Discover North Carolina's River Basins

ENVIRONMENTAL EDUCATION

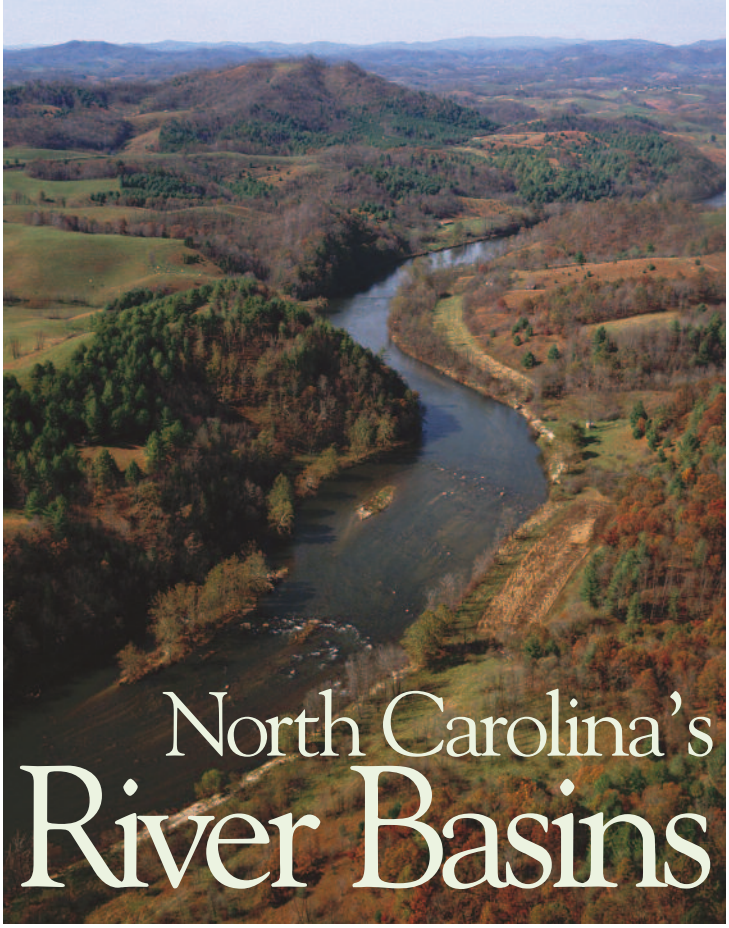
North Carolina is a diverse land with natural beauty that appeals to residents and visitors alike.

It is also a land experiencing competition for its natural resources that are already under stress and that could be lost to us in the absence of a widespread awareness of their existence, their significance and their value.

Natural resources are not isolated from each other or the people who use them. Each resource is an integral part of the ecosystem. When one part of the system is affected, other parts feel the impact. It is environmental education that provides the knowledge, understanding and awareness of this interconnectedness of all things and gives us the ability to make informed environmental decisions.

The more we understand and respect our own community, the more capable we are of being good stewards of the environment. If you have ever visited one of North Carolina's many Environmental Education Centers—nature centers, parks, aquariums, museums, the zoo, public gardens, etc.—then you have already started appreciating natural systems and had fun while learning about them.

Environmental education is not issue advocacy or a biased point of view. Environmental education enables communities to care for their own environment. Living within the limits set by the environment depends on the beliefs and commitment of individuals. Individuals working together as a community have more power to promote practices that can nourish rather than cripple their natural life-support systems.



KEN TAYLOR, WILDLIFE IMAGES

North Carolina's River Basins

In the 1990s, several crises elevated rivers in the public consciousness. First came *Pfiesteria*, a lethal organism that killed millions of fish in coastal waters. Then a series of hurricanes brought river and development issues to the forefront. How we treat rivers and the land around them has a direct relationship to our quality of life. The purpose of this booklet is to describe how river basins function and how humans and rivers are interconnected. It demonstrates how decisions we make as homeowners and citizens affect the quality of the water we drink, swim in and fish from. With this knowledge, individuals can make more informed decisions regarding their environment.

What is a River Basin?

A **river basin** is the land that water flows across or under on its way to a river. As a bathtub catches all the water that falls within its sides, a river basin sends all the water falling on the surrounding land into a central river and out to an **estuary** or the sea.

estuary: a semi-enclosed area where fresh water from a river meets salty water from the sea

river basin: drainage area of a river

GRAPHIC BY ERIN HANCOCK, NCWRC

A river basin drains all the land around a major river. Basins can be divided into **watersheds**, or areas of land around a smaller river, stream or lake. Large river basins, such as the Neuse and Cape Fear, are made up of many smaller watersheds. The landscape is made up of many interconnected watersheds. Within each watershed, all water runs to the lowest point—a stream, river, lake or ocean. On its way, water travels over the land surface—across farm fields, forestland, suburban lawns and city streets, or it seeps into the soil and travels as **groundwater**.

