North Carolina

State *of the* Environment *Report* 2011

Enjoy the "goodliest" land, air and water of the Old North State.

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North Carolina Department of Environment and Natural Resources

Beverly Eaves Perdue
Governor

Dee Freeman
Secretary

To the citizens of North Carolina:

Our state's scenic beauty and abundant natural resources have attracted new residents, new companies and tourists to our mountains, coastal areas and piedmont for many years. Though we all must share the responsibility of managing, protecting and conserving a high quality environment in North Carolina, the Department of Environment and Natural Resources (DENR) strives to lead efforts to conserve and protect these natural resources, and to continue our state's tradition of ensuring clean air, clean water and abundant natural spaces for the enjoyment and recreation of citizens and visitors alike.

The 2011 edition of the State of the Environment Report highlights DENR's strategic goals; the protection strategies the department uses to attain these goals and thus attain a healthy, vibrant environment in North Carolina; and data and trends (where available) to help quantify the status of the state's air quality, water resources and land resources. The report also discusses emerging challenges as the department faces its vision of securing the future of a cleaner environment, sustained natural resources, healthier lives and a stronger economy.

DENR's mission is to conserve and protect North Carolina's natural resources and to maintain an environment of high quality by providing valuable services that consistently support and benefit the health and economic well-being of all citizens of our state. Governor Perdue, the department and I believe that a clean environment lends itself to a thriving economy, and trust that our protection and conservation efforts over the years and into the future – in combination with the efforts of our partners and all of you – will continue to enable North Carolinians, businesses and visitors alike to enjoy the "goodliest" land, air and water of the Old North State.

Sincerely,

Dee Freeman

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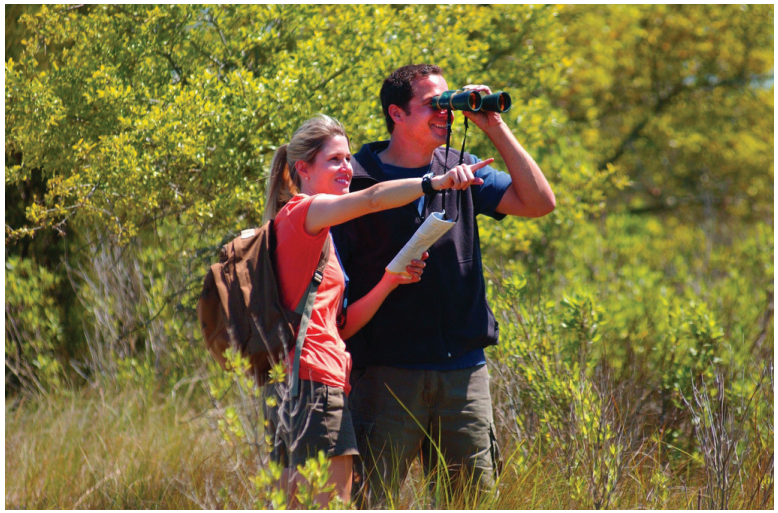
One NorthCarolina *Naturally*

North Carolina is a large and diverse state rich in resources, from its people and vibrant cultural institutions to its natural resources.

Executive Summary

North Carolina is a large and diverse state rich in resources, from its people and vibrant cultural institutions to its natural resources. This report is a science-based review of the state's air, water and land resources. This document also fulfills the requirements of G.S. 143B 279.5 by evaluating the quality of the state's environment and describing the department's efforts to protect the state's natural resources. The report identifies both current and emerging environmental issues facing the state.

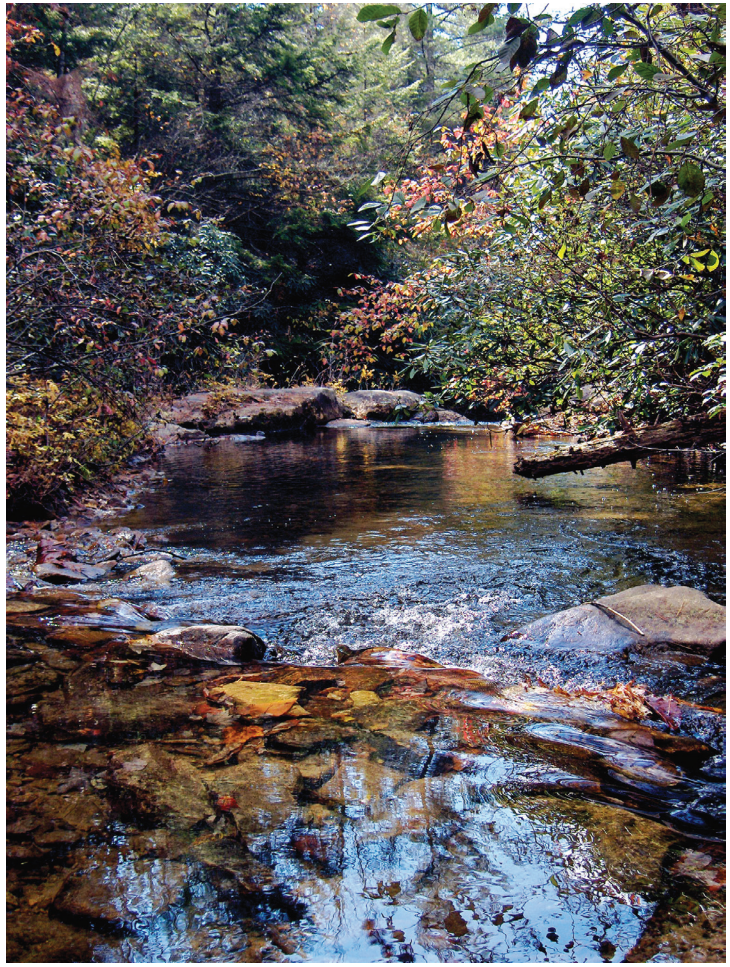


Much of the information presented in this report documents noteworthy progress in addressing past environmental challenges. For example, the state's environmental protection programs have resulted in significant improvements in air quality and water quality; those improvements are reflected by a number of the environmental indicators presented in the report.

Air quality in North Carolina has improved substantially since the 1980s. As a result of efforts at the federal, state and local levels – and with the cooperation of business and industry – the state has taken significant steps to reduce ozone and particle pollution. Additional reductions are expected as industries and motor vehicles meet more stringent federal air quality standards. The state has also achieved significant reductions in the emission of toxic air pollutants in recent years. New federal standards, including some still in development, represent the most significant emerging issue for the Division of Air Quality. Implementation of stricter standards requires additional program resources at the state level and meeting those standards becomes a greater challenge as the state's population increases.

The majority of the state's lakes, streams, and rivers have good water quality. Those waters support fisheries and fish habitats, provide drinking water and allow a number of recreational uses. However, about 40 percent of the state's waters have impaired water quality. Mercury, bacteria and large amounts of sediment are among the major causes of water quality impairment in the state. In some areas, excess nutrients (primarily nitrogen and phosphorus) have threatened water quality in both rivers and water supply reservoirs. The state has made significant progress in addressing nutrient pollution; nutrient management strategies for the Neuse and Tar-Pamlico river basins have been successful in reducing fish kills and noxious algal blooms. Similar strategies have more recently been developed for the Falls Lake and Jordan Lake water supply reservoirs. Recent accomplishments related to water supply include the development of local water shortage response plans to improve the state's

drought response; recovery of the aquifers in the Central Coastal Plain; increased collection of groundwater data; and development of water supply models for most of the 17 major river basins.



The state continues to face a number of challenges, however. Over the last decade, rapid population growth and development in some parts of the state put additional stress on water bodies and other sensitive natural areas. The state will need to maintain strong sedimentation and water quality programs to realize the benefits of growth without putting drinking water supplies, fisheries and wildlife habitat at risk. Growth (of both cars and people) in the state's urban and suburban counties will also make attainment of stricter air quality standards an ongoing challenge.

After a decade of strong growth, the rate of land conservation has declined since 2009. However, the state continues to work on protection of key parcels, focusing on acquisition of lands that are critical for water quality protection, wildlife habitat, recreation, agriculture and military activities. The North Carolina state parks system manages more than 213,000 acres, including 35 state parks, four recreation areas and a system of state natural areas. Since 1994, the Parks and Recreation Trust Fund (PARTF) has been used to acquire 18,622 acres of land for state parks. PARTF also collaborated with other funding agencies to preserve an additional 37,616 acres.

The state has continued to make progress in cleaning up contaminated properties and in helping to provide alternative water supply where drinking water wells have been contaminated. Progress in some programs continues to be slow, however, because of limited resources. In the most recent federal fiscal year, the N.C. Brownfields program received 45 proposals for voluntary cleanup and redevelopment of contaminated sites across the state – a 25 percent increase over the previous year. The state's Inactive Hazardous Sites program continues to focus on the more than 2,000 sites with hazardous contamination and the highest level of risk.

Since 1988, more than 17,730 petroleum-leaking underground storage tank (UST) releases have been assessed and remediated. Approximately 7,770 additional releases still need to be cleaned up and several hundred new UST releases are reported every year (more than 700 in 2010-2011). Progress toward cleaning up and closing out intermediate and low-risk UST sites has been slow in recent years because the commercial and noncommercial UST trust funds (which reimburse for cleanup of UST sites) do not receive sufficient revenue to reimburse for all of the cleanup work that needs to be done.

A major air quality development in 2011 was the settlement of a lawsuit against the Tennessee Valley Authority (TVA). North Carolina filed a public nuisance lawsuit against the TVA in 2006, claiming that the utility's coal-fired

plants sent polluted air into North Carolina. This agreement will result in the closure of many uncontrolled units and installation of emission-control equipment on almost all of the remaining units. In addition, the TVA will pay $11.2 million to North Carolina over the next five years to be used for energy efficiency and electricity demand reduction programs. These measures will improve North Carolina's air quality and reduce incidences of premature mortality, asthma, chronic bronchitis and other cardiopulmonary illnesses.

The department is promoting several new and ongoing initiatives aimed at improving the quality of environmental and natural resource data. In early 2012, the Albemarle-Pamlico National Estuary Program will release its State of the Sounds report, an assessment of the estuarine ecosystem in northeastern North Carolina and southeastern Virginia. The report, based on a suite of environmental indicators, will shed light on the overall health of the estuarine system and discuss some of its most significant threats. The Division of Marine Fisheries began a new spatial analysis of all coastal fish habitat to identify and prioritize a network of strategic habitat areas. Assessment of the northern half of the coast is complete, and assessments will continue in 2012 and 2013. Finally, the Office of Conservation, Planning and Community Affairs developed the Conservation Planning Tool to identify and prioritize areas for future conservation. This analysis pinpoints "gaps" in ecosystem networks and delineates unique resources or features.

In response to public feedback, the department created the Environmental Assistance Center in 2011 to increase its efforts to help small businesses, landowners and residents comply with environmental rules. This center, which uses existing agency staff, focuses on the needs of those customers who are frequently affected by environmental rules but lack the expertise and money to hire someone to guide them through the regulatory, permitting and compliance process.

The department also faces several important emerging issues. As directed in Session Law 2011-276, DENR is leading a state study to identify issues associated with oil and gas exploration in the state; the study will specifically focus on the use of horizontal drilling and hydraulic fracturing to extract shale gas. This report will be provided to the General Assembly by May 1, 2012.

DENR has done research on the potential impacts of climate change in North Carolina. Even small increases in temperatures could cause major changes such as disruption of normal growing conditions for food crops; melting of polar icecaps; rising sea levels and flooding of coastal lands; changes in ocean currents; and more frequent and stronger storms. The Coastal Resources Commission's Science Panel on Coastal Hazards has reviewed projections for sea level rise on the North Carolina coast; based on the panel's work, the Commission has begun to consider how to plan for the potential impacts of sea level rise. The department has also participated in statewide initiatives that focus on climate change adaptation and mitigation.

Water supply and allocation of water has become another emerging issue in the state. For the last five years, the General Assembly has debated a number of bills dealing with water conservation, drought response and

allocation of water resources between competing water users. Most recently, the General Assembly directed the department's Division of Water Resources to complete hydrologic models of the state's major river basins. The models -- which will demonstrate a water body's response to water withdrawals by various users under different conditions -- will be critical for future water supply planning.

North Carolinians value the state's environmental quality and rely heavily on outdoor resources and amenities for industrial and recreational pursuits. In a recent poll completed by Public Policy Polling, nearly half of respondents indicated that the state should be doing more to protect the environment. More than 80 percent of people surveyed indicated that protecting North Carolina's air and water is very important for attracting good jobs to the state. The recent recession and resulting state fiscal constraints have had noticeable impacts on various department programs. In the past few years, the aquariums, zoological park, Museum of Natural Sciences and state parks system have had some of the highest visitor numbers ever recorded. This has increased the needs for staff, exhibit and facility maintenance and program development. Reductions in fee income, trust fund balances, and appropriations have led to reduced levels of habitat preservation, fewer pollution prevention initiatives and a diminished ability to clean up polluted sites. The department is focusing on maintaining core services and evaluating opportunities to increase institutional efficiency in this challenging operational environment.

This document provides a tool to allow the people of North Carolina, state leaders and public agencies to assess the quality of the state's environment.

Introduction

North Carolina is a large and diverse state rich in resources, from its people and vibrant cultural institutions to its natural resources. This report is a science-based review of the state's air, water and land resources. This document provides a tool to allow the people of North Carolina, state leaders and public agencies to assess the quality of the state's environment. In addition, the report highlights management strategies for environmental and natural resource protection, specific accomplishments, current activities and emerging environmental issues.

The North Carolina General Assembly created the Department of Environment and Natural Resources (DENR) to protect the state's environment and natural resources and to prevent public health problems caused by pollution (G.S. 143B-279.2). The department also provides the organizational structure for several commissions created by the General Assembly with the specific authority to adopt environmental rules, including the Environmental Management Commission (air quality and water quality rules); Coastal Resources Commission (coastal development rules), Marine Fisheries Commission (fisheries management plans); Sedimentation Control Commission (rules on sedimentation and erosion control); and Mining Commission.

The department must provide staff support to the rule-making commissions and implement environmental policies set out in state law and through commission rules. Particularly in the programs addressing water quality, air quality, solid waste, hazardous waste and petroleum underground storage tanks, those statutes and rules often reflect federal requirements. The department also implements federal regulatory programs under the Clean Air Act, Clean Water Act, Safe Drinking Water Act and the Resource Conservation and Recovery Act by delegation from the U.S. Environmental Protection Agency (EPA).

DENR meets its environmental and natural resource management responsibilities in a number of different ways. Some programs carry out monitoring, permitting and compliance activities designed to balance growth and development with the need to be good stewards of the state's air, water and other natural resources for all of the state's citizens. Other programs focus on preserving natural areas; maintaining recreational lands for public use; restoring natural ecosystems; or cleaning up environmental contamination. The North Carolina Zoological Park, state aquariums, state parks system and the North Carolina Museum of Natural Sciences provide opportunities for citizens to learn about and interact with nature.

In meeting its state and federal responsibilities, the department must often find the right balance between effective environmental protection and the need for strong economic growth. The department works with the rule-making commissions to develop and enforce rules that are clear, consistent and practical. DENR also has programs designed specifically to assist business and industry with permitting issues and compliance problems. In addition to helping with compliance, the Division of Environmental Assistance and Outreach works with companies to identify waste reduction and efficiency measures that can reduce operating costs -- allowing the company to operate more profitably -- and in some cases eliminate the need for an environmental permit.

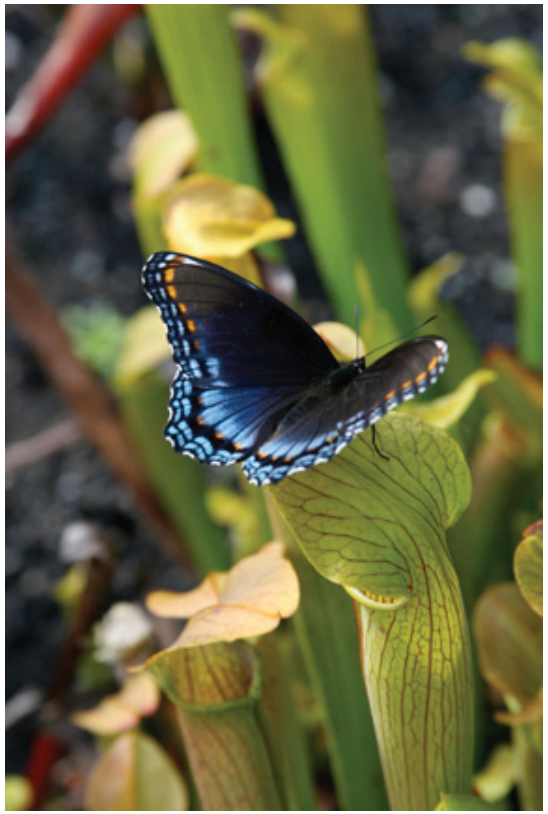
All of this goes on against a backdrop of significant growth and development over the last 20 years. According to Census Bureau estimates, North Carolina's population increased by nearly three million -- or 44 percent -- between 1990 and 2010. During the last decade, North Carolina had the fifth- highest growth rate in the country. By 2030, the state's population is expected to reach 12.5 million; that would represent an increase of another 25 percent over the current population. Much of this growth will come from people migrating into the state, many of whom do so because of the state's scenic beauty, natural resources and quality of life. As North Carolina continues to grow, maintaining the state's environmental quality will be one of our most important challenges.

We hope that the information in this report gives you a picture of the state's environmental health and allows you to see both the progress that has been made and the challenges for the future. Environmental quality is site-specific and can vary dramatically in different regions of the state; wherever possible this report contains links to websites that can provide location-specific measures of environmental quality. In addition, all of the reports that DENR submits to the General Assembly are available on our website at: http://portal.ncdenr.org/web/lia/denr-legislative-reports

The N.C. Department of Environment and Natural Resources' strategic plan identifies goals for the department that will support conserving and protecting the state's natural resources, while maintaining a high quality of life and fostering economic development.

Department of Environment and Natural Resources' Strategic Goals

The N.C. Department of Environment and Natural Resources' strategic plan identifies goals for the department that will support conserving and protecting the state's natural resources, while maintaining a high quality of life and fostering economic development. Broad supporting actions accompany each of the goals. These supporting actions serve as a starting point for divisions and programs to create measurable accomplishments. The 2009-2013 strategic plan contains eight specific goals:



Sustaining Water for the Future. Better manage the entire water cycle to prepare for the future by developing and implementing sustainable solutions based on sound science that effectively: protects water at its source; treats it to the highest standards; delivers it to homes and businesses; encourages its efficient use; and then collects and again treats the wastewater before reintroducing it safely back into the environment.

