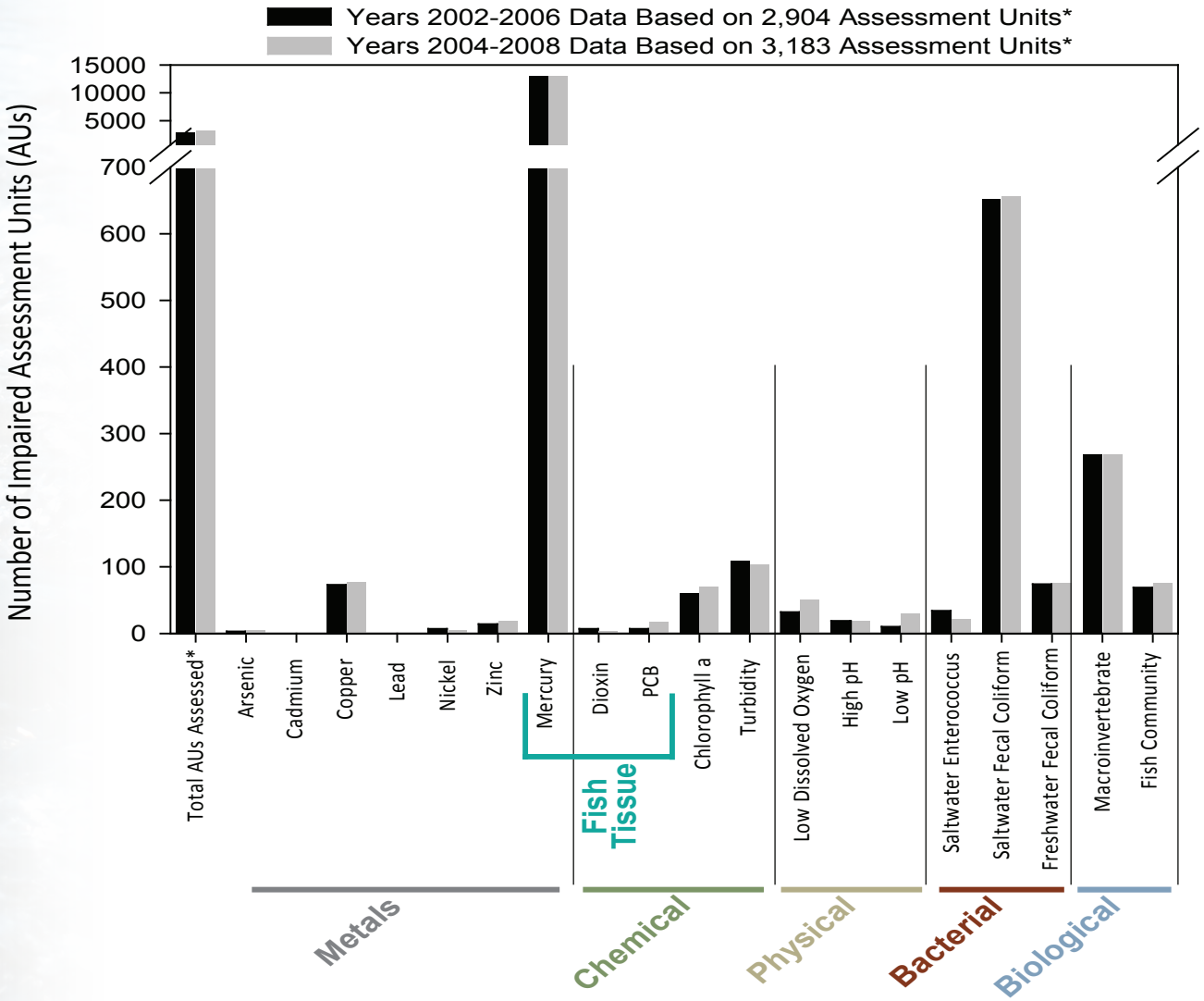
Table 2: Use Support Categories for Biological Ratings*

Biological Ratings	2010 Level of Impairment	Assessment Category	Percent of Surface Water
Excellent/ Natural	**Supporting** (Categories 1-2)	**Category 1** – all uses are monitored and supporting	**54%**
Good			
Good-Fair/ Moderate		**Category 2** - all monitored uses are supporting or not rated and no impairments	
Not Impaired			
Not Rated	**Not Rated** (Category 3)	**Category 3** - monitored uses are not rated and there are no impairments. Waters are not rated due to inconclusive or insufficient data.	**7%**
Fair	**Impaired** (Categories 4-5)	**Category 4** - at least one impairment but TMDLs are not required to address impairment	**3%**
Poor/Severe		**Category 5** - at least one impairment that requires development of TMDL	**36%**

*this table does not include mercury as all state waters are impaired for mercury

The results are based on a five-year compilation of water quality data that has been quality assured and quality controlled. For example, the 2010 year assessments are based on data collected from 2004-2008. Figure 10 illustrates the most recent (2008 and 2010) 303(d) water listings by source of impairment for North Carolina. Leading causes of impairment include metals, bacterial pathogens, biological conditions and turbidity.

Figure 10: Sources of Water Quality Impairments



* An assessment unit (AU) is a stream segment, lake or estuarine area that is assessed and assigned an identifying number.

Groundwater

About 42 percent of North Carolina's residents rely on groundwater as a drinking water source. Under a statewide private well testing program, all new private drinking water wells are sampled by local health departments and analyzed for a standardized list of chemical constituents by the State Laboratory of Public Health in the North Carolina Department of Health and Human Services. In addition to the information value to individual well users, these samples are the most abundant source of data on the status of groundwater quality across the state. Regular review of this data provides information on human impacts on groundwater quality, the quality of groundwater consumed by North Carolinians and potential impacts of groundwater on surface waters. Table 3 describes the various groundwater quality indicators.

