

# THE UPPER NEUSE CLEAN WATER INITIATIVE CONSERVATION PLAN

PROTECTING LAND AND DRINKING WATER FOR THE FUTURE



CITY OF RALEIGH  
CONSERVATION TRUST FOR NORTH CAROLINA  
ELLERBE CREEK WATERSHED ASSOCIATION  
ENO RIVER ASSOCIATION  
NEUSE RIVER FOUNDATION  
TAR RIVER LAND CONSERVANCY  
TRIANGLE GREENWAYS COUNCIL  
TRIANGLE J COUNCIL OF GOVERNMENTS  
TRIANGLE LAND CONSERVANCY  
THE TRUST FOR PUBLIC LAND  
UPPER NEUSE RIVER BASIN ASSOCIATION

Written by Kelley Hart, The Trust for Public Land

Designed and produced by  
Patrice Gallagher, Gallagher/Wood Design

Copyright 2006 by the Trust for Public Land  
All rights reserved



*cover photo left* The Conservation Trust for North Carolina

*cover photo center* The Trust for Public Land (archives)

*cover photo right* Upper Neuse River Basin Association

# THE UPPER NEUSE CLEAN WATER INITIATIVE CONSERVATION PLAN

PROTECTING LAND AND DRINKING WATER FOR THE FUTURE

*This conservation plan and other efforts  
of the Upper Neuse Clean Water Initiative  
were generously funded by the  
CITY OF RALEIGH, NORTH CAROLINA.*

# Table of Contents

INTRODUCTION	1
THE UPPER NEUSE RIVER BASIN TODAY AND TOMORROW	3
STRESSES ON DRINKING WATER SUPPLIES	4
THE REGULATORY FABRIC	7
LAND CONSERVATION AS A DRINKING WATER PROTECTION STRATEGY	9
Conservation Accomplishments and Efforts Underway	9
Advancing Land Conservation for Source Protection	10
Process	10
Results	12
GETTING TO IMPLEMENTATION	14
Potential Sources of Local Funding	14
Potential Sources of State and Federal Funding	16
CONCLUSION	17
APPENDICES	
Appendix A: Current Land Use in the Upper Neuse River Basin	18
Appendix B: How Development Impacts Water Quality: An Example	19
Appendix C: Primary Local Laws Related to Water Quality within the Upper Neuse River Basin	21
Appendix D: Highlights of Riparian Buffer (not including wetlands) and Erosion Control Rules	22
Appendix E: Description of Modeling Process	25
MAPS	
Upper Neuse Clean Water Initiative Study Area	2
High Priority Lands for Water Quality Protection in the Upper Neuse River Basin	<i>[inside back cover]</i>
FIGURES	
Figure A: Population Served by Public Drinking Water Suppliers Drawing from UNRB	4
Figure B: Projected Population Growth in Six County Area	5
Figure C: Current and Projected Demand v. Supply of Drinking Water	5
Figure D: Proportion of UNRB Acreage by County	13
Figure E: Proportion of Land that the Model Identifies by County for Acquisition in UNRB	13
TABLES	
Table A: Comparison in the UNRB of Total and Protected Acres in Each County and Water Quality Protection Scenario Results	12

# Acknowledgments

## *Upper Neuse Clean Water Initiative Technical Advisory Team Members*

Ben Bearden	Triangle J Council of Governments
Sydney Miller	Triangle J Council of Governments
Chris Dreps	Upper Neuse River Basin Association
Bob Heuer	The Trust for Public Land
Brenda Faber	The Trust for Public Land
Lisa Creasman	Conservation Trust for North Carolina
Silvia Terziotti	United States Geologic Survey
John Cox	City of Durham Stormwater Services
Amy Axon	North Carolina Department of Environmental and Natural Resources Public Water Supply Section
David Hammermann	North Carolina Department of Environmental and Natural Resources Public Water Supply Section
Geraldine Dumas	Kerr-Tar Council of Governments
Nancy Newell	City of Durham
Helen Youngblood	Durham City-County Planning
George Rogers	City of Raleigh
Derek Halberg	Tar River Land Conservancy
Rusty Painter	Conservation Trust for North Carolina
Jeff Masten	Triangle Land Conservancy
Rich Shaw	Orange County Environmental and Resource Conservation Department
Klugh Jordan	Eno River Association
Jason Falls	Granville County Environmental Programs
Barry Baker	Granville County Planning
Chris Mankoff	North Carolina Ecosystem Enhancement Program
Doug Newcomb	United States Fish and Wildlife Service
Wright Lowery	Wake County GIS
Cam McNutt	North Carolina Department of Environmental and Natural Resources Division of Water Quality
Tom Potter	North Carolina Department of Environmental and Natural Resources Division of Soil and Water Conservation
Bill Flournoy	Triangle Greenways Council
Diana Tetens	Ellerbe Creek Watershed Association

*Thanks also to the following land trusts who helped review various components of this Conservation Plan:*

Tar River Land Conservancy, Triangle Land Conservancy, Eno River Association, and Triangle Greenways Council.

# Introduction

**T**his Conservation Plan presents the case for a strategic, multiple step approach to drinking water protection in the Upper Neuse River Basin (UNRB). Specifically, it recommends a coordinated land conservation initiative to help safeguard a crucial natural resource that connects six counties and provides drinking water and economic infrastructure to over 535,000 people. Demand for water in the region is increasing rapidly due to immigration, and the population is expected to nearly double by 2030.

The region has been recognized repeatedly in national publications as one of the most desirable places in the country to live and work, and its economic growth has brought a new level of diversity and vitality. Thousands of new residents every year want to enjoy a high quality of life that includes clean water and air and green space.

Land conservation is a cost effective way to preserve the high-quality raw water in the UNRB for use as drinking water. A recent study by The Trust for Public Land found that water treatment plant costs were far lower for plants drawing surface waters from highly forested watersheds as opposed to highly

developed watersheds, all else held equal.<sup>1</sup>

There are also benefits for those who draw their drinking water from wells, because conservation of strategic parcels can reduce threats of groundwater contamination and safeguard recharge zones to keep the water table from dropping. In general, protecting natural lands helps to protect the potential for recharging surface and groundwater sources.

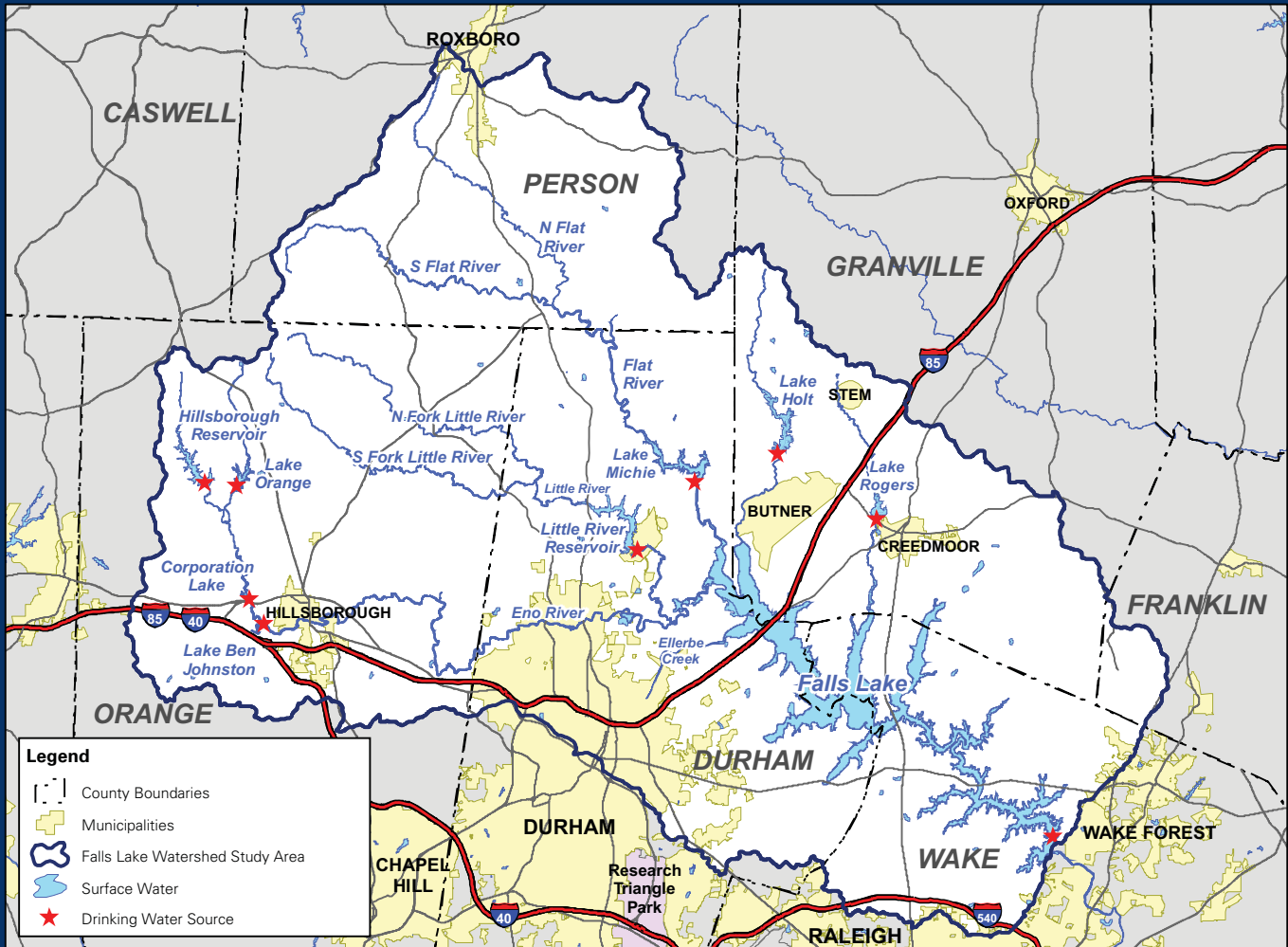
Land conservation for drinking water protection can dovetail with other community priorities. For example, land conservation can also protect rural quality of life, productive agricultural lands for local food production, and farmers' options to maintain working lands while realizing income. Land conservation can also be used to protect biodiversity, natural lands, heritage areas, and parks. It can even help reduce local governments' flood control costs and improve air quality.

This report lays out the background, new mapping tools, and a strategy for blending preservation of high-priority lands with existing conservation programs and water quality protection measures to help guarantee cleaner natural drinking water for the long term.

© TOM PENDER 2005



## Upper Neuse Clean Water Initiative Study Area



Triangle J  
Council of Governments

Map created by the Triangle J Council of Governments  
Geographic Information Systems  
May 22, 2006

For use in the Upper Neuse Clean Water Initiative.  
Information on this map is for discussion and visualization purposes only.