Sustaining Clean Air for the Future. Work to improve air quality of the state for the health and well-being of all its citizens by using sound science, monitoring and input from the public and regulated community.

Growing a Green Economy. The department will champion evolving, and support existing, primary industries that promote environmental protection and energy independence and use of products, production techniques and services that have minimal impact to the waste stream, while attaining energy independence, resiliency to climate change and economic development in the state, the region and the country.

Conserving Natural Areas and Sustaining Working Lands. DENR and its One North Carolina Naturally initiative will coordinate public and private efforts to sustain, conserve, restore and protect the state's natural, economic and social resources in a balanced, focused and integrated way for current and future generations.

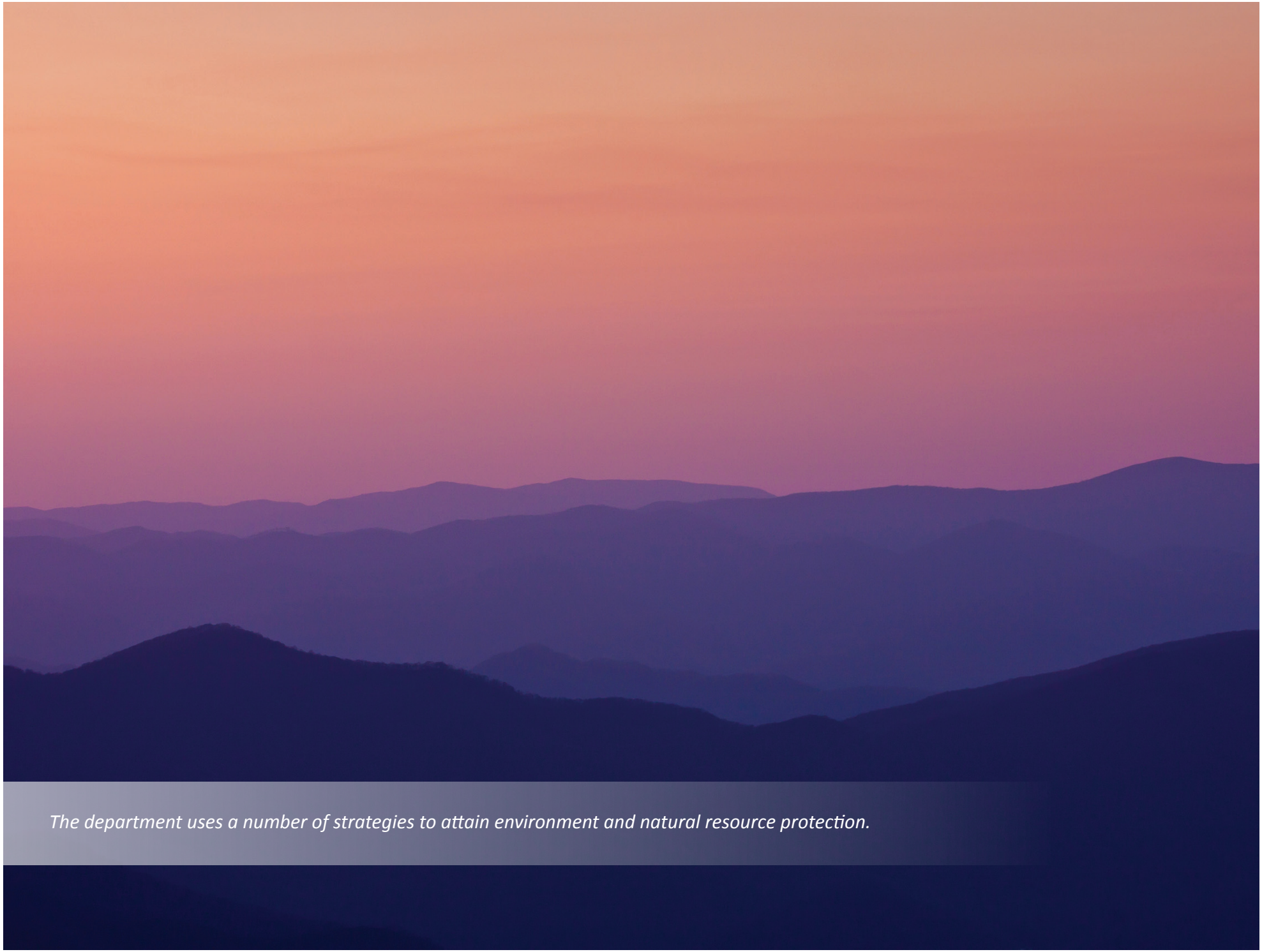
Climate Change. To address climate change in North Carolina in a comprehensive way, using mitigation efforts and adaptation strategies to increase the resilience of our state's resources to these complex changes.

More Effective Environmental Regulation. To protect the environment by developing and enforcing rules that are clear and consistent and result in business and government, together, preserving the environment and its resources, while growing our economy as well as maintaining the high quality of life for the state's citizens that attracts new companies and retains existing industry.

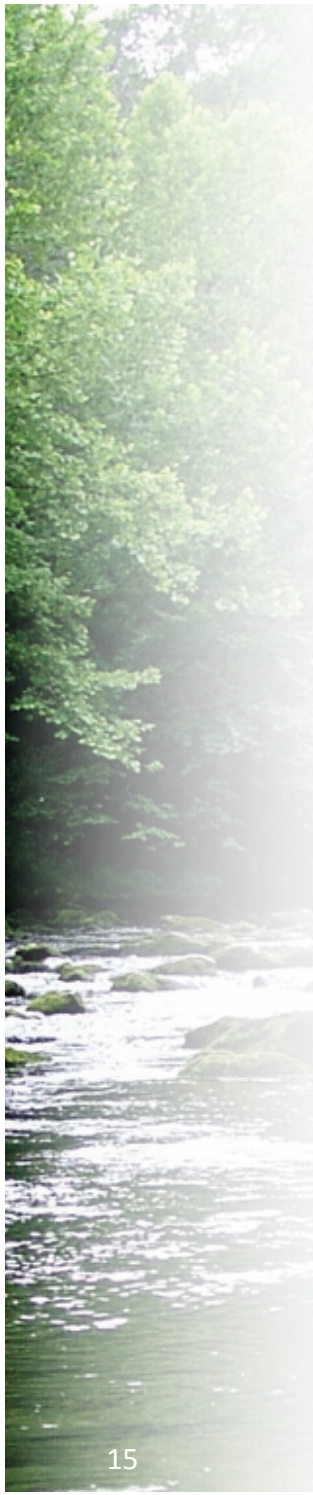
Growing DENR's Visitor Attractions and Nurturing North Carolina's Natural Resources. Enrich the quality of citizens' visits to our attractions by further developing the services within our museum, zoo, aquariums, state parks, coastal reserves and state forests. Create a memorable visitor experience that fosters awareness of environmental stewardship in a manner that is efficient, effective and ensures value.

Organizational Effectiveness Supporting DENR's Mission. An agency where all actions, services and products are of high quality, and serve the department's mission and vision through continuous improvement, optimum efficiency, effectiveness and customer satisfaction in all operations.

The full strategic plan is located on the department website:
www.ncdenr.gov.



The department uses a number of strategies to attain environment and natural resource protection.



Environment and Natural Resource Protection Strategies

The department uses a number of strategies to attain environment and natural resource protection. These include: pollution prevention, pollution mitigation, resource conservation, investment in environmental infrastructure, regulation and compliance and environmental education and outreach. These strategies are used alone or in combinations to achieve department goals. This section provides a working definition of these strategies and examples of DENR's program implementation of them.

Pollution Prevention

Pollution prevention, often abbreviated as P2, is a proactive, cost-effective strategy that creates a strong basis for environmental sustainability. Pollution prevention seeks to reduce waste from a production process by increasing efficiency, reducing the use of toxic materials, reducing resources consumed in the process and reusing waste where possible. Preventing pollution before it enters the state's land, water and air is a preferred method for natural resource protection because it is frequently the most cost-effective.

Since the mid-1980s, DENR has offered free and confidential pollution prevention services throughout North Carolina to public and private facilities. The Division of Environmental Assistance and Outreach offers P2 assistance through the Environmental Assistance Center, the Environmental Stewardship Initiative and Waste Reduction Partners.

The Environmental Stewardship Initiative is an environmental excellence program that recognizes regulated entities that have gone above and beyond regulatory requirements in their protection of the environment. The program also offers free assistance to those who wish to become environmental stewards. The requirements of the program are also proven tools for improving and assuring compliance.

Waste Reduction Partners (WRP) is one of DENR's most innovative programs. WRP is a team of highly experienced staff and volunteer retired engineers, architects and scientists, who provide North Carolina businesses and institutions with waste and energy reduction assessments and technical assistance. WRP services are typically grant-sponsored or supported through technical service contracts to provide services to clients at no cost. All services are non-regulatory and confidential.

Combined, the Waste Reduction Partners and Environmental Stewardship Initiative programs have seen their customers and members reduce water consumption by more than two billion gallons through efficiency techniques and technologies. Similarly, from 2004 to 2010, members reported reduced energy usage of 40 million (mmBTUs), or 40 trillion British Thermal Units, equivalent to the energy consumed annually by 526,000 North Carolina homes. These programs save the state's natural resources while simultaneously saving private companies money.

Pollution Mitigation

Pollution mitigation strategies allow communities to decrease the negative impacts of human activity on the natural environment, such as reducing the impacts of land development on water quality and wildlife habitat fragmentation, while still providing roads, buildings and other infrastructure necessary to support a growing population. North Carolina's nonregulatory Ecosystem Enhancement Program, founded in statute in 2003, provides an efficient and effective statewide compensatory-mitigation initiative that offsets unavoidable environmental damage to streams and wetlands caused by transportation-infrastructure improvements and other economic development. Compensatory mitigation involves an environmental crediting system in which a regulatory agency allocates credits and debits. Compensation activities – called "credits" – can involve habitat creation, restoration, enhancement, preservation or management, which may subsequently be used to offset unavoidable stream or wetland impacts -- called "debits"-- that occurred at a project development site. Cumulative Ecosystem Enhancement Program data is located in the Land section of this report.

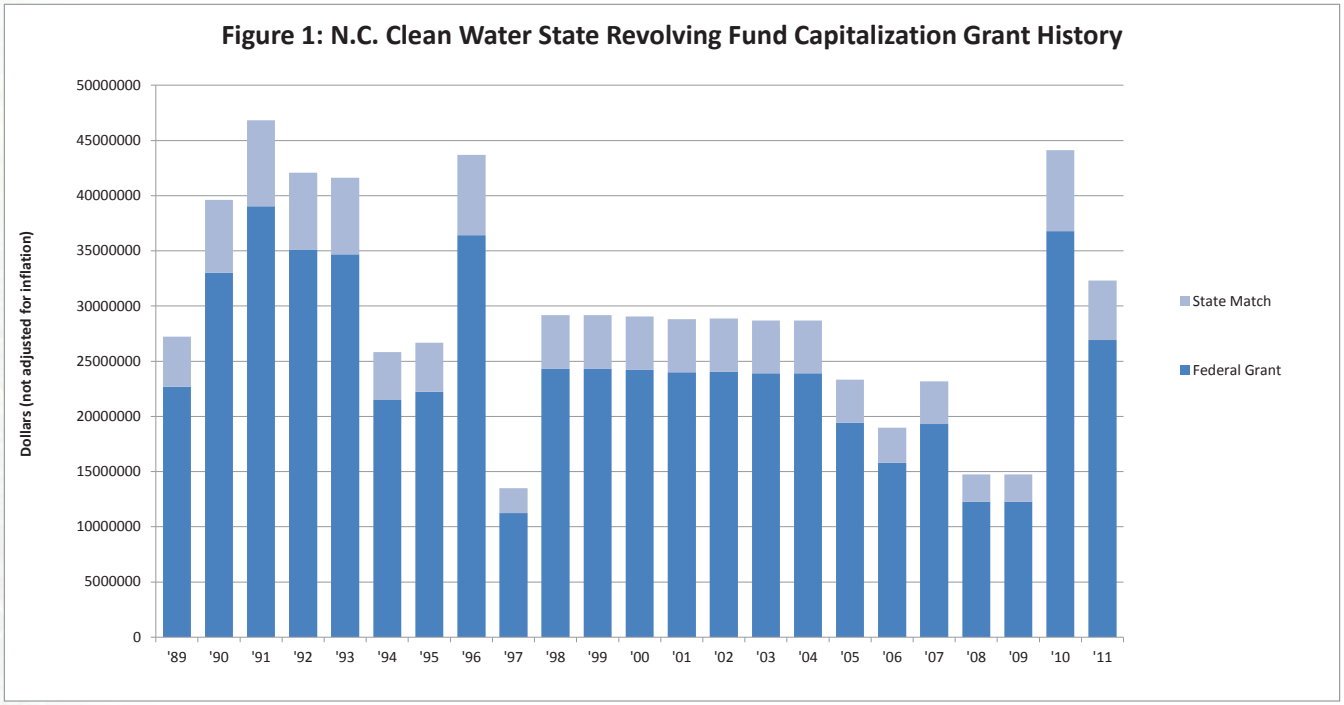
Resource Conservation

Resource conservation is the protection, preservation, management or restoration of wildlife and of natural resources such as forests, soil and water. DENR works with other state agencies, nonprofits, private industries and institutions to conserve plant and animal habitats and lands that offer the state opportunities for strategic resource preservation. North Carolina has many good reasons to engage in conservation, including: protection of water resources, enhancing outdoor recreation opportunities statewide, preserving working farms and forests, and protecting wildlife habitat. The conservation of these resources is critical for sustaining and enhancing the quality of life for current and future North Carolinians. Examples of recent resource conservation projects are located in the Land section of this report.

Environmental Infrastructure Investments

Environmental infrastructure consists of water supply, waste disposal and pollution control services. The Department of Environment and Natural Resources uses investments in environmental infrastructure to improve the quality of life for residents and to protect environmental and human health. Population growth, urbanization, changing environmental standards and industrial development place increasing demands on existing infrastructure. These demands in turn create a need for the planning, design and construction of new facilities.

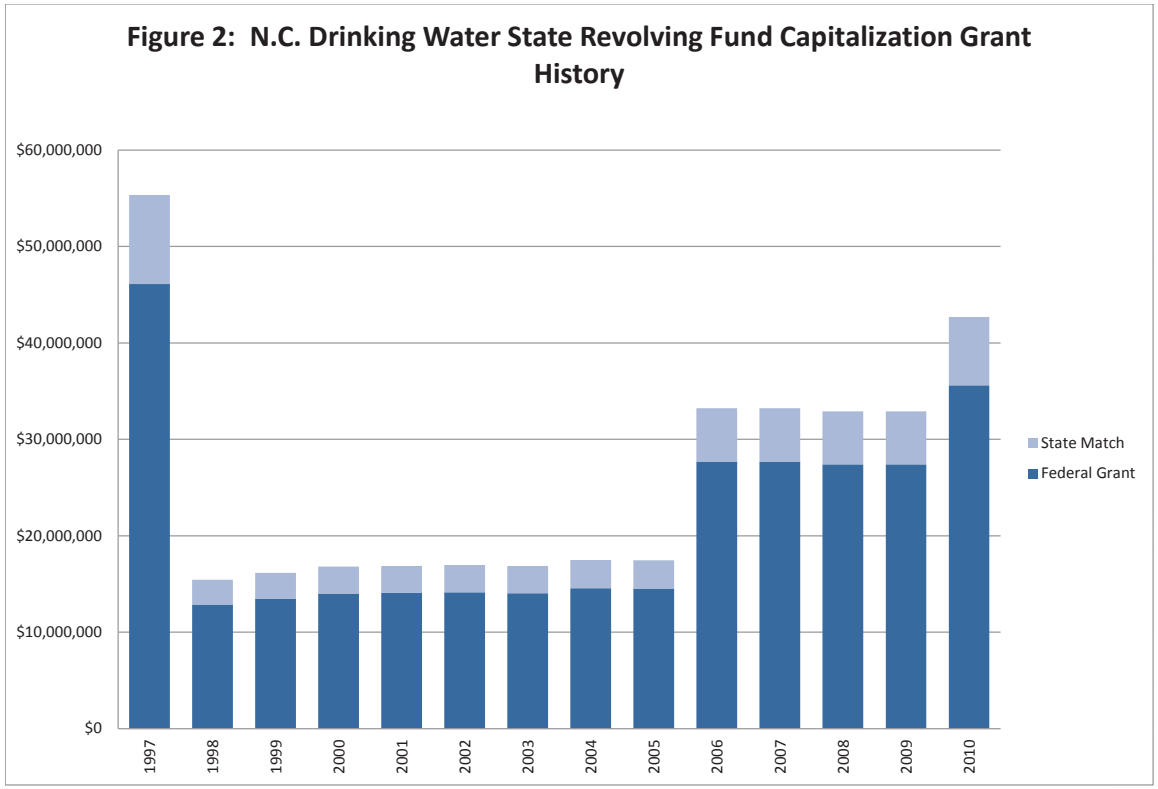
DENR assists local communities with the development of wastewater and drinking water facilities. The Division of Water Quality administers several clean water funding programs available to local government units. During FY 2011, North Carolina made a total of 17 binding commitments in the Clean Water State Revolving Fund program for the construction of wastewater facilities. A majority of these projects either aided impaired streams or were part of a basinwide strategy. These obligations totaled $172 million. In addition, projects totaling $5.4 million were funded through the state's Wastewater Reserve fund for the construction of wastewater facilities. These funding programs increase the affordability of clean water infrastructure projects by offering a lower interest rate compared to market interest rates. In addition, Technical Assistance Grants totaling $435,475 were made available to help develop plans to resolve non-compliance at wastewater facilities. Figure 1 below displays the federal capitalization grants and the associated state matching funds for each year since the program began. This table does not include supplemental, one-time American Recovery and Reinvestment Act funding.



The Clean Water Management Trust Fund has provided more than $248 million for 276 projects to improve wastewater systems for local governments and communities with failing systems dumping untreated waste into our surface water. These wastewater projects have focused on rural, economically distressed communities to eliminate failing septic tanks, straight piping (dumping sewage directly into the environment without treatment by a wastewater system) and failing wastewater collection and treatment plants. This effort has also focused on aiding communities in regionalizing treatment facilities and in better managing systems so that future repairs can be managed within the financial system of the community.

