# the WATER connection

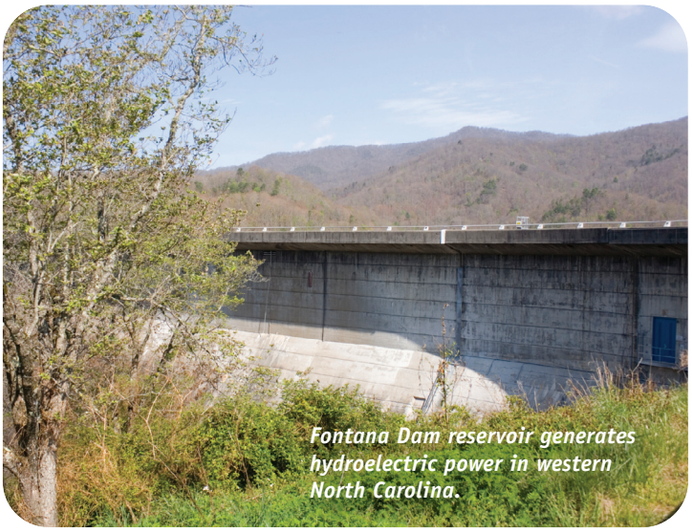
## WATER RESOURCES, DROUGHT AND THE HYDROLOGIC CYCLE IN NORTH CAROLINA

*Rafting on the Cheoah River, Graham County*

PHOTO COURTESY OF NC DIVISION OF TOURISM, FILM AND SPORTS DEVELOPMENT

*The average American family of four can use 400 gallons of water per day.*
**(Source: U.S. EPA)**

PHOTO COURTESY OF NC DIVISION OF TOURISM, FILM AND SPORTS DEVELOPMENT



*Fontana Dam reservoir generates hydroelectric power in western North Carolina.*

*Painted turtle*

NCWRC

*Salamanders and many other animals depend on seasonal rains to survive.*

# North Carolina is a place rich in water—from its cascading mountain streams and immense Piedmont reservoirs to its sprawling coastal waters.

These valuable resources support an interconnected social, economic and environmental system that sustains our quality of life. More than 9 million residents depend on this water for drinking, irrigation, manufacturing and industrial processes, mining, recreation, navigation and hydropower. Our diverse wildlife find food, shelter and breeding grounds in the state's rivers and wetlands. The state has 3,375 miles of tidal shoreline, 320 miles of coastline, vast reservoirs, 17 major river basins and a huge network of groundwater.

Because North Carolina has relatively abundant sources of water, we sometimes overlook the need for planning and conservation. Our vulnerability is most apparent during times of drought. To adequately protect North Carolina's precious water resources, we need to understand and appreciate where water comes from, how it replenishes itself, how we might unwittingly harm it, and how we can cope when we have too much or not enough of it.

*Fly fishing on Falls Lake near Raleigh*

*Boating in Wilmington, New Hanover County*

PHOTO COURTESY OF NC DIVISION OF TOURISM, FILM AND SPORTS DEVELOPMENT

*Irrigating soybean field*

*It takes 18,000-20,000 gallons of water to fill the average swimming pool.*

# North Carolina's Climate

Weather describes relatively short-term atmospheric changes, such as those that spawn a cold front or passing thunderstorm. Climate, on the other hand, is a composite picture of weather patterns observed over many years. Temperature, precipitation and prevailing winds combine to create the weather and, thus, the climate.

## What is North Carolina's climate like?

North Carolina has a humid, subtropical climate characterized by warm summers and short, mild winters. The growing season (the average annual freeze-free period) ranges from about 130 days in the highest mountain areas to around 290 days on the Outer Banks. At Hatteras, entire seasons often pass without frost or freezing temperatures.

A place's climate is determined by altitude (feet above sea level), topography (surface features), latitude (distance from the equator) and proximity to water (large lakes or oceans). The variation in altitudes in North Carolina—from 6,684 feet at the summit of Mount Mitchell to sea level at the coast—is the greatest of any state east of the Mississippi River. From the highest point to the lowest, the average temperature difference is more than 20 F, with the coolest weather happening in the mountains of western North Carolina. The Southern Appalachian mountains block much of the cold winter air coming out of the Southeast, moderating winter temperatures in the central Piedmont regions. Warm eddies spinning off the Gulf Stream current produce mild winters at the coast.

North Carolina receives an average of 48 inches of precipitation per year, falling predominantly as rain. The Coastal Plain gets about 48–60 inches annually, while the Piedmont usually sees 40–50 inches. The most extreme variations in annual precipitation are within the mountain region. The mountains create a barrier to moisture moving easterly from the Gulf of Mexico. As moist air rises over the mountains, much of the precipitation drops on the western slopes, reducing the amount of moisture reaching the eastern mountains. The average annual rainfall is about 38 inches east of the slopes, whereas places west of the slopes see much higher amounts. In some parts of the mountains, more than 90 inches are recorded in an average year. These places are considered temperate rainforests.

On the whole, winter precipitation in North Carolina is seldom associated with very cold weather. Average winter snowfall rates are about 1 inch per year on the Outer Banks and the lower coast, about 10 inches in the northern Piedmont and about 16 inches in the southern mountains. Some of the higher mountain peaks and upper slopes see an average of about 50 inches of snow each year.*

## How will global climate change affect North Carolina?

The average temperature in North Carolina increased by 1.2 F in the last century, and average precipitation has increased by 5 percent in many parts of the state. The Intergovernmental Panel on Climate Change estimates that average temperatures in the state could rise by as much as 5 F this century—causing an increase in the number of extremely hot days and making the climate more like that of present-day northern Florida. Precipitation could increase by up to 30 percent in some areas by the year 2100.** Many scientists predict that rising sea surface temperatures caused by global climate change will likely cause more frequent and intense hurricanes. In spite of more abundant precipitation, droughts may become more frequent due to greater evaporation rates connected to higher temperatures.

*Source: State Climate Office of North Carolina
**Climate Change and North Carolina. U.S. Environmental Protection Agency. Sept. 1998.

### RAINDROPS KEEP FALLIN'

**Precipitation could increase by as much as 30 percent in some parts of North Carolina by the year 2100.**

*View of Linville Gorge*

PHOTO COURTESY OF NC DIVISION OF TOURISM, FILM AND SPORTS DEVELOPMENT

# The Impact of Hurricanes and Floods

North Carolina has a long and storied history of hurricanes. The state is fourth in the nation in the number of recorded hurricane strikes, with 48 direct assaults on its coastline between 1851 and 2006.