Table 3: Description of the Groundwater Quality Indicators	
Nitrates	Naturally occurring levels of nitrates in groundwater are typically very low. Groundwater nitrate levels above 1 milligram per liter (mg/L) often indicate the influence of fertilizer application or human or animal waste disposal. Elevated levels of nitrates in groundwater also indicate the possibility that groundwater has been impacted by other pollutants from human activities, such as pesticides or other chemicals. Nitrate levels greater than the state groundwater standard of 10 mg/L in drinking water put infants at serious risk of methemoglobinemia ("blue baby syndrome") that interferes with the ability of an infant's blood to absorb oxygen. Discharge of groundwater with elevated levels of nitrate to surface water may also contribute to nutrient overloading in sensitive surface waters. Groundwater nitrate levels therefore provide an excellent indicator of human impacts to groundwater, health risks to private well users and potential impacts to surface waters. Because nitrate in groundwater can be an indicator at these two different levels, two separate indicators were identified from the nitrate data: 1. the percentage of samples exceeding 1 mg/L nitrate, which serves as an indicator of human impacts to groundwater and potential impacts to surface waters, and 2. the percentage of samples exceeding the state groundwater standard of 10 mg/L, which serves as an indicator of potential health risks to private well users
pH	pH is a measure of the acidity of water. Low pH groundwater can result from natural conditions or human influences, including mining or other land uses. Naturally-occurring low pH is common in North Carolina groundwater. Widespread changes in groundwater pH over time might result from long-term changes in the pH of precipitation (acid rain) as well as long-term changes in the distribution and infiltration of precipitation. While low pH in itself does not constitute a health risk to well users, low pH in groundwater may increase the likelihood of leaching of metals from aquifers, well materials and plumbing. Groundwater discharge to surface waters can also inhibit or promote acidification in surface waters. For these reasons, the percentage of samples number of samples with pH less than 6.5 may be an important indicator to track for human impacts to groundwater, potential health risks to private well users and potential impacts to surface waters.
Metals: Arsenic and Chromium	Arsenic and chromium may originate from human or natural sources. Arsenic in particular is well-known to occur naturally in North Carolina groundwater; due to geologic conditions, it is more likely to occur in the central Piedmont. Long-term consumption of groundwater containing these metals above health-based standards can cause health problems. Arsenic has been associated with some cancers. The percentage of wells exceeding state groundwater standards for arsenic and chromium is a useful indicator for tracking the degree to which private well users might be exposed to these metals.
Metals: Iron & Manganese	Iron and manganese are common in North Carolina soils and rocks and occur naturally in North Carolina groundwater, but elevated levels of iron and manganese may result from human activity as well. Elevated levels of iron and manganese in groundwater primarily result in concerns about water color, taste and staining of plumbing fixtures and laundry. Groundwater monitoring by DWQ in central North Carolina also suggests that elevated iron and manganese may reduce the mobility of arsenic in groundwater. Groundwater with high levels of iron and manganese may also contribute to high levels of these metals in surface water. The percentage of samples exceeding the state groundwater standard for each of these metals was identified as an indicator of naturally occurring groundwater quality and it can be used to assess whether human or environmental factors are impacting water quality at a large scale.

For the indicator parameters nitrate, pH and metals (described above), the results of private well sample analyses from 2010 are summarized in Table 4.

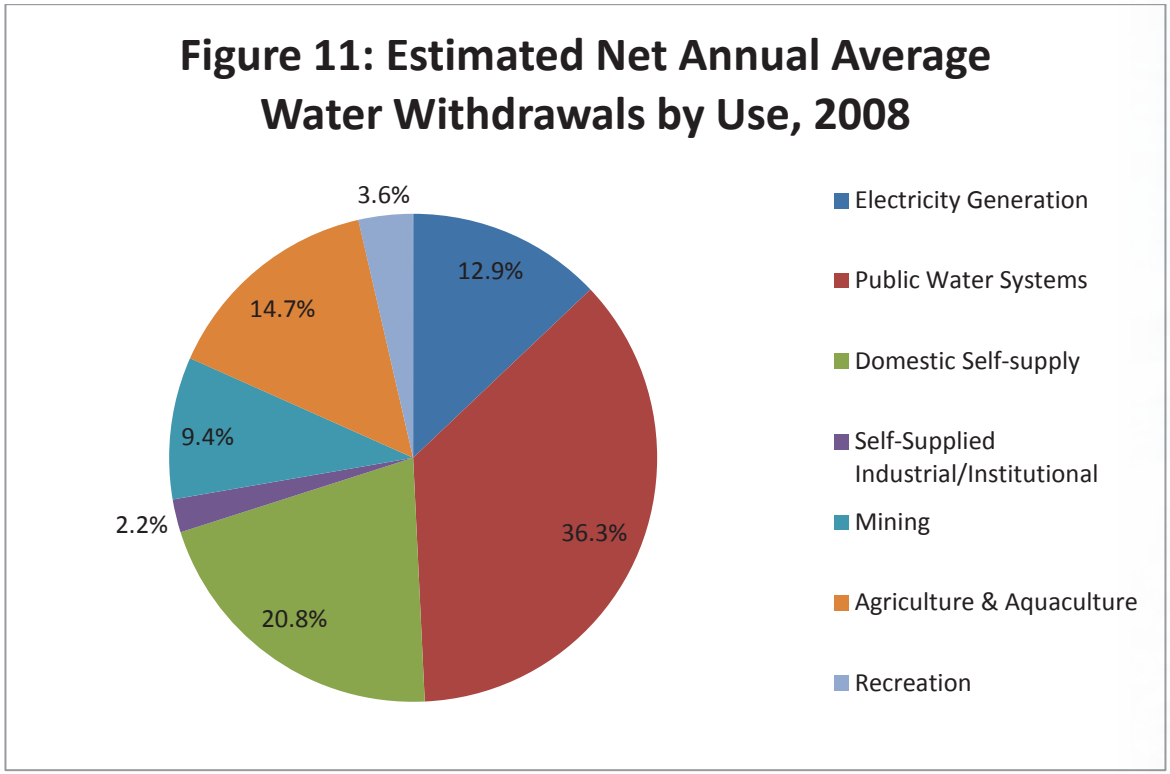
Table 4: Groundwater Pollution Indicators and Description

Parameter	**Nitrate**	**pH**	**Arsenic**	**Chromium**	**Iron**	**Manganese**
State Groundwater Standard	**10 milligrams per liter**	**6.5-8.5**	**10 micrograms per liter**	**10 micrograms per liter**	**300 micrograms per liter**	**50 micrograms per liter**
Number of private well samples analyzed	4,110	4,901	4,870	4,892	4,896	4,900
Samples exceeding the State groundwater standard	0.7%	18.4% below pH of 6.5	2.4%	1.5%	57.6%	39.9%

Use of the private drinking water well dataset to establish status indicators is a new practice made possible by the implementation of mandatory testing of all new private drinking water wells beginning in July 2008. No trends can be established yet. DENR will continue to evaluate this dataset for indicator parameters as long as the statewide well testing program remains in place.