# THE UPPER NEUSE RIVER BASIN TODAY AND TOMORROW

There are nine water supply reservoirs in the UNRB, Lake Holt, Lake Rogers, Lake Michie, Little River Reservoir, Falls Lake, Lake Ben Johnston, Lake Orange, New Hillsborough Reservoir and Corporation Lake (See map, opposite page). Falls Lake is the largest and furthest downstream, draining the entire 770 square-mile basin. Eight municipalities are wholly or partially located in the basin, and two of them — Raleigh and Durham —

In this relatively large region, urban and suburban development occupies 20% of the land. Only 16% of the basin is considered agricultural landcover and less than 3% is wetlands. In contrast, 60% is forested.<sup>2</sup> See Appendix A for a better sense of how various land uses are distributed throughout the basin. According to the Upper Neuse River Basin Association, “it is projected that by 2025, about 50,000 acres (13 percent) of the remaining undeveloped

COURTESY OF FROG HOLLOW CANOE & KAYAK SERVICES



are among the top five fastest growing cities in the state.

The region has experienced rapid change in recent decades. Raleigh and Durham have become thriving centers of high-technology research and industry, while the upper portions of the watershed have struggled economically with the demise of the tobacco program and decline of American manufacturing. People are flocking to the urban areas for jobs and education, and farmers and landowners in the rural areas are looking for ways to hold onto productive lands that have served them, their families, and rural communities for generations. Although rural communities have the opportunity to become “bedrooms” for the urban centers, they also seek ways to retain their unique identity and generate their own economic growth.

land will convert to developed land, bringing the total developed land to 140,000 acres (28 percent of the watershed).”<sup>3</sup>

Falls Lake is emblematic of the scarcity of new drinking water sources and the vulnerability of reservoirs to upstream impacts. Falls Lake was filled in the early 1980s to meet Raleigh’s growing demand for water, despite studies by the Army Corps of Engineers, North Carolina Division of Environmental Management, and Triangle J Council of Governments forewarning of likely water quality impairments. In a 1995 study of Falls Lake, the Cadmus Group concluded that the Falls Lake drinking water reservoir could maintain good raw water quality through 2020, but because it drains the entire watershed, it is susceptible to cumulative impacts from upstream degradation.

# STRESSES ON DRINKING WATER SUPPLIES

The number of people receiving drinking water from UNRB is expected to essentially double between 2002 and 2030 (see Figure A). According to the North Carolina State Demographics Unit, between 1990 and 2000 the population of the six counties grew by 36%. About a quarter of this population growth is due to immigration. The state is predicting about 90% growth across the 6 counties in the next thirty years (62% due to immigration). Wake County is experiencing the most rapid growth and will likely increase in population by 120% between 2000 and 2030 (see Figure B).

There are six public drinking water systems drawing raw water from the UNRB to serve this region. Although most of them are able to meet the demand today without purchasing water from external sources, meeting future demand will require tapping additional sources, and in some cases, purchasing additional water (see Figure C).<sup>4</sup> According to the 2002 North Carolina Water Supply Plans, the six systems draw primarily from surface water now and will continue to do so for the next several decades.<sup>5</sup> Sediment accumulation in some of the reservoirs, described below, will compound the supply shortage because sediment accumulation in reservoirs reduces storage volume.<sup>6</sup>

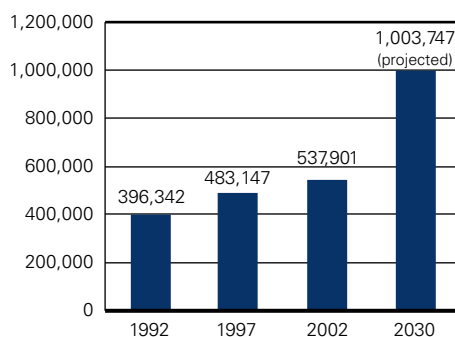
A growing population means more businesses and homes will be built in the watershed and more water will be needed. Forests have been cut down and wetlands paved over to create space for homes, shopping malls, and office parks. As residential and commercial development occurs and natural land cover is replaced by impervious surfaces — surfaces such as roads and rooftops that do not allow the water to filter into the ground — land that served as a green sponge now functions as a grey funnel. As a result, water runs off the land at a much higher volume and speed, decreasing replenishment of groundwater supply, eroding stream banks, and washing pollutants into waterways. Please see Appendix B for a compelling case study demonstrating just how much sediment and nutrient pollution a new development typically adds to the environment. When development occurs on a large scale, the remaining natural features that protect water quality in the watershed — wetlands, forests, and small streams — become stressed.

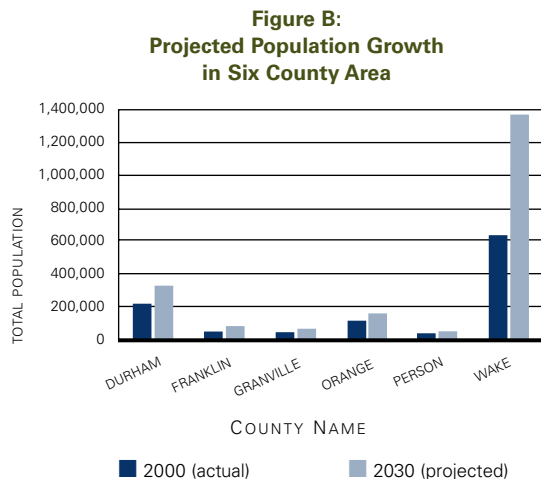
Most experts agree there is a threshold ratio of impervious surface to natural land which, when crossed, results in a measurable decline in water quality in the watershed. Many believe the threshold occurs when the watershed is 10% impervious.<sup>7</sup> Based on scenarios that take into account the population growth described above, more than one-third of the sub-watersheds in UNRB will exceed the 10% threshold by 2025.<sup>8</sup>

Multiple scientific studies throughout the United States, including the Southeast, have shown that forest cover helps maintain water quality. This is because healthy forests absorb and control stormwater, reducing negative impacts on streams and waterways. When forest cover drops below 70% in a watershed, there are measurable negative impacts on water quality.<sup>9</sup> Currently, about 60% of land in the watershed is forested, suggesting action must be taken immediately to protect existing forests.

Wetlands and headwater streams are also

**Figure A:**  
**Population Served by Public Drinking Water Suppliers Drawing from UNRB**



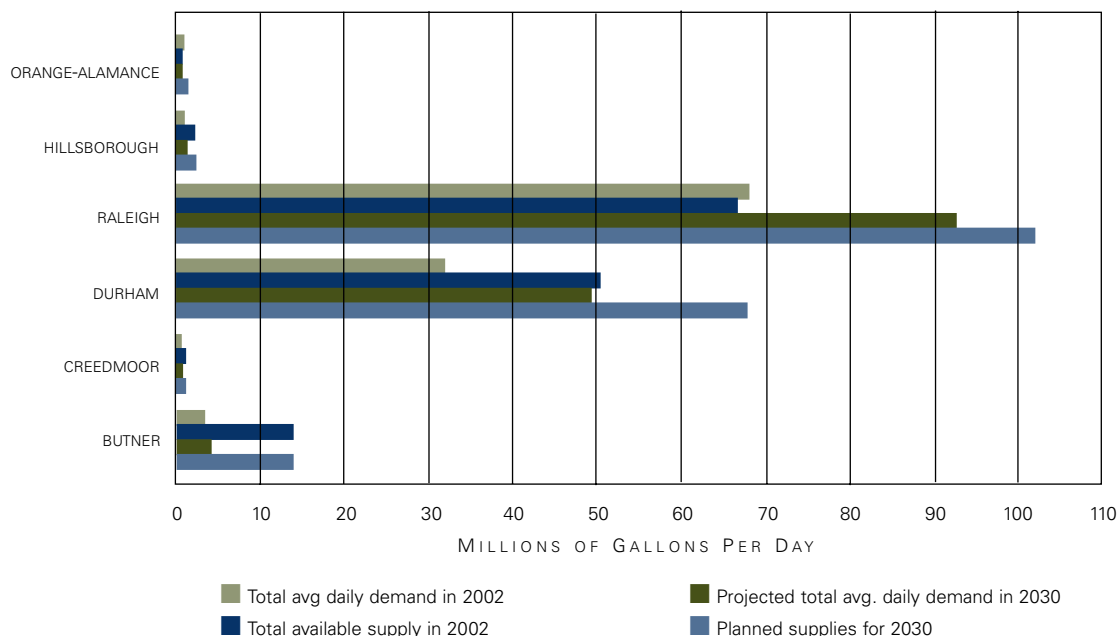


crucial for protecting water quality. Wetlands help mitigate floods, filter pollutants, recharge groundwater, and maintain a healthy (hydrologically stable) watershed. More than 34% of the UNRB's "baseline" wetlands have already been disturbed or destroyed.<sup>10</sup> Many wetlands were drained and cleared, and some were converted to pine forests.<sup>11</sup> Headwater streams are the bulk of the watershed's drainage network because small feeder streams comprise 85% of the total stream length in the watershed.<sup>12</sup> As

such, they collect most of the surface run-off and pollutants coming from the land and play an important role in maintaining the health of larger tributaries.<sup>13</sup> Because headwater streams are so small, they are often not thoroughly mapped and are frequently paved over or channeled during development.<sup>14</sup>

Converting natural land cover to impervious surfaces not only threatens the natural functionality of the remaining forests, streams, and wetlands, it also brings an array of pollutants from construction sites and suburban land uses. In the past, construction activities have been at least partially responsible for the impairment of one-third of the basin's stream segments and have damaged aquatic habitat in the Little Lick and Lick Creek subwatersheds.<sup>15</sup> Some of the most desirable locations for new homes, businesses, and industries border on streams and lakes, making clean drinking water sources vulnerable to contaminated run-off. During site construction, sediment is displaced (through rainfall or dumping) and often ends up in water bodies. When it accumulates, it can smother aquatic species, bury fish habitat, and decrease reservoir storage volume. For example, a 1995 report by Cadmus Group estimated that the "loss of storage capacity has been of considerable concern" in Lake Michie.<sup>16</sup> Because sediment can carry pathogens, pesticides, nutrients,

**Figure C:  
Current and Projected Demand vs Supply of Drinking Water**





COURTESY OF NEUSE RIVER FOUNDATION, 2004

and organic debris, increased sedimentation increases treatment costs at the water plant.

