


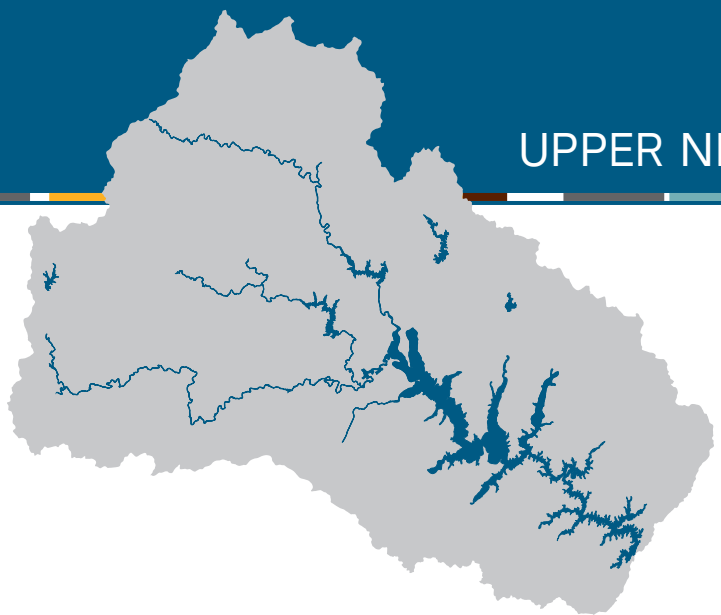

UPPER NEUSE CLEAN WATER INITIATIVE

2015 - 2045 CONSERVATION STRATEGY

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The Conservation Fund

The Conservation Strategy and other efforts of the Upper Neuse Clean Water Initiative were generously funded by the City of Raleigh, North Carolina.

THE CONSERVATION FUND

Ellerbe Creek Watershed Association

tlc TRIANGLE LAND CONSERVANCY

Triangle GREENWAYS Council

ENO River Association

The City of Raleigh PUBLIC UTILITIES DEPARTMENT

CONSERVATION TRUST FOR NORTH CAROLINA

TAR RIVER LAND CONSERVANCY

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1 EXECUTIVE SUMMARY

One of the most effective ways to protect drinking water sources is to protect the land around them. Forests, wetlands, and open fields slow down rain and runoff, giving water time to filter gradually through the soil. This traps sediment and pollutants before they flow into streams and lakes, and allows groundwater to recharge.

The Upper Neuse Clean Water Initiative 2015-2045 Conservation Strategy provides a framework for protecting drinking water supply resources through land protection, which is one key element of a comprehensive strategy of green and gray infrastructure investments that can help ensure clean water for the communities that receive drinking water from the Upper Neuse watershed in central North Carolina.

Land conservation provides benefits for local communities beyond water quality, including the creation of new parks and greenways, and the protection of ecological functions and processes that nature provides us for free (e.g., flood protection, air purification, and pollination).

Just 10 years after the completion of the original plan in 2006, the Upper Neuse Initiative has successfully protected 88 properties that include 84 miles of stream banks on 7,658 acres.

In 2015, the Upper Neuse Initiative partners and stakeholders undertook a planning process to design an updated land conservation strategy that uses the latest and best available science and geographic data to help refine and refocus land protection priorities.

Land conservation provides benefits for local communities beyond water quality, including the creation of new parks and greenways, and the protection of ecological functions and processes that nature provides us for free.

The result is an enhanced GIS-based Watershed Protection Model (FIGURE 1.2) that spatially identifies the most important locations to invest in land conservation based on four main goals:

1. **Protect water sources and conveyances**
2. **Conserve upland areas**
3. **Promote water infiltration and retention**
4. **Protect vulnerable areas**