*A hurricane approaches Topsail Beach.*

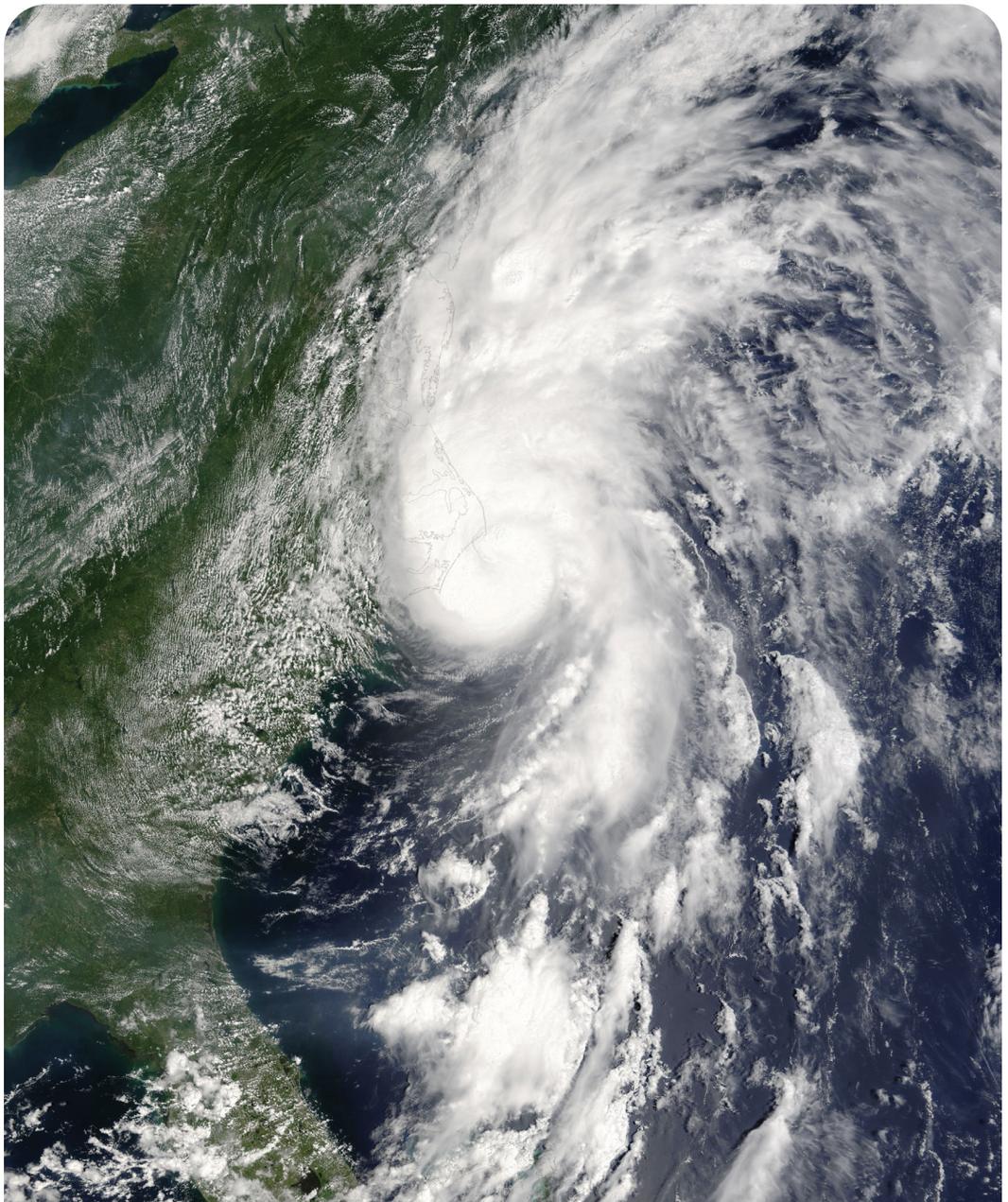
Much of the state's coastline, including Cape Hatteras, Cape Fear and Cape Lookout, juts into the ocean, making it an easy mark for tropical cyclones curving northward. Hurricane season in the Atlantic is from June to November, with peak activity in early September.

Tropical storms come close enough to influence North Carolina weather about twice in an average year. Though these storms may deliver damaging winds, heavy deluges and dangerously high storm surges to North Carolina, they also have benefits. In the years that they occur, tropical systems account for as much as 25 percent of our yearly rainfall totals. Often, a visiting hurricane is the main source of water for alleviating prolonged drought.

Precipitation from tropical systems is essential for refilling reservoirs and recharging groundwater, delivering the water we need to produce food and keep the taps flowing.

Floods, too, have benefits for the environment, even though they can cause misery for people. The most severe flooding in our state is associated with tropical storms in the fall, especially when they occur back-to-back. Flooding is more commonplace in the Piedmont in winter and early spring, when migrating low-pressure systems bring heavy rainfall. Flooding is part of the natural ebb and flow of stream ecology. Native fish, wildlife, trees and other plants have become adapted to seasonal fluctuations of water levels.

PHOTO COURTESY OF NASA



*Hurricane Alex skims the North Carolina shoreline at noon on Aug. 3, 2004. At that time, Alex was a Category Two hurricane with maximum sustained winds of 100 miles per hour.*