The Division of Water Resources (DWR) funds drinking water capital projects that protect public health through the Drinking Water State Revolving Fund (DWSRF). The DWSRF makes loans to communities at one-half of the market rate for a period of up to 20 years. All funded projects must address a threat to public health. At the end of FY 2010, the DWR committed approximately $296 million in low-interest and principal forgiveness loans as part of the DWSRF Program. Figure 2 below displays the federal capitalization grants and the associated state matching funds for each year since the program began in 1997. This table does not include supplemental, one-time American Recovery and Reinvestment Act funding.

For FY 2010, almost $36 million was committed to build a new five million gallon per day water treatment plant in Craven County, along with 16 new wells and various transmission lines. Other notable projects include a consolidation of nonviable Holly Hills and Mountain Creek Estates water systems in Jackson County; a raw-water bypass pump station for use in times of drought in Randolph County; and an installation of a water main extension along Thomas Langston Road to provide interconnection with the town of Winterville in Pitt County.



The N.C. Department of Environment and Natural Resources received more than $157 million as part of the American Recovery and Reinvestment Act. The department is using the money to stimulate the economy, create jobs and help cities, towns and counties with a host of environmental improvements. A substantial portion of this funding supports the development of needed environmental infrastructure.

- $70.7 million to fund wastewater improvements such as infrastructure projects that aid wastewater reuse, stormwater management, water efficiency and energy generation. Another $251,000 has been awarded to regional councils of government for planning and to assess water quality and develop plans to control water pollution.
- $65.6 million for public drinking water infrastructure improvements. The money will improve water quality in cities and towns by building interconnections between towns and replacing aging water lines. It has also been used to install more efficient residential water meters.

Regulation and Compliance

As a regulatory agency, DENR enforces state and federal pollution regulations. In addition, the EPA has delegated to DENR the authority to enforce federal laws and regulations dealing with air and water pollution in the state. Compliance activities include responding to complaints, conducting regular inspections, helping facilities meet regulations and taking enforcement actions against violators. Facilities and activities are often tracked and measured through the issuance of permits. The Division of Air Quality alone handles permits for more than 2,680 facilities with air emissions. DENR operates offices in each of the seven state regions to inform people about regulations and requirements, assist with permit applications, and conduct site visits for regulated activities.

In an ideal world, regulation is replaced by stewardship and an inherent respect for the environment. In this concept of stewardship, everyone takes responsibility for their actions and the use of resources for the benefit of the community. In the real world, stewardship is sometimes compromised by conflicting capabilities, priorities, values and perspectives. This creates the need for regulation and enforcement.

The challenge for regulators is to balance the use of compliance tools with the recognition of stewardship efforts. Regulated entities must be made aware of the conditions for compliance, made to feel the consequences of non-compliance and provided an opportunity to demonstrate behavior beyond compliance. When enforcement is necessary, it should be fair, focused, transparent and timely.

DENR balances enforcement with education, technical assistance and incentives to achieve compliance and encourage stewardship. In 2011, the department created the Environmental Permit and Compliance Assistance Center to increase its efforts to help small businesses, landowners and residents to comply with environmental rules. This center, which uses existing agency staff, focuses on the needs of those customers who are frequently affected by environmental rules but lack the expertise and money needed to hire someone to guide them through the regulatory, permitting and compliance process. Housed in the Division of Environmental Assistance and Outreach, some benefits of the Environmental Permit and Compliance Assistance Center include:

- Offering a single point of contact to guide applicants through the permitting system;
- Providing technical assistance to obtain necessary permits and/or address compliance assistance issues;
- Arranging pre-application meetings to outline potential permits, processes, timelines and expectations;
- Designating technical staff to answer – in plain English – regulatory questions, explain permit and regulatory issues, and receive and ensure resolution of environmental complaints and issues; and
- Providing technical assistance on compliance strategies, including those that reduce waste and enable companies to save money.

Claire Aubel - PKS

Environmental Education and Outreach

Another one of the Department of Environment and Natural Resources' strategies to protect natural resources is public education and outreach. Environmental education is a learning process that increases people's knowledge and awareness of the environment and associated challenges. Environmental education gives people an understanding of how individual actions affect the environment and allows them to acquire skills to weigh various sides of issues and become better equipped to make informed decisions.

More than ever, children and adults need to understand how ecological systems work and why they matter. Some people have become so disconnected from the natural resources that sustain them that they don't know where their food comes from or where they get their drinking water. The health of the environment is inseparable from humans' well-being and economic prosperity and to successfully address and solve environmental problems people require knowledge, tools and sensitivity.

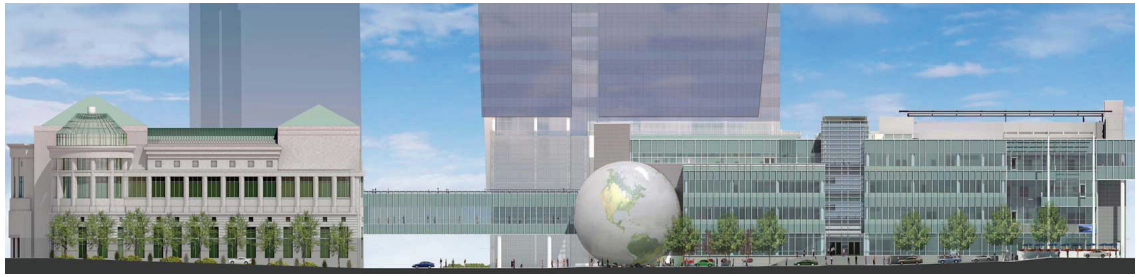
The Division of Environmental Education and Public Affairs administers the N.C. Environmental Education Certification Program. This program recognizes professional development in environmental education, to acknowledge educators committed to environmental stewardship and to establish standards for professional excellence in environmental education for formal and non-formal educators. Individuals who elect to take environmental education courses or workshops demonstrate a desire to develop a sense of stewardship for North Carolina's natural resources and to instill that sense of stewardship in children and adults.

The department operates several facilities that help provide recreational and educational opportunities to citizens and visitors. North Carolina's zoo, aquariums, state parks and the Museum of Natural Sciences facilitate a wide variety of experiences and activities to help people understand and appreciate the natural world. These facilities provide unique experiences and create a critical link to the department's role in environmental education.

- The N.C. Zoological Park in Asheboro is designed to exhibit representative species of animal and plant life from around the world. Approximately 500 acres have been developed into one of the largest "natural habitat" zoos in the United States. Animals are given enclosures that mimic their natural habitats including trees, ponds, rocks, plants and dirt. It is also designed to foster conservation, preservation and propagation of wildlife. In FY 2010-11, an estimated 372,828 students and teachers participated in education programs-school groups, classroom programs and on-site programs. In FY 2010-11, N.C. Zoo attendance was 750,000, a 13-year high.

- The North Carolina Aquariums, located at Fort Fisher, Pine Knoll Shores and Roanoke Island, and Jennette's Pier in Nags Head, provide exhibits of live marine life and other marine educational programs, including field trips, workshops and films. The aquariums are open year-round and are some of the state's most popular attractions. In FY 2010-11, almost 1.1 million people visited North Carolina Aquariums. Approximately 517,000 people participated in free and for-fee educational programs in FY 2010-11.

- The N.C. Museum of Natural Sciences encourages visitors to explore the natural world through an array of permanent and special exhibits, live programs and educational opportunities at the Museum, on school grounds and in the field that appeal to all audiences including students, teachers and the general public. The museum also operates the Prairie Ridge Ecostation, and the N.C. Museum of Forestry. In 2012, the museum's new wing, the Nature Research Center, an 80,000-square-foot environmental science center, is scheduled to open. In FY 2010-11 more than 709,000 people visited the museum and 449,354 individuals participated in natural science educational programs. In addition, the Research and Collections section responded to nearly 11,000 public information requests and had 655 people visit the research collections.



- The North Carolina state parks system preserves and protects high quality examples of the biological, geological, archaeological, scenic and recreational resources of North Carolina by including such resources in the parks system for public enjoyment, education and inspiration. The park system consists of more than 213,000 acres, including 35 state parks, four recreation areas and a system of state natural areas. In 2010, nearly 14 million people visited North Carolina state parks and nearly 370,000 participated in guided education programs.

- The North Carolina Coastal Reserve and National Estuarine Research Reserve program protects more than 41,000 acres of unique coastal habitats in 10 reserve sites throughout coastal North Carolina. Each year, the program reaches thousands of students, teachers, local government officials, coastal decision makers and other members of the coastal community through workshops, reserve site field trips, summer camps, and other educational activities.

Outreach

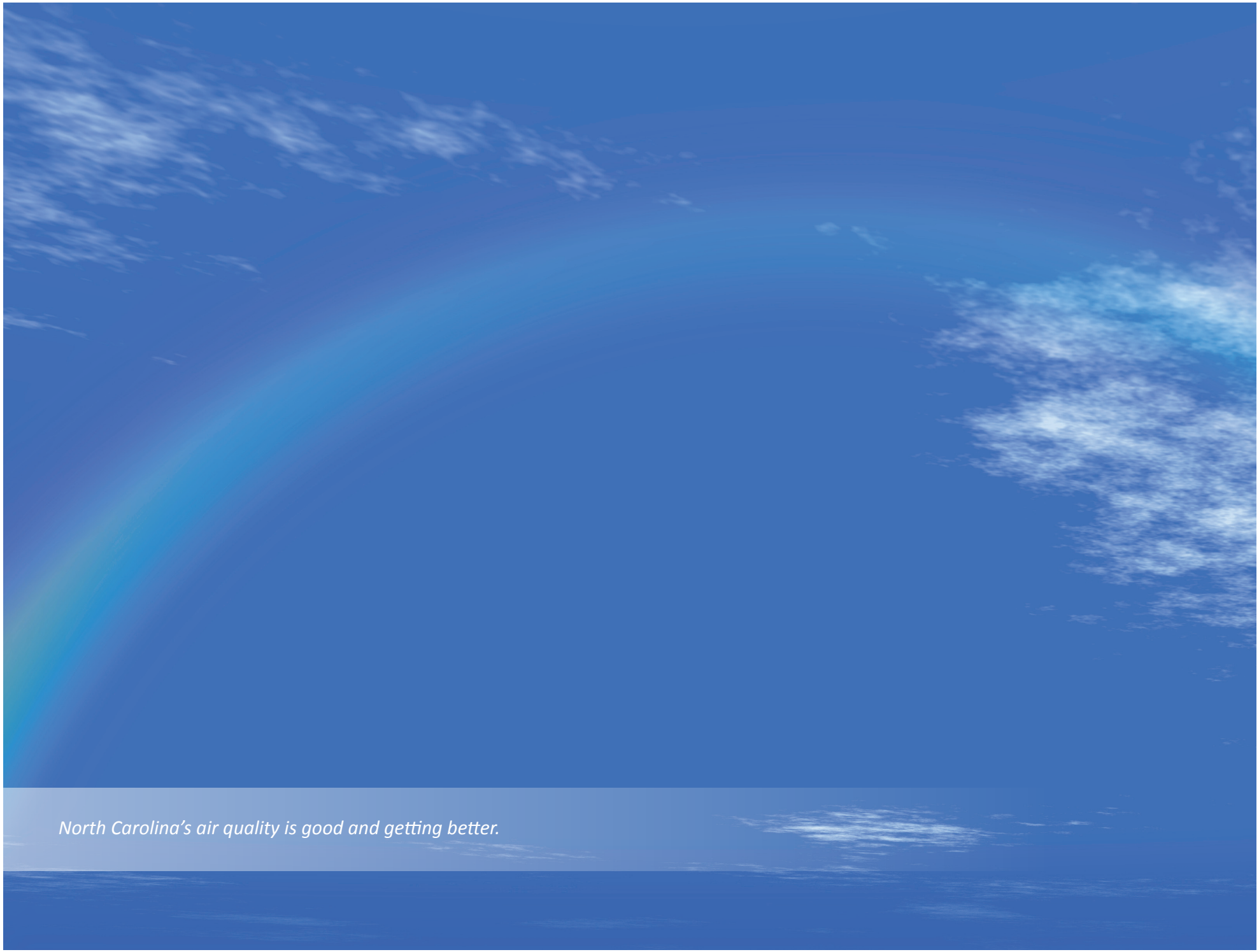
The department's outreach efforts provide residents with information on a wide variety of common environmental issues and measures that can be taken to minimize environmental impact. Disposal of light bulbs, drinking water quality and public grant opportunities are just some of the topics people may read about on DENR's website.

The department has also created a social media presence to more directly reach the public. Its Facebook page, which has more than 1,300 fans, highlights recent departmental press releases and accomplishments. It also provides information about special projects or programs staff are involved in, to provide insight and a more personal view into the services the department provides to the people of North Carolina. Close to 850 people follow DENR's Twitter page, which provides direct linkage to department press releases and activities, as well as other activities and programs of environmental interest in North Carolina.

DENR divisions provide outreach with websites, direct interaction with the public at meetings and special events, and through the production of publications and other guidance documents. Some examples of outreach:

- One of the state's key efforts for educating and informing the public is the air quality forecasting program operated by DAQ and the Forsyth County Department of Environmental Affairs. The program issues daily air quality forecasts for ozone and particle pollution in the Asheville, Charlotte, Fayetteville, Hickory, Rocky Mount, Triad and Triangle metropolitan areas. In addition, DAQ issues special air quality forecasts for unusual events, such as the wildfires that affected much of Eastern North Carolina with smoke in the summers of 2008 and 2011. Other DAQ outreach efforts include maintaining a website, conducting public hearings on rules and certain permits, developing brochures and other publications on air quality issues, working with the news media on air issues, staffing exhibits at special events, and working with educators to teach students about air quality issues.
- The N.C. Recreational Water Quality Program, in the Division of Marine Fisheries, monitors 240 swimming sites, located on ocean beaches, sounds and coastal rivers. All ocean beaches and high-use sound-side beaches are tested weekly from April through September; lower-use beaches are tested twice a month. All sites are tested twice a month in October and monthly from November through March. As needed, the division issues swimming alerts and advisories to notify the public when testing shows that bacteriological standards for safe bodily contact are exceeded. These alerts and advisories are sent to local officials and media through press releases, highlighted on a website and sent via Twitter to interested parties.

- The Division of Water Quality has a full-time coordinator who provides a comprehensive outreach and education program to support local governments, educators and citizen groups in promoting nonpoint source pollution awareness and prevention. The outreach program focuses primarily on assisting the regulated community in meeting the minimum requirements for public participation and outreach under their National Pollution Discharge Elimination System (NPDES) permits, as well as on providing resources and support to communities under state stormwater programs such as the Coastal Rules, Neuse Rules, Falls Lake Rules and Jordan Lake Rules. Secondary goals of the department's program include establishing partnerships with other environmental government agencies, water quality organizations, community groups and educators. In an effort to provide thorough customer service, the program coordinator also serves as a first point of contact to provide rapid response to public requests for assistance with stormwater issues, permitting questions and water quality complaints.
- The Division of Water Resources administers two environmental education outreach programs: Stream Watch and Project WET (Water Education for Teachers). Stream Watch is a stewardship program whereby local citizens can "adopt" a waterway or a portion of one, and act on its behalf by visual monitoring and collecting litter along stream banks. Project WET is a K-12 interdisciplinary water education program intended to supplement a school's existing curriculum.
- Environmental education is considered a key component of the state parks system's mission. More than 250,000 visitors each year attend one of hundreds of interpretive programs given by park rangers, all of whom are certified environmental educators or working toward certification. In addition, each of 21 visitor centers contains a museum-quality exhibit hall with hands-on displays of the parks' natural resources. These and numerous wayside exhibits are researched by rangers and the system's education specialists. In recent years, the education program has adopted a theme to showcase specific resources. In 2011 it was the Year of the Turtle in state parks and 2012 will be the Year of the Bat. In 2011, educational day camps were held for the first time on Jones Island, a recent addition to Hammocks Beach State Park. The Junior Ranger program was recognized with a 2011 Media Award from the National Association of Interpretation, and the division's education program was named "Outstanding Environmental Partner Organization" by Environmental Educators of North Carolina.


North Carolina's air quality is good and getting better.

North Carolina's air quality is good and getting better. State leaders, agencies and private industries have taken significant steps in recent years to address air quality problems – notably ozone and particle pollution - and this work is achieving impressive results. Additional reductions are expected as industries and motor vehicles meet more stringent federal requirements.

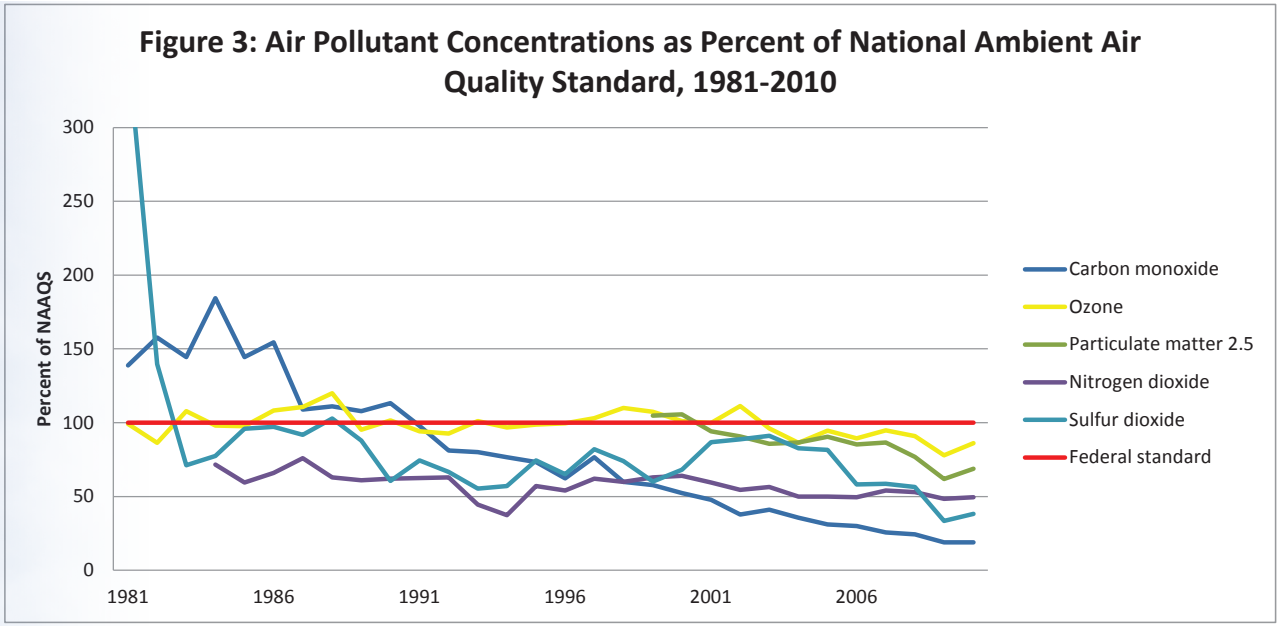
This section provides information about levels of air pollution in the state and state strategies to protect and improve air quality. For more information about air quality in your community, please visit the N.C. Division of Air Quality's Forecast Center or the U.S. Environmental Protection Agency's My Environment website.