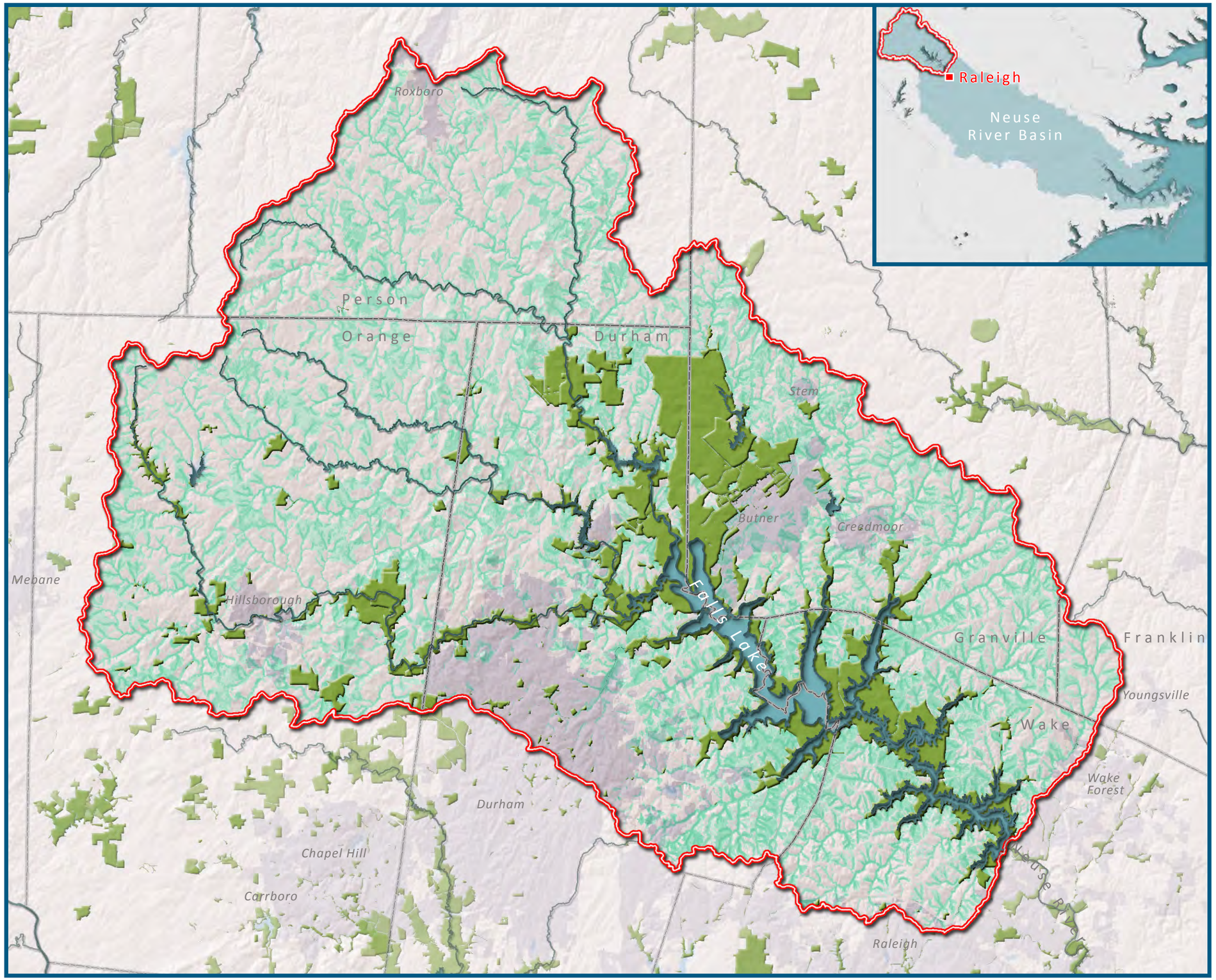
Through the convening of a Technical Advisory Team and stakeholder input meetings, model objectives (FIGURE 1.1) were refined and weighted to create a spatially explicit map of areas where land protection can provide the most "bang for the buck" in drinking water supply protection. The Model identifies over 17,000 parcels that encompass over 260,000 acres within the Upper Neuse watershed that would be eligible for funding from the City of Raleigh's Watershed Protection Program. A comparable model was also developed for the Upper Swift Creek watershed.