Water Quantity

Another factor that affects the environment and our quality of life is the quantity of available water. Effective management of water resources is critical to ensure that water will be available for North Carolina's citizens now and into the future. More than nine million residents depend on the state's water resources for drinking, irrigation, manufacturing and industrial processes, mining, recreation, navigation and electricity generation (See Figure 11 below). Combined, these users require an average of almost 11 billion gallons of water each day. Much of the water removed from waterways is treated and released back into the waterway after use. In addition, sufficient flow must be maintained in North Carolina's water bodies to support fish, wildlife and recreational uses of the state's lakes, rivers, streams and estuaries. The N.C. Division of Water Resources has a number of programs designed to ensure good stewardship of the state's water resources.



Drought Response-Water Shortage Response Plans

Although North Carolina is generally considered to be a water-rich state, water supply is not unlimited. The limits on the state's water resources become most apparent in times of drought. The state has experienced two major droughts in the past decade: one from 1998 to 2002 and another in 2007-2008. After the last major drought, the General Assembly enacted legislation to help mitigate the effects of future droughts by requiring the development of local water shortage response plans. The legislation requires each water system to define different local stages of water shortage severity and outline responses to each stage that meet minimum statewide standards. The intent is for each water system to have a framework for managing drought conditions in a way that minimizes impacts on drinking water supply and on the local economy. The plans, which must be approved by the Division of Water Resources (DWR), have to be updated every five years as part of the water system's broader water supply plan.

DWR has assisted local governments in successfully completing 533 of the 551 required local water shortage response plans. The remaining 18 are pending local government approval.

Hydrological Modeling Program

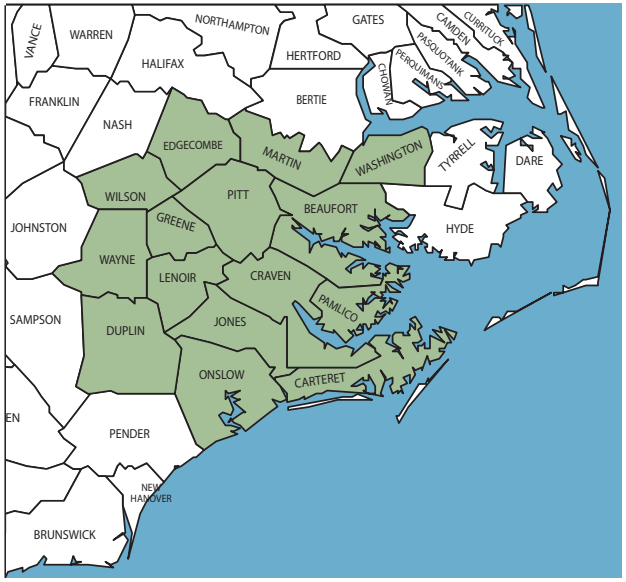
River basin hydrological models being developed by DWR will be used to project the future water needs and the availability of water in the state's 17 major river basins. These computer models are vital tools for comprehensively evaluating surface water availability in each basin and for predicting the impact of additional water withdrawals and transfers. For long-term strategic planning, the state will be able to use the models to make water resource policy decisions and to evaluate the potential impacts of proposed water withdrawals on water supply. DWR has completed hydrologic models for the Cape Fear and Neuse River Basins. The division is currently working on models for the Tar-Pamlico and Broad River Basins. The division is currently working on models for the Tar-Pamlico and Broad River Basins. Those models are expected to be completed by the end of 2011. Models for the remaining river basins will be completed during the next 10 years.

The division uses existing water use data and growth projections provided by local governments to develop the hydrologic models and to implement comprehensive basin-wide water resources planning. Local water shortage response plans will be incorporated into the river basin hydrologic models, allowing local governments to assess the effectiveness of the plans in the context of other influences on water supply. When completed, the models will be able to project where water shortages are most likely to occur 20 to 50 years into the future. Local governments will be able to use this information to prepare for or avoid these projected shortages and plan for continued economic growth.

Central Coastal Plain Capacity Use Area Rules (CCPCUA)

The central coastal plain capacity use area is a 15-county region in the coastal plain. For many years, the deep confined aquifers, which are the primary source of water in the area, were being over-used. Water was being withdrawn at a rate that was greater than the natural recharge. If this situation had been allowed to continue indefinitely, the aquifers would have eventually been permanently damaged, impairing their ability to function as a water supply. Because of this significant groundwater depletion, the Environmental Management Commission adopted rules, effective in August 2002, to manage withdrawals from the aquifers.

The rules require anyone who withdraws more than 100,000 gallons of groundwater per day to obtain a permit for the withdrawal; withdrawals of more than 10,000 gallons per day must be registered. Through the permitting system, large water users in some parts of the capacity use area were required to reduce withdrawals from the aquifers to allow the aquifer to recover. DWR has worked with local governments in the Central Coastal Plain to reduce reliance on these limited groundwater sources and develop alternative water supplies. By 2011, 33 percent of local governments in the area had new water sources or connectivity with other water systems, making those communities less vulnerable to drought and better able to sustain population growth and economic development. The Central Coastal Plain Capacity Use program has already shown early success; by reducing aquifer withdrawals, the aquifers have begun to recover -- with groundwater levels rising more than 30 feet in some areas.



Map 3: The 15-county Central Coastal Plain Capacity Use Area

Protecting Drinking Water

Public water systems range from large municipalities to country stores that serve a minimum of 25 individuals for 60 days per year. The complexity of the federal Safe Drinking Water Act (SDWA) can make compliance difficult to achieve for many small systems. Of the 6,390 regulated public water systems, about 5,641 serve a population of less than 500. The Division of Water Resources' Public Water Supply Section (PWS Section) is the primary agency responsible for assuring that the people of North Carolina are provided safe drinking water from public water systems.

In 2010, 96.5 percent of the state's citizens were served by systems meeting all health-based standards. This is otherwise known as citizens served by community public water systems having no maximum contaminant level (MCL) violations. This was an improvement compared to the previous year's 91.3 percent. Table 5 shows the compliance rates for the past four years, as well as the baseline measure from 1999.