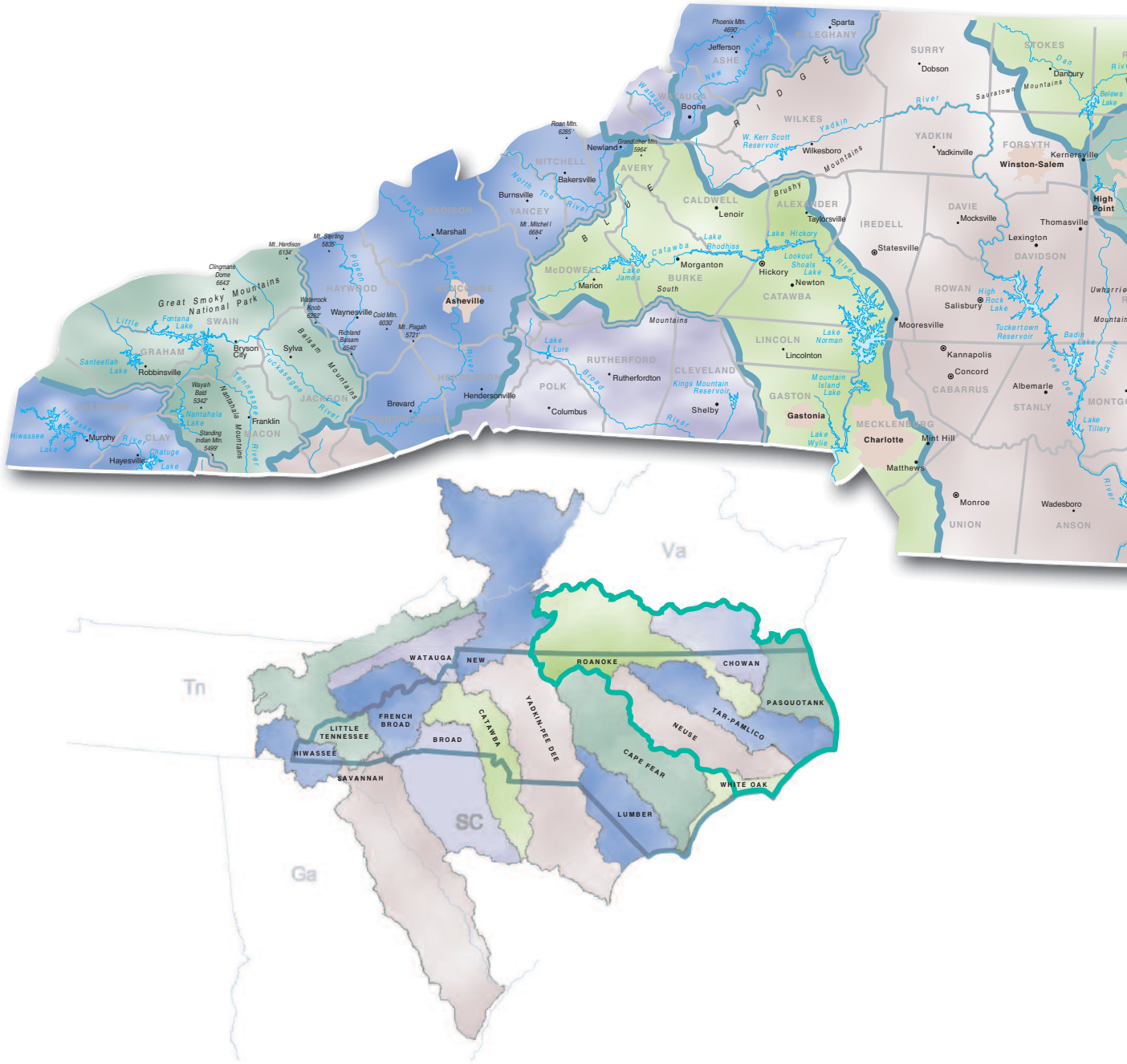
watershed: all the land drained by a river, stream or lake

groundwater: the water found in cracks and pores in sand, gravel and rocks below the earth's surface

Everyone lives in a river basin. You influence what happens in your river basin, good or bad, by how you treat the natural resources—the soil, water, air, plants and animals. As water moves downstream, it carries and redeposits gravel, sand and silt. Water also transfers bacteria, chemicals, excess nutrients and organic matter. Whatever happens to the surface water or groundwater upstream will eventually affect downstream systems. Therefore, the health of the aquatic **ecosystem** is directly related to activities on land.

ecosystem: a natural system linked by living (plants, animals) and nonliving (soil, air, water) things.