Of the ten stream segments in the UNRB listed as impaired by the state of North Carolina in 2006, at least seven are likely to have been degraded by urban stormwater run-off.<sup>17</sup> The state added six stream segments to the impaired list in 1998 and one in 2004. Between 2004 and 2006 the list of impaired stream segments did not change.

Urban and suburban development in UNRB is also contributing to the chronic eutrophication in the reservoirs. All reservoirs in the UNRB are threatened by eutrophication, which is manifested most visibly by algal blooms during the summer months. Eutrophication is a process by which a water body becomes enriched with nutrients (typically nitrogen and phosphorus) that promote algae growth. Algae choke off other vegetation and its decomposition reduces the oxygen in the ecosystem available for fish and other aquatic life. Excess algae also diminish the lakes' recreational and aesthetic values, clog drinking water intakes, and make drinking water taste and smell bad. Some algae produce dangerous toxins. Water suppliers often treat the

increased organic matter in the water (an indicator of eutrophication) by adding chlorine. The reaction between chlorine and organic matter produces disinfection by-products, which at high levels pose a risk to human health.

Upstream wastewater treatment plant (WWTP) discharges were once responsible for much of the nutrient loading in the watershed, but phosphorus has been dramatically reduced due to WWTP upgrades. It appears that the reservoirs' current eutrophication problems are caused by urban and agricultural run-off, failing septic systems and increased impervious surfaces in the watershed.

The UNRB tributaries and reservoirs are still good sources of drinking water, but the quality of these supplies is likely to decline based on population growth predictions and recent trends in degradation.<sup>18</sup> While there are a few prospects for new sources of drinking water, in the long run it will be significantly more cost effective to protect existing sources rather than seek out replacement sources or attempt to restore impaired waters once degradation has occurred.



# THE REGULATORY FABRIC

Many of the municipalities and counties in the UNRB have enacted ordinances to protect the basin's water quality. The character of these ordinances varies tremendously from jurisdiction to jurisdiction. They collectively represent a strong commitment to protecting water quality and a recognition that no single approach is adequate, but that the threats to water quality must be addressed through many means.

The regulatory approach generally includes the following: zoning overlays near waterbodies with special development restrictions within those overlays, including no-development stream bank buffers; mandated soil erosion control permits for construction sites that specify maximum allowable run-off during construction (sometimes detailing not only the amount but the maximum velocity permissible); prohibiting development within floodplains; requiring retention of stormwater on-site in new developments; and forbidding illicit discharges to the storm sewer system, where applicable. A more detailed list of the applicable local laws administered by each jurisdiction is in Appendix C.

Appendix D provides a glimpse into how much the rules differ, briefly comparing the stream bank buffer rules and erosion control ordinances of all the municipalities and counties in the basin. All the local governments have adopted the minimum requirements mandated by the North Carolina Neuse Nutrient Sensitive Water Rules, which set a baseline stream bank buffer width of 50 feet throughout the basin (30 feet must be undisturbed and managed in a natural state, with the remaining 20 feet functioning essentially as an additional building setback).<sup>19</sup> However, some local governments have established more protective measures. For example, Wake County requires a 100-foot buffer plus an additional 20-foot building setback for development adjacent to reservoirs. Creedmoor requires a 200-foot buffer in some places. The City of Durham requires up to 250-foot buffers in watershed

protection overlay districts.

Erosion control laws also vary greatly in terms of what is required of private landowners and how carefully permit compliance is monitored. In accordance with state standards, erosion and sediment control permits are required when more than one acre of land will be disturbed for development purposes. For example, in Person County, where minimum lot size is one acre, the state minimum standard applies and state personnel administer and enforce the program. Some other local governments require oversight for smaller projects. Consider Orange County, which requires an erosion control plan for all new development construction that will disturb 10,000 square feet or more in the Upper Eno area. In Wake Forest, all construction plats must be accompanied by an erosion control plan. The permit enforcement protocols vary from case-by-case inspections to systematic weekly visits to construction sites. Also, some jurisdictions specify how quickly ground cover must be restored and how large a buffer from construction must be maintained at all times.

THE TRUST FOR PUBLIC LAND (ARCHIVES)





CONSERVATION TRUST FOR NORTH CAROLINA (ARCHIVES)

Regulations across the region are helping to protect water quality and are a critical component of a comprehensive water resource protection strategy, but regulations alone cannot get the job done. Regulatory protection can be difficult to procure, and regulations can be changed, amended, dropped, or adapted as political climates change. Levels of protection and enforcement vary tremendously from place to place. An over-reliance on regulations puts the onus for protection primarily on owners of critical lands who may or may not consume the water that the rules are intended to protect.

Also, regulations emphasize stream or river buffers, but leave larger tracts of forested lands vulnerable to development despite the critical role they play in maintaining hydrologic health and minimizing overall stormwater loads and run-off pollution.

The considerable threats to drinking water in the UNRB necessitate an integrated and comprehensive response. Land conservation complements regulations, providing a place-based strategy that fills the gaps that regulations on private land can not or do not address.

# LAND CONSERVATION AS A DRINKING WATER PROTECTION STRATEGY

When communities invest in land protection as a way to protect their drinking water, they are investing in the long-term health and quality of life of their citizens. Voluntarily funded land protection strategies can permanently protect critical natural areas, guide growth away from sensitive water resources, protect farmland and natural habitats, preserve historic landscapes, and provide new park and recreational opportunities.

## CONSERVATION ACCOMPLISHMENTS AND EFFORTS UNDERWAY

Local governments, land trusts, watershed associations and others have been working for years to conserve sensitive lands in the watershed. As a result of these efforts, about 53,319 acres are already protected in the UNRB. Of this number, 38,575 acres are permanently protected lands, which are park land and nature preserves; lands managed for preservation by local/regional land trusts; and privately owned lands protected by conservation agreements. The statistic also includes 14,744 acres of partially protected lands, which are lands currently managed for conservation purposes with no binding agreement to do so in perpetuity.<sup>20</sup>

The protected lands across the basin represent decades of dedication to conservation, recreation, and watershed protection. A few landholdings and efforts will be highlighted here to represent what has been accomplished and what is currently underway. The North Carolina Division of Parks and Recreation (NCDPR) manages the Eno River State Park, Oconeechee Mountain State Natural Area, and Falls Lake State Recreation Area, which collectively comprise about 30,000 acres of conserved land. NCDPR is working on a “Mountain-to-Sea Trail” that will run parallel with the Falls Lake’s shoreline for 25 miles.

There is also much being accomplished and planned at the local government level. The Town of Creedmoor obtained a \$290,000 Clean Water Management Trust Fund (CWMTF) grant to acquire stream bank buffers. Hillsborough owns land around its reservoir and has recently received CWMTF dollars to create buffers along the West Fork Eno River and Corporation Lake. Hillsborough has also set aside money from its Capital Improvements Plan to acquire additional acreage for a river walk along the Eno River that will connect Oconeechee Mountain State Natural Area to the Orange County courthouse and river park complex in downtown Hillsborough.

Partially paid for with a 1996 bond, Durham City and Durham County are developing an extensive greenway system that links riparian corridors. The County has begun acquiring greenway lands in the North Fork Little River watershed with funding from the CWMTF. Under a separate initiative, Durham County has been acquiring open space in the Little River watershed for over four years. Orange County has conserved many acres to benefit watershed health through its Lands Legacy Program. For example, the county owns and stewards McGowan Creek Preserve and Seven Mile Creek Preserve and is purchasing additional buffer lands along Seven Mile Creek and the Upper Eno. Wake County has an open space program that was fueled, in part, by a \$15 million open space bond in 2000 and a subsequent \$26 million bond in 2004 for open space, recreation, watershed protection and wildlife protection. Wake County’s Watershed Management Program and County Open Space Plan target lands for acquisition that benefit water quality.

Several non-profit organizations are actively conserving acreage in the UNRB in partnership with many landowners and local governments,



including the Eno River Association, Ellerbe Creek Watershed Association, Triangle Greenways Council, Tar River Land Conservancy, Triangle Land Conservancy, and The Trust for Public Land.

Several institutions also hold land for research and recreation. For example, Duke University owns about 1,500 forested acres in Hillsborough and Durham. North Carolina State University owns about 3,000 acres: the Butner Beef Cattle Field Lab and Hill Forest in Durham County.

In just the last two years, jurisdictions in the Upper Neuse River Basin have spent millions of dollars to protect land for the purposes of creating parks, expanding recreational opportunities, conserving sensitive or important landscapes and protecting watersheds. This demonstrates a broad commitment to voluntary land conservation strategies and strong public support for funding these efforts.

UPPER NEUSE RIVER BASIN ASSOCIATION



## ADVANCING LAND CONSERVATION FOR SOURCE PROTECTION

Existing efforts to conserve land for the protection of drinking water have been effective, but there is a growing consensus that more needs to be done and that source protection efforts must be better coordinated across jurisdictions and strategically focused on protecting the parcels most critical to public drinking water sources.

Advanced Geographic Information Systems (GIS) technology and a growing body of research and science now allow local governments, watershed associations, land trusts, and water suppliers to bring a new level of rigor to place-based analysis and to better understand the dynamics of a watershed. The Triangle J Council of Governments (TJCOG), in collaboration with The Trust for Public Land (TPL), is using this technology to identify properties within the UNRB that offer the greatest protection value for the UNRB's water quality. Together they have conducted a comprehensive analysis of the opportunities that exist to protect additional lands critical to the UNRB's water quality today.

## PROCESS

Local landowners, elected officials, government agency representatives, technical experts, and scientists have worked with TJCOG and TPL to identify watershed goals for drinking water protection, while maximizing regional ecological, economic, and recreational benefits. TPL and TJCOG first asked community leaders and stakeholders to define conservation priorities in a public forum held October 26, 2005 at the Butner Advisory Council Meeting Facility. Over sixty individuals attended. Stakeholders identified protecting water quality as the primary conservation priority, and protecting working lands, aquatic habitat connectivity, and terrestrial habitat connectivity as secondary priorities.

TPL and TJCOG then assembled a Technical Advisory Team (TAT) of local experts in water quality, water resources management, and GIS to help them develop and weight model criteria and identify the highest quality data (See Acknowledgments for a list of TAT members.). Identifying lands that best reflect





THE TRUST FOR PUBLIC LAND (ARCHIVES)

local conservation goals required integration of numerous data sources over the 770 square-mile basin. The TPL Greenprint framework, a GIS-based model, was used to perform a structured, comprehensive analysis of regional resources.

In consultation with the Technical Advisory Team, TPL and TJCOG, structured the model to identify parcels that, if conserved, will help meet water quality priorities (called “Water Quality Protection Scenario”). The model does not prioritize protection of water quality of any one reservoir over any other in the basin. Rather, it provides a systematic approach for analyzing lands that offer highest conservation benefits across the UNRB based on the criteria refined by the TAT. Note that the model does not account for land that is protected by regulation. See Appendix E for a description of the modeling process and an outline of the criteria and data used in the model.