Table 5: Population Served by Compliant Community Public Water Systems

Compliance Measures	1999 (baseline)		2007		2008		2009		2010	
	Population[±]	Percent	Population	Percent	Population	Percent	Population	Percent	Population	Percent
Citizens Served by Community Public Water Systems having No MCL[*] Violations	6,475,785	97.5%	6,216,081	90.2%	6,913,713	94.4%	6,790,618	91.3%	7,550,874	96.5%
Citizens Served by Community Public Water Systems having No MR[†] Violations	5,801,083	87.3%	5,295,021	76.8%	6,801,313	92.8%	6,834,719	91.9%	7,291,626	93.2%
Total Service Population	6,644,281		6,891,776		7,327,179		7,440,822		7,821,672	

[*] *"MCL"* means a violation with regards to the maximum permissible contaminant level in water delivered by a public water system.[†] *"MR"* means a failure to monitor for required water quality tests as defined by federal and state regulations and for 1999 through the first half of 2005 includes systems that failed to report on time.[±] 1999 population data is based on last available record prior to Oct. 1, 2005.

Source Water Protection Program

The Public Water Supply Section continued to improve and implement North Carolina's Source Water Protection Program (SWP Program) during 2010. The SWP Program evaluates the susceptibility to contamination and initiates protective strategies for the state's public drinking water resources. Activities include delineation and assessment, wellhead and surface water protection, coordination with other state agencies and program creation designed to initiate SWP Program efforts. These activities allow public water systems to protect their water sources and thus increase capacity. Systems that maintain drinking water sources that are less susceptible to contamination achieve greater financial and technical capacity because fewer resources are spent maintaining water treatment.

The SWP Program promotes and provides technical expertise to assist communities with local SWP plans. A seven-step process has been used successfully across the state to protect ground and surface water sources. To date, the PWS Section has approved five local surface water protection plans which serve to protect drinking water for approximately 220,000 residents. The SWP planning process empowers local stakeholders to define and achieve long-term, proactive drinking water protection goals.

Coastal and Estuarine Resources

North Carolina's coastal ecosystem consists of 2.3 million acres of coastal and estuarine habitats. The Albemarle-Pamlico estuarine system is the second largest estuarine complex in the lower 48 states, with more than 3,000 square miles of open water. The system supports important habitat areas for fish and shellfish, including key nursery areas for east coast fisheries. North Carolina's coastal waters also sustain an array of economic, recreational and aesthetic functions that are of regional and national importance.

North Carolina is one of the nation's leading coastal fishing states. More than 90 percent of North Carolina's commercial fisheries landings and more than 60 percent of the recreational harvest (by weight) are comprised of species that depend on estuarine waters for some portion of their life cycle. Some of the most valuable commercial species include blue crab, shrimp and southern flounder, while sought after recreational species include spotted seatrout, red drum and striped bass.

The Division of Coastal Management (DCM) and the Division of Marine Fisheries (DMF) both protect coastal resources. The DCM carries out the state's Coastal Area Management Act, the Dredge and Fill Law and the federal Coastal Zone Management Act of 1972 in the 20 coastal counties, using rules and policies of the N.C. Coastal Resources Commission, known as the CRC. The CRC and the DCM work together to fulfill the primary mission of the Coastal Area Management Act, which is to balance the competing demands of protecting coastal resources while guiding and managing development in the 20 coastal counties, and to protect the public's opportunity to enjoy the physical, aesthetic, cultural and recreational qualities of the state's coastal shorelines. DCM's coastal nonpoint source program, administered through a partnership with the Division of Water Quality, provides federal funds to support projects and initiatives focusing on nonpoint source issues and concerns in the coastal area. It also supports water quality planning at N.C. Sea Grant, which provides education and outreach to local governments.

The Division of Marine Fisheries protects and manages coastal fisheries and habitats through the development of Fishery Management Plans and the N.C. Coastal Habitat Protection Plan (CHPP). The CHPP summarizes the environmental conditions required to sustain all coastal aquatic habitats, the beneficial services they provide to fish and the environment, their current status and trends, the major threats affecting them, and recommendations to protect, restore and enhance their condition. The full plan is available at DMF's website (http://portal.ncdenr.org/web/mf/59).

Coastal water quality directly affects the condition of other aquatic habitats that support coastal fisheries and enhance water quality. In addition to providing structure for fish, wetlands and oysters help to filter pollutants

and sediment from water and stabilize shorelines. Submerged aquatic vegetation (SAV) traps sediment, removes carbon dioxide from the water and releases oxygen into the water.

Changes in distribution of submerged aquatic vegetation and shell bottom (oyster beds) can be an indication of water quality changes. Mapping efforts indicate that SAV distribution in Pamlico, Core and Bogue Sounds is relatively stable. SAV has been expanding in the lower salinity areas of Albemarle Sound and tributaries, Currituck Sound and Back Bay, Neuse and Pamlico Rivers and tributaries, and high salinity areas south of Bogue Sound. The increase in coverage is thought to be related to increased salinity and improved water clarity associated with reduced frequency of major storm events and the persistent drought conditions present in eastern North Carolina in recent years.

Shell bottom consists of concentrations or reefs of oysters, clams and other shellfish. Shell bottom condition can be assessed by quantifying changes in acreage and distribution through mapping, and by monitoring the number of new oysters that settle onto shell (referred to as spatfall). In the 1990s, spatfall sampling data indicated that oyster stocks and harvest from Pamlico Sound remained low due to disease-related death and low number of adults (biomass). Since 2001, annual spatfall has increased in both the northern and southern areas of the coast (Figure 12). During the same period of increased spatfall, there was a decline in the prevalence of disease in adult oysters, indicating that the reduced disease prevalence may be resulting in less stressed oysters, lower mortality and increased reproduction.

Fish Consumption

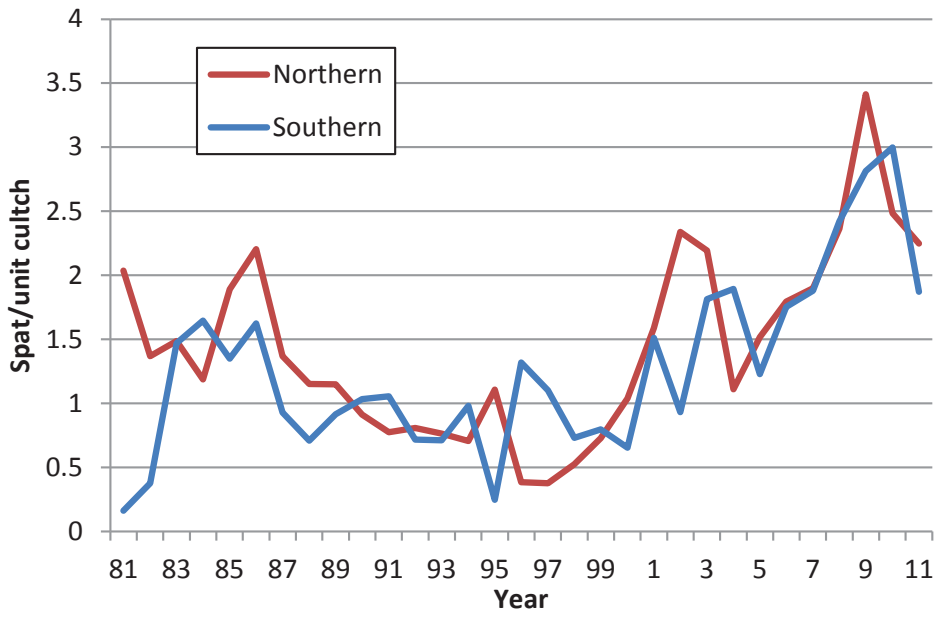
Many people enjoy fishing in North Carolina waters. They also enjoy eating their catch and fish is a healthy, low-fat source of protein. The Division of Water Quality routinely monitors water quality and fish tissue for potential problems.