Based on projected funds available from the City of Raleigh's Watershed Protection Fund and potential matching funds, the historic success of the Upper Neuse Initiative, and an assessment of future opportunities for land conservation, the Upper Neuse Initiative partners have identified **a goal of protecting 30,000 acres over the next 30 years**, which corresponds to about 11% of eligible acreage within the watershed.

Achieving this goal would provide tangible water quality benefits within the watershed and is a feasible target in a voluntary landowner, market driven system. Complementary strategies such as restoration, land use regulations, riparian buffers, and water and wastewater treatment upgrades will also continue to play a key role in maintaining and enhancing clean water. Broad support from stakeholders in the watershed will help turn this ambitious vision into a reality.

Water Sources and Conveyances	Uplands	Infiltration and Retention	Vulnerable Areas
Protect headwater streams	Protect uplands and pervious areas	Promote infiltration and retention through wetland protection	Protect wet and hydric areas
Support connected high quality water features	Protect areas with minimal impervious surface	Promote filtration through floodplain protection	Protect steep sloping areas
Protect riparian areas	Protect uplands with forest cover	Protect underground recharge areas	Protect uplands with forest cover

FIGURE 1.1: Watershed Protection Model Goals and Objectives



CONSERVATION TRUST FOR NORTH CAROLINA

THE CONSERVATION FUND

ENO River Association

Upper Neuse Watershed Association

Triangle Greenways Council

The City of Raleigh Public Utilities Department

tlc Triangle Land Conservancy

Tar River Land Conservancy

FIGURE 1.2: Land Conservation Strategy Map

UPPER NEUSE CLEAN WATER INITIATIVE:
CONSERVATION STRATEGY

2015 MODEL RESULTS

LEGEND

- Major Hydrology
- Upper Neuse River Basin
- County Boundaries
- Managed Open Space
- Watershed Protection Model Score

2 PLANNING CONTEXT

WATER QUALITY IN FALLS LAKE

Falls of the Neuse Reservoir (Falls Lake) is a multi-purpose impoundment of the Neuse River located in the Upper Neuse River Basin. The reservoir is the primary drinking water supply for the City of Raleigh and surrounding towns in Wake County. The Falls Lake dam was constructed and filled by 1983 and is currently operated by the United States Army Corps of Engineers.

The reservoir extends 28 miles to just above the confluence of the Eno and Flat Rivers. The uses for the reservoir include: water supply, flood control, recreation, wildlife enhancement, and augmentation of low flows for purposes of pollution abatement and water quality control in the Neuse River Basin. Algal blooms and eutrophic conditions have been present in the lake since impoundment.

Initially, Falls Lake was not designated as ”impaired” for any water quality indicator, so land conservation projects within the watershed could be considered a proactive, non-regulatory approach to protecting water quality before state and/or federal regulations required action.

However, in 2008, the North Carolina Division of Water Resources (formerly Division of Water Quality) collected water quality data which indicated the entire lake exceeded the chlorophyll a water quality standard (i.e., more than 10% of samples >40 micrograms per liter), and the upper basin also exceeded the turbidity water quality standard (>50 ntu). Chlorophyll a and turbidity are indicators of excess nutrients and sediment entering Falls Lake.

The City of Raleigh is a nationally recognized leader in protecting drinking water supply resources... with the goal of being an area known for plentiful, clean, and outstanding drinking water quality.

This information resulted in the Division of Water Resources designating Falls Lake as impaired for chlorophyll a and turbidity (for the upper basin only) and placed it on the EPA 303(d) list for impaired surface waters. As prescribed in the federally

promulgated Clean Water Act, a state sponsored management strategy was initiated (in lieu of a Total Maximum Daily Load rule making process) as an effort to improve water quality in Falls Lake so that it would consistently meet water quality standards.

Overall, the upper area of Falls Lake (generally defined as upstream of the Interstate 85 bridge) has experienced the highest number of chlorophyll a exceedances, with water quality generally improving in the central portion (around the Highway 50 bridge) and lower areas. In contrast, the Beaverdam impoundment to the east has consistently met all water quality standards. This sub-watershed is generally undeveloped with mostly forested land cover.