Air Monitoring

Local and regional air monitoring began with the initial passage of the federal Clean Air Act in the early 1970s. Under the act, EPA set federal standards for six major air pollutants (called "criteria pollutants"): ozone, lead, particulates, carbon monoxide, nitrogen dioxide and sulfur dioxide. The federal standard for each pollutant is set at the level deemed to protect public health and the environment. Concentrations of these pollutants in the air – as measured by air quality monitors - are not supposed to exceed the federal standards.

North Carolina has 65 air quality monitoring sites for criteria pollutants. The monitors are located in 45 counties and operated by DENR's Division of Air Quality (DAQ), local air programs and EPA. The state also has special purpose air quality monitors - nine for measuring acid precipitation and six to measure toxic air pollutants. Although monitors are distributed across the state, monitoring equipment tends to be concentrated in urban areas that have more air quality problems.

Figure 3 depicts the change in air pollution concentrations over time. The majority of the state's air has levels of ozone, nitrogen dioxide, sulfur dioxide, particulate matter and carbon dioxide that are below the National Ambient Air Quality Standards established by the Environmental Protection Agency. The decline in ambient SO_2 is one of the most striking changes in Figure 3. North Carolina's reductions in SO_2 concentrations were experienced after the implementation of the federal acid raid program in 1983 and the N.C. Clean Smokestacks Act in 2002.

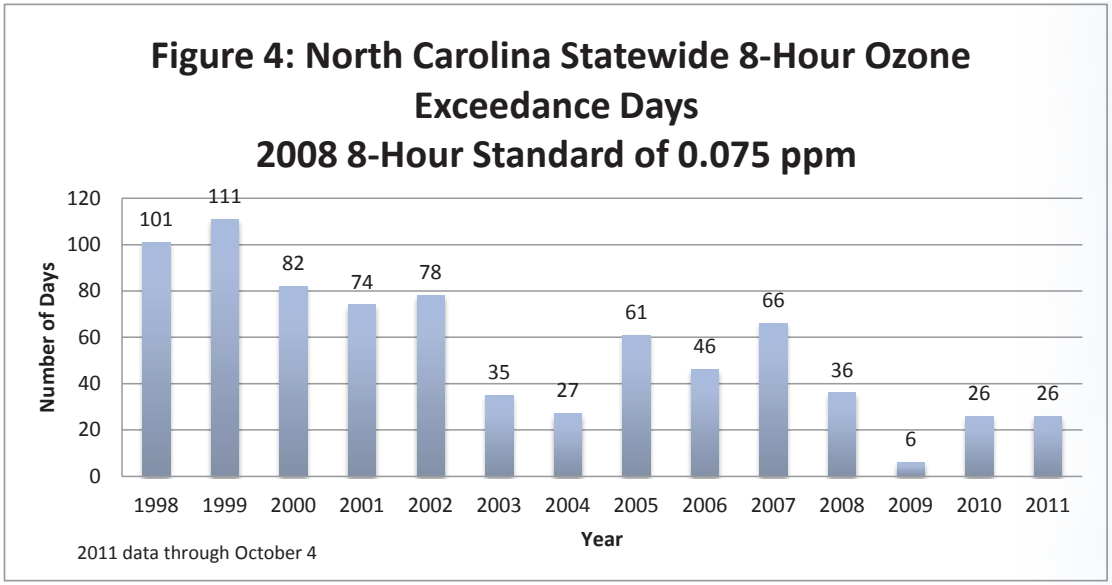


Ozone, a highly reactive form of oxygen, is North Carolina's most widespread air quality problem. In the upper atmosphere, ozone protects the Earth from damaging solar radiation, but ground-level ozone is unhealthy to breathe and can damage trees and crops. Ozone is a secondary pollutant that forms when nitrogen oxides (NOx) react in the air with volatile organic compounds (VOCs) on hot, sunny days with little wind. Strategies for controlling ozone primarily focus on NOx because the southeastern United States has naturally high levels of VOCs in the air coming from trees and other vegetation.

NOx is formed during the combustion of fuels or other burning. The primary sources of NOx emissions in North Carolina are cars, trucks and other highway vehicles, representing 47 percent of all NOx emissions. Industrial point sources such as boilers and coal-fired power plants represent another 39 percent of emissions. Another significant source is non-road vehicles, which include construction equipment, railroad trains, lawnmowers and airplanes.

In the past, substantial portions of North Carolina had ozone levels exceeding the standard, and areas once designated nonattainment[1] of these standards included more than 30 counties in the Charlotte, Fayetteville, Rocky Mount, Triad and Triangle metro areas, as well as the Great Smoky Mountains National Park. However, as depicted in Figure 4, ozone levels have substantially declined across the state since the 1970s.

[1] Nonattainment areas are regions officially designated by the EPA as not meeting air quality standards and the state must develop plans for bringing such areas back into compliance. Areas that are re-designated to attainment are called maintenance areas.



The EPA has adopted more stringent ozone standards several times during the last two decades. In 1997, the federal agency adopted a new 8-hour standard of 0.08 parts per million (ppm) and subsequently discontinued the previous 1-hour standard of 0.125 ppm. In 2008, the EPA lowered the 8-hour standard to 0.075 ppm, but postponed its implementation in 2009 while considering whether to lower the standard to a level ranging from 0.060-0.070 ppm. In September 2011, the EPA announced that it would keep the ozone standard at 0.075 ppm and restart the process of designating nonattainment areas under the 2008 standard.

Currently, the Charlotte metropolitan area is the state's only designated nonattainment area for the 1997 ozone standard. The area now meets that standard, and North Carolina has requested that EPA remove the nonattainment designation. However, the Charlotte area still violates the 2008 ozone standard and DAQ expects the EPA to designate the area as nonattainment for this standard in 2012. Ozone levels in the Triad metro area also exceeded the 2008 ozone standard during the 2008-2010 period, but met the standard during the 2009-2011 period, so DAQ does not expect a nonattainment designation for this area.

The state and local governments in the Charlotte metropolitan area must develop plans for reducing ozone-causing emissions in nonattainment areas. These plans include specific proposals for curbing ozone, such as measures to reduce emissions from cars, trucks, industries and power plants. Nonattainment designations also result in stricter controls on new industrial emissions. Companies seeking to build large, new industrial sources or expand existing large sources in nonattainment areas must install the most advanced or best-available pollution control technology. New or expanded industrial sources also need to obtain "offsets" if they would be increasing the overall emissions of ozone-forming pollutants in nonattainment areas.

Particle Pollution consists of very small solids and liquid droplets in the air. Unlike other pollutants, which generally consist of a single compound, particle pollution can contain a range of substances such as acids, organic

compounds, metals, soil and dust. Particle pollution can be unhealthy to breathe and contributes to the haze that obscures visibility. Exposure to particle pollution can cause or contribute to lung and heart disease. The EPA adopted a new standard for fine particles in 1997 due to growing concerns about the health effects.

The EPA regulates particle pollution according to the size of individual particles. Smaller particles are more of a concern because they can penetrate deep into a person's lungs and can be absorbed more readily into the bloodstream. Currently, the EPA has standards for fine particles, which are 2.5 micrometers in diameter or less, and coarse particles, which are less than 10.0 micrometers. Although the EPA has no air quality standard for larger particles, North Carolina has a standard for total suspended particulates (TSP) that covers particles larger than 10 micrometers.

A wide range of sources contribute to particle pollution, including power plants and other industry, cars and trucks, wood stoves and outdoor fires. Some particles form during the burning of fuels and others form later when pollutants react in the air. Emissions from coal-fired power plants are considered the largest source of fine particle pollution in North Carolina; this is largely due to sulfur dioxide, which converts in the air to sulfate fine particles, and represents about 33 percent of particle pollution in North Carolina. In 2008 and 2011, substantial portions of eastern North Carolina were affected by particle pollution from large wildfires.

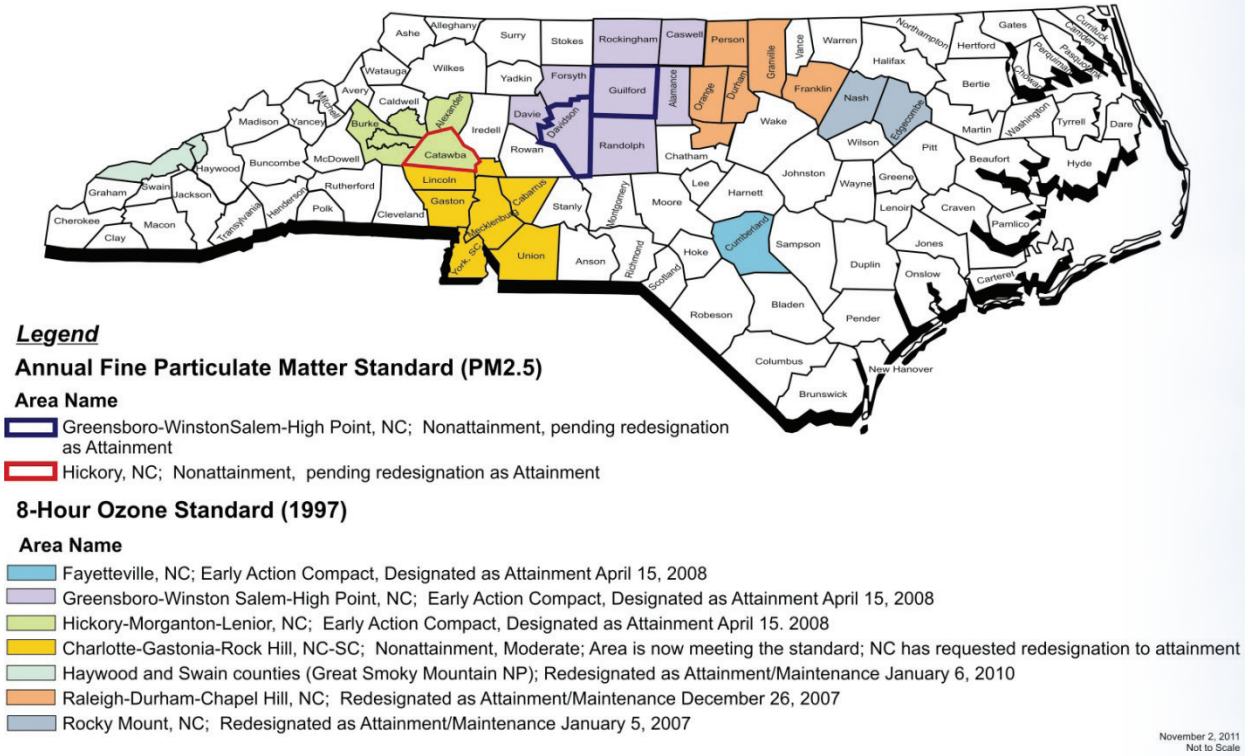
Unlike ozone, which occurs in the warmer months, high levels of particles can occur throughout the year. Typically, particle pollution events are associated with air stagnation events, inversions (when cooler air is trapped near the ground) or during forest fires and other large-scale outdoor burning. For example, high particle levels were measured after the ice storm in December 2002, when many people were using fireplaces to heat their homes due to widespread power outages and cold-air inversions trapped smoke near the ground. Absent such events, particle levels tend to be higher in the summer when higher humidity levels can enhance sulfate formation.

In December 2004, the EPA designated nonattainment areas for fine particle pollution based on air quality monitoring, commuting patterns and other factors. In North Carolina, the EPA designated nonattainment for fine particles (PM 2.5) in three counties: Catawba, Davidson and Guilford. PM 2.5 levels have declined substantially across the state since the 2002 passage of the state's Clean Smokestacks Act, which required substantial reductions in sulfur dioxide emissions at coal-fired power plants. Currently, all of North Carolina meets the fine particle standard and the state has requested that the EPA redesignate Catawba, Davidson and Guilford counties as attainment. The EPA is in the process of finalizing approval of the redesignation for all three counties.

In 2006, the EPA adopted a new 24-hour standard for PM 2.5 in addition to the annual standard. North Carolina has not had any areas that have violated or were designated nonattainment with the daily fine particle standard. Currently all areas are observing PM 2.5 levels that are well under the 24-hour standard.

Lead levels decreased in North Carolina once the EPA banned the use of leaded fuel in most vehicles. North Carolina still monitors for lead, but does so as a subset of the fine-particle pollution network with PM 2.5 monitoring data

Map 1: North Carolina Current Nonattainment and Maintenance Areas



(SO_2) is a pungent gas that is unhealthy to breathe and can damage trees and other vegetation. One of the first regulated air pollutants, SO_2 can be emitted by industries burning coal and fuel oil as well as by certain mining operations. In 2010, the EPA adopted a more stringent standard for SO_2, setting a 1-hour limit of 75 parts per billion (ppb). The new standard replaced two standards that had previously been in effect, a 24-hour standard of 140 ppb and an annual standard of 30 ppb. Industrial facilities account for most (93 percent) of the SO_2 emissions in North Carolina.

North Carolina had no compliance issues under the previous SO_2 standards, but the Wilmington-New Hanover County area has exceeded the new limit in recent years. DAQ has asked the EPA to defer designation of a nonattainment area for the 1-hour SO_2 standard until after 2012 due to the closure of several large sources in the area and the resulting drop in SO_2 levels. The New Hanover County monitor has measured no SO_2 values above the new standard so far in 2011. If the EPA will not agree to postpone the nonattainment decision for the Wilmington-New Hanover County area, North Carolina has recommended that the federal agency only designate

the northwestern corner of New Hanover County, bounded by the Cape Fear and Northeast Cape Fear rivers and the Pender County line.

Nitrogen Dioxide (NO_2), one of six criteria pollutants identified in the federal Clean Air Act, is unhealthy to breathe and contributes to ozone formation. The major source of NO_2 in North Carolina comes from highway vehicles. All of North Carolina complies with the federal NO_2 standard, and measured levels have declined over the years. However, the EPA adopted a more stringent NO_2 standard in 2010, which sets more stringent emissions limits for industries and establishes new monitoring requirements for the states. DAQ will implement the new standard through the permitting process for large industries and is in the process of evaluating the monitoring requirements.

A major development in 2011 was the settlement of a lawsuit against the Tennessee Valley Authority (TVA). In 2006, North Carolina filed a public nuisance lawsuit against the TVA, claiming that the utility's coal-fired plants sent polluted air into North Carolina. This agreement will result in the closure of many uncontrolled units and installation of emission-control equipment on almost all of the remaining units. Nitrogen oxide and sulfur dioxide emissions from these plants are linked to increased incidence of premature mortality, asthma, chronic bronchitis and other cardiopulmonary illnesses in North Carolina. In addition, the TVA will pay $11.2 million to North Carolina over the next five years to be used for energy efficiency and electricity demand reduction programs.

Other Air Quality Issues

Several air quality issues have emerged or assumed greater importance in recent years for a number of reasons, including population increases and global trends. In addition to EPA's recent efforts to strengthen the sulfur dioxide and ozone standards, the federal agency has also focused attention on visibility, mercury and air toxics.

Visibility

Visibility refers to the clarity of air and the ability to view the landscape unobstructed by haze. Various pollutants cause haze that reduces visibility, including particle pollution, ammonia and sulfur oxides. Visibility has important implications for the state's tourist economy, aesthetics and recreation because haze can obscure views and detract from scenery – a critical issue in the mountains. In the eastern United States, haze from man-made emissions has reduced natural visibility in Class I Areas (national parks and wilderness areas) from about 90 miles to 15-25 miles.

The EPA has no health-based standard for haze, but in 1999 adopted a Regional Haze Rule aimed at improving visibility in national parks and wilderness areas. The rule required states to develop haze control plans, with an ultimate goal of restoring visibility to natural background levels by 2064. DAQ worked with other southeastern states to develop the first regional haze plan to improve visibility through 2018. Work is now underway to evaluate the plan and the next full plan is due in 2018, covering the period through 2028. Efforts to reduce sulfur dioxide emissions, which are the primary source of haze in the southeast, are helping to improve visibility in the area.

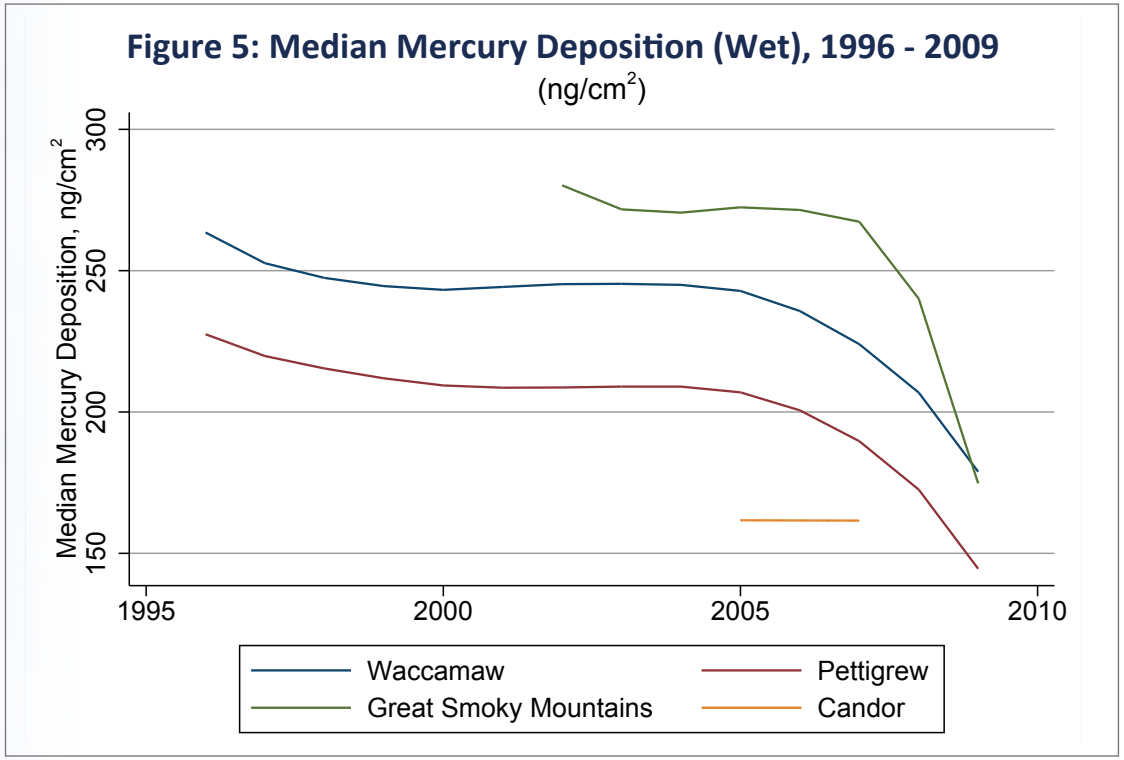
Mercury

Mercury is a metal that can be toxic to breathe at high-enough concentrations and can pose serious hazards, caused by eating certain fish, not by inhaling the air, even at low levels due to bio-accumulation in the environment and the food chain. The primary sources of man-made mercury emissions are coal-fired power plants (which account for about two-thirds of the mercury emissions in North Carolina) and other industrial facilities such as incinerators and factories that use mercury in their processes. There also are significant natural sources of mercury air emissions, such as volcanic eruptions, and much of the airborne mercury in North Carolina is transported into the state from other areas.