Once the Water Quality Protection Scenario was complete, TPL and TJCOG explored various ways to incorporate the other conservation priorities that the stakeholders identified. For example, some stakeholders would like to help conserve working lands and need to know which parcels identified for water quality protection are also farms or ranchland. So the team mapped working lands over the the Water Quality Protection

Scenario results. The same process was repeated for overlap with wetlands and then again for sites that are of “special biodiversity significance” according to the North Carolina Natural Heritage Program.

Another way TPL and TJCOG explored integrating various priorities for conserving lands was by weaving them into the model. To accomplish this, in consultation with the TAT, they created a second scenario – the Overall Protection Scenario – that identified lands that, if conserved, will benefit water quality and the other conservation priorities that stakeholders identified. Results from the Overall Protection Scenario included lands with Natural Heritage values (e.g., rare plants and/or animals), significant aquatic habitats (e.g., existing wetlands), and working lands (existing farmed/ranchled lands and lands with prime agriculture soils).

These results and products were shared with community leaders and stakeholders in a public forum held April 5, 2006 at the Butner Advisory Council Meeting Facility. Based on feedback from that meeting and subsequent discussion with land trusts and others, TPL and TJCOG developed parcel selection criteria that, when paired with the Water Quality Protection Scenario results, identify lands that can meet the aforementioned stakeholders’ priorities and additional criteria specific to individual land trusts.

**Table A:**  
**Comparison in the UNRB of Total and Protected Acres in Each County and Water Quality Protection Scenario Results**  
**(expressed as acreage, parcels and percentage of County)**

	Total Area of County [acres]	Area of UNRB [acres]	County land within UNRB [percent]	Proportion of UNRB Acreage [percent]	Total currently protected area in UNRB [acres] *	Total unprotected high-priority area [acres]**	Percent of all unprotected UNRB acreage in county identified as high priority***
<b>Durham County</b>	191,360	130,825	68%	27%	22,151	6,862	5%
<b>Franklin County</b>	316,160	5,692	2%	1%	0	157	3%
<b>Granville County</b>	343,040	84,310	25%	17%	11,775	4,992	6%
<b>Orange County</b>	254,720	125,117	49%	25%	5,762	5,454	4%
<b>Person County</b>	251,072	83,609	33%	17%	0	2,585	3%
<b>Wake County</b>	549,000	64,139	12%	13%	13,631	3,585	6%
<b>TOTAL</b>	1,905,352	493,692	n/a	100%	53,319	23,635	n/a

- \* The total area of protected parcels with the area of surface water that occurs on those parcels subtracted out. This includes permanently and non-permanently protected lands.
- \*\* The total area of “High-Priority for Water Quality” cells (with score 3-5 [out of 0 to 5] from the water quality model output) located on non-protected parcels only.
- \*\*\* The total acreage of unprotected high-priority area \*\* divided by the total acreage of the county located in the UNRB.

## RESULTS

The highlighted columns in Table A contain the results by county of the Water Quality Protection Scenario. These results are expressed as total acreage without consideration for parcel boundaries. Of all UNRB lands not already protected,<sup>21</sup> the model identified about 24,000 acres as high priority for conservation to protect water quality. Together, these high-priority acres represent just under 5% of the Upper Neuse River Basin land.

Durham County and Orange County have roughly the same proportion of UNRB acreage (see Figure D), and the model identi-

fies roughly the same proportion of land for protection in each county (see Figure E), but slightly less for Orange County. Granville and Person County also have similar proportions of UNRB acreage (about half as much as Durham and Orange), but the model identifies about twice as much land in Granville County for protection than in Person County. Wake County’s proportion is significantly smaller than Person County, yet it has about 40% more high-priority area. See Appendix E for more details on modeling inputs. The inside back cover contains a map which visually displays the model results.

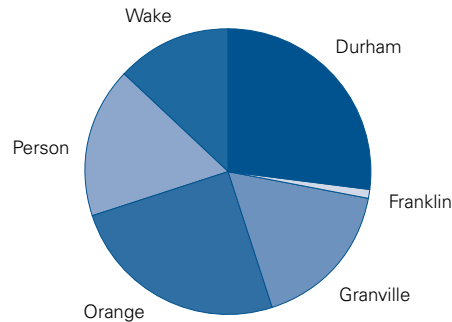
The county with the highest percentage of its UNRB land already protected — Durham County — also has the most unprotected land in need of conservation. However, the county with the second-most acreage already conserved — Wake County — is not among the top three counties in terms of number of acres in need of protection. Significant land protection is needed in Orange County and Granville County. It is important to note that all efforts to protect priority parcels will be based on voluntary participation by the landowner.

The water quality model prioritizes lands that are important to protecting water quality without consideration of parcel boundaries. For example, a 50 acre parcel may only have 10 acres of high priority land. Because protection will happen on a parcel-by-parcel basis, the partners needed criteria for selecting parcels for protection that contain important water quality lands. The land trust community selected criteria that, when considered on those sites that the model already determined were high priority for water quality protection, could help identify the parcels that have the greatest conservation benefits. These criteria include:

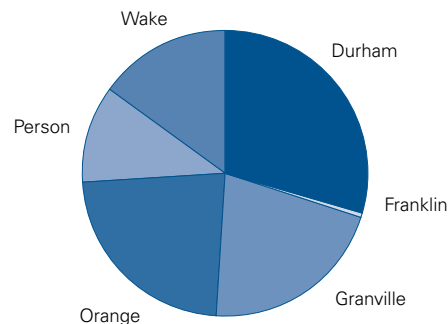
- adjacency to protected land,
- presence of or adjacency to a significant natural heritage area,
- presence of or adjacency to a Natural Heritage Element occurrence,
- parcel size, and
- length of stream frontage on the parcel.

The GIS software permits flexibility in setting criteria thresholds and determining whether to apply one or all criteria across a given area. By first considering the parcels selected as high priority by the Water Quality Protection Scenario model, then assessing each parcel for its ability to meet the parcel selection criteria, key parcels emerge as ideal candidates for protection. For example, a 50 acre parcel with 10 acres of high priority land, 2,000 feet of stream frontage, adjacent to protected land, that is also part of a significant natural heritage area, would be prioritized over a 10 acre parcel with 10 acres of high priority land, that does not meet the other criteria.

**Figure D:**  
**Proportion of UNRB Acreage by County**



**Figure E:**  
**Proportion of Land that the Model Identifies by County for Acquisition in UNRB**



# GETTING TO IMPLEMENTATION

If this effort to protect land critical to water quality in the UNRB is to be a success, it is essential to move beyond assessing priorities, and conserve more land. There are six land trusts active in the UNRB, already working with willing landowners and other partners to protect special places. There are at least four watershed associations already working to protect water quality.<sup>22</sup> These land trusts, watershed associations, local governments, and other partners in conservation have at least two ways to use the GIS tools described in this report to advance their efforts.

First, they can use results from the Water Quality Protection Scenario to identify areas with the highest conservation value for water quality, while determining these lands' relative locations to working lands and lands prioritized for aquatic and terrestrial habitats. They can also use one or more parcel selection criteria to hone in on specific types of parcels that the Water Quality Protection Scenario has identified as high priority. This allows them to conduct individualized analyses of parcels to determine their conservation value relative to other parcels in the basin. Armed with this information, land trusts and watershed associations can work with local governments to further prioritize the parcels identified and consult with interested landowners about voluntary options, such as conservation agreements, fee-simple purchase, donations, bargain sales, etc.

A range of funding options can be utilized to create a "funding quilt" that will sustain land acquisition both in the near term and over the long term. A funding quilt is the combination of funding sources — state, local, federal, and private (i.e. foundation and individual dollars) — that are brought together to help achieve conservation objectives. Due to fierce competition for state, federal, and private funding, these sources should be viewed as supplements or incentives, but not as central funding sources. The most reliable form of funding to achieve conservation objectives over the long term is local funding. Although local governments have

competing needs and limited resources, local support for water quality protection is generally strong across the country.<sup>23</sup>

Wake County's consolidated open space plan in North Carolina provides an illustration of a successful funding quilt in action. The foundation for funding is provided by two county bonds. In November 2000, county voters approved a \$15 million bond and four years later voters approved a second bond for \$26 million. The county commissioners then created an open space partnership grant program that provides matching funds to municipalities to support conservation projects and planning. To date, 11 of 12 municipal governments have received county grants. These local funds have been leveraged to attract state, federal, and private funding sources to support a number of protection projects in the county. These sources include the North Carolina Clean Water Management Trust Fund, Parks and Recreation Trust Fund, Natural Heritage Trust Fund, the Farmland Preservation Trust Fund, the Ecosystem Enhancement Program, and the federal Farm and Ranchland Protection Program.

## POTENTIAL SOURCES OF LOCAL FUNDING

In North Carolina, counties and municipalities have the power to levy taxes that are authorized by the North Carolina Constitution or statute. The expenditure of funds raised through local taxes is generally restricted to purposes enumerated by statute. Among the revenue sources authorized are bonds, property taxes, and local sales taxes. General obligation bonds and property taxes are the principal local revenue sources permitted for land conservation purposes.

Bonding enables local communities to create dedicated sources of funds for land conservation and to receive matching grants from state and federal programs. While it may seem



© TOM PENDER 2005

difficult to gain voter approval in the current economy, local land conservation ballot measures continue to receive strong public support. To date, several watershed communities — Durham, Durham County, Orange County, Raleigh, Wake Forest and Wake County — have successfully garnered voter approval for bonds that include funding for land conservation. In North Carolina, 26 of 30 (87%) land conservation measures placed on the ballot since 1996 were approved, generating more than \$600 million, including roughly \$400 million for parks and land conservation in these communities.<sup>24</sup> The jurisdictions that passed referenda represent roughly 25% of the state population and the state's largest metropolitan areas.

North Carolina counties and municipalities could be enabled by the state to utilize dedicated revenue streams for land conservation from sources other than general obligation bonds. The property tax is the largest revenue source for many local jurisdictions, and these proceeds may be expended for parks and open space. Property taxes could generate a steady source of funding for land conservation if they can be

dedicated for multiple years. Communities in the UNRB could seek state legislation that would enable them to adopt dedicated open space taxes and fees at the local level.

As another option to increase the funds available for land conservation, the six water utilities in the UNRB could consider incorporating dedicated fees for land acquisition as a supplement to their rate structure, as Salt Lake City, Utah has done. Since its fund was established in 1991, Salt Lake City has purchased 1,400 acres of land to protect its drinking water sources.