The N.C. Department of Health and Human Services (DHHS) issues fish consumption advisories if a particular fish species presents a health threat because of contamination in the water body where the fish is found. The advisory may suggest limiting consumption of those fish or recommend avoiding eating those fish altogether.

There is a general statewide advisory that recommends limiting the consumption of all fish from North Carolina waters in relation to low-level mercury contamination. Covered species include cobia, marlin, orange roughy, shark, swordfish, catfish (caught wild), largemouth bass, and yellow perch.

There also are fifteen water body-specific fish consumption advisories for a variety of species. View information at the N.C. Department of Health and Human Services to learn more about fish consumption advisories near you.

Figure 12: Average number of attached juvenile oysters (spatfall) per unit cultch (shell), in northern and southern coastal waters (southern district includes from Newport River to South Carolina), 1981–2011



The 2010 N.C. Coastal Habitat Protection Plan assessed the effect and severity of land and water based activities on coastal waters and habitats. Water quality degradation not only impacts the waters that fish and people rely on, but also the habitats that need certain environmental conditions to thrive.

Threats to coastal waters and habitat come from many sources and usually affect more than one habitat to various extents. Table 6 lists different human activities that can affect coastal habitats and water quality, and rates the potential severity of these activities, pollutants, and other stressors on each fish habitat. Stormwater runoff, associated with numerous activities, is considered a major threat to coastal water quality and fish habitat. Climate change and accelerated sea level rise can have an overarching effect on all of North Carolina's coastal waters and nearshore habitats. North Carolina was rated as one of the four most vulnerable states in the United States to sea level rise. Climate change and sea level rise are now recognized as a priority issue for DENR.

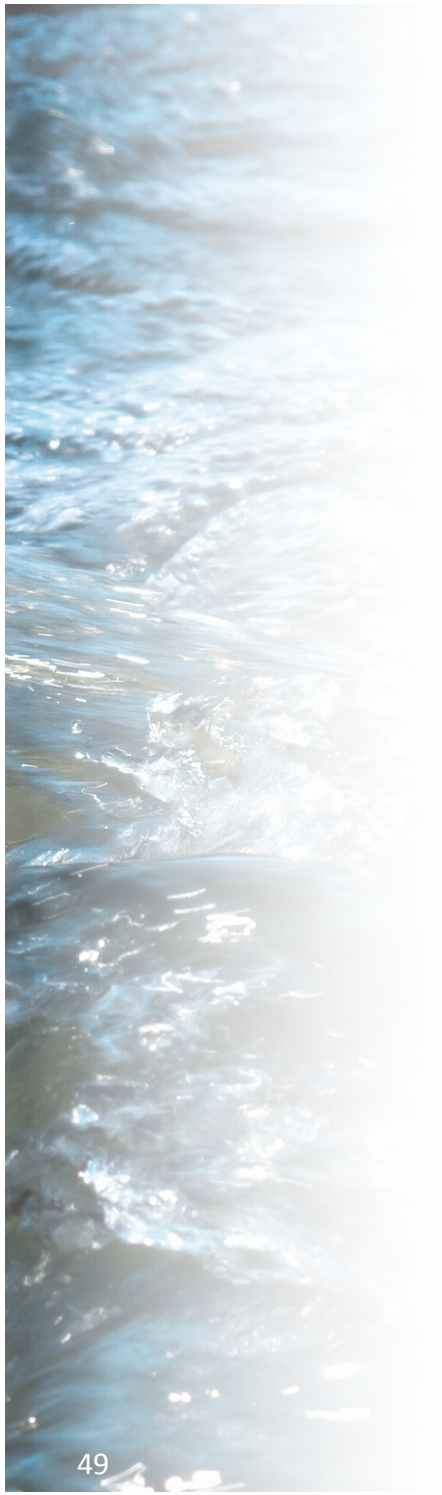


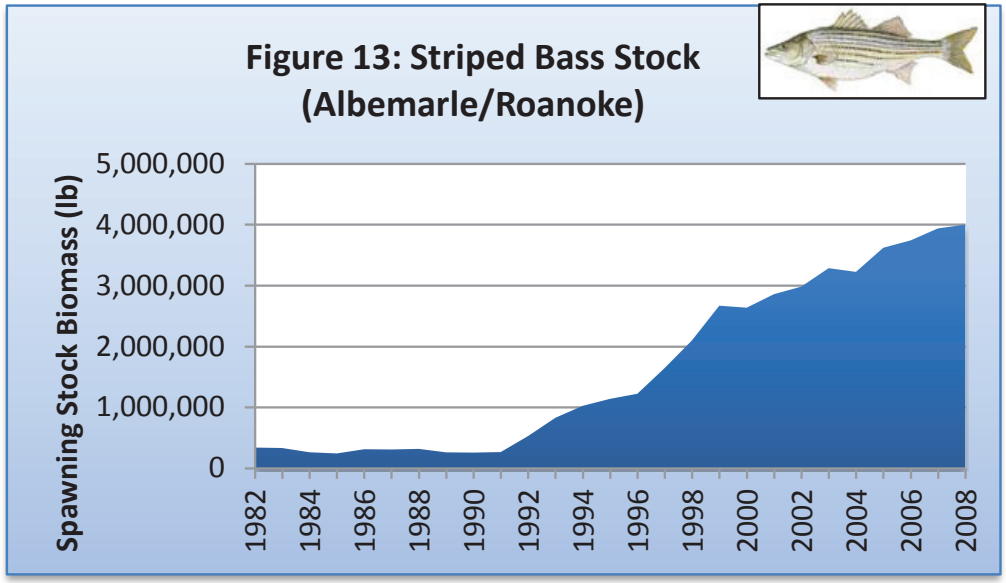
Table 6:
Threat sources and impact severities to coastal fish habitat. Shading = relative severity of impact; white = no impact/ unknown, yellow = minor, orange = moderate, red = major