North Carolina's

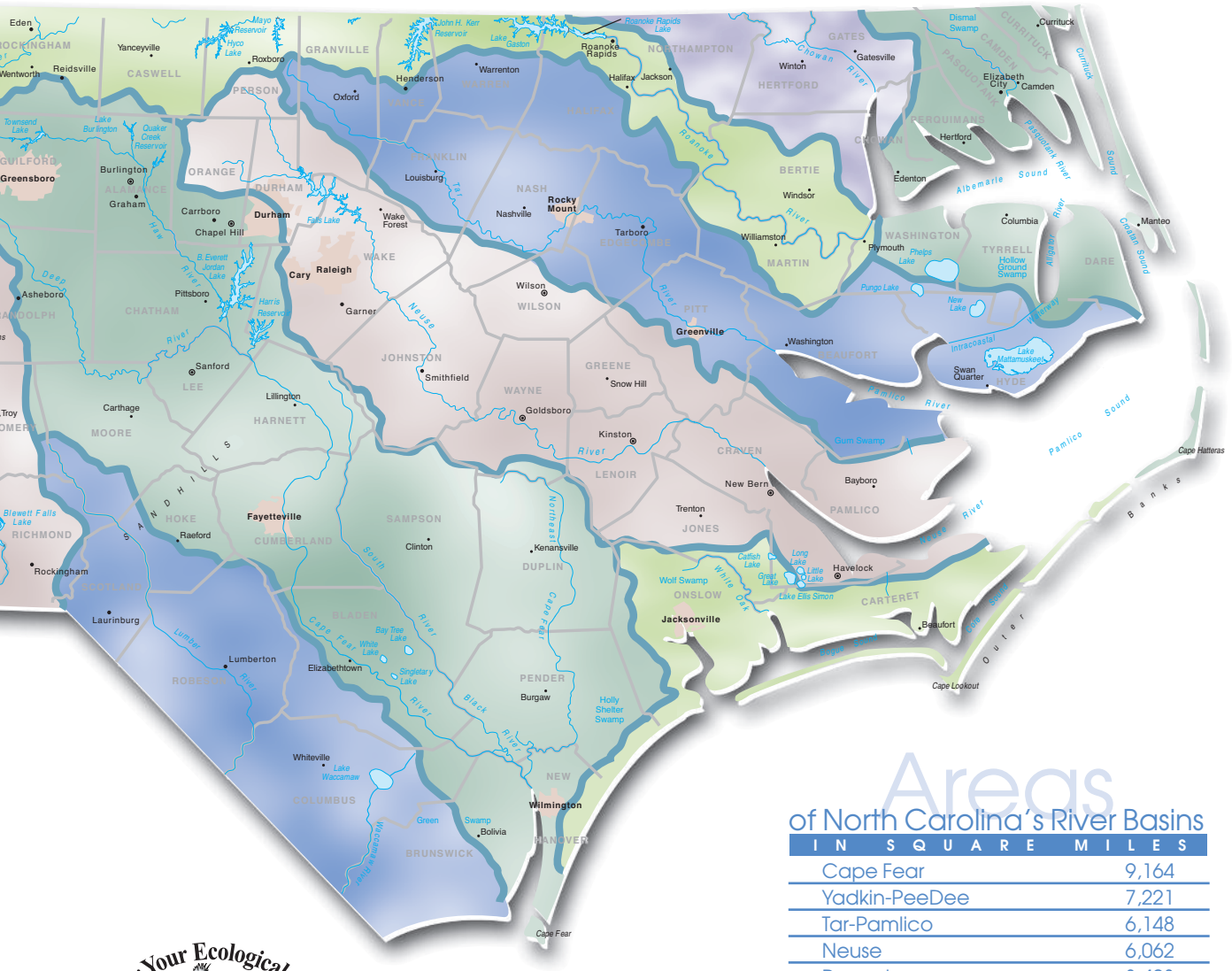


North Carolina has **17** major river basins.

Five of the state's river basins—the Hiwassee, Little Tennessee, French Broad, Watauga and New—are part of the Mississippi River Basin, which drains to the Gulf of Mexico. All the others flow to the Atlantic Ocean. Of the 17 basins, 11 originate in North Carolina, but only four are contained entirely within the state's borders—the Cape Fear, Neuse, White Oak and Tar-Pamlico.

*The green boundary on the small map marks the River Basins of the Albemarle-Pamlico Estuarine System.

River Basins



This map is provided in poster format by the Office of Environmental Education and Public Affairs in the N.C. Department of Environment and Natural Resources.

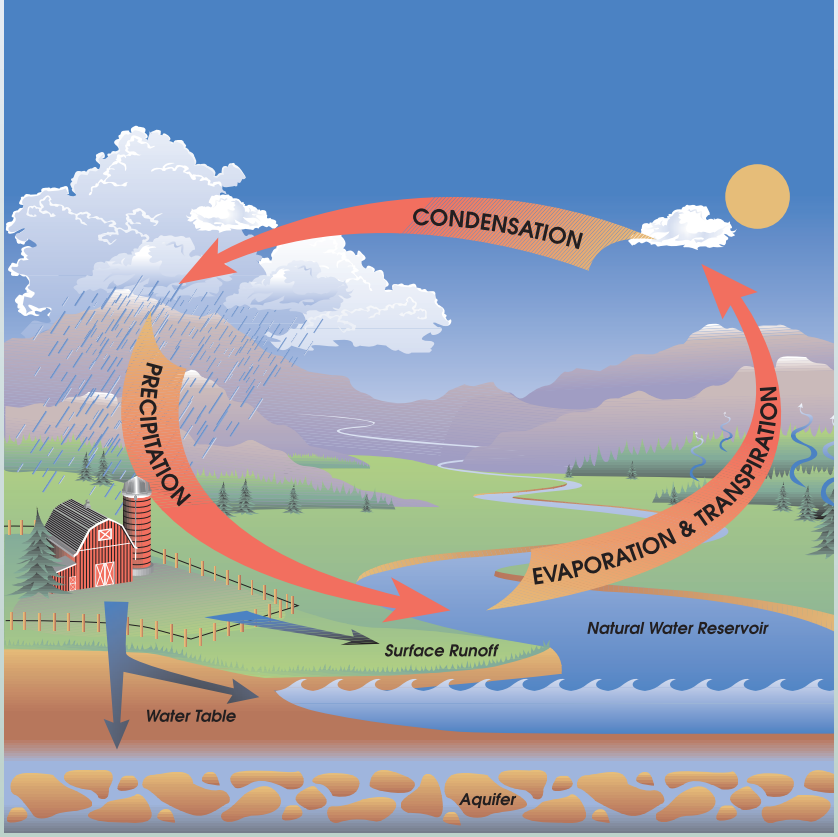
Map by Lee Ratcliffe, from the Nov. 1999 special issue of *Wildlife in North Carolina* Magazine, "Rivers of North Carolina," published by the N.C. Wildlife Resources Commission. Base map copyright John Fels, 1997.

Sources: NCDENR Division of Water Resources; NCDENR Office of Environmental Education and Public Affairs; N.C. Department of Transportation; N.C. State University School of Design.

Areas of North Carolina's River Basins

IN SQUARE MILES	
Cape Fear	9,164
Yadkin-PeeDee	7,221
Tar-Pamlico	6,148
Neuse	6,062
Roanoke	3,493
Pasquotank	3,366
Lumber	3,329
Catawba	3,285
French Broad	2,829
Little Tennessee	1,797
Broad	1,514
White Oak	1,382
Chowan	1,298
New	754
Hiwassee	644
Watauga	205
Savannah	171

Only indicates square mileage within North Carolina's borders



GRAPHIC BY ERIN HANCOCK, NCWRC

Do you know?

The same amount of water on the planet today was present 3 billion years ago: not a drop more or less. Water on earth circulates continuously. It falls as rain, filters into the ground to recharge **aquifers** and runs along the earth's surface as creeks, rivers and streams. That same water transpires through plants or evaporates from the surface, re-enters the atmosphere as vapor, then falls again as rain or snow.

aquifer: a porous rock layer underground that is a reservoir for water

DISCOVER YOUR ECOLOGICAL ADDRESS

Most of us are far removed from the source of the water we use every day. The development of indoor plumbing and sewage systems has made our connection to rivers and streams less obvious. When pollution closes waters to swimming or fishing, when droughts force us to curb water consumption, and when flooding brings rivers closer to our doorstep, we are reminded of our close relationship with rivers and streams. But if we are to preserve this lifeline, we must be aware that we make choices every day that affect our land, our water and our air.

When you turn on a faucet to get a drink, where does your water come from? When you flush a toilet or drain your bathtub or sink, where does your water go? When rain washes down your street and into a ditch or drain, where is it headed? To answer these questions, you must know what river basin you live in—part of your ecological address.