Raleigh has already set a precedent for watershed protection in the basin, as the Raleigh City Council dedicated \$500,000 from its 2005-2006 and \$500,000 from its 2006-2007 water/sewer utility revenue (separate from Raleigh's general fund) to expand protection in the Falls Lake watershed. The project includes development of this Conservation Plan and the model that informs it; outreach to landowners, local government officials, and the general public; and land protection through donation or purchase.



## POTENTIAL SOURCES OF STATE AND FEDERAL FUNDING

Local supporters of land conservation could advocate for continued statewide funding for land conservation. North Carolina already undertakes and funds land conservation through a number of state agencies and programs. Four separate conservation trust funds have been established since 1986: the Clean Water Management Trust Fund, Natural Heritage Trust Fund, Parks and Recreation Trust Fund, and the Farmland Preservation Trust Fund. These programs represent the bulk of state funding for land and water protection, as well as parks.<sup>25</sup> In 2000, the North Carolina General Assembly voted overwhelmingly in support of Governor Hunt's plan to preserve one million acres by December 31, 2009. The Million Acre Initiative would increase the percentage of land preserved in North Carolina from 8.8 percent to 12 percent; however, no additional money was attached to the plan beyond existing funding.

In 2005, several of the state's leading non-

profit conservation organizations, along with business, government, and professional interests, launched the Land for Tomorrow initiative. The coalition aims to secure support from the public and the North Carolina General Assembly for a Land and Water Conservation Bond to protect land, water, and historic places throughout the state. Land for Tomorrow is seeking a commitment of state bonds in 2006 to increase conservation spending by \$200 million per year for five years. The Land for Tomorrow Coalition recommends \$167 million per year in additional funding for the four existing conservation trust funds and \$33 million per year for a new program to support job creation and protection of historic resources, as well as coordination and planning efforts.<sup>26</sup> A local match is often required to leverage these types of funds.

Increased funding for the conservation trust funds would allow the state to support key land acquisitions in the basin and provide additional matching funds to help local communities meet their conservation goals. Local support and state leadership are needed for the state bond measure to be successful.

At the federal level, there are two distinct types of funding for land conservation: state-directed programs, in which states receive grants from the federal government but are given broad discretion to allocate funds (subject to federal program rules); and direct federal programs, in which the federal government makes grants to local recipients, usually local governments. State-directed federal grants include the Clean Water State Revolving Fund, the Drinking Water State Revolving Fund, and the Clean Water Act Section 319 Nonpoint Source Grant Program. Direct federal programs include the Farm and Ranchland Protection Program and the Forest Legacy Program. Additional federal funds may be available through earmarks and grants.

TAR RIVER LAND CONSERVANCY



## Conclusion

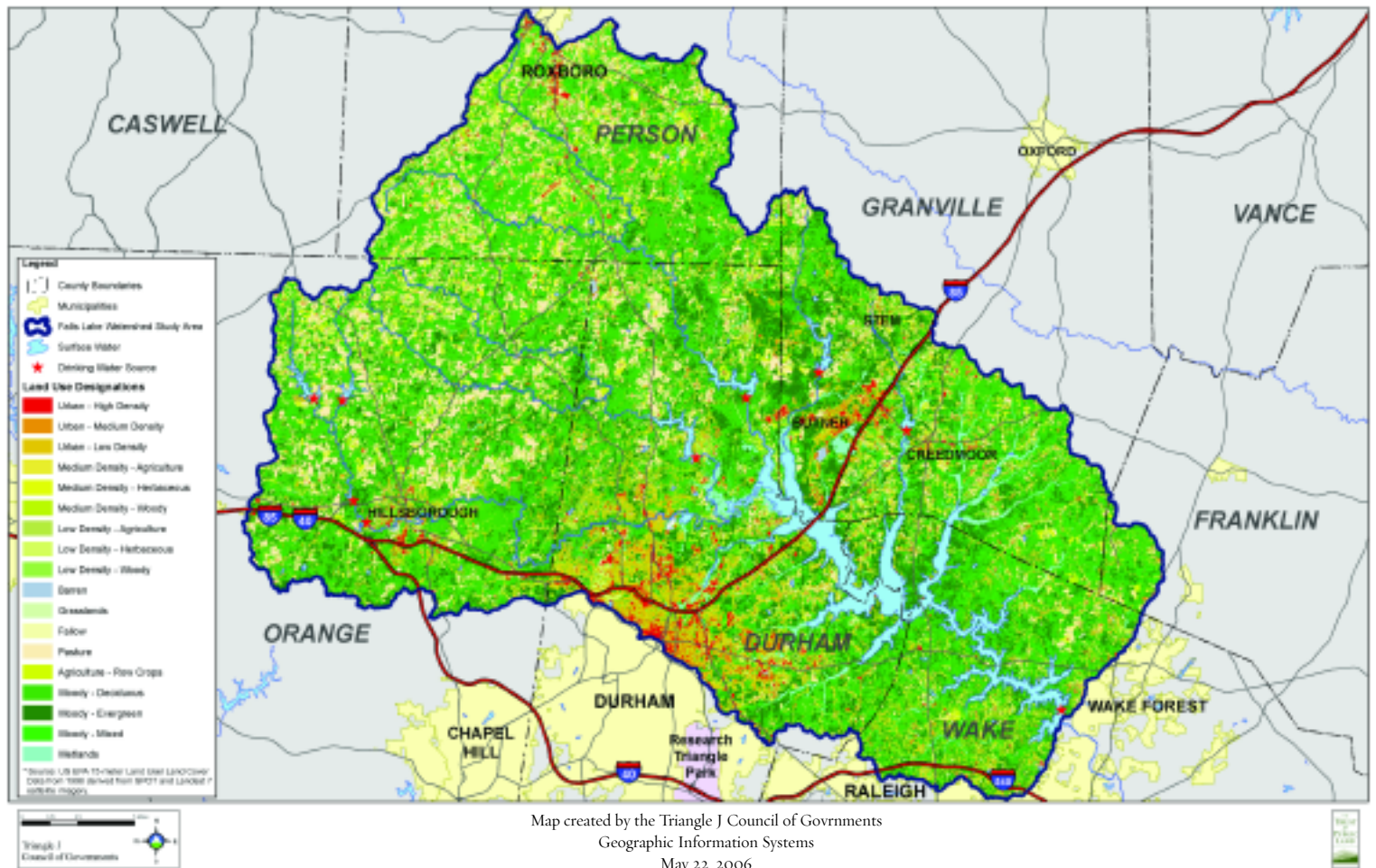


© JEFF MASTEN, COURTESY OF TRIANGLE LAND CONSERVANCY

Land conservation is a cost-effective key to assuring watershed protection, and it will only work while undeveloped sensitive lands remain. With these model results and seed funds to begin implementation, conservation leaders and local governments are equipped to protect the parcels that have the greatest impact on stemming the degradation of water quality in the UNRB, such as parcels

blanketed in forests or adjacent to headwater streams or wetlands. Existing protected lands and regulations can lessen the impacts from development along streams, but additional land conservation of strategic parcels in the basin will permanently assure a more sustainable supply of high-quality drinking water from existing sources.

## Appendix A: Current Land Use in the Upper Neuse River Basin





## *Appendix B: How Development Impacts Water Quality: An Example*

A subdivision was built on 139 rural acres in the Eno River watershed. The completed development included 47 single-family residential units with an average lot size of approximately 2.5 acres each, with the remainder of the land either used as road right-of-way or reserved as open space. Before the development process began, this land was almost entirely forested with a mix of hardwoods and early succession pines (some of the site had been logged in the past).

Planners analyzed the water quality impacts of the development using the Upper Neuse Site Evaluation Tool (SET). The SET is a Microsoft Excel-based spreadsheet that uses basic site information (land cover, soil type, impervious surfaces, etc.) to compare pre-and post-development conditions in terms of stormwater volume, sediment, nitrogen, and phosphorous.



Pre-development land cover and subdivision parcels.



Typical houses in this rural subdivision.

The results, presented in the table on page 20, demonstrate that placing development on previously forested areas increases pollutant export and stormwater run-off for a variety of reasons, including soil compaction and fertilizer use. Twenty-four of this tract's 139 acres were cleared to make way for the development. About 14 acres (10% of the tract) became impervious surfaces (structures, patios, sidewalks, driveways, and roads). The remaining 10 disturbed acres became the lawns and other landscaped areas surrounding each home site. Because the dwelling unit density is relatively low, no stormwater management practices were required.

Even relatively low-intensity development, such as this subdivision, increases nitrogen, phosphorous, and sediment export from a given area. Land protection is therefore an important tool to protect our rivers, lakes, and streams from development impacts.

continued next page

## Appendix B: How Development Impacts Water Quality: An Example (CONTINUED)

### Pollutant export for this subdivision according to the Site Evaluation Tool

Parcel Run-off	Pre-Development	Post-Development	Parcel Increase
Nitrogen	92 pounds per year	322 pounds per year	230 pounds per year
Phosphorous	16 pounds per year	52 pounds per year	36 pounds per year
Sediment	1.6 tons per year	45 tons per year	2.6 tons per year
Peak flow for the one-year/24-hour storm	17 cubic feet per second	51 cubic feet per second	34 cubic feet per second

Pollutant output analysis performed using the Upper Neuse Site Evaluation Tool, version 3.3c, April 2006. Developed by Tetra Tech, Inc. for Upper Neuse River Basin Association. See the SET website ([www.unrba.org/set](http://www.unrba.org/set)) for details on the SET, case selection methodology, and calculation assumptions.

### ABOUT THIS TOOL:

The Upper Neuse Site Evaluation Tool (SET) is a Microsoft Excel program that calculates pre- and post-development total stormwater volume, total suspended solids (sediment), total nitrogen and total phosphorous amounts. The SET requires basic site information, such as land use, land cover, soil type, impervious surfaces, hydrology and stormwater BMPs. Triangle J Council of Governments is using the SET to evaluate various parcels in the Upper Neuse River Basin to determine how much

polluted run-off would be generated if a parcel was developed in a manner typical to that area, compared to run-off generated had the parcel remained undeveloped. These estimates of polluted run-off from development in the UNRB will give an indication of how much pollution can be prevented by protecting land from development. Results from the analysis will be available in a subsequent report. Additional information on SET can be found at: <http://www.unrba.org/downloads.htm>.

