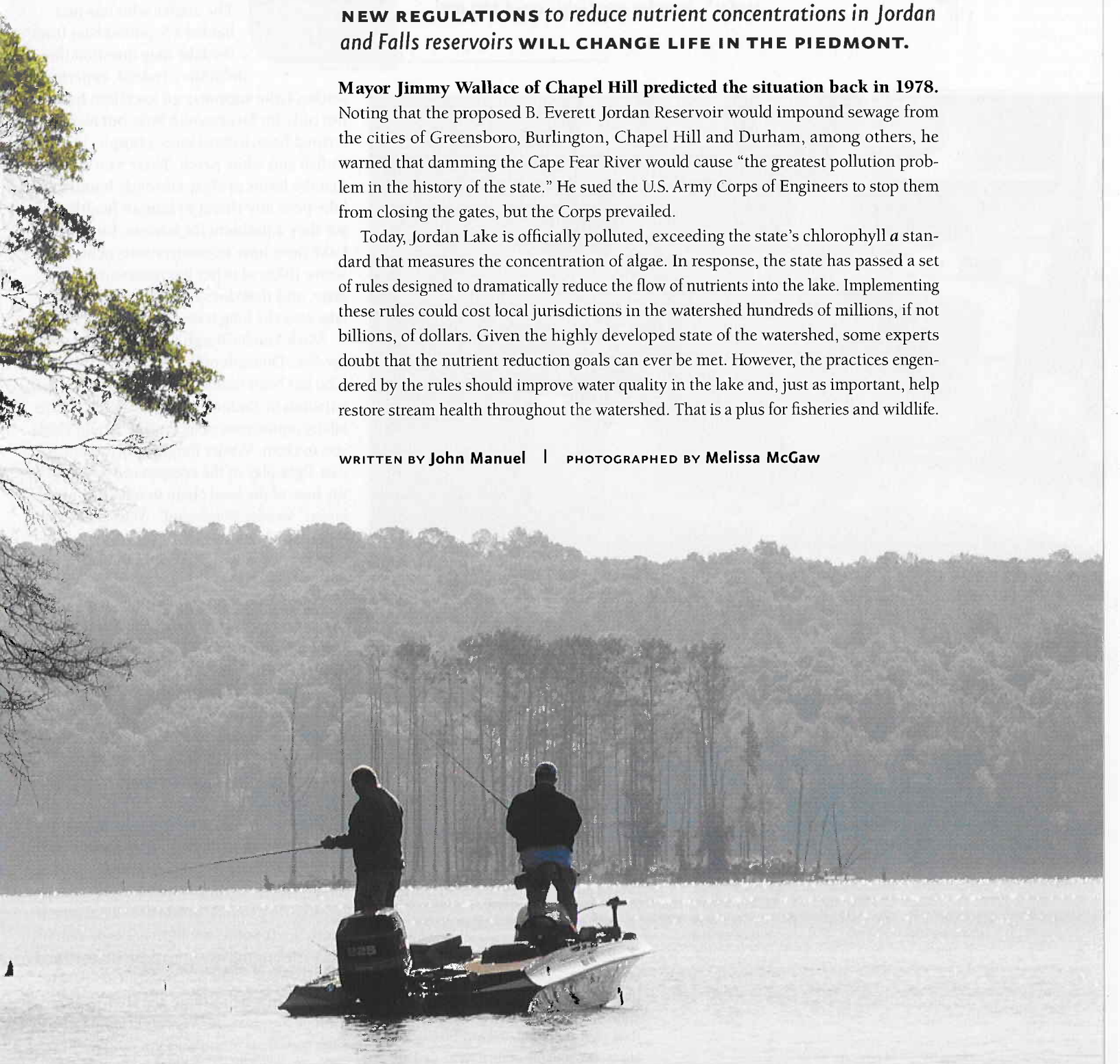
THE JORDAN RULES

NEW REGULATIONS *to reduce nutrient concentrations in Jordan and Falls reservoirs* **WILL CHANGE LIFE IN THE PIEDMONT.**

Mayor Jimmy Wallace of Chapel Hill predicted the situation back in 1978. Noting that the proposed B. Everett Jordan Reservoir would impound sewage from the cities of Greensboro, Burlington, Chapel Hill and Durham, among others, he warned that damming the Cape Fear River would cause "the greatest pollution problem in the history of the state." He sued the U.S. Army Corps of Engineers to stop them from closing the gates, but the Corps prevailed.