Threat category	Source and/or impact	Water column	Shell bottom	SAV	Wetlands	Soft bottom	Hard bottom
Physical threats/ hydrologic modifications	Boating activity						
	Channelization						
	Dredging (navigation channels, boat basins)						
	Fishing gear impacts						
	Infrastructure (i.e., pipelines)						
	Jetties and groins						
	Mining						
	Obstructions (dams, culverts, locks)						
	Estuarine shoreline stabilization						
	Ocean shoreline stabilization						
	Upland development						
	Water withdrawals						
Water quality degradation-sources	Land use change and nonpoint sources						
	Water-dependent development (marinas and docks)						
	Point sources						
Water quality degradation-causes	Marine debris						
	Microbial contamination						
	Nutrients and eutrophication						
	Saline discharge						
	Suspended sediment and turbidity						
	Toxic chemicals						
Disease and microbial stressors							
Non-native, invasive or nuisance species							
Sea-level rise/climate change							

Fish Populations

The state of fishery stocks is due to a combination of factors, including environmental conditions, fishery management and habitat condition. DMF conducts sampling to determine the status of stocks annually (http://portal.ncdenr.org/web/mf/stock-status-reports). Annual changes in the amount of adult spawners are often used to assess trends in fish populations and determine the status of a stock. The estuarine striped bass stock in the Albemarle Sound and Roanoke River is an example of a stock that has increased dramatically from very low levels in the early 1990s (Figure 13). Red drum, the state saltwater fish, relies on estuarine wetlands, grass beds and oysters for nursery area, cover and food, and migrates to ocean waters with age and season. The status of the red drum has also improved (Figure 14). Blueback herring migrate upstream to spawn but use small tributaries and flooded wetlands for spawning. Blueback herring and alewife comprise the river herring fishery, which is one of the state's oldest fisheries, and of great cultural importance in northeastern North Carolina. Blueback herring is an example of a stock that has not recovered, despite a fishing moratorium since 2007 (Figure 15). Changes or obstructions to water flow and water quality degradation are potential reasons. Management is focused on monitoring the stock during the fishery closure, determining the location of spawning habitats and removing stream blockages (i.e., dams and culverts) to historic spawning habitats.

Figures 13-15. Trends in stock size currently used to address stock status. The "threshold"(red line) is the point at which a stock is no longer considered depleted, while the "target" (green line) is the level which management aims to achieve. No target is available for Albemarle/Roanoke striped bass.



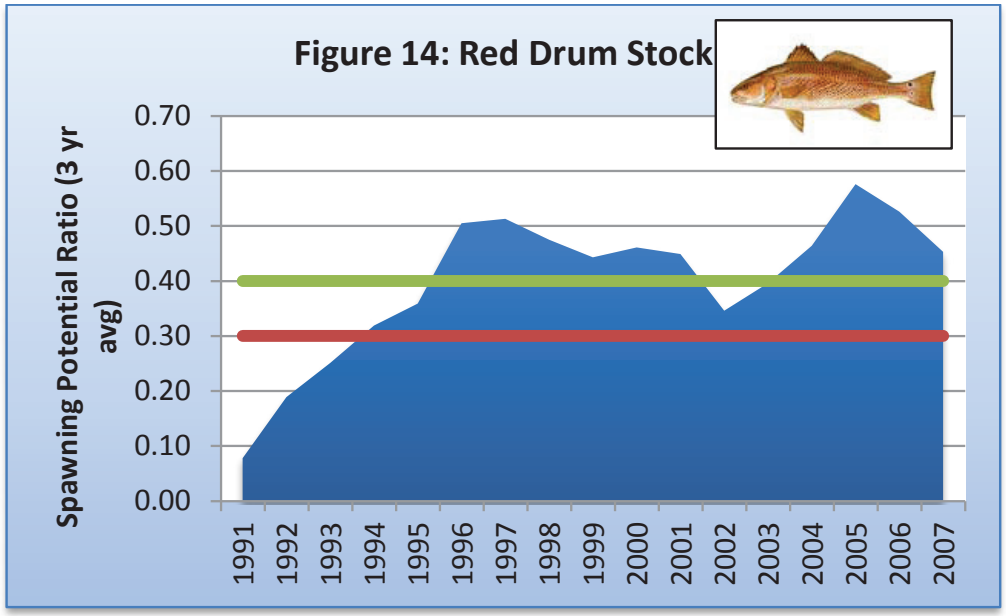


Figure 14: Red Drum Stock
Spawning Potential Ratio (3 yr avg)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007

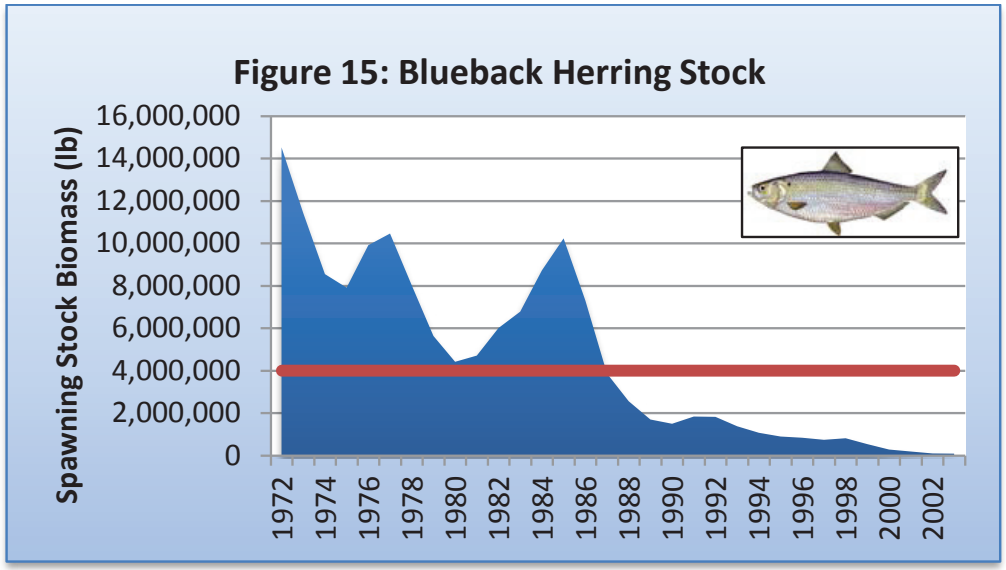


Figure 15: Blueback Herring Stock
Spawning Stock Biomass (lb)
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