## *Appendix C: Primary Local Laws Related to Water Quality within the Upper Neuse River Basin*

### **County      Local Watershed Protection Laws Administered**

#### **Durham County:**

Stormwater Management Ordinance  
Voluntary Farmland Protection  
Ordinance  
Unified Development Ordinance —  
County Enforces Sedimentation and  
Erosion Control Portion  
Sewer Use Ordinance  
Flood Damage Protection Ordinance

#### **Franklin County:**

Zoning Ordinance  
Subdivision Regulations  
Flood Damage Prevention Ordinance  
(state rules apply for erosion control,  
NC DENR reviews individual  
developer plans)  
(state rules apply for stormwater)

#### **Granville County:**

Land Development Ordinance  
(includes the Zoning, Subdivision,  
Watershed and Floodplain Ordinances)  
(state rules apply for erosion control,  
NC DENR reviews individual  
developer plans)

#### **Orange County:**

Flood Damage Protection Ordinance  
Zoning Ordinance  
Subdivision Regulations  
Soil Erosion and Sediment Control  
Ordinance  
Environmental Impact Ordinance  
Stormwater Ordinance for Lands within  
the Neuse River Basin

#### **Person County:**

Person County Planning Ordinance  
Subdivision Regulations

#### **Wake County:**

Zoning Ordinance  
Subdivision Ordinance  
Draft Unified Development Ordinance  
Historic Preservation Ordinance  
Wake County Stormwater Control,  
Management, and Watercourse Buffer  
Regulations  
Erosion and Sedimentation Ordinance  
(ESO)  
Regulations Governing Sewage Treatment  
and Disposal Systems in Wake County

### **City      Local Watershed Protection Laws Administered**

#### **Creedmoor:**

Zoning Ordinance for City of Creedmoor  
Flood Damage Prevention Ordinance  
City of Creedmoor Subdivision  
Ordinance  
City of Creedmoor Hazard Mitigation  
Plan (draft)  
(state rules apply for erosion control,  
DENR reviews individual  
developer plans)  
(state rules apply for stormwater)

#### **Durham:**

Unified Development Ordinance  
Stormwater Performance Standards for  
New Development  
Flood Damage Protection Ordinance  
Storm Sewer Ordinance (in revision)  
Sewer Use Ordinance  
Cross Connection Control Ordinance  
Water Conservation Ordinance

#### **Hillsborough:**

Hillsborough Floodplain Ordinance  
Zoning Ordinance  
Subdivision Ordinance  
Tree Ordinance  
(the following County rules apply in  
Hillsborough: Stormwater Ordinance  
for Lands within the Neuse River  
Basin, Soil Erosion and Sediment  
Control Ordinance, and septic  
regulations)

#### **Raleigh:**

Zoning Ordinance  
Subdivision Ordinance  
Soil Erosion and Sedimentation Control,  
Floodprone Area and Reservoir Water  
shed Protection Regulations  
Stormwater Control, Management, and  
Watercourse Buffer Regulations

#### **Wake Forest:**

Zoning Ordinance  
Subdivision Ordinance  
Sedimentation and Erosion Control  
Ordinance  
(the following Wake County rules apply in  
Wake Forest: Wake County ESO and  
Wake County Stormwater Control,  
Management, and Watercourse Buffer  
Regulations)

## Appendix D: Highlights of Riparian Buffer (not including wetlands) and Erosion Control Rules

Local Laws Administered	COUNTIES
<b>Durham County</b>	
Stormwater Ordinance	Implements Neuse Nutrient Management Strategy including 50' no-disturbance buffer, nutrient limits, and 1-year 24-hour peak flow control. Equivalent strategy for Cape Fear except nutrient controls are not included.
Unified Development Ordinance (Sedimentation and Erosion Control)	Administered for county and city. Any disturbance over 12,000 square feet requires a permit and any disturbance over 1 acre requires a sedimentation and erosion control plan and a permit. There are special standards for HQW zones, e.g., the design storm for erosion and sediment control measures is the 25-year storm.
Unified Development Ordinance - Environmental Protection	Tree Protection, Floodplain Protection, Water Supply Reservoir Buffer (250 feet), Watershed Protection Standards (impervious limits and increased buffer requirements - to 100 feet for High Density), Steep Slope Protection Standards (less than 25% slope within 100 feet of intermittent stream or within 200 feet of floodway fringe or perennial stream), Wetland Protection Standards (25 foot buffer for wetlands greater than 1 acre in size)
<b>Franklin County</b>	
Zoning Ordinance	Includes 2 water supply watershed districts - 50' riparian buffers required for new development in Watershed Protection Overlay Districts.
<b>Granville County</b>	
Land Development Ordinance	Includes water supply watershed zones, within which a shoreline buffer is required for all development activities — a minimum 50' vegetative buffer along all perennial or intermittent waters, with 30' of the buffer remaining in a natural undisturbed vegetative state along the perennial or intermittent waters. Stormwater plans required for development in the critical watersheds and water supply watershed areas.
(state rules apply for erosion control, DENR reviews individual developer plans)	
<b>Orange County</b>	
Zoning Ordinance	Includes 13 water supply watershed protection overlay districts with buffer rules applying to each. Stream buffers in the 13 water supply watersheds range from 65' - 85' (measured from top of bank or 100-yr floodplain, whichever is greatest). Outside of the water supply watersheds there is a minimum stream buffer of 50'. There is an exception in the stream buffer rules for golf courses in Orange County (which may or may not be overridden by the Neuse Rules) — where the line of play crosses a stream buffer, trees which obstruct the line of play may be cut, provided that stumps and root mass are kept and they are removed in a way that minimizes disturbance.
Soil Erosion and Sediment Control Ordinance	All building permits undergo review by Orange County Erosion Control, and they may decide that an Erosion Control Plan is required even if 10,000 sf will not be disturbed. However, in general, Land-Disturbing Permit and an approved Erosion Control Plan are required before activities that will disturb more than 20,000 sf can begin. A plan is required in the Upper Eno if disturbance is greater than or equal to 10,000 sf. Control of discharge (volume) and velocity are required in the Upper Eno watershed.
Environmental Impact Ordinance	The EIO requires that an environmental assessment be performed for any project (1) that will disturb more than 40,000 sf (not including roads); (2) in a water supply watershed critical area; (3) containing features listed in one of two inventories; (4) requiring an NPDES permit; or (5) containing slopes of greater than 25% outside of drainage easements and stream buffers at a contour of 10'.
Stormwater Ordinance for Lands within the Neuse River Basin	This ordinance codifies the Neuse Rules. The minimum buffer on all intermittent and perennial streams, lakes, ponds, and estuaries in the Neuse River Basin is 50'. There are some uses expressly exempted, allowable, allowable with mitigation, and prohibited in the stream buffer. In general, flows must be diffused before entering a stream buffer; remediative measures may be periodically necessary to prevent gullyng.
<b>Person County</b>	
Person County Planning Ordinance	Includes 8 special districts for watersheds and critical areas. Buffer requirements: Perennial Waters: 30' vegetative buffer; Public Water Supply Impoundments: 50' buffer; Others: use minimum state standards for water supply watershed buffers.
Subdivision Regulations	Erosion and sediment control required for construction on lots greater than 1 acre. Uses state standards, and state enforces.

## Wake County

Zoning Ordinance	Includes Water Supply Overlay District, Watershed Critical Area Overlay District, Watershed Management Area Overlay District and Watershed Protected Area Overlay Districts. Water supply impoundments (draining greater than 25 acres) must have an undisturbed 100' buffer plus an additional 20' building setback. Impoundments draining more than 5 but less than 25 acres must have an undisturbed 30' buffer plus a 20' building setback. Wake County has implemented only the low-density development option in water supply watershed districts. High-density projects (greater than 24% impervious) in the balance of Wake County must conform to the Neuse Rules with regard to 85% TSS removal, treatment for 1-year/24-hour storm, drawdown between 24 and 120 hours, etc. The Neuse Rules are also triggered for any developments proposing impervious surface levels 15% or greater.
Wake County Stormwater Control, Management, and Watercourse Buffer Regulations	Stream buffer width requirements: 50' (30' undisturbed, 20' of setback and stable vegetation) is required for all intermittent and perennial streams.
Erosion and Sedimentation Ordinance (ESO)	A permit is required for all sites that disturb more than one acre. SEC on sites less than 1 acre may be required "where sediment control measures are needed to protect against off-site damages." Re: buffers: Neuse Rules have been incorporated with some minor modification. There are additional requirements for HQWs and trout waters. E.g. There is a minimum buffer of 25' as measured from the top of the bank for designated trout waters.

Local Laws Administered	CITIES
<b>Creedmoor</b>	
Zoning Ordinance for City of Creedmoor	A minimum 200' undisturbed vegetative buffer is required for all new development activities along Lake Rogers, as measured from the mean high water mark around the lake.
City of Creedmoor Hazard Mitigation Plan (draft) (state rules apply for erosion control, DENR reviews individual developer plans).	The City adopted riparian buffer requirements of 50' each side (total of 100') buffer for intermittent streams and 100' each side (total of 200') for perennial streams.  During construction, erosion & sediment control required for sites greater than 1 acre. County conducts compliance inspections weekly during construction
<b>Durham</b>	
Stormwater Performance Standards for New Development	Implements Neuse Nutrient Management Strategy including 50 ft buffer on intermittent and perennial streams, nutrient limits, and 1-year 24-hour peak flow control. Requires management of peak flows for 2 yr and 10 yr storms to mitigate impacts.
Unified Development Ordinance (Sedimentation and Erosion Control)	Administered by county within city. Any disturbance over 12,000 square feet requires a permit and any disturbance over 1 acre requires a sedimentation and erosion control plan and a permit. There are special standards for HQW zones, e.g., the design storm for erosion and sediment control measures is the 25-year storm.
Unified Development Ordinance - Environmental Protection	Tree Protection and Tree Coverage, Floodplain Protection (restricts development with the 100-year floodplain), Stream Buffer Protection (minimum 50 feet with 10 ft construction setback on perennial & intermittent streams), Water Supply Reservoir Buffer (250 feet), Watershed Protection Standards (stormwater treatment, impervious limits and increased buffer requirements - to 100 feet for High Density), Steep Slope Protection Standards (greater than 25% slope within 100 feet of intermittent stream or within 200 feet of floodway fringe or perennial stream), Wetland Protection Standards (25 foot buffer for wetlands greater than 1 acre in size)
<b>Hillsborough</b>	
Zoning Ordinance*	There are two watershed protection overlay districts. For lands within these districts, additional, and potentially more stringent, methods of calculating buffer widths are provided.
(the following County rules apply in Hillsborough: Stormwater Ordinance for Land within the Neuse River Basin, Soil Erosion and Sediment Control Ordinance, and septic regulations)	* City methods for calculating buffer width in the Hillsborough Subdivision Ordinance and Zoning Ordinance are trumped by the more stringent Neuse Rules which are codified in the Orange County Stormwater Ordinance for Lands in the Neuse River Basin.