Today, Jordan Lake is officially polluted, exceeding the state's chlorophyll *a* standard that measures the concentration of algae. In response, the state has passed a set of rules designed to dramatically reduce the flow of nutrients into the lake. Implementing these rules could cost local jurisdictions in the watershed hundreds of millions, if not billions, of dollars. Given the highly developed state of the watershed, some experts doubt that the nutrient reduction goals can ever be met. However, the practices engendered by the rules should improve water quality in the lake and, just as important, help restore stream health throughout the watershed. That is a plus for fisheries and wildlife.

WRITTEN BY **John Manuel** | PHOTOGRAPHED BY **Melissa McGaw**



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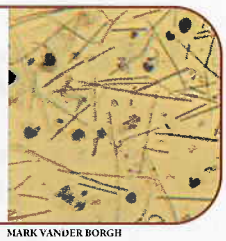

MARK VANDER BORGH

Jordan Lake polluted? The angler who has just hauled a 5-pound bass from the lake may question that definition. Indeed, experts say Jordan Lake supports an excellent fishery, not only for largemouth bass but also for striped bass, hybrid bass, crappie, bream, catfish and white perch. There's no evidence that the forms of algae currently found in the lake pose any threat to human health, nor are they a problem for boaters. But Jordan Lake does have concentrations of algae far above those of other big reservoirs in the state, and that does not bode well for the lake over the long term.

Mark Vander Borgh is the biologist with the N.C. Division of Water Quality (DWQ) who has been tasked with defining the algae situation in Jordan Lake. Surrounded in his lab by aquariums your mother would chide you to clean, Vander Borgh describes the role that algae play in the ecosystem. "Algae form the base of the food chain in our streams and lakes," Vander Borgh said. "Without it, the lakes would be sterile. But when concentrations become high, they can pose a threat to fish."

Vander Borgh displays a photograph taken through a microscope of a water sample from Jordan Lake. It looks like a blizzard with dozens of kinds of algae and diatoms crowding the image. "Jordan Lake is a phytocological wonderland," Vander Borgh said. "Water samples I've taken from other large reservoirs average around 10,000 units [of algae] per milliliter. Jordan's samples regularly exceed 100,000."

During daylight hours, algae produce oxygen through the process of photosynthesis. At night, photosynthesis shuts off, causing oxygen levels to drop. This also causes fluctuations in pH and carbon dioxide levels. If these fluctuations are high enough, fish in the surrounding water become stressed and may even die. "Those conditions may have resulted in a fish kill in March of 2006," Vander Borgh said. "We can't know for sure. Fish can die [en masse] for a number of reasons, and there's no easy way to determine the cause."

Vander Borgh said the algae found in Jordan do *not* include the mat form that people frequently see covering the surface of ponds. Rather, the algae in Jordan are primarily

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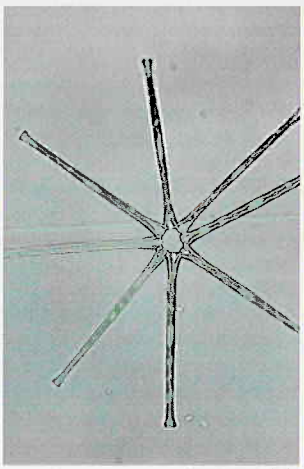

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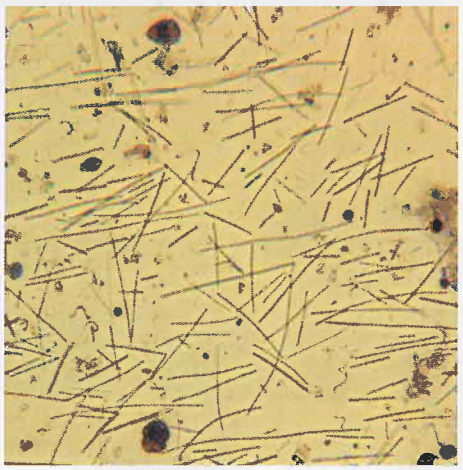

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Mark Vander Borgh (here with colleague Elizabeth Fensin) is tasked with defining the algae situation at Jordan. Among the microscopic plants living in the lake are (left to right): filamentous blue-green algae, the diatom asterionella and an assemblage of various algal species.

blue-green varieties that hang suspended in the water column. Though they can be eaten by aquatic organisms, blue-greens are not a preferred food source. And they can create problems for suppliers of drinking water.