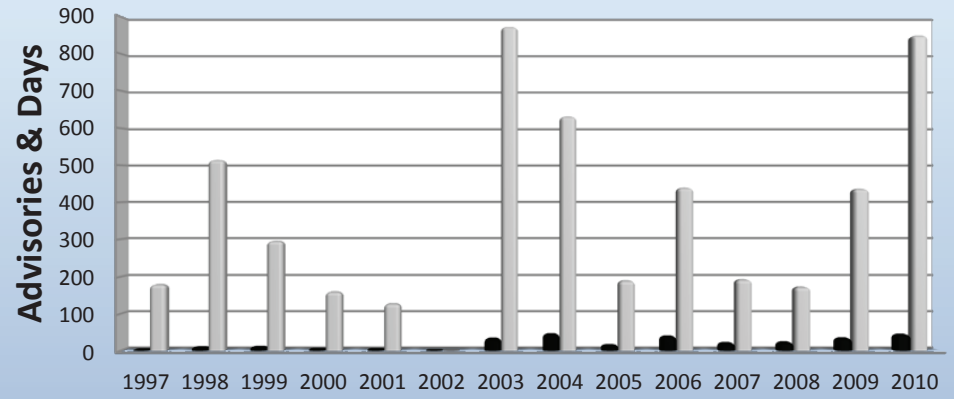
Beach Water Quality Monitoring

In addition to ensuring that water quality is safe for aquatic species, DENR also makes sure that coastal waters are safe for human activities. The DMF Recreational Water Quality Program monitors 240 sites along the ocean beaches, sounds and coastal rivers and notifies the public when water quality does not meet standards for swimming. The water is tested for the bacteria enterococci. While enterococci may not cause illness itself, its presence is used as an indicator that other disease-causing organisms could be present. Swimming advisories and signs are posted when results exceed swimming water standards.

Figure 16 shows the number of swimming advisories for each year. The total time a site is under a swimming advisory can vary in duration from one day to multiple months. The total number of advisory days (days under advisory, summed over all individual advisory sites) may be a better indicator of water quality trends than the total number of advisories issued (Figure 16). In 2003, the increase in both advisories and advisory days is due to a change in criteria for classifying recreational waters and the unusual amount of rainfall for that year. The majority of the swimming advisories occur at sound-side beaches and approximately 10 of these sites have recurring advisories and are responsible for many of the advisory days depicted in the graph. Storm water run-off, pets, marinas, wildlife and birds all contribute to these sound-side swimming advisories.

2007 and 2008 were both abnormally dry and this contributed to the low number of advisories. The increase in advisories in 2010 is a result of increased rainfall and a larger number of days under advisory. Other than a few exceptions, monitoring has shown excellent water quality for North Carolina's ocean beaches. An interactive map and data are available showing the location and advisory status of recreational water quality monitoring at: http://xapps.enr.state.nc.us/eh/beaches/viewSiteMap.do

Figure 16: Coastal Swimming Advisories by Year



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
# of Adv. Issued	3	10	11	5	4	0	34	46	16	40	22	24	35	45
Total Days Under Adv.	180	515	296	160	128	0	874	633	190	440	193	173	437	851

Current Initiatives

Stormwater Management – Stormwater runoff is one of the most critical threats to preserving and improving water quality. Runoff from developed areas, active construction sites, farms and industrial operations can carry a wide range of pollutants to rivers and streams. Those pollutants include sediment, pesticides, nutrients (from fertilizer, animal waste), oil and other chemical pollutants that run off hard surfaces like roofs and paved roads. One of the primary tools for controlling the water quality impacts of stormwater runoff from urbanized areas and from development activities is through the federal National Pollutant Discharge Elimination System (NPDES) permit program. This program, created under the federal Clean Water Act, requires permits for point source discharges of stormwater from industrial activities and from municipal stormwater systems. (In this case, a "municipal" stormwater system means any public system that collects and discharges stormwater; it may actually be operated by a county, a university, a military base or other public entity.) DENR's Division of Water Quality implements the NPDES stormwater permitting program in North Carolina.

The department also implements stormwater programs created under state law to control stormwater runoff to sensitive water bodies such as water supply reservoirs, shellfish waters and other water bodies experiencing pollution problems.

In connection with these regulatory and permitting programs, the Division of Water Quality provides technical assistance, educational materials and outreach:

- Staff continues to maintain and regularly update a manual of stormwater best management practices BMPs) and provides technical assistance on the materials. Conservation tillage, vegetative buffers along streams and sediment retention ponds are all examples of BMPs.
- The division continues to partner with N.C. State University to offer regular Stormwater BMP Reviewer Certification workshops for local governments. The workshop includes training on stormwater management, regulatory issues and review of BMP design, implementation, maintenance and inspection. Due to limited funding only one workshop has been held in 2011.
- The division collaborates with the Water Resources Research Institute to offer regular stormwater and wetlands training activities for engineers, consultants, local governments and other interested parties. These efforts have been well received and are continuing on a regular basis at various locations across the state.

Learn more about the division's stormwater awareness outreach and education efforts by visiting http://www.ncstormwater.org.

Nutrient Management – High levels of nutrients in surface waters (such as nitrogen and phosphorus) can cause excessive algal growth and fish kills. In response to nutrient problems in rivers, water supply reservoirs and the Neuse River estuary, North Carolina has developed nutrient control management strategies for both point sources (wastewater and industrial dischargers) and nonpoint sources (urban stormwater, agricultural activities, and septic systems). Those strategies have evolved over time in response to lessons learned through implementation. The major nutrient reduction strategies currently in place typically include phosphorus and/or nitrogen limits for facilities with NPDES permits and BMPs to control nutrient loading from agricultural land, urban areas and other nonpoint sources.

These nutrient management strategies have been successful in the Neuse River and the Neuse estuary, which had experienced serious algal blooms and large fish kills in the late 1980s because of excess nutrients. Similar nutrient management strategies have more recently been developed for two large water supply reservoirs –Jordan Lake and Falls Lake – to protect future drinking water supplies. Those strategies are just moving into implementation.