The river basin you live in is one component of your ecological address, but even within those boundaries, there are subtle differences in your address and that of your neighbors—just as your own house may be different from others on your street. Your ecological address is made up of nine components: (1) river basin, (2) topography, (3) wetlands, (4) groundwater, (5) biodiversity, (6) soil, (7) air, (8) climate and (9) energy.

Think about the following questions as you consider the scope of your ecological address.

what river basin do you live in?

Even if you don't live on the waterfront, the land around your house drains to a river, estuary or lake nearby. Into what river or stream does your land eventually drain? Does the water running off your property enter a storm drain, a ditch or an open field? Did you know that water flowing into a storm drain goes directly to a river or stream, not to a wastewater treatment plant? How fast does runoff enter local streams and to what extent is it filtered and cleansed by vegetation? How is land used alongside the nearest stream? How much is paved or covered with hard surfaces such as roads or rooftops?

NC AQUARIUMS

topography: how is the land shaped around your home?

Topography describes the physical features of a place, or the terrain—such as mountains, valleys and floodplains. Is the land around you flat or hilly? How close are you to a floodplain (a usually dry area that becomes inundated with water when streams and rivers overflow)?

where are the wetlands near your home?

A wetland is an area where the water table is at, near or above the land surface long enough during the year to support the growth of specially adapted plants. Wetlands help regulate water flow and act like a sponge, filtering pollutants and providing flood control. How do nearby wetlands connect to the system of streams that drain your river basin?

groundwater: where do you get your drinking water?

If it comes from a well, the source is groundwater. The quantity and quality of groundwater are of concern to humans. Water that flows through contaminated soils can become tainted. What is the quality of groundwater where you live?

biodiversity: what species share your backyard?

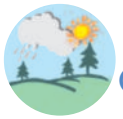
Biodiversity is the totality of genes, species and ecosystems in a region. Humans depend on biodiversity for food, medicine and balanced natural systems. These natural systems affect the quality and quantity of water and tell us much about the health of the whole river basin. How much land is forested? What species are endangered where you live? Are there any rare natural areas near your home?

what kind of soil is beneath your feet?

The local soil type determines what happens when bare soil is exposed to wind and rain, what happens to toxic material dumped on the soil (such as oil from your car or pet and human wastes), how groundwater percolates, what kinds of plants can grow and how much rainwater is absorbed by vegetation before it reaches a river. Is the land around you permeable (absorbent) or impermeable (water runs off readily)?

how clean is your air?

The quality of the air in a river basin also influences its forests, agricultural crops and surface waters. Pollutants in the air, such as automobile exhaust and industry emissions, will eventually return to the ground and enter the water supply.



what is your climate like?

Consider how much rain or snow is typical for a given year and when it falls. This will give you an idea of when the ground is likely to be saturated with water. When no more water can seep into the ground, runoff rushes quickly over land.

how much energy do you use each day?

Energy is the ability to do work. Everything we do requires energy. Our bodies get the energy they need from food. We use fossil fuels to power our cars and provide houses with electricity. How does your food get to your table? How much water was used to grow it? What other resources were involved in getting it to you? To further explore your ecological address, check out the Office of Environmental Education and Public Affairs' website at www.eenorthcarolina.org/resources-discover-ecoaddress.html.

THE ECOSYSTEM CONNECTION

A river is merely the course that water takes as it flows from the highest point in a river basin to the lowest. Together, the stream and its surrounding land make up rich and diverse ecosystems. These ecosystems provide habitats for living creatures both large and small. Every creature—whether clad in scales, feathers, fur, shells or clothing—shares a common home that stretches from the bed of the stream to the top of the trees and to human dwellings around the floodplain. The stream plays a vital role in human lives, and our activities strongly influence the condition of the stream.

Learning your ecological address will help you to better appreciate how your lifestyle influences your surroundings. Consider your daily habits.

- How do you maintain your lawn and garden?
- How much do you use your car?
- How much water do you consume?
- What kind of detergent and household cleaners do you use?
- How do you dispose of common and toxic household wastes?
- How many pets do you have and where is their waste deposited?

If you were the only person making these daily decisions, then the effects would be hardly noticeable. But you are one of over 9 million people in North Carolina whose daily contributions—both positive and negative—add up quickly. Answers to questions like the ones above help determine your **ecological footprint.**

ecological footprint: the amount of land and water needed to support one's lifestyle using current technology

DERRICK HAMRICK

Invasive SPECIES

Animals and plants that are not a part of the local ecosystem, commonly called invasive, exotic or non-native species, pose a threat to rivers and streams. These species come from all over the world. They are intentionally and sometimes accidentally being introduced through plant nurseries, the pet/aquarium trade and boats that travel from one body of water to another. These species are considered to be invasive if they disrupt the balance of the native ecosystem. Invasive species often cause economic, human health or environmental damage in areas where they are introduced. Examples of invasive aquatic species in North Carolina include hydrilla, an aggressively spreading plant that clogs waterways, and flathead catfish, an introduced fish that is threatening the existence of native fish species.

A healthy streambed teems with aquatic insects and other organisms that crawl around or attach themselves to the bottom. They eat decomposed twigs and plant matter or other creatures. Many of these small creatures are in the immature—or larval—stages of their life cycle. Many eventually emerge as terrestrial or winged creatures and mate and lay eggs in the stream. In all their stages, they are food for fish and larger creatures. They are the base of the aquatic food web and the foundation of the **riparian** ecosystem. Both a large variety and large numbers of aquatic organisms indicate good water quality.

riparian: pertaining to the edges of streams or rivers

Plants and trees surrounding the stream—often described as a **vegetative buffer**—also influence the health of the ecosystem. Riparian forests provide shade to keep water cool and capable of holding more oxygen. They also keep soil in place along riverbanks, filter nutrients and many toxic substances from runoff and contribute organic matter (rotting leaves and other material) that feeds a stream's smallest inhabitants.

As a stream becomes polluted, many small, juvenile organisms are the first to perish. Large quantities of **sediment**, nutrients and chemicals entering the stream will smother and poison tiny aquatic creatures, wreaking havoc throughout the food web—from insects to fish to humans. A diverse population of aquatic insects is essential for maintaining fish populations. A clean stream is also necessary if humans are to have ample food, water, recreational opportunities and even jobs.