Populations of the three most populous counties in the watershed, Durham, Orange, and Wake, grew 130% between 1976 and 2005, according to a study from the Renaissance Computing Institute (RENSI) at UNC Charlotte. During the same time period, developed acreage increased 650%. The study predicts 106% population growth in the Durham, Orange, and Wake County area by 2040, and a 154% increase in development in this region, at an average rate of 17 acres per day. By 2040, 36% of the Triangle is forecast to be covered by impervious surfaces.

At the same time, the water customer base of Raleigh, Durham, Orange Water and Sewer Authority and South Granville Water and Sewer Authority are also expected to increase. The City of Raleigh alone expects to increase its water customer base by almost 290,000 people by 2030.

...protecting land along streams from development prevents additional pollutants and sediment from entering water in the first place... Retaining and restoring buffers is one of the least expensive strategies for reducing nitrogen loads

WATER QUALITY BENEFIT OF FORESTS AND WETLANDS

One of the most effective ways to protect drinking water sources is to protect the land around them. Forests, wetlands, and open fields slow down rain and runoff, giving water time to filter gradually through the soil. This traps sediment and pollutants before they flow into streams and lakes, and allows groundwater to recharge. Forests and wetlands can filter nitrogen, phosphorus, and sediment from overland runoff. As nitrogen is removed, phosphorous is simultaneously filtered. Maintaining and enhancing these filtering capabilities can help improve chlorophyll a and turbidity water quality indicators.

Studies have demonstrated reductions of 30 to 98% for nitrogen, phosphorus, sediments, pesticides, and other pollutants in surface and groundwater after passing through a forested land along streams and other waterbodies. A recent study in the Upper Neuse found that nitrogen and phosphorus levels from forested watersheds are significantly lower than those loads from new development meeting the Falls Lake Rules.

Moreover, protecting land along streams from development prevents additional pollutants and sediment from entering water in the first place. Based on a study in the Upper Neuse River Basin, we estimate that land conservation projects completed by the Upper Neuse Clean Water Initiative along streams in the basin **avoid at least 7,926 lb of nitrogen and 1,408 lb of phosphorous annually from entering nearby waterways**. Retaining and restoring buffers is one of the least expensive strategies for reducing nitrogen loads.

Numerous studies have demonstrated that wetlands change water quality through retention and/or modification of sediments, toxins, and nutrients in the water. As water passes through wetlands, its velocity is reduced, large populations of microbes decompose organic substances, and particles are bound to sediments. Submerged and emergent plants help purify water both directly (by absorbing nutrients and other chemicals through their roots) and indirectly (by supplying substrates for bacterial growth, providing a medium for physical filtration and absorption, and restricting algal growth and wave action).

A 2011 study found that wetlands filter 63% of nitrogen, 45% of phosphorous, and retain 69 to 94% of sediment. The authors reported an $840,000 annualized municipal water treatment cost of losing 3,132 acres of wetlands over 15 years, or $281 per acre per year.

Protecting natural watersheds can even help avoid having to invest in expensive filtration plants to purify water from degraded watersheds. A 2007 study found that a 1,800 acre natural wetland could save $300,000 per year in annualized capital costs and operation and maintenance to filter wastewater at one million gallons per day ($171 per acre per year). A survey of 27 water suppliers found that the more forest cover in a watershed, the lower the water treatment costs. The same study found that 55% of the variation in treatment costs could be explained by the percent of forest cover in the source area. Furthermore,

for every 10% increase in forest cover in the watershed, treatment and chemical costs decreased about 20%, up to about 60% forest cover.

Land conservation provides benefits beyond water quality for local communities, including the creation of new parks and greenways, and the protection of ecological functions and processes that nature provides us for free (e.g., flood protection, air purification, and pollination).