continued next page

*Appendix D: Highlights of riparian buffer (not including wetlands) and erosion control rules (CONTINUED)*

Local Laws Administered	CITIES
<b>Raleigh</b>	
Soil Erosion and Sedimentation Control, Floodprone Area and Reservoir Watershed Protection Regulations	All sites with a land-disturbing activity more than 12,000 sf in size must obtain a permit and meet with the conservation inspector if requested to do so. According to the ordinance, a municipal inspector must inspect the SEC devices before grading can begin. Additional permits, inspections and/or surveys are required for clearing and development activities in the Falls Lake and Swift Creek watershed protection areas.
Stormwater Control, Management, and Watercourse Buffer Regulations	A stormwater plan must be submitted for approval whenever there is any increase in impervious area proposed for a development.
<b>Wake Forest</b>	
Zoning Ordinance	Includes a Reservoir Watershed Protection Overlay District and 2 Residential Watershed Protection Districts. According to the ordinance, “[I]n all cases where development is proposed adjacent to streams, rivers, creeks, lakes, or ponds, every effort should be made to preserve these natural assets.” Wake Forest requires 50’ riparian buffers measured from “the edge of the water body” or, if the water body is prone to flooding, 50’ from the 10-year flood boundary. Development near streams, creeks, rivers, and lakes must meet the landscape requirements of the zoning ordinance. These standards are also applied to redevelopment (with somewhat greater flexibility). Wake Forest offers developers density bonuses as incentives to preserve existing trees.
Sedimentation and Erosion Control Ordinance	All construction plats must be accompanied by an erosion control plan.

*The term “Neuse Rules” is used throughout as short-hand for Neuse Nutrient Sensitive Waters Rules.*

## Appendix E: Description of Modeling Process

### HOW THE MODEL WORKS

1. The GIS technicians assembled local and regional datasets that inform the conservation objectives identified by the stakeholders, and translated the data — called criteria — into a spatial representation. For example, one objective is to protect water quality via riparian areas. Criteria for that objective are locations of streams, other waterbodies and floodplains.
2. The GIS technicians combined the criteria building blocks into a set of composite conservation priority maps — one for each conservation objective.
3. Together with the stakeholders and Technical Advisory

sory Team, the technicians explored alternative conservation scenarios by modifying the relative importance of the conservation objectives, and agreed upon a weighting or value for each.

4. They asked the model to identify the parcels with the highest combined conservation value. The conservation value reflects the combining of scores for each of the conservation objectives identified.

What follows is list of the data used for each conservation objective and its weighting in both scenarios described in the Conservation Plan.

Conservation Objective	Criteria	Water Quality Protection Scenario	Overall Protection Scenario
Protect water quality via riparian areas:		32%	20%
	Stream (100 ft buffer)		
	Waterbody (100 ft buffer)		
	Floodplain		
Protect water quality via wetland retention:	Wetlands	19%	9%
Protect water quality via vertical hydraulic conductance:	Hydraulic conductance	8%	8%
Protect drinking water via drinking water source:		9%	11%
	Critical area catchments		
	Groundwater wells		
Protect water quality via minimizing soil erosion:	Erosive soils	7%	3%
Protect water quality via land use:	Land use	12%	8%
Protect water quality via headwater streams:	Low order catchment areas	13%	13%
Protect aquatic habitat:		—	13%
	Wetlands		
	Natural Heritage		
	Diabase sills		
	Stream (100 ft buffer)		
	Waterbody (100 ft buffer)		
Protect terrestrial habitat:		—	11%
	Stream (300 ft buffer)		
	Waterbody (300 ft buffer)		
	Wetlands		
	Natural heritage		
	Areas adjacent to protected land		
Protect working lands:	Working lands	—	4%



# Endnotes

- <sup>1</sup> The study was conducted by The Trust for Public Land and the American Water Works Association's Source Water Protection Committee. Caryn Ernst, et. al. "Protecting the Source: Conserving Forests to Protect Water," *Opflow*, Vol. 30, No. 5, May 2004.
- <sup>2</sup> These figures do not reflect space occupied by waterbodies other than wetlands. They are based on 1998 landcover data derived by the United State Environmental Protection Agency's Landscape Characterization Branch, Research Triangle Park, North Carolina.
- <sup>3</sup> Upper Neuse River Basin Association and Tetra Tech, Inc., "Upper Neuse Watershed Management Plan," May 2003, p. ES-3.
- <sup>4</sup> This data is based on 2002 Local Water Supply Plans compiled by the North Carolina Division of Water Resources. Butner draws only from surface water and has no additional sources planned for 2030. Creedmoor also draws surface water and purchases .3 MGD, which it plans to continue through 2030 with no additional supplements. Durham draws from surface supplies and purchases 3.5 MGD but plans to discontinue purchase contracts before 2030, and to get 21 MGD in additional supplies from Jordan Lake and Teer Quarry, both surface water sources. Raleigh draws entirely from surface water supplies, and by 2030 plans to draw an additional 35 MGD from Little River Reservoir and Lake Benson Wheeler (Swift Creek). Hillsborough draws only from surface supplies and has no additional sources planned for 2030. Orange-Alamance draws from surface water and gets .572 MGD from groundwater and purchase contracts, with plans to purchase .8 MGD from the Haw River and draw .057 MGD from local groundwater by 2030.
- <sup>5</sup> Of the six, only Orange-Alamance was using ground water in 2002. Even so, the majority of its supply comes from surface sources.
- <sup>6</sup> As part of its modern design, a sediment pool was constructed in Falls Lake and sediment has not accumulated in the reservoir faster than originally projected.
- <sup>7</sup> For example, the Wake County Watershed Management Plan Task Force performed a correlation analysis of impervious surfaces to watershed classification based on water quality data and they found that watersheds of unimpaired streams averaged 8% imperviousness, impacted streams averaged 11%, and degraded streams averaged 24%. Information on this analysis can be found in the 2/7/03 Wake County Watershed Management Final Plan on page ES-5, available at <http://projects.ch2m.com/WakeCounty/>.
- <sup>8</sup> Upper Neuse River Basin Association and Tetra Tech, Inc., "Upper Neuse Watershed Management Plan," May 2003, p. ES-4.
- <sup>9</sup> E.g. R.R. Horner, C.W. May, and E. Livingston, et. al. "Structural and Non-Structural BMPs for Protective Streams," Seventh Biennial Stormwater Research & Watershed Management Conference, May 22-23, 2002.
- <sup>10</sup> Upper Neuse River Basin Association and Tetra Tech, Inc., "Upper Neuse Watershed Management Plan," May 2003, p. 33.
- <sup>11</sup> Id.
- <sup>12</sup> K. Hopper and C. Ernst, *Source Protection Handbook: Using Land Conservation to Protect Drinking Water Supplies*, The Trust for Public Land, 2005, p. 29.
- <sup>13</sup> Bruce Peterson, "Control of Nitrogen Export from Watersheds by Headwater Streams," *Science*, 292:86-90 (2001).
- <sup>14</sup> Channelized streams have been straightened, typically to protect adjacent properties from flooding or streambank erosion.
- <sup>15</sup> Upper Neuse River Basin Association and Tetra Tech, Inc., "Upper Neuse Watershed Management Plan," May 2003, p. 32.
- <sup>16</sup> Storage capacity of Lake Michie is in jeopardy because it has an 89% trap efficiency. (The Cadmus Group, Inc. "Falls Lake Watershed Study – Final Report," October, 1995, p. 5-15).



<sup>17</sup> Based on North Carolina 303(d) Impaired Waters List – draft.

<sup>18</sup> According to North Carolina DENR, Division of Water Quality's 2001 Assessment (most recent available) of the UNRB, "biological sampling showed no evidence of major changes in water quality for this subbasin between 1995 and 2000." ("2001 Neuse River Basinwide Assessment Report," p. 41). However, numerous stream segment impairments were identified in the late 1990s in the UNRB, and many have not yet been resolved, as revealed by the state's 303(d) lists. As of the 2006 303(d) draft, ten stream segments are not meeting their designated uses in the UNRB. But the state classified these changes as less than "major." According to the 2001 Basinwide Assessment, many of the creeks, rivers and lakes are supporting their uses, but impacts of pollutant loading are evident. For example, the Flat River above Lake Michie is still meeting its designated uses, but its bioclassification has declined ("Basinwide Planning Program: 2002 Neuse River Basinwide Water Quality Plan" by North Carolina Division of Water Quality).

<sup>19</sup> Riparian buffer requirements are just one of six elements of the Neuse River Nutrient Sensitive Water Rules first adopted in 1983 and subsequently modified. The rules seek to reduce nitrogen loading from three primary pollutant sources: wastewater discharges, urban stormwater, and agricultural activities. These state rules regulate individual behavior and use of property (e.g. a farmer's use of Best Management Practices on his land) as well as certain local government activities.

<sup>20</sup> The protected lands data sets were created by Triangle J GIS from a variety of sources.

<sup>21</sup> Lands that that have already been permanently or partially protected have been factored out of this modeling exercise. Permanently protected lands includes park land and nature preserves; lands managed for preservation by local/regional land trusts; and privately owned lands protected by conservation agreements. Partially protected lands includes lands which are cur-



CONSERVATION TRUST FOR NORTH CAROLINA (ARCHIVES)

rently managed for conservation purposes with no binding agreement to do so in perpetuity. The protected lands data sets were created by Triangle J GIS from a variety of sources.

<sup>22</sup> Friends of South Ellerbe Creek, Ellerbe Creek Watershed Association, Upper Neuse River Basin Association and Eno River Association.