### STORM LINGO

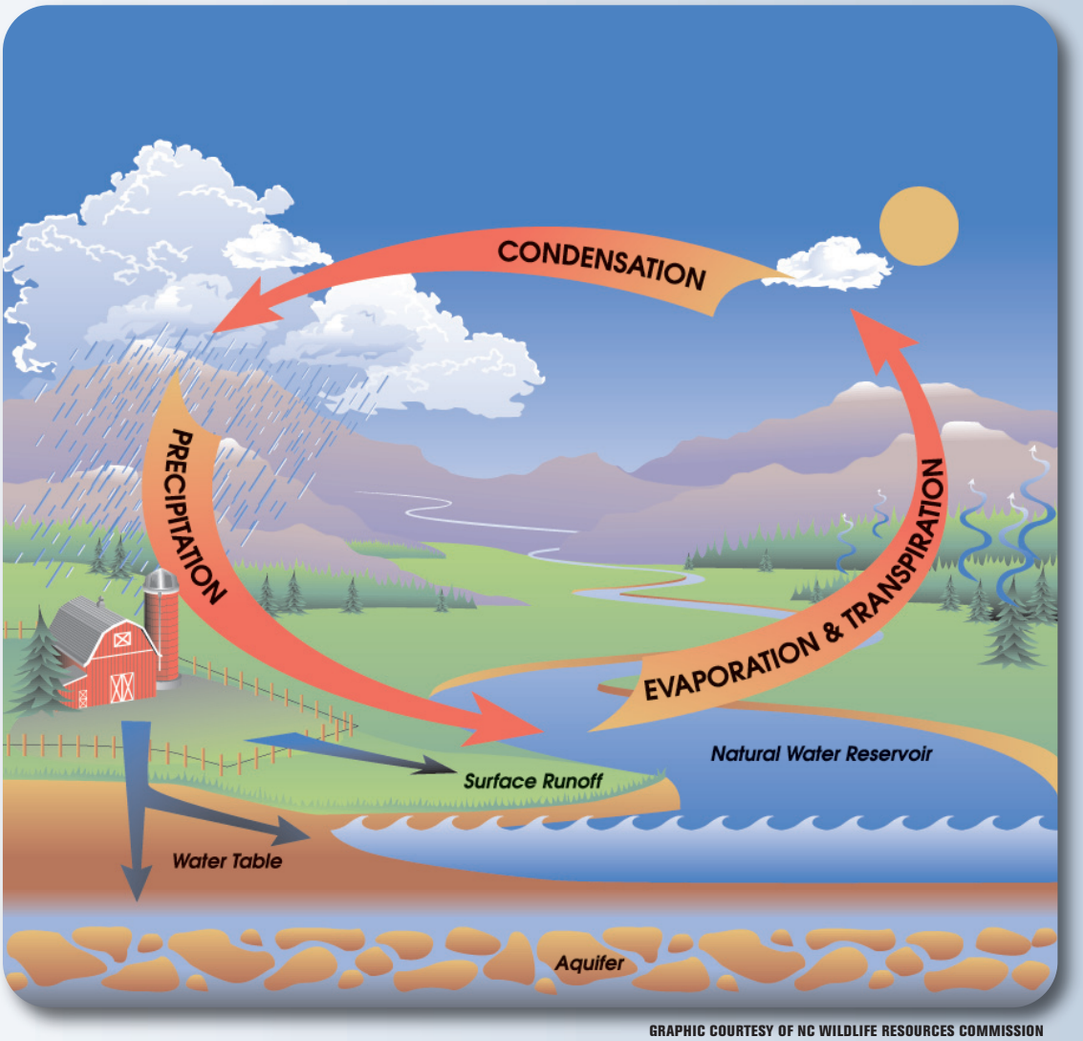
**TROPICAL CYCLONE**
A low-pressure system that develops over warm, tropical waters and has an organized, counterclockwise circulation of wind.

**TROPICAL STORM**
A tropical cyclone in which the maximum sustained surface winds range from 39 mph to 73 mph.

**HURRICANE**
An intense form of tropical cyclone. When the maximum sustained winds (1 minute or longer) reach 74 mph, these storms take on the status of hurricanes.

# The Hydrologic Cycle

The ocean covers 70 percent of the planet's surface. About 97 percent of the world's water is saltwater. The remaining 3 percent is fresh water—about 2 percent is frozen in glaciers and ice caps, leaving less than 1 percent in a form that humans can access for drinking and irrigating crops.




GRAPHIC COURTESY OF NC WILDLIFE RESOURCES COMMISSION

### WHERE DOES IT GO?

**Of all the precipitation that reaches the ground, about one-third runs off land, and the remainder either soaks underground or evaporates. About 90 percent of water in the atmosphere is evaporated from the surface of the ocean and other bodies of water. About 10 percent is evaporated from the ground.**

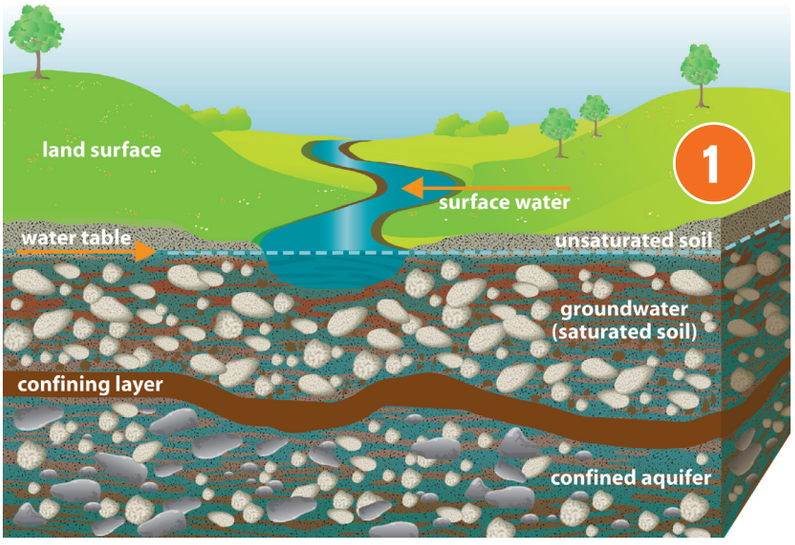
Water is nature's shape shifter—taking the form of a liquid (rain, surface waters such as groundwater, and oceans), a gas (water vapor) or a solid (snow, ice, sleet, hail). All the water on Earth moves between the ground and the atmosphere, over and over again, through the natural processes of precipitation, evapotranspiration and condensation.

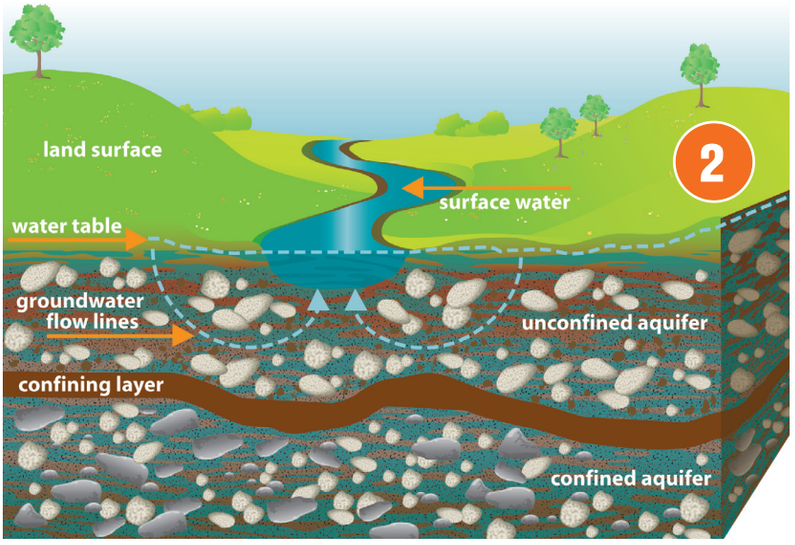
**Evapotranspiration** The sun is the engine for the water cycle, and precipitation is its gears. When the sun heats the ocean, lakes and rivers, warm water at the surface evaporates (turns into invisible vapor) and rises into the atmosphere. Moisture also evaporates from the ground. Additionally, plants take up water through their roots and release it back into the air as vapor via tiny openings in their leaves. This process is called transpiration. The sum of all evaporation and transpiration is known as evapotranspiration.