Some of the mercury in air emissions eventually settles to the earth in precipitation or dry particles that reach streams, lakes and coastal waters. When mercury reaches water bodies, certain bacteria can convert it to methyl mercury, a toxic organic form of mercury. Methyl mercury can bio-accumulate in the food chain, eventually reaching potentially harmful levels in the flesh of certain predatory fish. Eating mercury-contaminated fish is particularly hazardous for children, pregnant women (because of the potential impact on fetuses) and people who eat a lot of fish from affected water bodies. Due to such concerns, the EPA lowered the allowable mercury emissions rates from certain industrial facilities in 2010. The more stringent standards are generally applied through the permitting process for large industrial sources.

Coastal areas are especially susceptible to mercury because impacts to the entire aquatic food chain may occur if the water chemistry is conducive to transformation of deposited mercury to the more toxic -methyl mercury. For this reason, DAQ has been conducting mercury monitoring since 1995 at Pettigrew and Waccamaw state parks in the eastern part of the state. An inland site was briefly operated at Candor from 2005 to 2007. Weekly rainwater samples from monitors are analyzed for mercury and the results used to determine long-term trends. This monitoring method does not directly measure mercury in the air. Factors such as localized sources, long-range transport, and type of mercury (elemental, water-soluble and particulate) affect the amount of mercury in these samples.

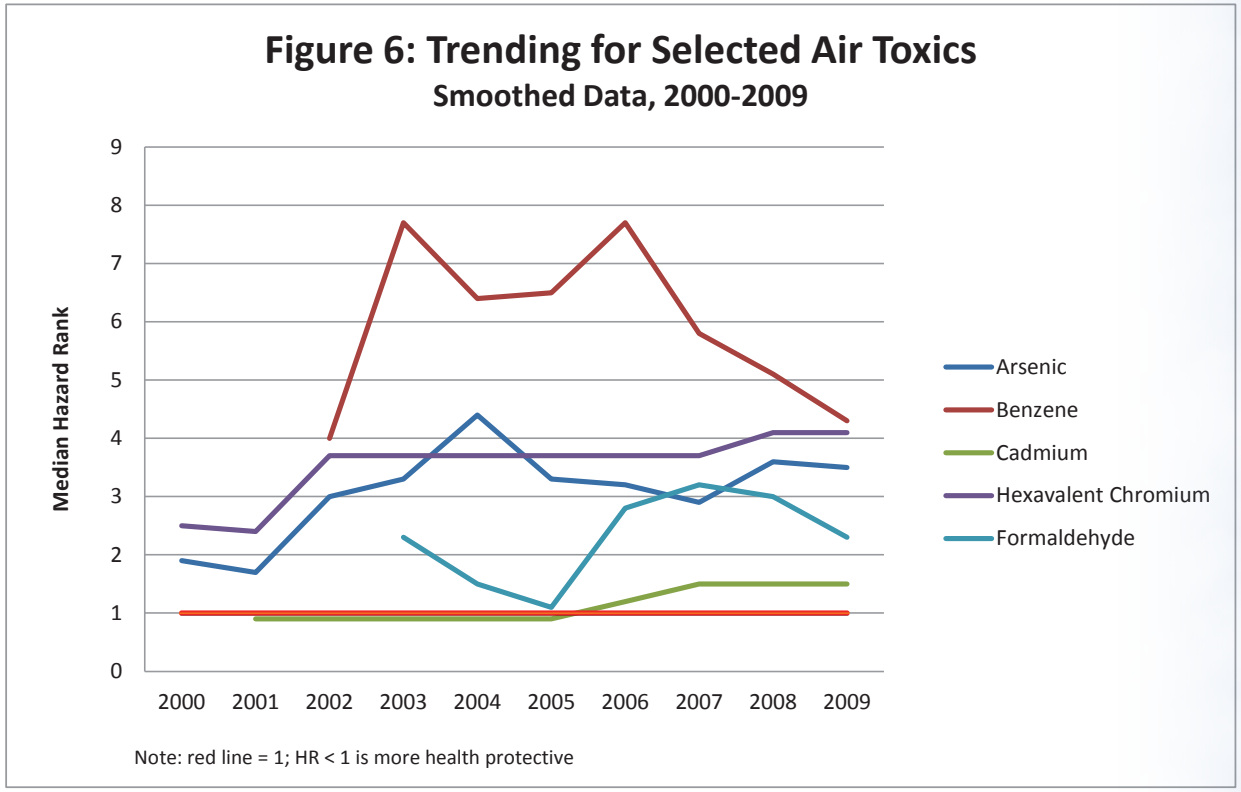
Figure 5 depicts the comparison of deposition rates at sites in North Carolina and eastern Tennessee (Great Smoky National Park). These data show a generalized slight downward trend in the deposition rate (measured in units of ng/cm2). Continued monitoring at these sites is necessary to determine if this is a continuing trend. Since the controls placed on large coal-fired utilities under the Clean Smokestacks Act have the additional benefit of reducing mercury emissions, those controls are contributing to any reduction.



Air Toxics

Air toxics include a range of pollutants generally emitted in lower amounts than criteria pollutants but having potentially significant adverse health effects. In addition to mercury, North Carolina and the EPA regulate a number of other toxic air emissions. North Carolina's air toxics rule sets health-based standards on 97 toxic air pollutants, and the EPA regulates 187 hazardous air pollutants through technology-based limits set by industry category that requires the installation of specific controls on emission sources. There are 76 pollutants that are common to both the state and federal lists, and some pollutants appear on one list but not the other. DAQ enforces these limits primarily through the permitting process for facilities that potentially emit air toxins higher than specified health-based standards. Facilities subject to the state air toxics program must demonstrate compliance through computer modeling.

In addition, several DAQ air monitoring programs are aimed at measuring levels of toxic air pollutants, including urban air toxics, mercury deposition and selected metals. Monitoring data are used to track trends and identify potential problem areas but are not used for permitting purposes. To identify the toxic air pollutants with the greatest potential for adverse health effects in North Carolina, a hazard rank was calculated by dividing pollutant concentrations from monitoring data by a "benchmark," or reference concentration. Figure 6 shows how selected toxic air pollutants have trended since the year 2000. Hexavalent chromium, arsenic and cadmium show slight upward trends. Formaldehyde may have a slight upward overall trend, but since 2007 has been trending slightly downward. The benchmark used for formaldehyde is one developed by EPA and that benchmark was substantially lowered in 2009 as a result of an EPA reassessment of risk posed by formaldehyde. Benzene has generally trended upward since 2002, but since 2007 has trended down. As Figure 6 shows, benzene poses the most significant risk of exposure of all toxic air pollutants sampled and analyzed in North Carolina.



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.

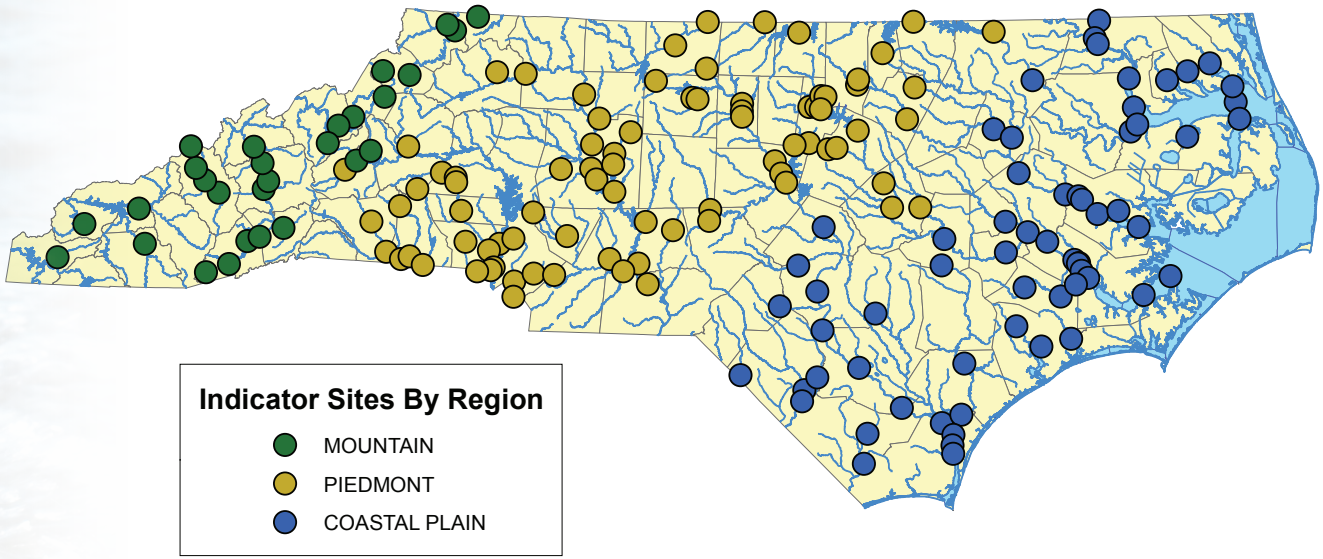
Surface Water

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

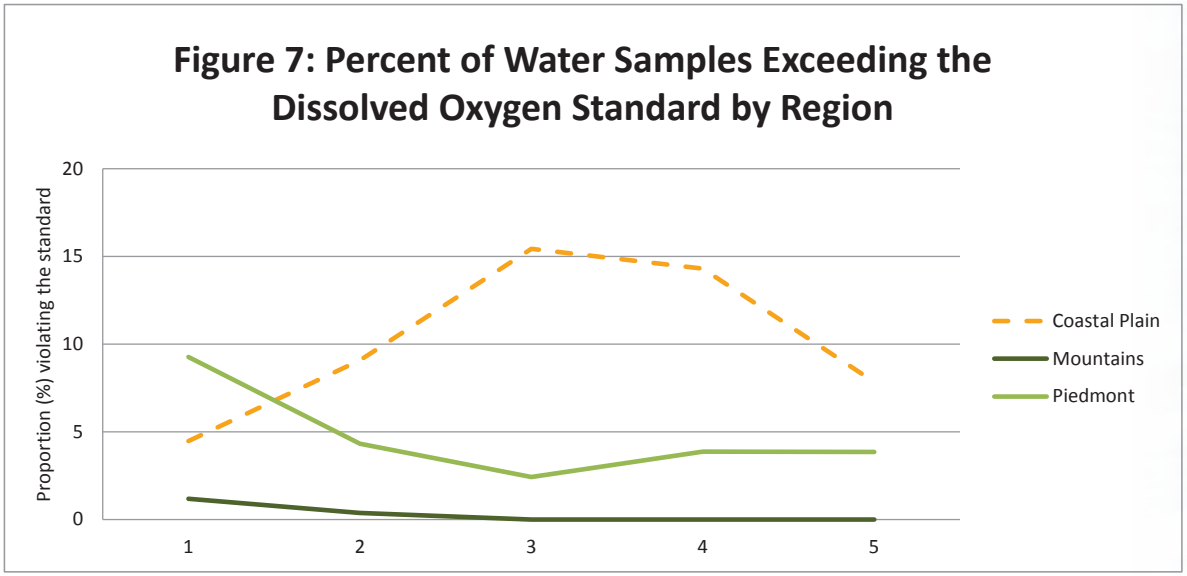
		Number of Results (Notes: Period: January 1970 through December 2010. Summer is defined as June, July, August and September and only surface results used (< 1m)).		
Region	**Number of Stations**	**Turbidity**	**Fecal Coliform Bacteria**	**Summer Dissolved Oxygen**
Coastal Plain	63	16,556	19,289	8,290
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

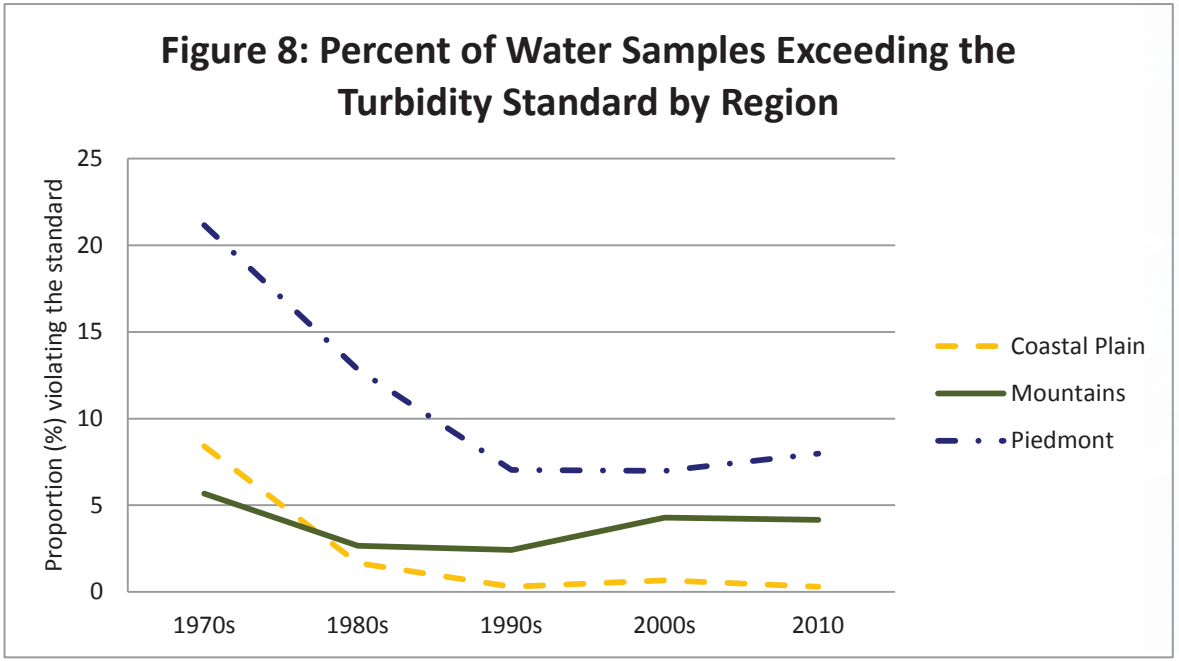


Results for dissolved oxygen, turbidity and fecal coliform bacteria were grouped by region (mountains, piedmont and coastal plain). The following graphs are based on the results from 172 currently active DWQ monitoring stations that were established before 1979. Since the data set is large and has been 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.