<sup>23</sup> Results of a national poll conducted by TPL and The Nature Conservancy in 2004 indicate that voters prioritize water as a critical reason to purchase and protect land, no matter how it is expressed: the vast majority of those polled see it as "very important" to buy land to protect drinking water quality (84%); improve the water quality in our lakes, streams and rivers (75%); protect lakes, rivers and streams (72%); and protect watersheds (66%). Moreover, water is tops in every region (not just the perennially thirsty West) and rates just as high in big cities (85% very important) as rural areas (84%).

continued next page

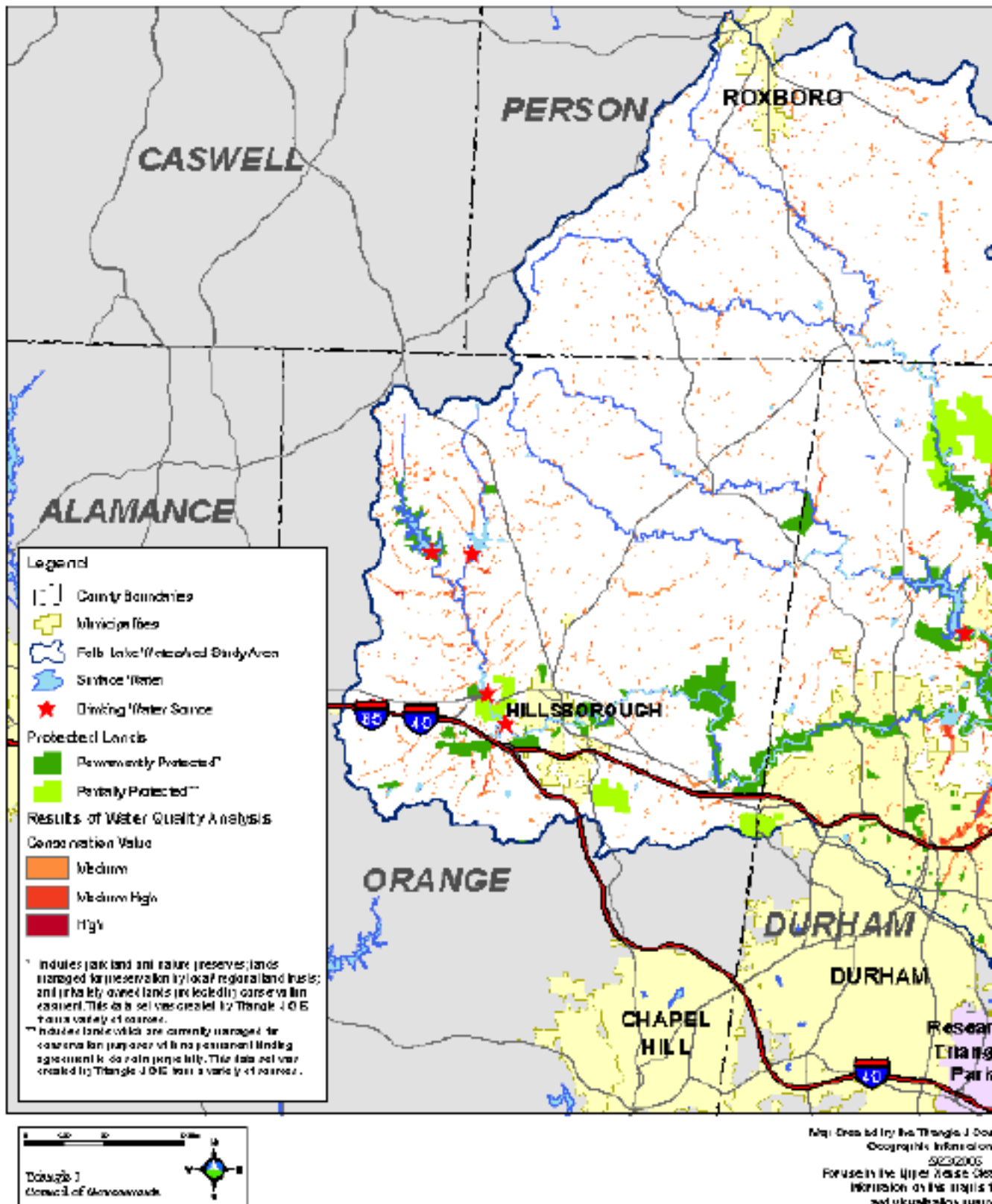
<sup>24</sup> There are two figures because many bond measures include dollars for other purposes besides land conservation.

<sup>25</sup> The Farmland Preservation Trust Program has not received state funding since 2003.

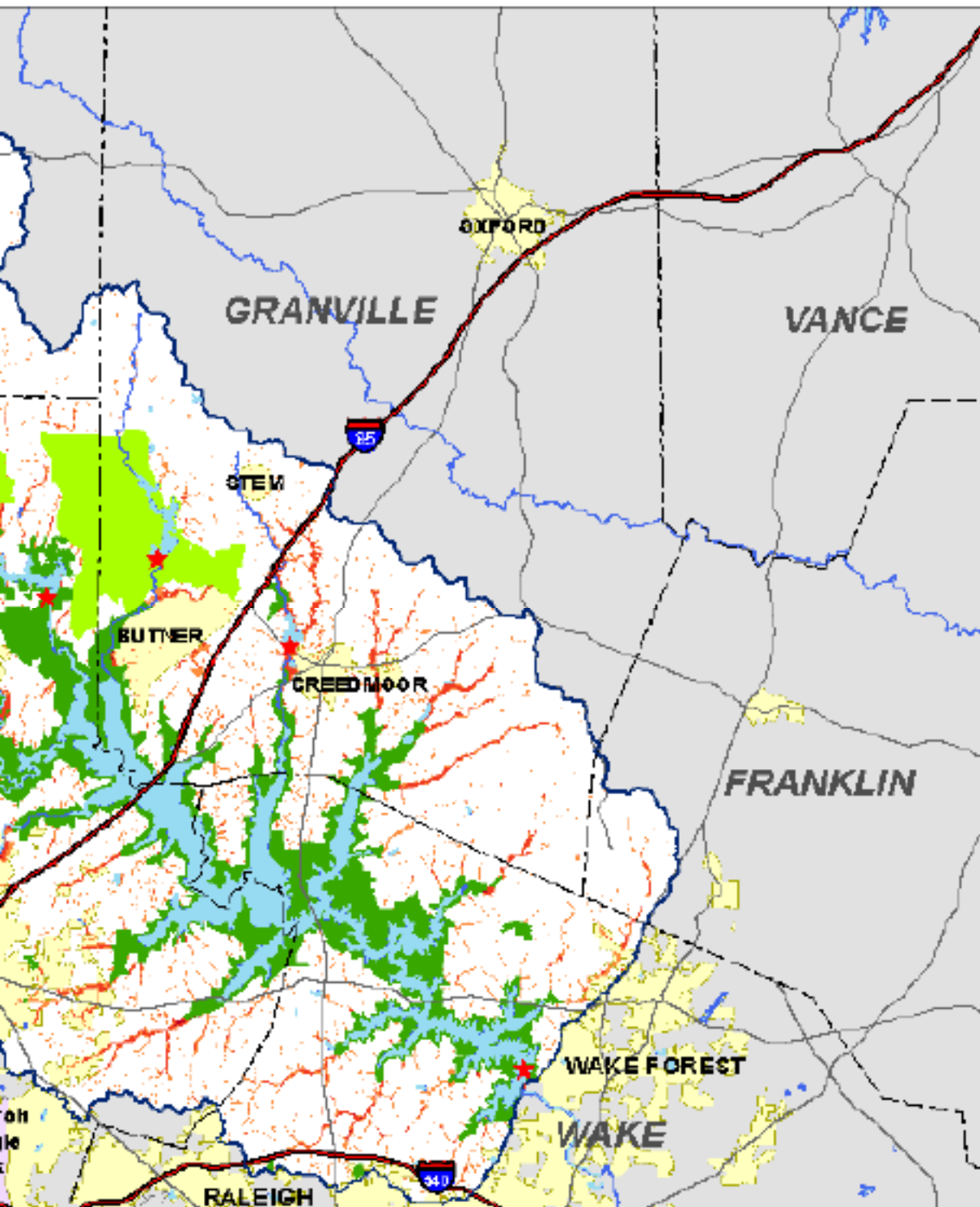
<sup>26</sup> *Saving the Goodliest Land: A Five Year Plan for Investing in North Carolina's Land, Water, History and Future*  
<http://www.landfortomorrow.org/>.

← *Please open to view map*

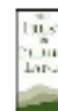
# High Priority Lands for Water Quality Protection in the U



# Upper Neuse River Basin



Level of Government  
Data  
by Water Initiative  
for Discussion  
uses only.





CITY OF RALEIGH  
222 W. HARGETT STREET  
RALEIGH, NC 27601  
MAIN INFORMATION LINE: (919) 890-3000  
[WWW.RALEIGH-NC.ORG](http://WWW.RALEIGH-NC.ORG)



TRIANGLE GREENWAYS COUNCIL  
PO Box 2746  
RALEIGH, NC 27602  
(919) 545-9104  
[WWW.TRIANGLEGREENWAYS.ORG](http://WWW.TRIANGLEGREENWAYS.ORG)



CONSERVATION TRUST FOR NORTH CAROLINA  
1028 WASHINGTON STREET  
RALEIGH, NC 27605  
(919) 828-4199  
[WWW.CTNC.ORG](http://WWW.CTNC.ORG)



TRIANGLE J COUNCIL OF GOVERNMENTS  
POB 12276  
RESEARCH TRIANGLE PARK, NC 27709  
(919) 549-0551  
[WWW.TJCOG.DST.NC.US](http://WWW.TJCOG.DST.NC.US)



ELLERBE CREEK WATERSHED ASSOCIATION  
P.O. Box 2679  
DURHAM, NC 27705-2679  
(919) 698-8161  
[WWW.ELLERBECREEK.ORG](http://WWW.ELLERBECREEK.ORG)



TRIANGLE LAND CONSERVANCY  
1101 HAYNES STREET, SUITE 205  
RALEIGH, NC 27604  
(919) 833-3662  
[WWW.TLC-NC.ORG](http://WWW.TLC-NC.ORG)



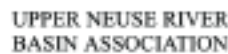
ENO RIVER ASSOCIATION  
4419 GUESS ROAD  
DURHAM, NC 27712  
(919) 620-9099  
[WWW.ENORIVER.ORG](http://WWW.ENORIVER.ORG)



THE TRUST FOR PUBLIC LAND  
116 NEW MONTGOMERY STREET, 4TH FLOOR  
SAN FRANCISCO, CA 94105  
(800) 714-5263  
[WWW.TPL.ORG](http://WWW.TPL.ORG)



NEUSE RIVER FOUNDATION  
P.O. Box 15451  
NEW BERN NC 28561  
(252) 637-7972  
[WWW.NEUSERIVER.ORG](http://WWW.NEUSERIVER.ORG)



UPPER NEUSE RIVER BASIN ASSOCIATION  
POB 12276  
RESEARCH TRIANGLE PARK, NC 27709  
(919) 558-2702  
[HTTP://WWW.UNRBA.ORG/](http://WWW.UNRBA.ORG/)



TAR RIVER LAND CONSERVANCY  
123 N MAIN STREET, PO Box 1161  
LOUISBURG, NC 27549  
(919) 496-5902  
[HTTP://WWW.TARRIVER.ORG](http://WWW.TARRIVER.ORG)

*printed on recycled paper*