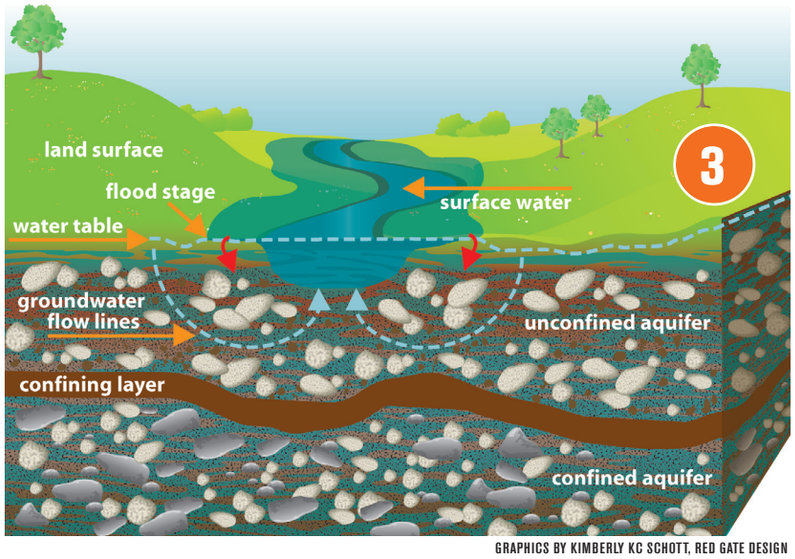
**Condensation** When the warm vapor rising from the surface meets cooler air aloft, it condenses and becomes liquid again. Tiny droplets of water coalesce into clouds. These water droplets combine to form bigger droplets, which eventually become dense enough to fall as precipitation.

**Precipitation** Precipitation that reaches the ground returns directly to bodies of water or runs over the land on a downward path to these surface waters. This water is called runoff. Some precipitation is "intercepted" by plants in forests, fields, pastures and gardens, some evaporates directly from the soil surface, and some seeps (infiltrates) underground to replenish groundwater supplies.

# Groundwater and Surface Water Connections




GRAPHICS BY KIMBERLY KC SCHOTT, RED GATE DESIGN

## What are surface water and groundwater?

When it rains, some of the water washes over land and by the force of gravity finds its way into creeks, streams, rivers, ponds, lakes, estuaries and, ultimately, the ocean, which contains most of the water on the planet. This water is called surface water. The rain that doesn't run off soaks into the soil, where it is used by plants or evaporated. When precipitation is abundant enough, water seeps (infiltrates) deeper and deeper underground, traveling through spaces (pores) between soil particles and fractured rock until it reaches a solid (impermeable) layer such as compacted clay or rock. When all the empty spaces are filled up, the ground becomes saturated. The saturated area is groundwater. The top of this saturated area is known as the water table.

## How do groundwater and surface water interact?

Though they are called by different names, groundwater and surface water actually have a reciprocal relationship, regularly feeding each other. Most streams and rivers, for example, get about half their volume from groundwater. When the water level in a stream drops lower than the water table, groundwater flows into the stream channel. During long periods without rain, groundwater may sustain the entire flow of streams and rivers. Conversely, surface water sources can recharge aquifers when the stream channel exceeds the height of the water table. The major source of groundwater recharge, however, is precipitation.

## water wise

1 The ground above the water table may be wet to a certain degree, but it does not stay saturated. The dirt and rock in this unsaturated zone contain air and some water and support vegetation. The ground below the water table is saturated. The saturated zone below the water table has water that fills the tiny spaces (pores) between rock particles and the cracks (fractures) of the rocks. (Source: USGS)

2 Groundwater and surface water have a reciprocal relationship, regularly feeding each other. Most streams and rivers get about half their volume from groundwater.

3 During a flood, surplus surface water helps recharge groundwater.

# Groundwater and Surface Water Connections *continued*

## How does groundwater move?

Many people mistakenly think of groundwater as an underground river, mimicking how a river flows at the surface. Unlike the water in lakes, streams and oceans, groundwater is a virtually invisible resource—so it's understandable that there are misconceptions about what it is, where it comes from and how we use it. Groundwater is not static—it doesn't just sit still, waiting to be pumped to the surface. It is constantly moving. Groundwater flows under the influence of gravity and varying hydraulic and atmospheric pressures. The speed of movement depends on many factors, including the amount of precipitation and the type of material through which groundwater must flow. In clay-rich soils, for example, it travels more slowly; in sandy soils, the flow is faster. Compared to river and streams, groundwater travels at a glacial pace. While the flow of rivers and streams is measured in feet per second, the rate of some groundwater flow may be as little as inches per year.

## What is an aquifer?

An aquifer is underground soil and/or rock through which water can easily move. Groundwater is stored in aquifers. Aquifers are typically made of fine-grained rock like gravel, sand, sandstone or limestone. There are two types of aquifers: unconfined and confined. An unconfined aquifer has no barrier between its top layer and the surface of the ground—the water level rises and drops in response to precipitation infiltrating directly from above. Confined aquifers are sandwiched between two largely impenetrable layers like clay or shale and so they are under pressure. Depending on the geology of a region, multiple aquifers may be "stacked" on top of one another. Because multiple aquifers can interact with one another, they are perhaps more accurately thought of as aquifer systems.

## How and when is groundwater recharged?

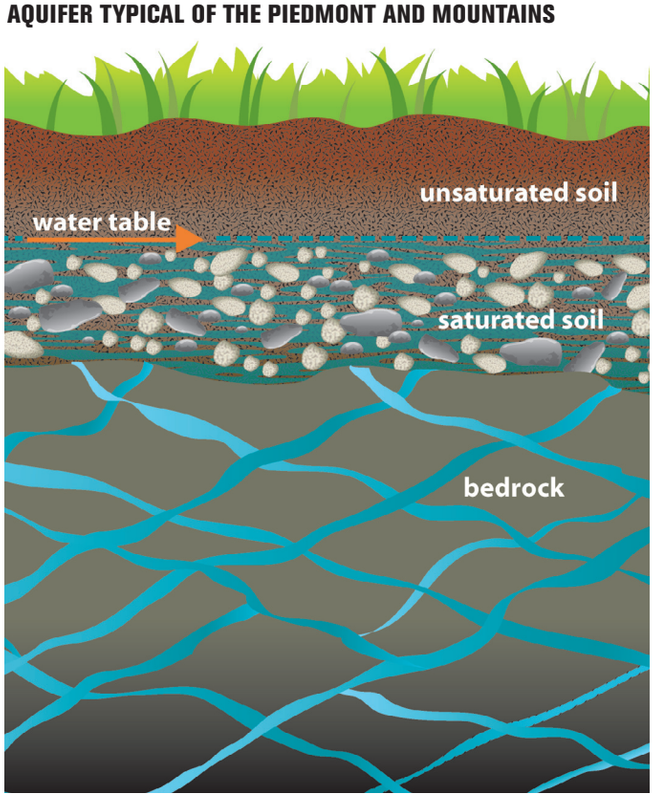
The rate of groundwater recharge depends upon the climate (amount of precipitation), the geology of the region, the soil type and infiltration capacity, the depth to the water table, and the landscape type and slope.