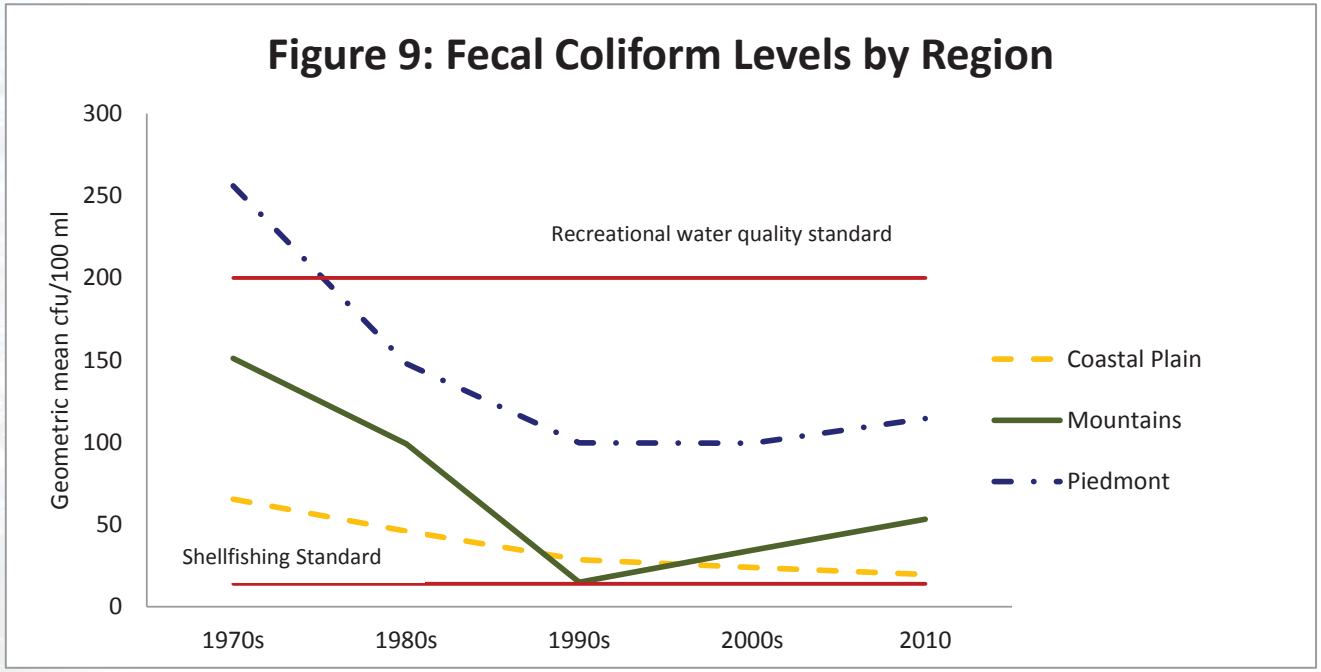
Dissolved oxygen (DO) in water is necessary for aquatic life, like fish and their food chain, to survive. Wastewater can contain contaminants, organisms and conditions that consume DO and take it from the oxygen available for aquatic life. Figure 7 shows that DO conditions have improved in the mountain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

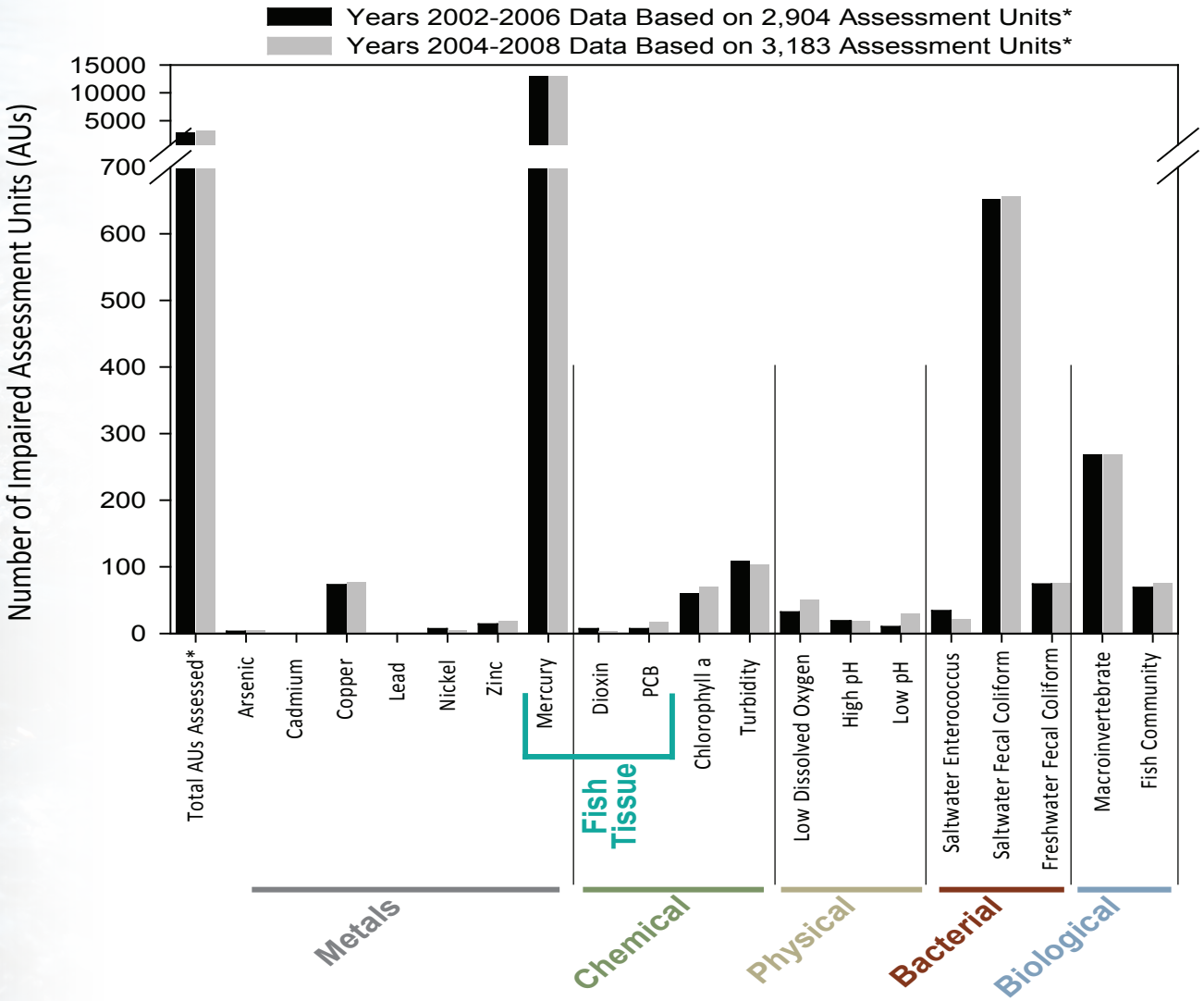
Table 2: Use Support Categories for Biological Ratings*

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.

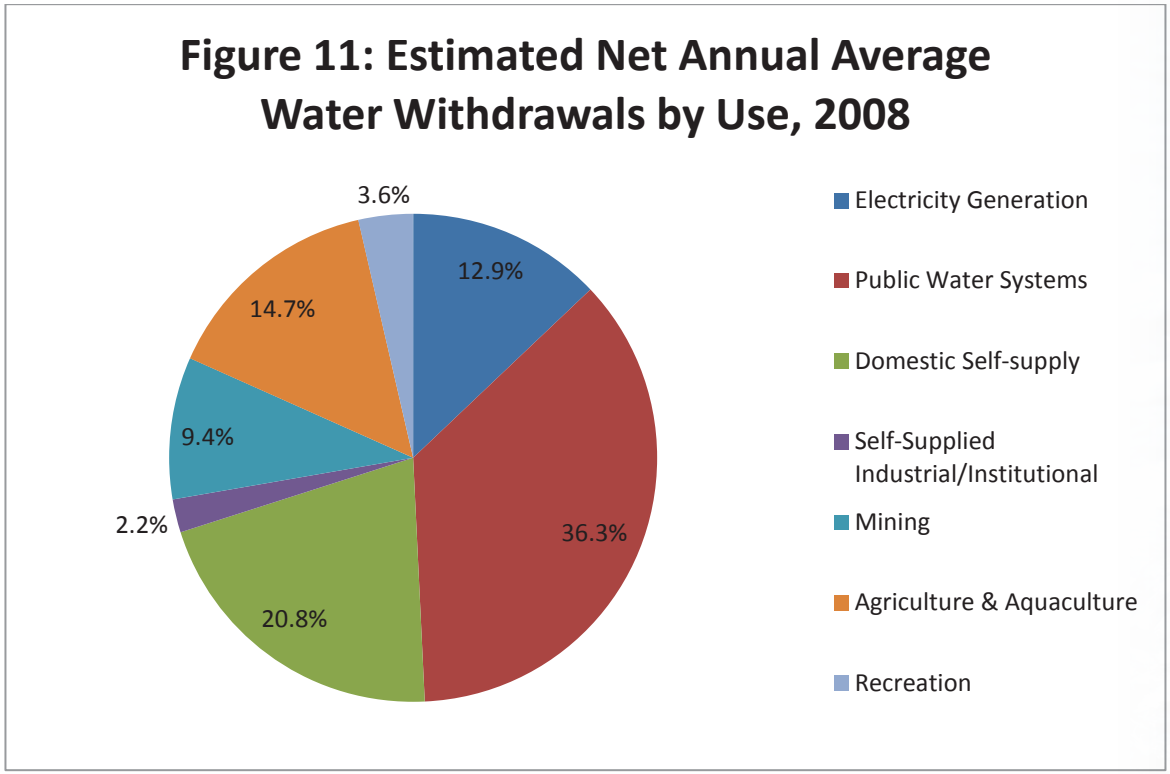
Table 4: Groundwater Pollution Indicators and Description

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

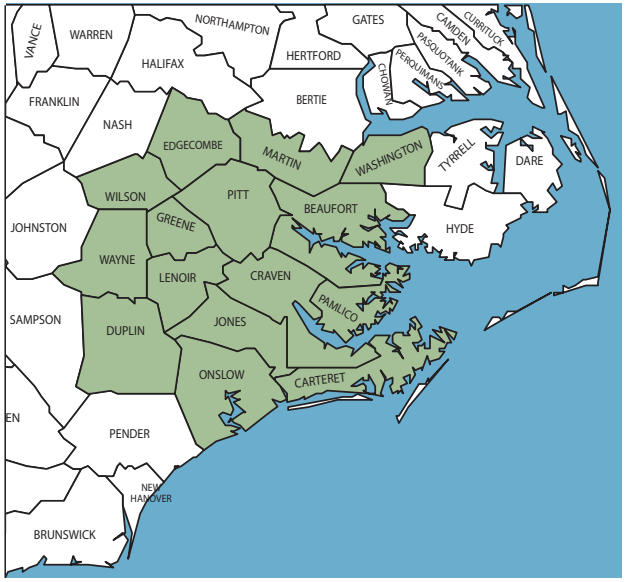
River basin hydrological models being developed by DWR will be used to project the future water needs and the availability of water in the state's 17 major river basins. These computer models are vital tools for comprehensively evaluating surface water availability in each basin and for predicting the 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

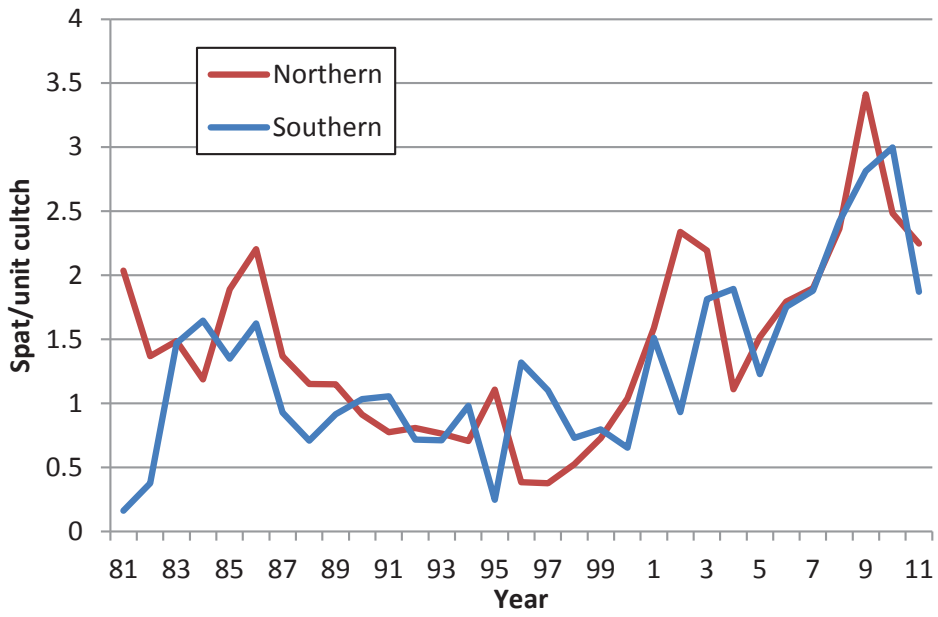
Many people enjoy fishing in North Carolina waters. They also enjoy eating their catch and fish is a healthy, low-fat source of protein. The Division of Water Quality routinely monitors water quality and fish tissue for potential problems.

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.

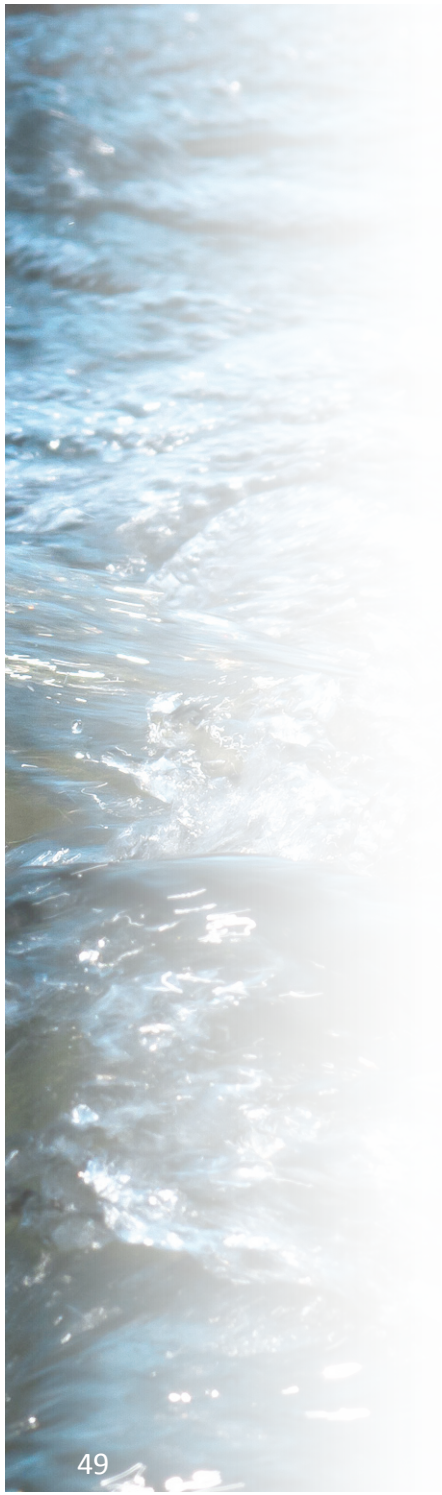


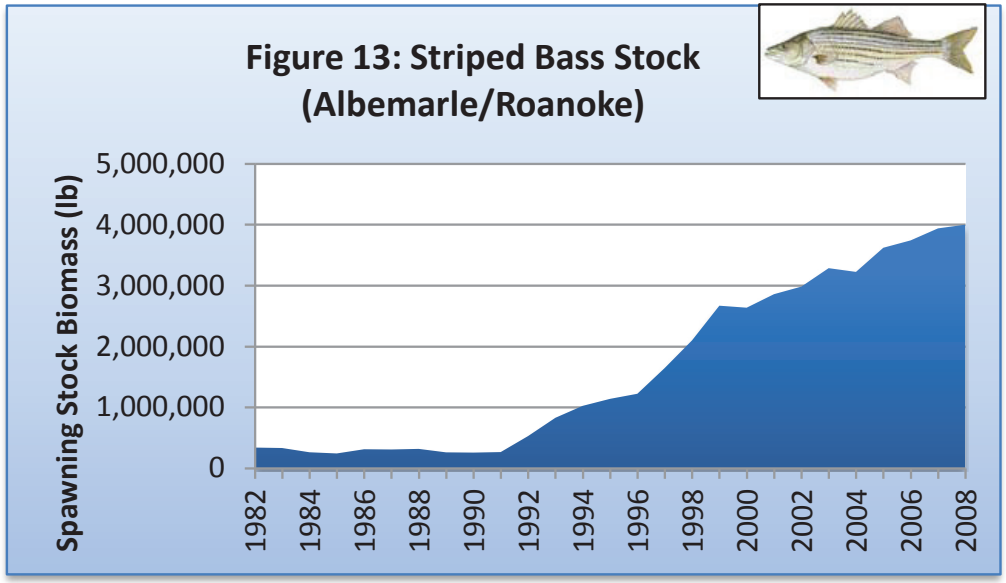
Table 6:
Threat sources and impact severities to coastal fish habitat. Shading = relative severity of impact; white = no impact/ unknown, yellow = minor, orange = moderate, red = major

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.



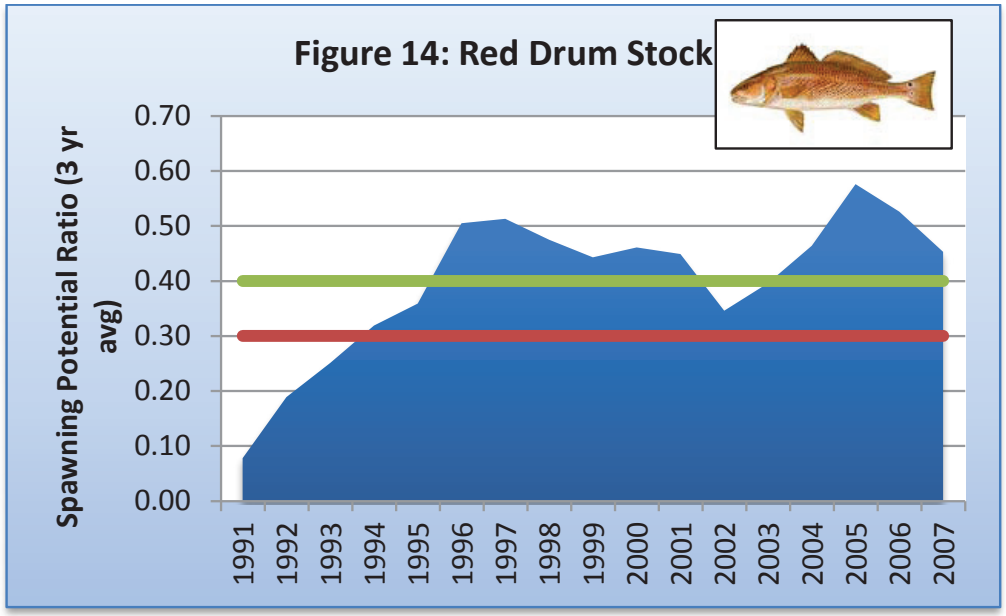


Figure 14: Red Drum Stock
Spawning Potential Ratio (3 yr avg)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007

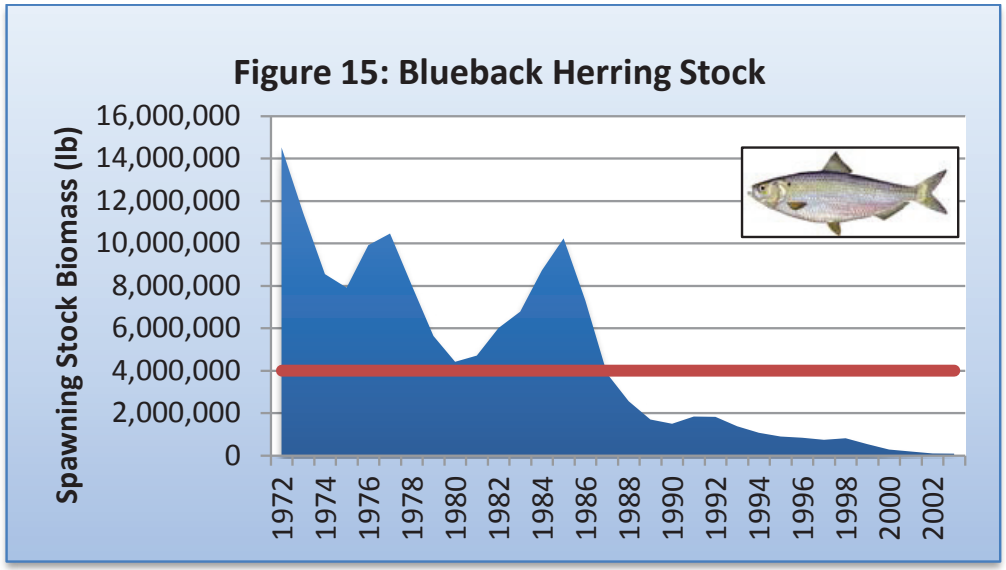


Figure 15: Blueback Herring Stock
Spawning Stock Biomass (lb)
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

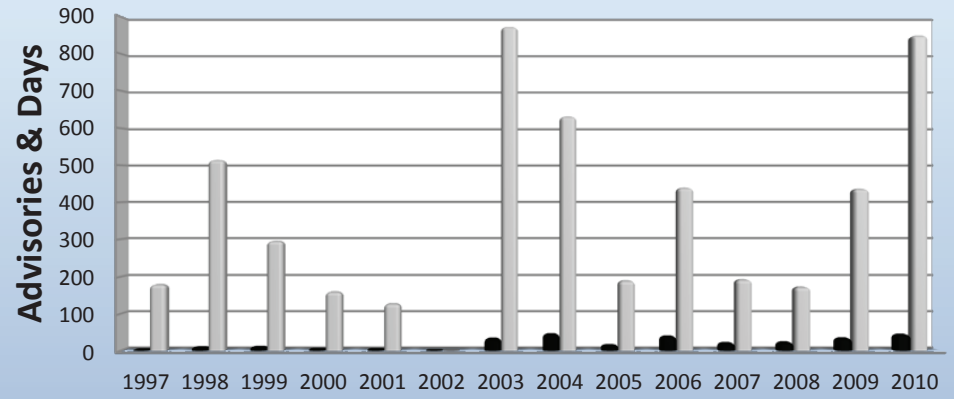
Beach Water Quality Monitoring

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.