Kelvin Creech is manager of the Cary/Apex water treatment plant, which draws drinking water from the New Hope Creek arm of Jordan Lake. Creech says that all algae have some taste, but blue-greens are particularly malodorous. When these are in bloom, the treatment plant must take costly steps to neutralize the taste and odor. Further, excessive algae can clog the plant's filtration system. That forces operators to "backwash" the filters, a process that involves discharging water back into the lake and pumping an additional amount as makeup water. That, too, is an additional expense and a waste of energy.

"We do our own algae identification and enumeration, looking for types that we know will create taste and odor problems," Creech said. "As populations start increasing, we know we need to prepare for additional treatment. 2009 was the worst year I can remember, and I've been working at the plant since 1996."

In fact, Jordan Lake began experiencing problems with algae all the way back in 1983, the year the gates were closed. Jordan has consistently exceeded the state's chlorophyll *a* standard of 40 milligrams per liter for surface reservoirs and lakes. Conditions have been especially troubling in the Upper New Hope arm, which receives a high volume of nutrients from three waste treatment plants and a variety of "nonpoint sources" such as parking lots, streets, subdivisions and farms. The Upper New Hope arm is shallow, and water has a long residence time owing to the Fearrington Road causeway, which acts like a bottleneck, restricting the flow of water to the southern part of the lake. These conditions are especially conducive to algae growth.

The state first declared the reservoir a Nutrient Sensitive Water in 1983 and required waste treatment plants in the watershed to reduce their phosphorus outputs. But there was no formal effort to control the nutrients coming from nonpoint sources. Meanwhile, population in the watershed exploded. Local governments weren't about to restrict their own development for the benefit of some downstream water user, and the state legislature balked at taking meaningful action.

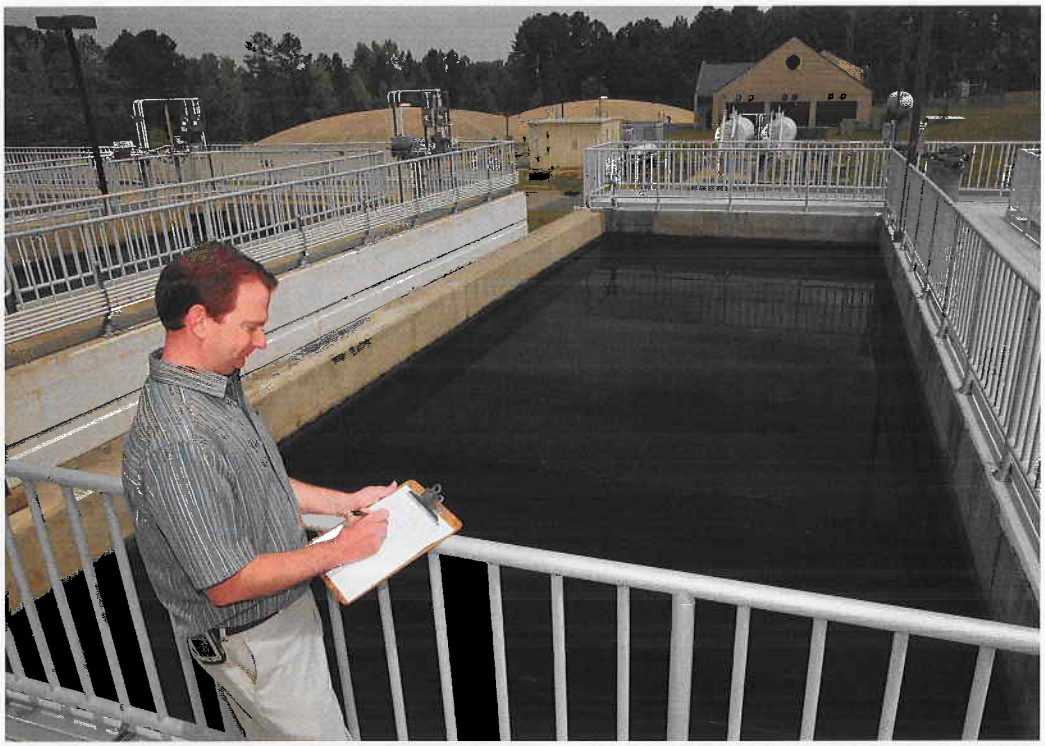
Retention ponds are becoming a common part of many new developments in sensitive areas. The ponds, low-lying areas planted in native vegetation, hold water for several days. The water leaves behind phosphorous and nitrogen which the plants absorb.