Unconfined aquifers have an expansive upper area that is open to recharge—they fill rather quickly in response to local precipitation. Confined aquifers, by comparison, have a limited number of places through which rainfall can

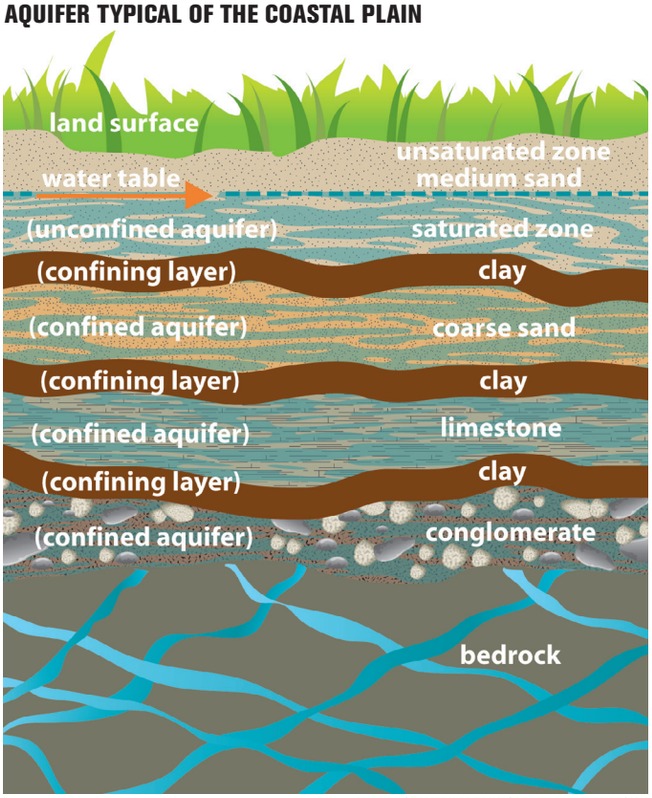
## aquifers 101

**In the Piedmont and Mountain regions, groundwater is stored in soil, weathered rock and bedrock. In the Coastal Plain, layers of sand, limestone and other sedimentary rock form a series of confined aquifers containing huge stores of water.**

**AQUIFER TYPICAL OF THE PIEDMONT AND MOUNTAINS**




**AQUIFER TYPICAL OF THE COASTAL PLAIN**




GRAPHICS BY KIMBERLY KC SCHOTT, RED GATE DESIGN

# Groundwater and Surface Water Connections *continued*

**WATER SUPPLY**

**In North Carolina, residents draw their water from both surface water and groundwater. About half of our water is supplied through groundwater.**

enter, so they are recharged much more slowly. The recharge areas for confined aquifers are often many miles away from where wells are located.

Groundwater levels rise and fall during and after rain. However, in North Carolina, evaporation plays a greater role in surpluses and deficits of groundwater throughout the year. Groundwater levels are higher in late winter and early spring due to slower rates of evapotranspiration and lower in summer due to higher rates.

### Can we run out of groundwater?

Though technically groundwater is a renewable resource, it is for practical purposes a finite one. In some places, it may take thousands of years for aquifers to be replenished. It is possible for people to remove groundwater faster than it can be replaced. Such a phenomenon is becoming more common, with an ever-increasing population and accompanying growth of business, industry and agriculture. Depletion of groundwater is becoming a vexing issue in some parts of eastern North Carolina.

*Drawdown*. If individual wells are pumped faster than they can be replenished, the water level can drop below the intake. This drawdown may cause wells to "run dry." In the Coastal Plain, extensive confined aquifers are so well-connected that large withdrawals of well water, such as for irrigation or a town's water supply, may affect users far away, reducing both pressure and supply. Water levels have plunged to such a degree that the state is now forced to limit withdrawals in a large portion of this region.

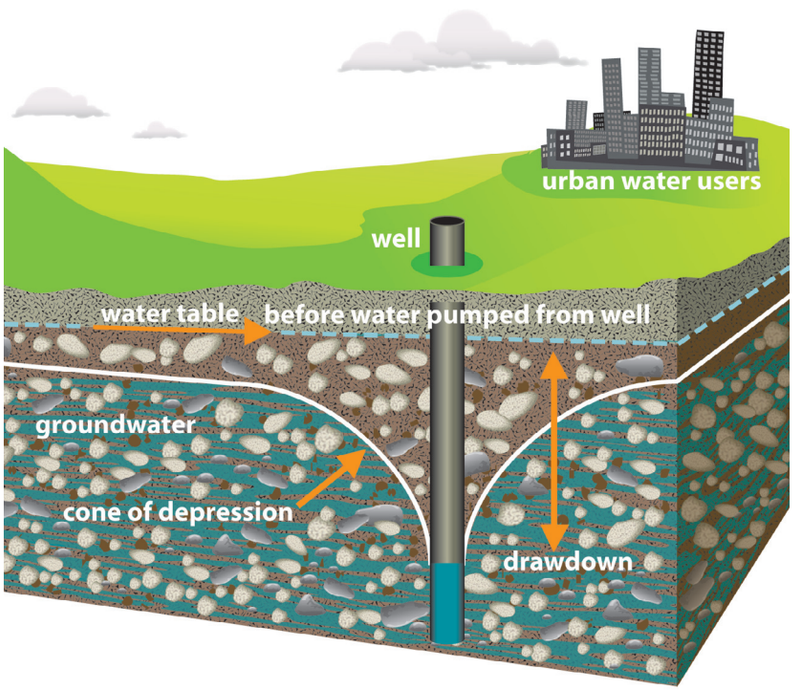
*Saltwater intrusion*. When pumping exceeds the freshwater recharge rate, saltwater can migrate into aquifers, contaminating wells located at or near the coast.

*Subsidence*. When water levels in confined aquifers decrease due to overpumping, the land over the aquifer can settle, causing loss of storage capacity or complete collapse of the aquifer. Significant subsidence has been observed in parts of the Coastal Plain.