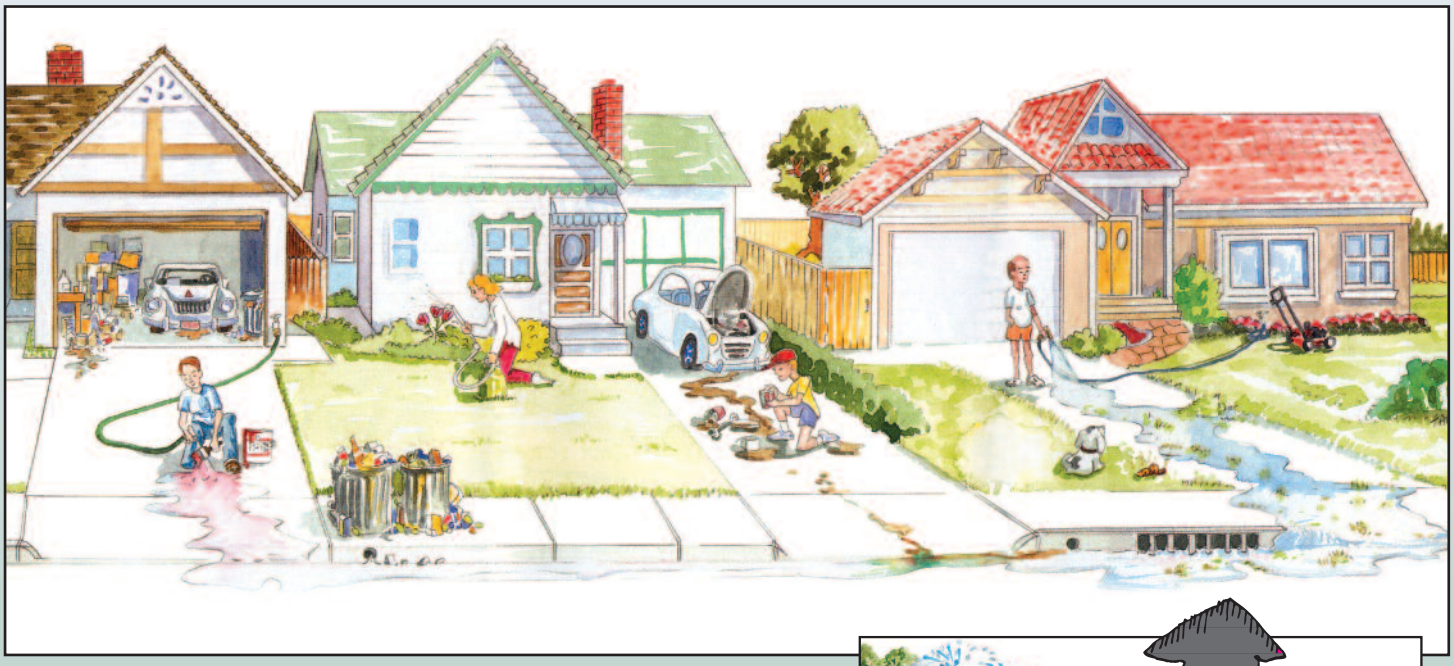
sediment: eroded soil particles that wash or blow into rivers

Streams are affected not only by what is put into them, but also by how they are physically manipulated. Humans often alter the land around the river and even change the path of the water itself influencing water quality and quantity. As a result, communities may be more vulnerable to flooding because humans have filled wetlands, straightened streams and paved and developed large areas. We have also changed the way water flows which impedes the ability of many natural systems to absorb and detain floodwaters. However, in some basins man-made dams can mitigate flooding and also provide water supplies, recreation and hydroelectric power. A river basin that drains thousands of square miles has many natural features—including wetlands and woodlands—that store excess rainwater and slow its movement. Accelerated urban development and land disturbance reduce the land's ability to absorb run off. Because of this, a building site that 30 years ago was designated outside the 100-year floodplain might be considered in the middle of the floodplain today.

THE HUMAN CONNECTION

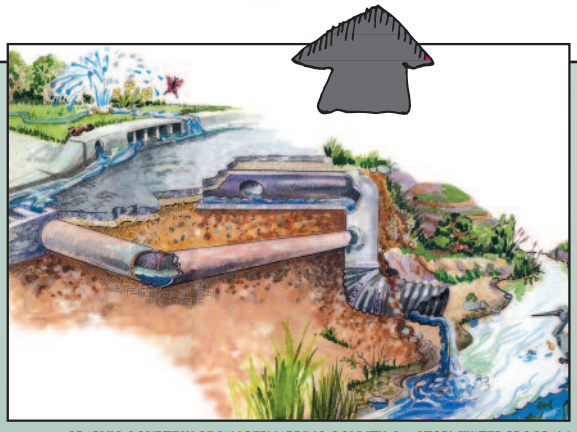
Historically, human development clustered around a good supply of water. Communities looked first to streams, then eventually to wells and springs, to satisfy their thirst. As populations increased, people dipped into water upstream and emptied their wastes downstream. Advanced technology supplied running water to individual homes and enabled the development of mechanized systems to dispose of wastewater. In the

KEN TAYLOR, NCWRC



Do you know?

Does the water running off your property enter a storm drain, a ditch or an open field? When rain falls on your street, roof or yard, what creek or river will it eventually flow into? What kinds of things from your yard will the rainwater carry with it on its way to that creek or river? Is your street flat or hilly? How close are you to the nearest stream or river? What kinds of things can wash from your yard during a storm? How fast does water running off your yard enter those streams or rivers nearby? How is the land used alongside the stream nearest your home? Is it mainly vegetation or hard surfaces such as roads and rooftops? Explore your ecological address to find out how you affect the water quality in your river basin.



GRAPHIC COURTESY OF SAN BERNARDINO COUNTY, CA, STORMWATER PROGRAM

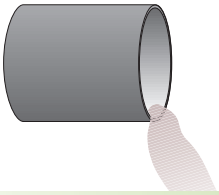
mid-1950s, a connection became apparent between decline in water quality and the management of wastewater. By the early 1970s, the government became involved in the construction of facilities to treat wastewater and safeguard human health and aquatic ecosystems downstream.