In 1997 the state passed the Clean Water Responsibility Act, requiring the Environmental Management Commission (EMC) to set both nitrogen and phosphorus limits on wastewater treatment facilities discharging to Nutrient Sensitive Waters, and to impose nutrient reduction goals on point and nonpoint sources. Over the next half-dozen years, consultants monitored and modeled the lake to determine the relative nutrient contributions from different sources (e.g., wastewater plants, development and agriculture) and to estimate the nutrient-loading reduction needs required to achieve nutrient-related water quality standards.

Beginning in 2003, the DWQ conducted an 18-month process in which stakeholders—local governments, developers, state and federal agencies, environmental groups—met to seek a consensus on nutrient-loading goals, discharge allocation methods and a conceptual nonpoint source strategy. Draft rules were published in 2007 and public hearings held in different locations in the watershed. The meetings were contentious, with stakeholders wrangling over a variety of aspects, most notably the degree and time frame of nutrient reduction goals for existing development.

After numerous revisions, the EMC adopted the rules in 2008, and they were passed into law by the General Assembly in 2009. The final rules set nutrient reduction goals for each of three hydrologically distinct arms of Jordan Lake. The goal for the Upper New Hope arm is a 35 percent reduction in nitrogen and an 8 percent reduction in phosphorus relative to a baseline of 2001. The goal for the Haw River arm is an 8 percent reduction in nitrogen and a 5 percent reduction in phosphorus. The goal for the Lower New Hope arm is to match the 2001 baseline year.

To achieve these reductions, the rules set stringent limits in terms of pounds per acre of nitrogen and phosphorus allowed from different sources (e.g., waste treatment plants, new development, existing development and agricultural lands). Local governments



Excessive concentrations of algae can be costly for municipalities. Kelvin Creech, manager of the Cary/Apex water treatment plant, says that when blue-green algae are in bloom, his facility must take extra steps to neutralize the taste and odor caused by the plant. Although Jordan Lake is considered "polluted," the algae do not affect the lake's thriving fisheries (opposite).

have the responsibility for designing methods of reaching these limits. Citizens will bear the cost.

What will these rules mean for residents of the Jordan Lake watershed? With respect to new residential and commercial development, developers will be required to install Best Management Practices (BMPs) designed to reduce and/or slow stormwater runoff. For any given development, multiple BMPs may be required. These work best when installed in sequence.

The first line of defense is to slow the flow of rainwater from hardened surfaces. This might be accomplished with technologies such as green roofs, cisterns and porous pavement. Stormwater can then be channeled to a bioretention (or bioremediation) cell, a low-lying area planted in natural grasses and shrubs on top of loamy soil, and often with an underdrain to keep water from ponding for more than a couple of days. Stormwater is slowed as it percolates through this medium and leaves behind phosphorus and nitrogen, which bind to the soil and are absorbed by the plants. Third in line are stormwater wetlands. These "mini-swamps" are designed to hold water over a matter of days or weeks, allowing for further slowing of runoff and trapping of nutrients and sediment.

Frank Thomas, director of government relations for the Home Builders Association of Durham, Orange and Chatham Counties, says the requirement for BMPs will make it "significantly more expensive" to build new homes in the watershed. "Residential communities will also be higher density in order to make room for BMPs," he said.

Theoretically, smartly designed bioremediation cells and stormwater wetlands could provide open space for residents and habitat for a variety of birds, reptiles and amphibians. (A good example are the BMPs installed beside the N.C. Wildlife Resources Commission's headquarters in Raleigh.) However, many subdivisions fence off these ponds to avoid liability for an accidental drowning.

Existing developments pose a much greater challenge when it comes to reducing nutrient loads. There is simply not room in most urban environments to put in the sequential BMPs mentioned above without tearing out buildings and/or streets and parking areas. Owing to the difficulties and untested nature of reducing nutrients from existing development, DWQ has adopted a two-stage program for that sector. Stage 1 calls for educating the public regarding ways to reduce nutrient loading. Actions residents can take include applying less fertilizer to lawns and gardens, containing pet waste and reducing driving (because atmospheric deposition of nitrogen is a major source of harmful nutrients in the Triangle).

Stage 1 will also include an effort to identify leaky septic systems and get them hooked up to city sewers, and an effort to promote the maintenance of existing BMPs. Many newer developments already have stormwater retention ponds, but unless these are regularly maintained, they fill up with silt and clay and their performance as nutrient and sediment filters declines.