*Contamination*. Though a sufficient volume of groundwater may be present, the supply may become contaminated by seepage from septic tanks, fuel tanks, landfills or surface pollution.

## how do wells work?

**Most people are familiar with groundwater because of wells. There are different types of wells, but basically all are made by puncturing an aquifer. A pipe is sunk into the aquifer below the water level, and water is pumped to the surface. North Carolina wells can vary from about 20 feet deep to more than 1,000 feet deep.**




GRAPHIC BY KIMBERLY KC SCHOTT, RED GATE DESIGN

### Where does my water come from?

Almost 90 percent of residents in the state's Coastal Plain rely on groundwater from private or community wells. The Coastal Plain is composed of layers of sand, limestone and other sedimentary rock that have accumulated over millions of years from the weathering of the sloping lands to the west. These layers form a series of productive aquifers that contain huge stores of water. Though many rivers flow through the Coastal Plain region, the relatively flat terrain offers few natural or convenient locations to develop reservoirs to hold water. Use of coastal rivers for water supply is also limited because saltwater migrates upriver during dry periods.

The populous, urban centers of the Piedmont get their supply primarily from surface waters; many mountain residents also draw on large reservoirs. The rolling hills of the Piedmont and steep terrain of the mountains contain many valleys through which large rivers flow. Many of these rivers have been dammed to harness the power and volume of water for generating electricity and providing drinking water. Aquifers in the Piedmont and mountain regions are not as plentiful and accessible as coastal aquifers. In these two regions, groundwater is stored in the soil and weathered bedrock and also within deep layers of bedrock. Wells here typically tap into water in cracks and crevices in rock formations.

# All about Drought

Some regions naturally receive more rainfall than others, due to geography and climate. Where you live, you probably have a good idea of how often and how much it typically rains. If it rains less than normal over a prolonged period, the affected area is in a drought. Droughts may last for months or years.

A severe drought can be disastrous for people, just like a hurricane or tornado. But unlike those conspicuous, relatively sudden storms, a drought has a gradual onset, and its consequences aren't always immediately noticeable.

## Who is affected by drought?

No part of the public or private sector—whether commercial, industrial, institutional or residential—is immune from the effects of drought. Water shortages caused by drought affect all kinds of essential goods, services and activities that many of us take for granted. Every year, drought in America may cause between $6 billion and $8 billion in damages, according to the Federal Emergency Management Agency.

*Agriculture.* One of the most costly and damaging effects of drought is agricultural. Due to lack of rain or water for supplemental irrigation, farmers face reduced or zero yield on staple crops such as corn, soybeans, wheat and hay. The supply of food they grow for America's table also dwindles. Livestock production is as vulnerable as crops. Parched pastures become unusable for grazing or producing hay. Farmers may be forced to find supplemental hay and feed, the prices of which can spike due to tight supply. Orchards, nurseries and vineyards are similarly vulnerable parts of the agricultural sector. Droughts may even harm the aquaculture and commercial fishing industry, due to factors such as changes in the freshwater/saltwater balance in estuaries, increased water temperatures and concentrated pollution.

## types of drought

### METEOROLOGICAL DROUGHT

Meteorologists and climatologists regularly measure precipitation at the local, regional, state and national scales. By studying historical trends and local geological conditions, they have learned what levels of rainfall are normal for a given area. A pattern of abnormally dry weather is usually the first indicator of drought. It may take months of dry weather before conditions meet the definition of meteorological drought.

### AGRICULTURAL DROUGHT

When there isn't enough moisture in the soil to adequately sustain crops, yields may be reduced or wiped out altogether. This type of drought is obvious to anyone who makes his or her living from any form of agriculture, but the public is usually slow to take notice. Drought directly affects farmers and producers; it indirectly affects consumers.

### HYDROLOGICAL DROUGHT

Hydrological impacts are usually the last to be felt. Lake levels drop significantly, streams flow more slowly, and groundwater supplies diminish. At this point in a drought, users may begin to compete openly for available surface water and groundwater. Man-made reservoirs are substantial sources of water for drinking water, irrigation, hydropower and recreation in urban areas. Depletion of groundwater supplies also has an impact on irrigation and drinking water.

*Residential*. Drought reduces water supply in wells and reservoirs, from which we get water for drinking, bathing, washing clothes and dishes, cooking and other domestic uses.

*Industry*. An ample supply of water is critical for some manufacturing and industrial processes.

*Forestry*. Dry conditions along with strong winds that can accompany drought make forests more vulnerable to fire. A lightning strike or wayward match can turn drought-stricken forests into an inferno, laying waste to timberland and threatening property near the blaze.

*Power generation*. The power that heats and cools our homes and businesses, gives us light and runs our appliances and machines is supplied by methods that rely heavily upon water, such as hydropower, nuclear and coal-fired power plants. If water levels in reservoirs drop low enough, hydropower plants have less intake water for power generation. Nuclear power plants depend on lakes for water for cooling their reactors. Coal-fired plants also withdraw surface water for their cooling condensers.

*Recreation*. Water-based recreation and tourism take a hard hit from drought—river rafting, boating, swimming and fishing, to name a few activities. Parched fairways may even keep golfers off the green.

*Natural resources*. Decreased water flows reduce habitat for fish, shellfish and other aquatic species in rivers, lakes and wetlands, and indirectly affect other species bound to aquatic environments. Upland ecosystems such as forests also suffer ill effects from drought, including stunted growth and increased risk of disease.

*Navigation*. Low water levels impede navigation and affect shipping routes.

### Are droughts normal?

Droughts are nothing new. By studying trees and sediments, for example, climatologists have been able to reconstruct a picture of droughts that happened hundreds and even thousands of years ago. Drought is a natural part of cyclical weather patterns in North America. Drought is always occurring somewhere in the United States. In a given year, an average of 12 percent of the country (lower 48 states) is suffering severe to extreme drought conditions, according to the National Drought Mitigation Center.

### Can scientists predict droughts?

Though droughts are a weather phenomenon, meteorologists can't deliver long-range forecasts on the nightly news. To predict a drought, climatologists would have to be able to foresee precipitation and temperature many months in advance. They can and do, however, study historical data and look for patterns and trends that are enlightening. Some assumptions can be made about the likelihood of dry weather, based on observations of cyclical climate events such as La Niña, a cold-water phenomenon in the Pacific that happens about every two to seven years. La Niña usually brings with it a ridge of high pressure over the Southeast, which steers moisture-bearing storms west and north of North Carolina and other Southeast states. This explains why drought might plague those of us in the Southeast at the same time the Midwest is deluged.

### How are surface water and groundwater levels affected by drought?

During long periods without rain, water evaporating from lakes and other surface waters is greater than the amount of water entering surface waters. For that reason, water levels drop. During drought, groundwater may be the only contributor to the flow of rivers and streams. As drought continues, the groundwater supply decreases, depleting streams even more.