A wide variety of pollutants—including sediment, nutrients and chemicals—enters our rivers from various sources. The federal Clean Water Act of 1972 established a goal of making all the nation's waters fishable and swimmable. To meet that directive, North Carolina surveyed and evaluated its streams and rivers and labeled most bodies of water with a use that each has traditionally supported, such as fishing, swimming and drinking.

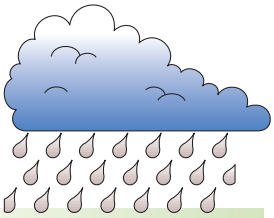
RIVER BASIN PLANNING

In the late 1980s, North Carolina established a water quality management program focused on each of the state's 17 river basins. The N.C. Department of Environment and Natural Resources' (DENR) Division of Water Quality updates the management plan for each river basin every five years based on extensive data from water quality sampling. Public input is gathered before drafting the basinwide plan. Later, a public review period is held to obtain comments on the draft plan. The plans contain available information on characteristics of the basin, current water quality and management strategies for protecting or improving water quality. For more information about river basins and nonpoint source pollution in North Carolina, explore the website of the Basin Planning Program: http://portal.ncdenr.org/web/wq/ps/bpu. For each river basin, you'll find a basinwide plan, river statistics, notices of upcoming events, links to contacts for watershed groups and other helpful information.

NC AQUARIUMS



point source pollution: discharge entering a stream at a specific, detectable point such as a pipe or outfall



nonpoint source pollution: diffuse runoff from large areas of land

The state monitors and collects information on streams to determine if they are fulfilling their labeled use. If not, the waters are considered impaired. The government has a legal obligation to protect these uses and to create and implement strategies to reduce pollution in impaired waters. The goal is that water quality in every river will be good enough to support its designated use. What is the quality of water in your river basin? You can find out more information about your river basin by referring to the individual river basin inserts available from the Office of Environmental Education and Public Affairs.

To curb water pollution, we must know its source. Pollution entering rivers is classified as one of two types, depending on its origin. **Point source pollution** comes from a central point or location, such as a pipe. **Nonpoint source pollution** comes from land use activities within a river basin; it results from rainwater washing pollutants off the land and into streams. This type of pollution includes pesticides and fertilizer from yards and fields, human and animal waste, eroded sediments, oil and chemicals on streets and parking lots as well as chemicals or particles in the air that eventually "rain down" on land. Water running over and off land is a natural phenomenon; the problem lies in the pollutants that get picked up and moved along the way. Nonpoint source pollution is harmful to rivers for many reasons. Large amounts of sediment can smother stream animals and block sunlight to aquatic plants. Excess nutrients may cause harmful **algal blooms** that deplete oxygen needed by fish. Toxins have acute and chronic effects, killing organisms immediately or by accumulating in the food chain.

algal bloom: rapid, dense growth of algae that robs the water of oxygen as it dies and decomposes

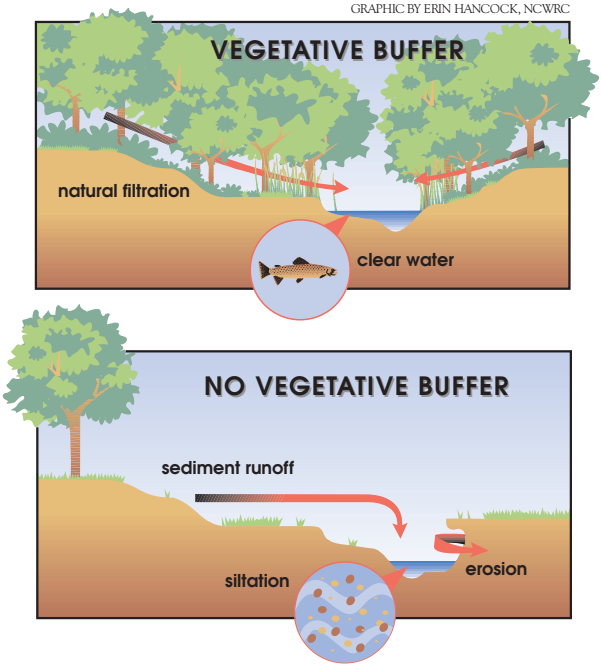
The kind and amount of pollution in point source discharges are monitored and regulated by state and federal governments, but nonpoint source pollution, which accumulates from individuals over large areas of land, is more difficult to pinpoint and regulate.

To fully appreciate nonpoint source pollution where you live, examine how the land around you is used. How much land is developed in your river basin? How much area is paved or covered with hard (impervious) surfaces? This will influence the amount of **stormwater** and how fast it runs off. Is land in your neighborhood covered with natural vegetation or is it mostly lawns? Are there parks and greenways? What types of pollution sources are immediately affecting you?

stormwater: surplus water from rain and melted snow

THE EFFECT OF PLANTS AND TREES

GRAPHIC BY ERIN HANCOCK, NCWRC



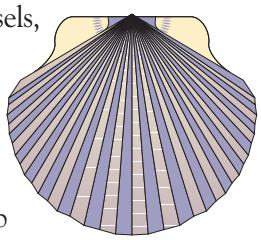
WHAT CAN I DO?

Citizen involvement helps determine government policy. Legislators listen to citizens, then respond by setting policies that state government must adopt. In this manner, government plays a role in protecting and often repairing riparian ecosystems. For example, the state now requires vegetative buffers along many streams and rivers

- to protect their banks from erosion,
- to reduce the impact of nonpoint source pollution by trapping, filtering and converting pollutants, and
- to supply food, shelter and shade to fish and other aquatic wildlife.

Other government programs promote "best management practices"—more environmentally friendly methods of agriculture, forestry and development.

Laws alone cannot completely protect river basins. Our rivers will be only as pure as our commitment to preserving them. What we do in river basins ultimately affects striped bass, freshwater mussels, oceangoing fish and shellfish and even us. Damage done to aquatic ecosystems can be irreversible or cost millions of dollars to fix—it is easier, safer and more economical to consider future consequences as we develop our river basins. Protection is much cheaper than restoration. Staying actively involved in the decisions affecting your community and state is the key to ensuring a healthy future for river basins.