If monitoring data shows that Stage 1 measures are not meeting water quality standards for the lake, local governments must devise more stringent measures for existing development. This determination will be made by 2014 for the Upper New Hope arm and by 2017 for the Haw and Lower New Hope arms.

In the agricultural sector, local governments will work with farmers and livestock owners to preserve and increase vegetative buffers around streams, to practice no-till agriculture, and to avoid overapplication of fertilizers. State rules require that commercial applicators applying fertilizer for any of a host of land uses (e.g., croplands, horticultural farms, golf courses) must complete a nutri-

ent management course to understand the importance of proper management of nitrogen and phosphorus.

The Jordan Rules require that vegetative buffers be maintained within 50 feet of all streams in the watershed, both intermittent and perennial, as well as lakes and ponds. The first 30 feet must be kept as undisturbed vegetation. Limited uses are allowed in the second 20 feet. Intended as a method for filtering nutrients from the adjoining land, the buffers will provide some wildlife habitat and will help prevent sedimentation and warming of streams.

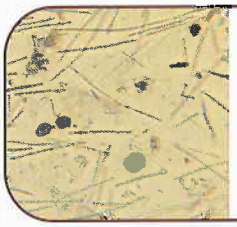
Will implementation of all these technologies and practices work?

"I do not know enough about the limits and reductions to give a definite answer," said Vander Borgh. "I do know that whatever the effects are, they will not be immediate. The nutrient cycle is complex; they [nutrients] can be sequestered for a time, only to be released when plants and animals die and decompose. I can say that reducing nutrients will keep algal productivity from increasing."

Following on the heels of the Jordan Rules will be a similar set of rules for the Falls Lake watershed. Falls Lake provides drinking water for the City of Raleigh, and plant operators are facing problems similar to those of the Town of Cary with respect to taste and odor due to excessive algae. DWQ officials state that the nutrient reduction goal for Falls will be even greater than for Jordan—40 percent of nitrogen and 77 percent of phosphorus from the baseline year of 2006.

As in the Jordan watershed, stakeholders in the Falls watershed, including the cities of Durham, Hillsborough, Butner and Creedmoor, are concerned about the cost and time frame for achieving these goals. The state's latest estimate for cleaning up Falls Lake is $1.5 billion, with most of that cost borne by local governments. Experts are likewise concerned about whether the goals can be met for the lake, particularly the nutrient-laden Ellerbe Creek arm. Public hearings have been ongoing. Adoption of the final rules is scheduled for January 2011.

Uncertainties notwithstanding, experts agree that efforts to lower nutrient loads in Falls and Jordan must be made. Water quality in both lakes is headed downhill, and dramatic changes in development patterns and, to a lesser extent, agricultural practices are needed to reverse the situation. If these are wisely executed, benefits will extend beyond the two reservoirs and will encompass more than just nutrients.



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Lisa Creasman of the Conservation Trust for North Carolina believes the rules could provide an added incentive for a variety of organizations and agencies to work together to achieve mutual goals. "Considering the ecosystem services provided by land conservation and sustainable lands management, the ongoing work of the land trusts and natural resource agencies to preserve natural areas and working lands will contribute to maintaining if not improving water quality and quantity in the Upper Neuse River basin," she said. "It's our hope that as regulators and local governments design and implement strategy for the Falls Lake Rules, they will recognize the value of including land conservation."

William Hunt, professor of biological and agricultural engineering at N.C. State University, believes the rules will help restore the function of ephemeral streams, those that run only part of the year but play a vital role in ecological health. "As soon as you pave over an area, you speed up the flow of water, and streams that were ephemeral just become ditches, "Hunt said." They run maybe 30 percent of the time, where before they may have run 70 to 90 percent of the time. Stormwater BMPs will improve water infiltration and lead to more appropriate recharging of streams and aquifers."

"Dirty water gets to the lake via dirty creeks, and every city suffers from these," said Elaine Chiosso, executive director of the Haw River Assembly. "The beauty of these rules is that in the process of reducing the nutrient pollution in stormwater runoff to Jordan Lake, we will be reducing all water pollution. These rules will reduce sediment, heavy metals and other pollutants that run off the land into our streams during storms. We'll be doing the things to protect water that we should have been doing all along." ◆

John Manuel is a freelance writer living in Durham, and a regular contributor to Wildlife in North Carolina.

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APACHE JUMPING SPIDER (*Phidippus apacheanus*)

Jumping spiders make up the largest family of spiders with more than 5,000 species recognized worldwide. This tiny species is one of North Carolina's most colorful spiders.