**Drought severity is defined by impacts, such as to agriculture and our water resources. Without impacts, it's just dry weather.**

# All About Drought *continued*

### Who declares drought, and how do I know how badly my area is affected?

The N.C. Drought Management Advisory Council has a team of climatologists, geologists and experts in forestry, agriculture, water resources and other relevant disciplines that meets weekly to assess drought conditions. These experts take into consideration streamflows, groundwater levels, the amount of water stored in reservoirs, climate, weather forecasts, the time of year and other relevant factors. The team reports its findings to the U.S. Drought Monitor. Drought status, updated weekly, can be viewed at www.ncdrought.org.

Drought officials use a ranking system that ensures that response measures don't target a larger portion of North Carolina than necessary. Drought intensity is classified on a scale of 0 to 4, from least intense (D0) to most intense (D4). State and local officials use the drought categories to help local governments and other water suppliers determine appropriate responses, such as voluntary or mandatory water restrictions.

### How can I find out about water restrictions where I live?

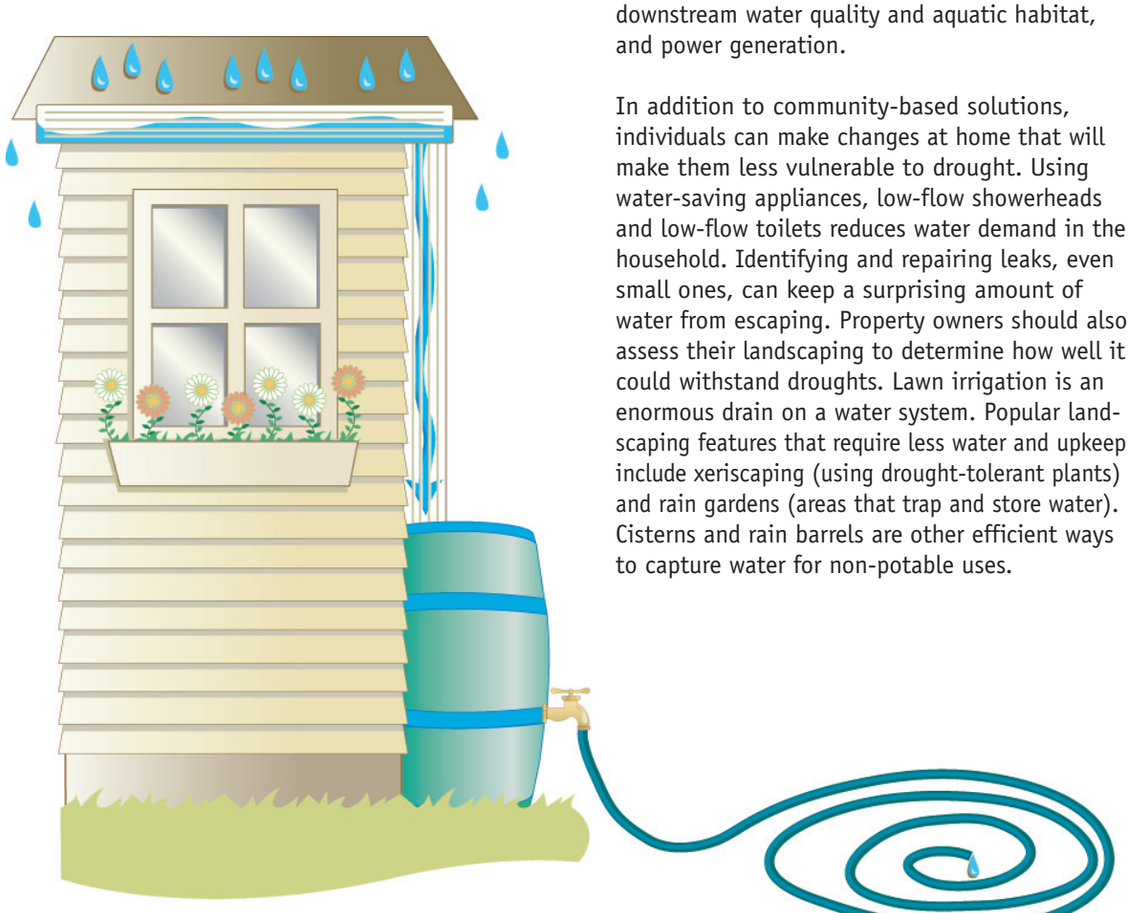
The Web site, www.ncdrought.org, provides an updated list of any restrictions in effect, by county.

### How can we prepare for drought?

Because droughts are a normal part of the weather cycle, we should anticipate and prepare for them, just as we do for hurricanes. We know that population growth increases vulnerability to drought. Therefore, planning for future growth is essential. In the future, more people will be competing for the same amount of water. If communities identify and address ways in which they are at risk, they can reduce the impact of future droughts on all water users.

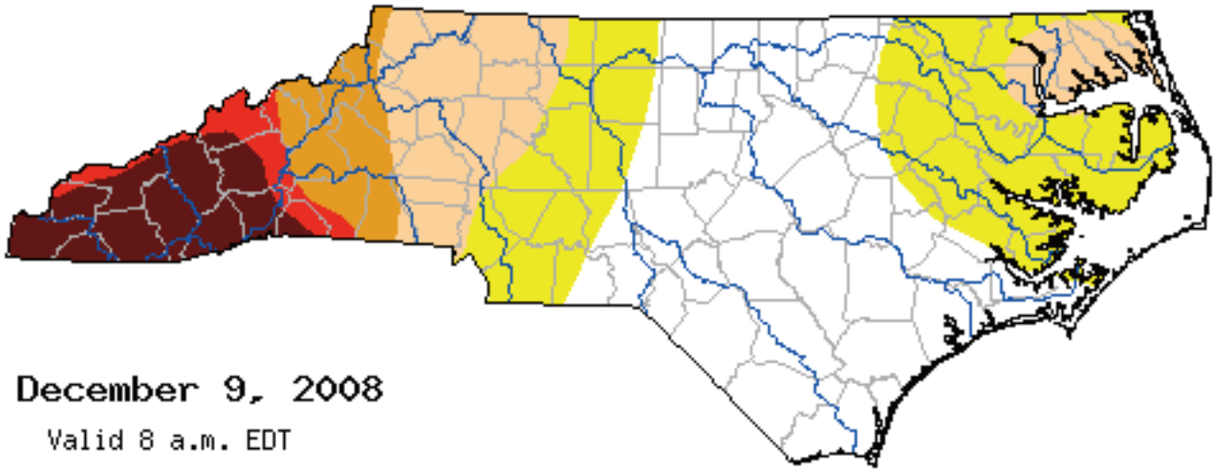
In North Carolina, all municipal and large private utilities are now required to have a Water Shortage Response Plan in place. The plan establishes authority for declaration of a water shortage and defines different stages of its severity. The plan must also outline appropriate responses for each stage so that essential needs are satisfied, including drinking-water supply, maintenance of downstream water quality and aquatic habitat, and power generation.