In connection with final legislative approval of the Jordan Lake nutrient management strategy, the General Assembly, in Session Law 2009-216, required the department to create a scientific advisory board to evaluate and assign nutrient reduction credits to different nutrient reduction best management practices. The work of the N.C. Nutrient Scientific Advisory Board will help DWQ and local governments identify effective strategies for reducing nutrient loading from existing development as required under both the Jordan Lake and Falls Lake nutrient management strategies.

The difficulty of crafting cost-effective nutrient reduction strategies for existing development in the Jordan Lake and Falls Lake watersheds has focused attention on the need to manage the nutrient impacts of new development before water quality becomes impaired. In 2012, the Division of Water Quality will host a two-day forum - "Water Quality Standards & the Management of Nutrient Over-enrichment: The Science, Regulation, Economics and Public Policy," targeted for state, federal, local governments as well as research, industry and any other groups conducting water-related monitoring in North Carolina. The goal of the conference is to share the most recent scientific, economic and policy development information on nutrient over-enrichment and nutrient management.

Sedimentation – Sediment has a significant impact on water quality and the state has taken measures to reduce the amount soil that enters waterways. During land development, land is cleared and graded, removing natural vegetation and topsoil and making the area susceptible to erosion, which carries sediment onto nearby lands and into water bodies.

It is very rare today to walk on a construction site or mine where sediment has poured off the site leaving deep eroded gullies. Repairing damage from sedimentation is expensive both economically and environmentally. Sediment deposition destroys fish spawning beds, reduces the useful storage volume in reservoirs, clogs streams, may carry toxic chemicals and requires costly filtration for municipal water supplies. Suspended sediment can reduce in-stream photosynthesis and alter a stream's ecology. Many environmental impacts from sediment are cumulative, and the ultimate results and costs may not be evident for years. The consequences of off-site sedimentation can be severe and should not be considered as just a problem to those immediately affected.

Photo - NC State

The Sedimentation Pollution Control Act of 1973 authorized the state to create and administer a program to reduce sedimentation resulting from erosion when people disturb the land. The sedimentation and erosion control program in the Division of Land Resources (DLR) plays a key role in the state's NPDES construction stormwater permitting program. The Division of Water Quality issues a general construction stormwater NPDES permit based on compliance with a sedimentation and erosion control plan approved by the Division of Land Resources. These control plans often require silt fences and undisturbed buffers to protect watercourses. More than 3,000 new or revised sedimentation plans were reviewed by DLR during FY 2010-11. Fewer than 500 of these plans were disapproved. Monitoring of the approved sites was achieved through 20,152 inspections. In addition, the state may delegate authority to implement the Sedimentation Pollution Control Act to cities and counties that adopt a qualifying local erosion and sediment control ordinance in compliance with state requirements. Local programs' staffs perform plan reviews and enforce compliance with plans within their jurisdictions.

Two new challenges have emerged during the economic downturn since 2008. First, large construction projects that stopped before completion because of bankruptcies and defaults left a bank responsible for sites requiring work to stabilize disturbed areas and address ongoing sedimentation problems. The second challenge is the limited staff to enforce the requirements of the sedimentation and erosion control program. The DLR has documented past assessments of staff resources and the inability to provide sufficiently frequent inspections of active construction sites with existing staff.

Estuarine Health Tracking – A recent development at DENR is the creation of a comprehensive "report card" for the Albemarle-Pamlico National Estuary that will help elected officials, environmental managers and the general public understand both the overall health of the estuarine system and the most significant threats it faces, based on trends in environmental indicators collected from other divisions and agencies. This project is being led by the Albemarle-Pamlico National Estuary Program in line with its mission to effectively restore and protect the Albemarle-Pamlico estuarine system. In the future, these measures may be able to provide a clearer understanding of coastal water quality and needed protective actions.

Sea Rise – The Division of Coastal Management (DCM) and the Coastal Resources Commission (CRC) have worked to educate the public about sea level rise and develop a sea level rise policy to guide future planning. In 2010, the CRC's Science Panel on Coastal Hazards completed the "North Carolina Sea Level Rise Assessment Report" and presented the report at a Sea Level Rise Science Forum attended by more than 250 stakeholders from the public, academic and policy institutions and state and federal agencies. The report assessed the best available science on sea level rise in the state, evaluated different projections of sea level rise increases for North Carolina through 2100, and recommended the adoption of one meter (39 inches) of sea level rise as a rate for future policy development and planning purposes.

Strategic Habitat Identification – As part of CHPP implementation, DMF began a new initiative to identify Strategic Habitat Areas. An ecological spatial analysis of all coastal fish habitat is conducted to identify and prioritize a network of high functioning areas within a system. These areas, referred to as Strategic Habitat Areas, represent a subset of areas supporting high quality, diverse and productive habitats – the best of the best. Assessment of the northern half of the coast is complete, and assessments will continue in 2012 and 2013.

National and Regional Leadership – Secretary Dee Freeman represents both North Carolina and the South Atlantic States (North Carolina, South Carolina, Florida and Georgia) with the National Ocean Council in its implementation of President Obama's National Ocean Policy. As a member of the Council's Governance Coordinating Committee (GCC), he advocates the needs and coordinates the actions being undertaken by the South Atlantic states to sustain the Atlantic by reducing environmental impacts, facilitating compatible uses of the South Atlantic coasts and estuaries, and preserving critical ecosystem services to meet economic, environmental, security and social objectives.

Prior to the formation of the Governance Coordinating Committee, Gov. Perdue, along with the governors from the three other South Atlantic states, created the Governor's South Atlantic Alliance, a regional response to address the key environmental, economic and cultural issues facing the southeastern U.S. coastal and ocean region. The governors of North Carolina, South Carolina, Georgia and Florida have identified four priority issues that are of mutual importance to the sustainability of the Southeastern U.S. region's resources: healthy ecosystems; working waterfronts; clean coastal and ocean waters; and disaster-resilient communities. Working waterfronts is a particularly important issue area for North Carolina, with a goal to more effectively manage the future of our ports and other water access points by striking a balance among new development, historic uses, port expansion and sustaining resources for the future.

The Alliance is unique from the other existing alliances in that it recognizes national defense and the military as a key component of its working waterfronts issue area. To that end, one of the top three objectives is to protect U.S. military waterfront access and water-dependent land use related to military footprint, operational readiness and training missions by engaging military representatives in the identification of sites that support military operational and training capacity and national defense mission.