AIRLIE GARDENS

Here are just a few ways citizens are making a DIFFERENCE in their communities:

STREAM WATCH

Clean waterways are as important as safe neighborhoods. The Stream Watch program is based on the philosophy that those in the best position to notice the signs of a stream's distress are its neighbors: the people who live along its banks or use its waters. The program is one of the best examples of citizen monitoring in North Carolina. With the help of the state Division of Water Resources, Stream Watch volunteers are encouraged to take an active role in promoting the well-being of the waterway they "adopt."

macroinvertebrate: animal that lacks a backbone and is visible to the naked eye

Stewardship activities include stream and riverbank cleanups, wildlife identification and inventories, water quality testing, surveys of **macroinvertebrates**, educational programs and nature walks. For more information, contact the Division of Water Resources at www.ncwater.org and click on "Stream Watch."

NCDENR DIVISION OF WATER QUALITY

URBAN STREAM RENEWAL

Unfortunately, most urban streams have been straightened, walled in concrete, diverted through culverts and filled with trash until they seem to barely exist as natural entities. Several programs funded by public and private partners are focusing attention on these lost and abandoned waterways.

greenway: open space or connector along a natural corridor (such as a river) used for parks and trails

Projects include trash cleanups, plantings and natural methods of erosion control along man-made channels and acquisition of land for parks and **greenways**. To learn how you can work through local government to acquire funding for stream restoration, conract the N.C. Division of Water Resources at www.ncwater.org.

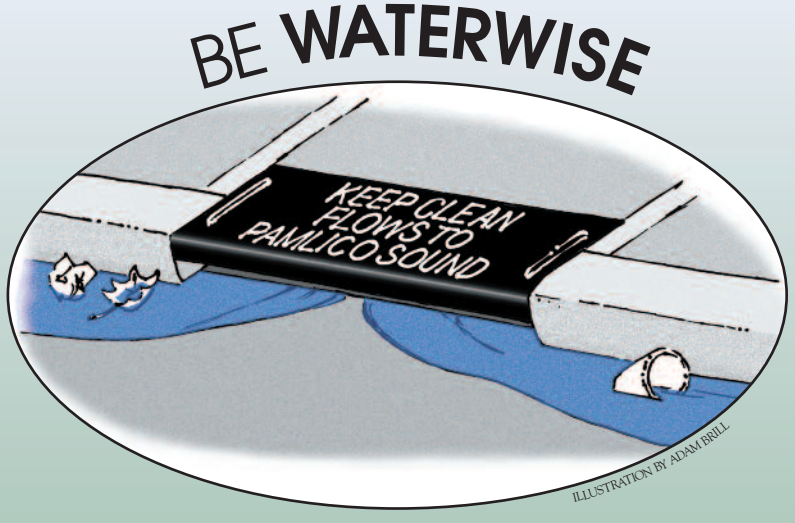


ILLUSTRATION BY ADAM BRILL

When you're out walking or riding, pay attention to the continuing changes in the landscape. Look around at subdivisions, shopping centers and new construction and make a mental checklist of the structures you see and what they are used for. After a heavy rain, notice how and where the stormwater flows. Try to follow the route of a stream as it passes through your community or city: Where is it visible and where does it seemingly disappear? What is good or bad about all of the things you see? Think about your everyday habits and practices and how they affect your immediate environment and your quality of life.

NC AQUARIUMS

RIVERWORKS AT STURGEON CITY

OFFICE OF ENVIRONMENTAL EDUCATION AND PUBLIC AFFAIRS

LAND CONSERVATION

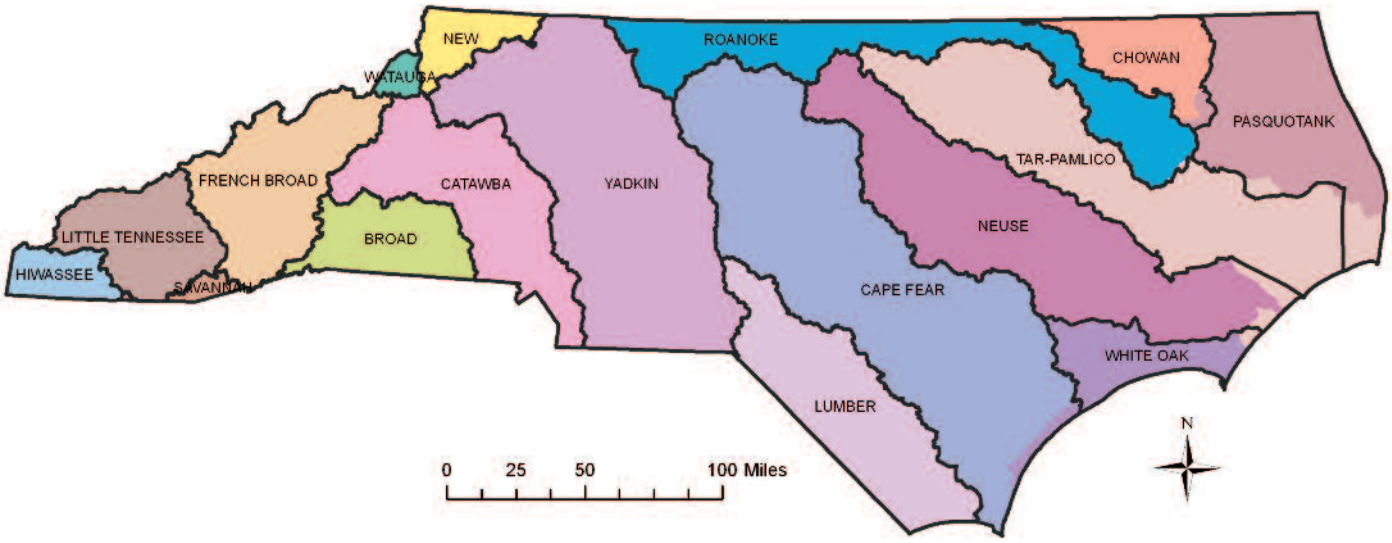
Land conservancy groups across the state are vital to clean water efforts because they purchase and protect land bordering riparian areas. Another trend is conservation easements on land that borders rivers and streams; this practice gives landowners tax breaks in exchange for their promise to preserve and not develop certain parts of their land. To find out how to contribute to or participate in a conservation easement program, contact your local soil and water conservation district or a land conservancy or trust in your area.