North Carolina has abundant land resources. The state contains three main geographic sections: the coastal plain, which occupies the eastern part of the state; the Piedmont region, which contains the central portion of the state; and the Appalachian Mountains and foothills.

North Carolina has abundant land resources. The state contains three main geographic sections: the coastal plain, which occupies the eastern part of the state; the Piedmont region, which contains the central portion of the state; and the Appalachian Mountains and foothills. Mount Mitchell, located in the Black Mountains, is the highest point east of the Mississippi River at 6,684 feet. This variety of landforms, elevations and climates has produced as diverse a range of ecosystems. The state's scenic beauty and diverse geography make North Carolina rank as the nation's sixth most visited state.

The Land section of this report focuses on commercial land activities such as mining, land preservation and mitigation programs, and waste management activities to manage hazardous and municipal waste and redevelop polluted lands to restore them to productive uses.

Mining

North Carolina has a wealth of mineral resources, including aggregate (sand, gravel and crushed stone) to stone (granite, various metamorphic rocks and limestone) to industrial minerals such as phosphate, high-purity quartz, gemstones, glass sand, garnet, roofing granules, feldspar, mica, refractory minerals, bricks and peat. These resources are mined from the almost 800 permitted mines covering 113,000 permitted acres in the state. The area permitted for mining represents less than 4/10th of one percent of the state's 48,000 square miles.

Mines in North Carolina are required to carry a bond so that the state can reclaim the mine site if the mine operator declares bankruptcy or fails to reclaim the site. During the last 11 years, an average of 1,000 acres per year has been reclaimed and released from bond. The highest number of acres reclaimed and released was 1,793 acres in 2010. During FY 2010-11, DLR received 683 complaints and conducted 1,106 mining inspections. As a result of those inspections, 37 operators were cited with Notices of Violation for mining without a permit, 28 received Notices of Violation of their permit and 29 received letters of deficiencies. Only seven cases were not voluntarily resolved and referred to enforcement.

Land Conservation

DENR's land conservation initiatives are led by the Office of Conservation, Planning and Community Affairs. As part of these efforts, the office developed a Conservation Planning Tool to streamline the process of identifying and prioritizing the areas in North Carolina's landscape that are essential for conservation. The Conservation Planning Tool consists of statewide assessments and maps developed by the N.C. Natural Heritage Program (NCNHP) to identify, evaluate and prioritize essential high quality natural resources required to maintain healthy and sustainable ecosystems. This analysis pinpoints areas that are already protected as well as those areas in the landscape that represent "gaps" in a functional ecosystem network. Assessments of the state's important resources are conducted using the best available, most current data and information on biodiversity and wildlife habitat, forestry and farmland, water resources and open space and conservation lands.

In 1998, the General Assembly established a goal to conserve an additional million acres during the next 10 years. In that time, more than 683,000 acres were protected by DENR and its partners in the land conservation community. While North Carolina did not meet the goal to protect an additional million acres by Dec. 31, 2009, tremendous progress was made, increasing the rate of land protection far beyond what it had been, during a period that included two economic recessions and limited federal support. Since 2009, the rate of land conservation, whether for natural or agricultural uses, has continued to decline. However, the state continues to work on protection of key parcels that are critical for a variety of purposes including riparian or military installation buffers, or wildlife habitat, water quality and recreation, along with agricultural protection.

Development and maintenance of the North Carolina state parks system is another land conservation program. The state parks system exists for the enjoyment, education, health and inspiration of citizens and visitors. Residents and visitors made more than 14 million visits to North Carolina state parks in 2010 - the second highest level of attendance ever recorded.

The mission of the state parks system is to conserve and protect representative examples of the natural beauty, ecological features and recreational resources of statewide significance; to provide outdoor recreational opportunities in a safe and healthy environment; and to provide environmental education opportunities that promote stewardship of the state's natural heritage. The park system manages more than 213,000 acres, including 35 state parks, four recreation areas and a system of state natural areas. Since 1994, the Parks and Recreation Trust Fund (PARTF) has been used to acquire 18,622 acres of land for state parks. PARTF funds used in conjunction with at least one other funding agency have preserved an additional 37,616 acres.

The state park system's determined conservation efforts have resulted in highly diverse landholdings throughout the state. These diverse landholdings provide refuge for many plant and animal species and function as outdoor laboratories and research opportunities in a variety of disciplines such as botany, geology, zoology, ecology and archaeology/anthropology. Parklands provide settings for scientific studies ranging from simple descriptive inventories to complex, ecosystem-scale analyses. Over the last decade several hundred researchers have conducted research in North Carolina state parks.

The Natural Heritage Trust Fund, Clean Water Management Trust Fund and North Carolina state parks system have undertaken land acquisition projects together to achieve common goals. In 2010, these groups contributed more than $16.7 million to add more than 4,800 acres to the North Carolina state parks system. This public funding was used as leverage to raise more than $11 million in private donations and federal grants. Many of these land acquisitions are in nationally significant natural heritage areas and will help provide recreational opportunities for residents while protecting water quality, and providing plant and animal habitat.

The Division of Coastal Management preserves coastal habitats with the N.C. Coastal Reserve (NCCR) & National Estuarine Research Reserve (NCNERR) program. The N.C. General Assembly created this program in 1989 to acquire, improve and maintain undeveloped coastal land and water areas in a natural state. Twenty years later, that seemingly simple act of legislation has led to the preservation of more than 41,000 acres of unique environments on 10 coastal reserve sites along the entire length of our coast. These undeveloped natural areas are vital to continued fishery and wildlife protection, water quality maintenance and improvement, aesthetic enjoyment and public trust rights such as hunting, fishing, navigation and recreation. Such land and water areas are necessary for the preservation of state estuarine areas, constitute important research facilities and provide public access to waters of the state.

Land Use Planning

As North Carolina grows in population, it will be increasingly necessary to coordinate long-range planning activities among different entities to preserve important land resources and to promote compatible land uses. DENR has created or participated in three different groups that lead and collaborate on these efforts. The department is a founding member of the Southeast Regional Partnership for Planning and Sustainability (SERPPAS). SERPPAS promotes better regional collaboration in making resource-use decisions. SERPPAS includes the states of North Carolina, South Carolina, Georgia, Florida and Alabama. SERPPAS works to prevent encroachment around military lands, encourages compatible resource-use decisions and improves coordination among regions, states, communities and military services.

The N.C. Working Lands Group, established by NCDENR in partnership with the U.S. Department of Agriculture, promotes a long-term working relationship between the U.S. Department of Defense (DoD) and state agencies. The purpose of the North Carolina Working Lands Group is to create and implement an integrated strategy to sustain natural resources, land use and military operations and training that is economical and achievable. The group emphasizes conservation and compatible use of lands and waters critical to North Carolina's environmental health, economic strength and national defense. The group's mission is to maintain a collaborative partnership that uses leveraged resources to protect, preserve, enhance and sustain farms, forests, ranch lands and working waters in a manner that ensures mutual sustainability of economic, environmental, natural resource, cultural and national defense missions while creating net multiple benefits to all partners.

Finally, DENR led the establishment of the North Carolina Commanders' Council to deal with the challenges of compatible land use and development encroachment on military installations and training areas. The council, and its products, provide the means for North Carolina's military installation commanders to achieve greater shared awareness and understanding, and more compellingly speak with a "single voice" on common and complementary military/operational issues to our state government and regional partners (both internal and external to North Carolina's military installations).

Land Development and Wetland Impacts Mitigation

Urbanization, economic development and the development of physical infrastructure such as roads can negatively impact the size and number of wetlands in North Carolina. The objective of the Ecosystem Enhancement Program (EEP) is to compensate in an efficient and effective manner for wetland or stream impacts that are unavoidable because of land development or transportation infrastructure projects.

Founded in statute in 2003, EEP maintains more than 580 projects statewide, with more than 600 miles of streams, 30,000 acres of wetlands and 1,200 acres of streamside buffers having been conserved, restored or enhanced, and with 95 percent of all projects successfully meeting regulatory criteria. EEP also has helped to preserve more than 50,000 acres of natural areas statewide for future generations.

Customers in EEP's four separate in-lieu fee mitigation programs have included more than 1,400 homeowners and a roughly equal number of commercial, industrial and retail clients, as well as schools, churches and the military. The North Carolina Department of Transportation (NCDOT) is the largest customer for compensatory mitigation. Not a single NCDOT road project has been delayed since 2003 because of a lack of mitigation, which has helped move forward more than $8 billion in transportation projects. EEP's funding is receipt-based and the initiative receives no general fund appropriations. Customers use EEP on a voluntary basis for their mitigation needs.

A unique characteristic of the initiative is its commitment to offset impacts from development before the impacts occur, meeting concerns from environmental organizations and state and federal regulatory agencies about lag time that can occur between an impact to a stream or wetland and the required mitigation of the damage. EEP has achieved nationally unprecedented levels of advance mitigation to address impacts from development projects proactively.

Waste Management

In North Carolina, as in all states, a number of properties have been contaminated by petroleum products, solvents, pesticides and other environmentally harmful and toxic substances. Much of the contamination is a legacy of activities -- both public and private -- that occurred before the adoption of state and federal environmental standards. In many cases, soil and groundwater contamination resulted from waste disposal, including trash collected by local governments for disposal and chemicals used in manufacturing. Leaking petroleum underground storage tanks deteriorated over time and leaked petroleum product into the soil and groundwater. These contaminated sites can pose a threat to both public health and the environment, particularly when contamination affects drinking water supplies. The presence of environmental contamination also inhibits the sale and redevelopment of property, hindering economic development.

A number of DENR programs assess, remediate and redevelop contaminated property. The Division of Waste Management (DWM) implements most of those remediation programs and regulates all forms of waste disposal. DWM and the Division of Environmental Assistance and Outreach also provide technical assistance and incentives related to recycling and waste reduction to businesses, industries, local governments and citizens.

Brownfields Program

Brownfields are abandoned, idled or underused properties where environmental contamination hinders redevelopment due to concerns about environmental liability. The Brownfields Property Reuse Act removes barriers to redevelopment by protecting prospective developers from liability for contamination they did not cause. The N.C. Brownfields Program, in partnership with the U.S. Environmental Protection Agency (EPA), has been successful in revitalizing and promoting safer use of brownfields properties across the state. The program also supports other community goals, such as preservation of green space and reduction of urban and suburban sprawl, making urban development more economically efficient. For each brownfield property redeveloped, a green space is saved.

Since the Brownfields Program began in 1997, 204 properties (representing a total of 2,775 acres) have received completed redevelopment agreements. The remediation of these properties has resulted in approximately $8.2 billion in private capital investment since the program started.

In reviewing trends over the past few years, the extreme economic downturn since late 2007 resulted in plummeting real estate investment in 2009 and a slow recovery since then. As a direct result of those difficult market conditions, the N.C. Brownfields Program saw a substantial reduction in the numbers of redevelopment applications -- from 50 in Federal Fiscal Year (FFY) 2007 to 27 each in 2008 and 2009. In FFY 2011, the program received 45 applications. This compares favorably with the 36 applications received in FFY 2010 and indicates a continuing improvement in the real estate market.

Local governments continue to have great success in competing for EPA brownfields grant funds. The EPA awarded approximately $60 million in competitive brownfields grants to local governments in FFY 2011. The brownfields grant program has had statewide reach, as 35 local government entities have been awarded 56 separate grants.

Before - Abandoned Textile Mill, circa 1888 and Chromium Electroplater, circa 1955

After - Alpha Mill Apartments bordering uptown Charlotte

Underground Storage Tank Program

Leaking petroleum underground storage tanks can contaminate groundwater, which often is used as a source of drinking water. DWM's Underground Storage Tank (UST) Section ensures compliance with all relevant state and federal laws and regulations by assisting owners and operators of USTs in compliance. This section also oversees the administration of trust funds for the reimbursement of cleanup costs associated with UST releases and manages permanent closure activities of UST systems. Since 1988, more than 17, 730 UST releases have been remediated. The state has approximately 7,770 additional releases that still need to be cleaned up.

Discharges or releases from petroleum USTs are reported to DENR regional offices and added to an incident management database. Table 7 lists, for each region and for the entire state, the number of incidents reported, the number of incidents closed out and the number of UST systems properly closed without leaks or releases (called "clean closures"). These numbers are listed for FY 2011 and for the entire history of the UST program.

Incidents closed out in any year are not necessarily the ones reported in that year – many releases take years to clean up and close. Note that in FY 2011, the program closed more incidents than were reported -- a trend that decreases the backlog of UST contaminated sites that have not been fully addressed. There are probably various reasons for this, including the economic downturn, that has slowed property transfers and construction; many new releases are discovered during real estate transactions and construction projects. The UST program has also been able to increase the number of incidents being addressed based on availability of resources in the Commercial Cleanup Funds.

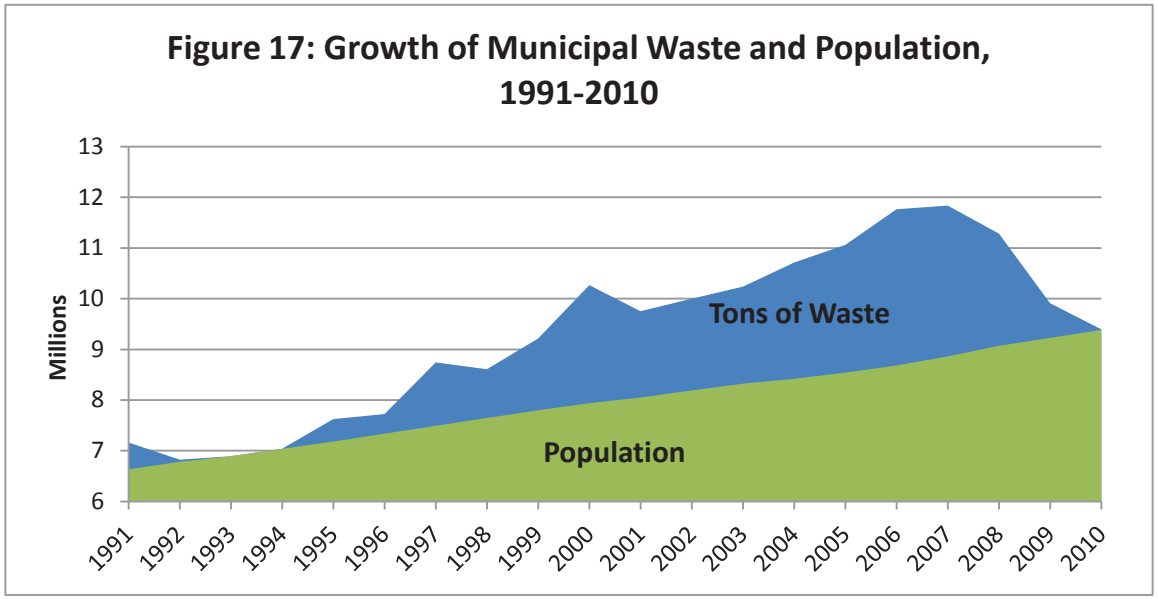
Table 7: Petroleum UST Incidents By Region [1]						
Region	**7/1/10 – 6/30/11**			**7/1/88 – 6/30/11**		
	Reported	Closed	Clean Closures	Reported	Closed	Clean Closures
Asheville	100	88	9	2,744	1,777	882
Fayetteville	29	58	26	1,182	1,072	1,481
Mooresville	121	165	18	5,111	3,799	1,298
Raleigh	160	184	10	5,305	3,534	693
Washington	115	136	1	3,390	2,232	114
Wilmington	53	58	3	2,041	1,282	472
Winston-Salem	153	206	15	5,731	4,035	2,015
State Totals	**731**	**895**	**82**	**25,504**	**17,731**	**6,955**

Incidents affecting groundwater that have been closed:	6,075
Incidents closed since risk-based corrective action began on 1/2/98:	13,434
Remaining open incidents:	7,773
Open commercial incidents:	6,257
Open noncommercial incidents:	1,516

At present, 6,257 commercial incidents have yet to be closed out. Although responsible parties continue to have a statutory duty to clean up petroleum releases, Session Law 2004-124 limits the amount of cleanup work that DENR can direct at any one time to the amount that can be reimbursed by the state trust funds within 90 days. This approach has eliminated the negative balances in both the Commercial Fund and the Noncommercial Fund, but has resulted in a backlog of properties waiting to be cleaned up. While the UST program works to clean up and close existing incidents, new (or newly discovered) releases are also being reported. There was a modest decrease in the number of releases reported this year - 731 in FY 2011 as compared to 793 in FY 2010.