In addition to community-based solutions, individuals can make changes at home that will make them less vulnerable to drought. Using water-saving appliances, low-flow showerheads and low-flow toilets reduces water demand in the household. Identifying and repairing leaks, even small ones, can keep a surprising amount of water from escaping. Property owners should also assess their landscaping to determine how well it could withstand droughts. Lawn irrigation is an enormous drain on a water system. Popular landscaping features that require less water and upkeep include xeriscaping (using drought-tolerant plants) and rain gardens (areas that trap and store water). Cisterns and rain barrels are other efficient ways to capture water for non-potable uses.



## what is a rain barrel?

**A rain barrel captures water from a roof that otherwise might be lost to runoff or diverted to storm drains. It stores water for supplemental watering of gardens or tasks like car or window washing. A rain barrel conserves about 1,300 gallons of water for the average homeowner during peak summer months.** (Source: U.S. EPA)




**DROUGHT CLASSIFICATIONS**

- D0—Abnormally Dry
- D1—Moderate Drought
- D2—Severe Drought
- D3—Extreme Drought
- D4—Exceptional Drought

**U.S. DROUGHT MONITOR FOR NORTH CAROLINA**

***The Web site, www.ncdrought.org, provides weekly updates on where drought is impending, lessening or worsening in the state. It includes a map for handy reference and a county-by-county summary of any water restrictions in effect.***

## Reflections on Drought

The 2007–2008 drought in North Carolina was the worst in the 112-year recorded rainfall history. The state accelerated from normal conditions to record drought status in less than a year. The state also set records in the number of days of low humidity and number of days with temperatures above 90 F.

The 2007 drought had wide-reaching, drastic effects:

- Water-use restrictions affected 53 percent of the public water systems and about 5 million people. At one point, as many as 30 cities and towns were confronted with running out of water or having to ration it. Many were within 100 days of exhausting their supplies.
- Forest landowners and many residents in wildfire-prone areas were hit hard by drought. Local firefighters and the N.C. Division of Forest Resources fought 7,200 wildfires—30 percent more than the annual average of 5,000. The fires burned more acreage than had burned in any year in the previous two decades.
- Farmers suffered $500 million dollars in damages due to losses of soybeans, corn, cotton, tobacco and other crops.

# Planning for the Future

Though it's true that the amount of water on Earth essentially doesn't change, the number of people on our planet does. Population growth increases pressure on all of our vital natural resources. Though North Carolina has not experienced the intense water wars common in the West, competition for water is heating up in some parts of North Carolina.

With 9.2 million people, North Carolina is the 10th most populous state, and it continues to grow. It is now the sixth-fastest-growing state in the nation. Much of North Carolina's expansion is happening in the Piedmont region, in a broad swath between Raleigh and Charlotte. Raleigh and Charlotte are among the 10 fastest-growing cities in the nation. Between April 2000 and April 2030, North Carolina's population is expected to grow by 4.4 million people (55 percent), reaching 12.5 million by the end of the 30-year period. Roughly 61.4 percent of this growth, 2.7 million people, will come from people migrating into the state.

Most water users in a 15-county area of the central Coastal Plain now must curtail their groundwater withdrawals and use alternative sources of water. Population in this area is projected to increase by 48 percent between 1997 and 2020 to more than 1 million people. In the most stressed areas, water users are required to reduce withdrawals by up to 75 percent over a 16-year period. Such steps are necessary to prevent destruction of the aquifers. Some cities in the Coastal Plain are planning major regional water treatment and distribution projects to help meet the growing demand.

The increasing costs and challenges of generating adequate water sources will make it less practical for many communities to act independently to meet their needs. In many cases, local water suppliers will need to explore regional solutions to water-supply issues. In some communities, suppliers may have to find alternative sources of water through cooperative relationships with other municipalities/utilities. Some cities and towns are working to build water lines that can deliver water from water-rich towns to communities with less water. In many places, success may depend not only on supplemental supplies, but also on conserving water and more efficiently using the resources that already exist. One conservation strategy being used in some places is partial treatment and recycling of water for non-potable uses like irrigation and industrial processes.

The N.C. Division of Water Resources is implementing a new river basin water-supply planning strategy to ensure that North Carolina has sustainable water resources to meet future needs. The plan created in 2001 provides a comprehensive assessment of water supply needs, water use and water availability across the state; identifies the major water-supply issues; and provides guidance for sound water-supply planning.

Local government-operated water systems and large community water systems are now required to prepare local water supply plans that evaluate their water-supply needs and available resources by looking at least 20 years into the future. These systems must assess current population and water availability and look at projected population changes and any associated changes in water supply and demand.

Meeting North Carolina's growing water-supply needs will require local governments, consumers and state government working together to orchestrate a successful combination of monitoring, planning and regulation. Smart decisions will be necessary to ensure that all of us have enough water for the future.

**THE LAND AND WATER CONNECTION**

**The development that comes with population growth affects water resources in ways besides increasing demand for water. As more ground is covered by buildings, parking lots and roads, there is less surface through which rain can seep into the ground and recharge groundwater supplies. Further, water runs off quicker and in greater volume over impervious surfaces than natural ones, causing streams to run higher and faster and exacerbating erosion and flooding.**

NCDENR

NCDWR

## WHAT IS THE N.C. DIVISION OF WATER RESOURCES?

The N.C. Division of Water Resources is under the umbrella of the state's Department of Environment and Natural Resources. The division's mission is to manage the state's water resources in a manner that provides for the health and welfare of the public, continued economic growth and the long-term sustainability of groundwater and surface water resources. In addition, the division manages an annual budget for water resources development grant projects. Key program areas in the division include river basin management, water supply planning, groundwater management, and water projects such as hydropower relicensing and the administration of grant funds for harbor and waterway dredging, beach nourishment, flood control and stream restoration.

**STATE OF NORTH CAROLINA**
Beverly Eaves Perdue, Governor

**DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES**
Dee A. Freeman, Secretary

Raleigh, North Carolina • September 2009

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## CREDITS

All photographs, unless otherwise noted, from www.istock.com.

Cover photographs of Falls Lake in Durham County, N.C., by Kevin Greene

Photograph of Sampson County, N.C., cornfield in drought (icon) courtesy of Tony Matthis

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