ENVIRONMENTAL EDUCATION

Public education is critical for protecting rivers and streams. Through environmental education, you can learn more about the natural systems that support you. To encourage citizens to make informed environmental decisions, North Carolina offers many environmental education programs to the public through facilities from the mountains to the coast. These include parks, museums, environmental education centers, aquariums, zoos and botanical gardens.

To learn about the wealth of programs and opportunities available, please visit the Office of Environmental Education and Public Affairs' website at www.eenorthcarolina.org.

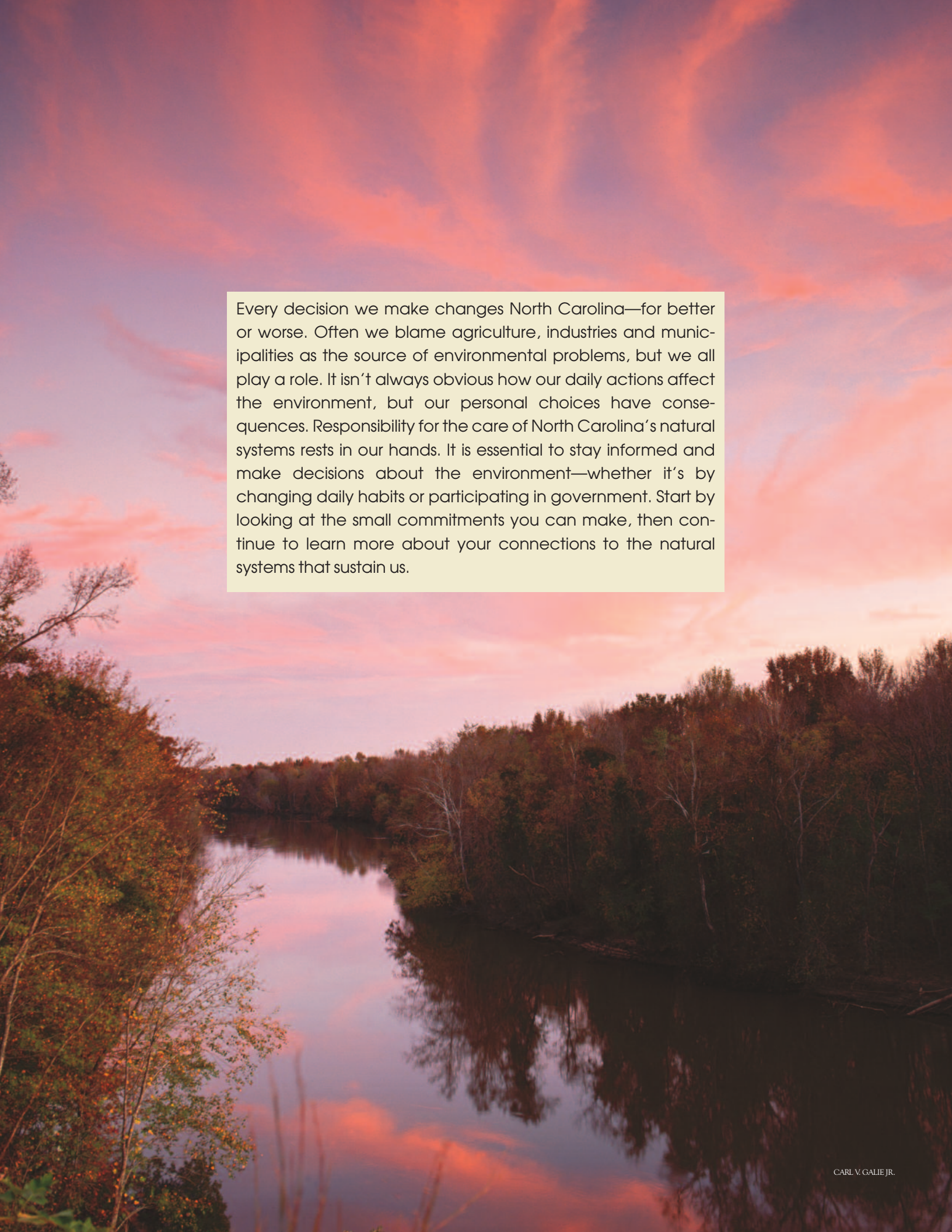
What's Different?



You may have noticed some minor changes to the map and some of the river basin boundaries. Good eye! About half of the basins experienced small changes to their borders. These changes help make the basins more accurate. They now reflect the flow of the water instead of political lines such as county and city borders. The changes are very minor, but the most obvious change came to the White Oak and Cape Fear basins. The White Oak River Basin now extends south to near Wilmington. This change better demonstrates how the water flows.

The map above illustrates the changes to the basins. The black lines represent the former boundaries. The different colors represent the new boundaries.

Original map courtesy of



Every decision we make changes North Carolina—for better or worse. Often we blame agriculture, industries and municipalities as the source of environmental problems, but we all play a role. It isn't always obvious how our daily actions affect the environment, but our personal choices have consequences. Responsibility for the care of North Carolina's natural systems rests in our hands. It is essential to stay informed and make decisions about the environment—whether it's by changing daily habits or participating in government. Start by looking at the small commitments you can make, then continue to learn more about your connections to the natural systems that sustain us.

CARL V. GALIE JR.

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North Carolina Department of Environment and Natural Resources
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The Office of Environmental Education and Public Affairs is part of the N.C. Department of Environment and Natural Resources. The office helps coordinate many environmental education programs and resources offered by the department and throughout North Carolina, and offers several related publications and services.

To learn more contact:
Office of Environmental Education and Public Affairs
http://www.eenorthcarolina.org
or
N.C. Basinwide Planning Program
http://portal.ncdenr.org/web/wq/ps/bpu

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