Solid Waste Generation

Solid waste or garbage consists of everyday items we consume and discard. It predominantly includes food wastes, yard wastes, containers and product packaging, and other miscellaneous inorganic wastes from residential, commercial, institutional and industrial sources. Inorganic wastes include appliances, clothing, boxes, disposable tableware, furniture, wood pallets and rubber tires. Until recently, the amount of waste generated in the state had grown as the population rose (Figure 17).



The state per capita disposal rate is approximately one ton per person per year, which represents a reduction of eight percent from FY 1991-92. Despite this reduction, North Carolina local governments generated and disposed of 9.4 million tons of municipal and construction and demolition waste. Analysts have attributed recent declines in solid waste disposal to the continued economic recession that began in the fall of 2008; the downturn in the housing market has been a major factor in the decrease because of the reduction in construction waste.

North Carolina has 41 operational municipal solid waste (MSW) landfills and one municipal solid waste incinerator. The total remaining capacity of all North Carolina MSW landfills measures approximately 358 million cubic yards, equating to approximately 221 million tons of MSW waste. If North Carolina's rate of landfill use remains steady at approximately 7.6 million tons annually, the state would have 29 years of landfill capacity remaining.

Overall, statewide capacity is sufficient, but some parts of the state face limited regional capacity. Regions may experience disruptions and additional costs as facilities close, open or change service areas. Much of the state's waste capacity is not widely available due to permit conditions, franchise arrangements, service areas and distance.

Municipal solid waste represents an opportunity for reuse, recycling and material recovery. Recycling has gained momentum in North Carolina; recycling employment increased in the state by 4.8 percent from 2008 through 2010 and recycling companies have made combined investments in plant and equipment in the past three years exceeding $150 million. This expanded recycling infrastructure is helping North Carolina further reduce the tonnage and environmental impacts of solid waste disposal.

NC DENR has promoted recycling by implementing a series of policy measures since 2008. The ABC bar and restaurant recycling law requires certain holders of Alcohol Beverage Control permits to recycle all recyclable beverage containers. The North Carolina electronics recycling producer responsibility law requires computer equipment and television manufacturers to be responsible for the collection of their equipment (this also includes a ban on the disposal of televisions and computer equipment). Other policies banned disposal of wooden pallets, oil filters and plastic bottles. These combined measures have led to an estimated additional recovery of 200,000 tons of recyclable commodities annually. The number of curbside recycling programs in North Carolina jumped from 214 to 259 and the number of households served by those programs increased to the highest level ever, at 1.62 million. Market prices for recycled materials rebounded from the dramatic drop experienced in 2008 and remained high throughout FY 2009-10. In FY 09-10, about 1.3 million pounds of waste was diverted from landfills through recycling. This is approximately 12 percent of all municipal waste.

Hazardous Waste Management Program

Hazardous waste is waste that poses substantial actual or potential threats to public health or the environment. Hazardous waste includes materials that are known or tested to have traits such as flammability, reactivity, corrosivity or toxicity. Many types of businesses generate hazardous waste. For example, dry cleaners, automobile repair shops, hospitals, exterminators and photo processing centers all generate hazardous waste. Larger industrial sources of hazardous waste include chemical manufacturers and electroplating companies. Because hazardous wastes are so dangerous, they cannot be disposed of like common household waste.

In 2009, North Carolina's 497 generators reported production of 71,763 tons of hazardous waste. This was a decrease of approximately 24,000 tons (20 percent) since 2007, although the number of large quantity generators increased by 64. Large quantity generators generate 1,000 kilograms per month or more of hazardous waste, or more than one kilogram per month of acutely hazardous waste. North Carolina ranks 27th among the states in the amount of hazardous waste generated.

The Hazardous Waste Section in DENR's Division of Waste Management has implemented a program that requires the removal and recycling of mercury-containing convenience light switches from scrap automobiles known as "end of life" vehicles. Initially enacted in 2005, and revised by the General Assembly in 2007, this program requires auto recyclers and scrap metal processors to remove mercury switches before the vehicles are crushed, shredded and recycled into the manufacture of steel. The vehicle recyclers and scrap metal processors receive $5 for each switch that is removed, collected and sent for recycling. Removal of the switches prior to recycling greatly reduces mercury emissions during the steel-making process.

Since 2007, implementation of the Mercury Switch Removal Program has resulted in the removal and recycling of 281,853 mercury switches in North Carolina. As a result, 620.1 pounds of mercury have been prevented from entering the environment. In 2010, 95,123 mercury switches were removed from vehicles.

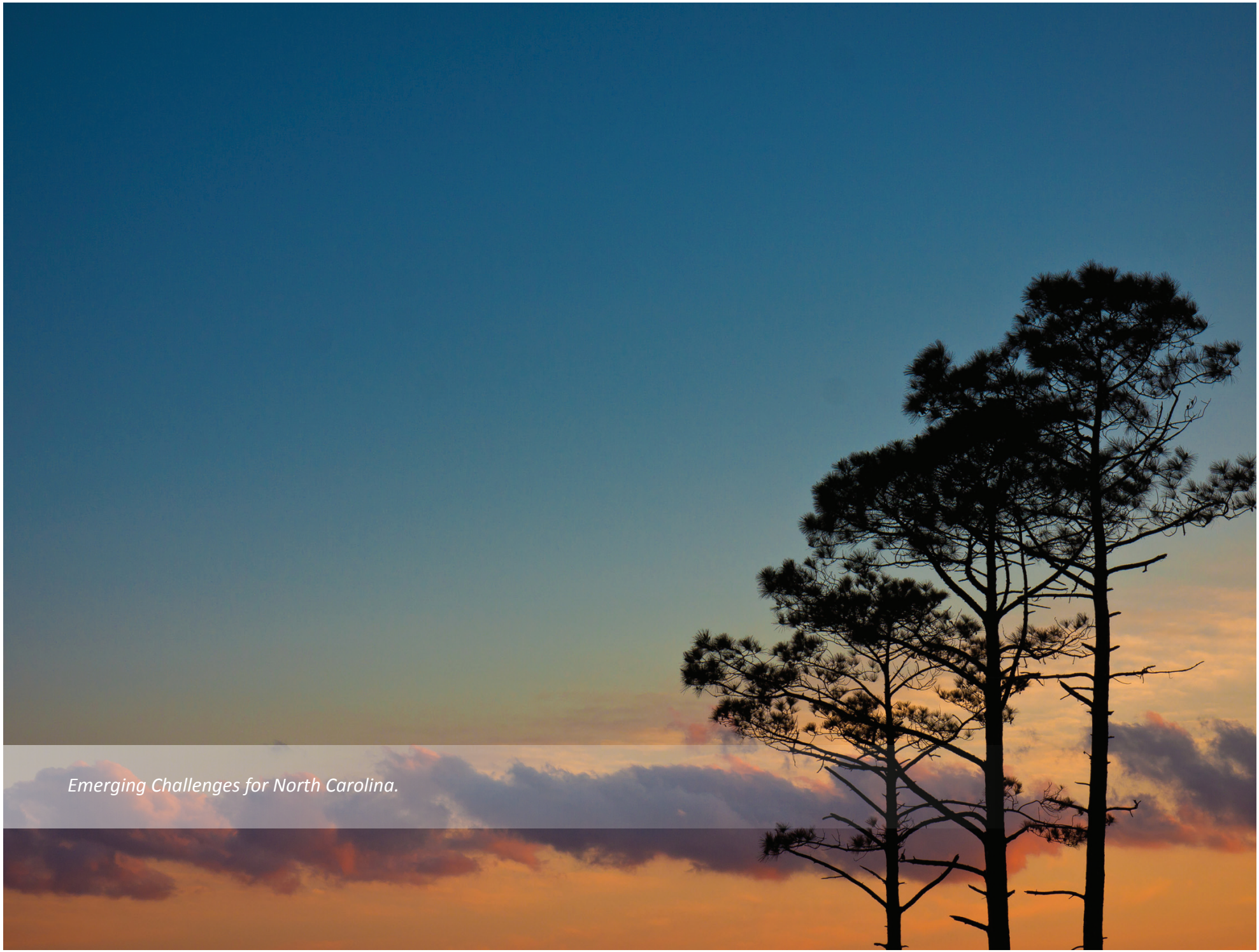
Inactive Hazardous Sites

While the Hazardous Waste program manages facilities actively producing, using and handling hazardous waste, the Inactive Hazardous Sites program was created by the N.C. General Assembly to address properties contaminated with hazardous substances as a result of past activities. To date, DENR has identified 3,044 chemical spill or disposal sites and old, unlined dumps or landfills that are not being addressed by other environmental programs. Of this number, 2,592 still require assessment, remediation or both.

Of the 2,592 remaining open cases, 676 are old, non-permitted, unlined landfills that operated before state and federal rules set modern environmental standards for solid waste disposal (pre-regulatory landfills). Half of the proceeds of a statewide solid waste disposal tax are directed by statute to the Inactive Hazardous Sites Cleanup Fund for the purposes of addressing contamination at pre-regulatory landfills.

Limited funds are available to assess and clean up other contaminated sites where the person responsible for the contamination lacks the necessary financial resources. Inactive Hazardous Sites Cleanup Fund revenue can be used to address these "orphan" sites as funds are available. In FY 2010-11, DENR used Inactive Hazardous Sites Cleanup Fund revenue to supply alternate drinking water supplies at three sites, conduct assessment to determine the nature and/or extent of contamination at 11 sites and to conduct an ongoing cleanup at another site.

Currently 372 sites, of which 214 are higher-priority cases, have been identified that require further action but have no financially-viable responsible parties. An estimated average cost of cleanup can range from a few thousand to several million dollars, with an average cost of approximately $563,500. Given the current annual income to the fund of $450,000, few sites can be addressed and the backlog of sites continues to grow.



Emerging Challenges for North Carolina.

Emerging Challenges

Changing Federal Air Quality Standards. The Clean Air Act mandates that EPA evaluate each health-based air quality standard every five years to determine if the standard is adequate to protect public health and the environment. EPA has often failed to meet the five-year review requirement, resulting in court-ordered deadlines to review several standards. The agency is now more consistently meeting the five-year deadlines. Collectively, these changing standards represent the most significant emerging issue for DAQ in the coming years because of the resources required to implement the new standards at the state level. The standard changes (described in more detail above) include:

- A new 8-hour ozone standard. The next step will be designation of non-attainment areas for regions not meeting the standard. Once the designations are done, DAQ must work with local governments in the non-attainment areas to develop plans to bring those areas into compliance with the standard. The challenge for North Carolina will be to identify cost-effective emissions reductions to achieve the lower ozone standards, given all the efforts already made to reduce ozone emissions. EPA is scheduled to review the ozone standard again in 2013 and the health data supports a lower standard than the 2008 level.
- A new 24-hour standard for fine particle pollution (PM 2.5) that the EPA adopted in 2006. No areas in North Carolina currently exceed the daily standard. Several counties previously violated the annual PM 2.5 standard adopted in 1997; those counties now comply with the annual standard and DAQ has been working to have the counties redesignated as in attainment. EPA has not yet redesignated those areas; once that happens, DAQ will need to develop plans to ensure that these continue to meet or maintain the standard. EPA is due to review the PM 2.5 standard by 2011, but does not expect to issue a new standard until 2012. Similarly to ozone, the health data suggests that the PM 2.5 standard should be lowered, but it will be a challenge to find additional emission reductions.
- A new 1-hour standard for sulfur dioxide that EPA adopted in 2010. DAQ's air monitor in New Hanover County has shown levels violating the new SO2 standard and the EPA is expected to designate portions of the area non-attainment in 2012. If that designation occurs, DAQ must work with local governments to develop a plan for bringing the area into compliance. In addition, DAQ must work with large SO2 sources across the state to ensure that their emissions are not causing localized violations of the standard.
- A new more stringent nitrogen dioxide standard that the EPA adopted in 2010. This new standard presents some permitting challenges for new and modified sources given the stringency and the short term nature (1-hour) of the new standard. In addition, DAQ must develop a new monitoring network for NO2 emissions.
- The EPA recently proposed a new regulation that, if adopted, would establish technologies required for controlling toxic air emissions from industrial boilers. DAQ would be charged with implementing this regulation through the permitting process for facilities that emit hazardous air pollutants above certain minimum levels.

Shale Gas. DENR is evaluating the potential of natural gas resources in North Carolina. The department's N.C. Geological Survey has concluded that a commercially viable reserve of natural gas may underlie parts of the Triassic basins of North Carolina. Technically recoverable gas is thought to exist in the Sanford sub-basin (including Lee, Chatham and Moore Counties) and possibly the Dan River Basin (including Stokes and Rockingham Counties). A number of factors, including increased interest in non-conventional energy sources, access to existing natural gas pipelines in the area, and energy demand from nearby industries and utilities could make this potential reserve a target for exploration and development. As directed in Session Law 2011-276, DENR is leading a state study to identify issues associated with oil and gas exploration in the state. The study will specifically focus on the use of horizontal drilling and hydraulic fracturing to extract shale gas. The potential exists to develop more energy resources but it must be done in a manner that balances energy needs with the protection of public health and the preservation of the environment.

Water Supply. Although North Carolina has historically been a water-rich state, many areas of the state have felt the impact of drought in recent years. Some parts of the state experienced severe drought in 2002 and 2007; conservation measures imposed in response to those droughts affected agriculture, industry and residential water users. Since 2007, the General Assembly acted to require water systems to develop more effective water shortage response plans and to give the state a more active role in managing drought response.

Although the state as a whole has had very stable drinking water supplies, the most easily tapped water sources are not always located in the same river basin as urban areas experiencing rapid growth and increasing water demand. That has led to conflict in recent years over the practice of piping water from one river basin to another and legislative action to make "interbasin transfer" approvals more difficult to obtain.

The General Assembly has also wrestled with the issue of water allocation. North Carolina continues to be one of only two states without a water withdrawal permitting system for most of the state. (The department only issues withdrawal permits in a 15-county area of the central coastal plain where deep aquifers became depleted due to overuse; in that area, state permits are needed for large groundwater withdrawals from the affected aquifers.) As the state's population has grown and competition for water resources increased, the state has begun to focus more attention on water supply planning and allocation. A 2009 report commissioned by the General Assembly recommended development of a statewide permitting system for large water withdrawals. The legislature has not acted on that recommendation, but has taken a series of more modest action. Most recently, the General Assembly directed the department to continue work on development of hydrologic models for all of the state's river basins as a planning tool for future water supply decisions.

Coal Ash. A final emerging issue that has affected several DENR divisions is the need to store and monitor coal combustion residuals, or CCRs. Coal combustion residuals are wastes generated by coal-fired electric power plants. CCRs consist of the following types of waste:

- Fly Ash (silty)
- Bottom Ash (sandy)
- Boiler Slag (rock-like)
- Flue Gas Desulphurization residuals (gypsum)

Within the last decade, power plants have been converting their air quality controls to accommodate changing federal and state laws. In the future, DENR anticipates that there will be fewer coal-fired power plants in the state, but there will continue to be large amounts of dry CCRs. While markets exist for some of these waste products, ultimately, a larger amount of ash will have to be transported to landfills.

This poses a challenge to the state due to a continuing need for landfill space for this type of industrial waste disposal and the associated environmental hazards. Environmental concerns from CCRs pertain to pollution from impoundments and landfills leaching into groundwater and structural failures of impoundments, like the one that occurred in 2008 at the Tennessee Valley Authority's plant in Kingston, Tennessee. TVA's Kingston spill of coal combustion residuals flooded more than 300 acres of land, damaging homes and property. The released materials flowed into the Emory and Clinch Rivers, filling large areas of the rivers and resulting in fish kills.

In the past, much of the ash produced was 'wet' and ended up in surface impoundments (coal ash ponds). After the CCR release in Tennessee, the N.C. Division of Land Resources has conducted inspections of all existing coal ash impoundments in North Carolina. The state inspectors determined there are no problems threatening the immediate safety of the impoundments. In addition, many existing National Pollution Discharge Elimination System (NPDES) permits did not require groundwater monitoring around the coal ash ponds. Since the public concern after the Tennessee catastrophe, the N.C. Division of Water Quality (DWQ) has been meeting with the utility companies to take more proactive steps in determining if these surface impoundments have affected groundwater quality.

State utility companies are working with DWQ to put monitoring wells around every active ash pond and some inactive ash ponds for NPDES permitted facilities to determine if groundwater exceedances exist due to the impoundments of ash. These monitoring wells were approved and in place by May 2011. Since May, both utility companies have completed one to three sets of groundwater sampling for each facility, and they continue to work with DWQ staff to determine if exceedances reported are naturally occurring or if corrective actions will be required.

Another DENR agency, the N.C. Division of Waste Management (DWM), regulates coal ash as a solid waste. Generators of dry CCRs are required by state law to obtain a permit from the N.C. Division of Waste Management before operating a landfill to dispose of dry CCRs. Generators of CCRs are also required to notify the division if they intend to reuse dry CCRs as a structural fill, a term used to describe a building pad, parking lot or a foundation

for a structure. DENR's solid waste industrial landfill regulations have been in place since the early 1980s and have been updated several times. Eight landfills in North Carolina accept CCRs. Two additional CCR landfills have been proposed. Existing CCR landfills will continue to expand in size. Today, all CCR landfills are lined and include a leachate control system. Monitoring of groundwater is accomplished through use of groundwater monitoring wells and (liner) leak detection systems at the bottom of the ash landfill.

Climate Change refers to changes in temperatures, precipitation, sea levels and other environmental conditions due to emissions of carbon dioxide (CO2) and other greenhouse gases and particles. Scientific measurements have documented a substantial increase in CO2 levels in the atmosphere since the mid-1800s, coinciding with increased industrial development in much of the world. CO2 and other greenhouse gases (GHGs), such as water vapor, methane, nitrous oxide, black carbon and fluorocarbons, can trap heat in the atmosphere by reflecting radiated heat back toward the Earth. Even small increases in temperatures could cause major changes such as disruption of normal growing conditions for food crops, melting of polar icecaps, rising sea levels and flooding of coastal lands, changes in ocean currents, and more frequent and stronger storms.

A 2007 Supreme Court decision holding that GHGs are air pollutants covered by the Clean Air Act set in motion a number of EPA actions leading to permitting of GHG emissions. In response to the court ruling and lawsuits filed by environmental groups, the EPA issued GHG emissions standards for motor vehicles in June 2010. Also in 2010, EPA required Title V facilities – the largest stationary sources – to start reporting their annual emissions of CO2 and other GHGs. Effective Jan. 2, 2011, federal rules require permits for facilities that have the potential to emit more than 100,000 tons of greenhouse gases per year.

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