Please see the literature review, Page 26, for the list of studies referenced in this section. Cost estimates were adjusted from the original studies to 2015 dollars using the Bureau of Labor Statistics Consumer Price Index Inflation Calculator: www.bls.gov/data/inflation_calculator.htm

RALEIGH'S WATERSHED PROTECTION PROGRAM

The 770-square-mile Upper Neuse basin contains nine public drinking water reservoirs (Falls Lake, Lake Michie, Little River Reservoir, Lake Holt, Lake Orange, New Hillsborough Lake, Corporation Lake, Lake Ben Johnson and Lake Rogers) and includes portions of 6 counties (Wake, Franklin, Granville, Durham, Orange, and Person) and 8 municipalities (FIGURES 2.2,2.3). The basin drains into Falls Lake, the drinking water source for the City of Raleigh and other local municipalities. The City of Raleigh's Public Utilities Department provides water and sanitary sewer service to approximately 183,000 metered water and sewer customers and a service population of approximately 510,000 people.

The City of Raleigh is a nationally recognized leader in protecting drinking water supply resources. Protection and enhancement of water supply resources is a fundamental function of the City of Raleigh's Public Utilities Department, which serves the Towns of Garner, Knightdale, Rolesville, Wake Forest, Wendell, and Zebulon. The Department seeks to have measurable and long term beneficial impacts resulting in an area known for plentiful, clean, and outstanding drinking water quality.

The City's Watershed Protection Program works to protect and enhance drinking water resources through land and easement acquisitions, planning, and other innovative water quality improvement activities (FIGURE 2.1) which:

1. **Have long term, lasting, measurable, and beneficial impacts;**
2. **Are non-regulatory and voluntary;**
3. **Address impacts from a variety of sources, including agricultural and forestry activities;**
4. **Leverage additional partners and funding resources; and**
5. **Are located in an active drinking water supply watershed including the Upper Neuse River Basin and the Upper Swift Creek Watershed**

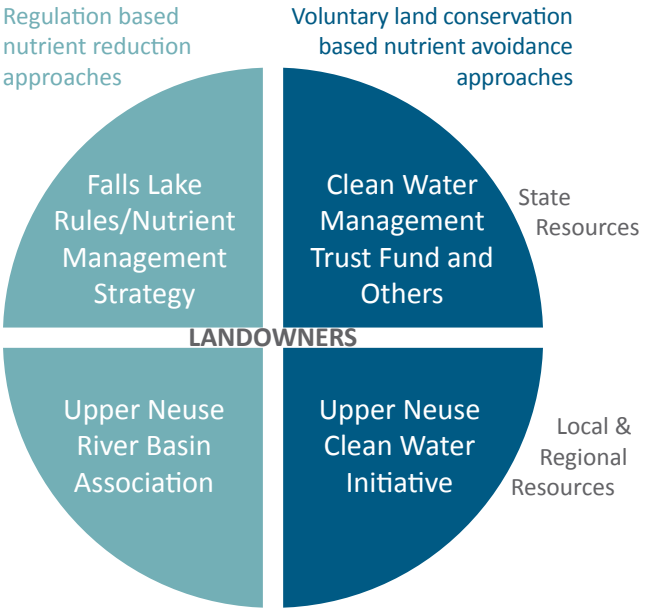


FIGURE 2.1: Conservation Efforts and Programs

UPPER NEUSE RIVER BASIN ASSOCIATION (UNRBA)

The City of Raleigh and the other local governments in the Upper Neuse Watershed participate in the UNRBA as part of their watershed protection efforts. The UNRBA was formed in 1996 to provide an ongoing forum for local government and stakeholder cooperation on water quality protection and water resource planning and management within the watershed. The Mission of the UNRBA is to preserve the water quality of the Upper Neuse River Basin through innovative and cost-effective pollution reduction strategies, and to constitute a forum to cooperate on water supply issues within the Basin.

The UNRBA achieves this through:

1. **Forming a coalition to secure and pool financial resources and expertise;**
2. **Collecting and analyzing information and data, and developing, evaluating and implementing strategies to reduce, control and manage pollutant discharge; and**
3. **Providing accurate technical, management, regulatory, and legal recommendations regarding the implementation of strategies and appropriate effluent limitations on discharges into the Basin.**

The current focus on the UNRBA is on maintaining and enhancing a robust Falls Lake monitoring program, overseeing a nutrient credit trading program with the NC Department of Environmental Quality, and developing a framework for analyzing and updating rules within the Falls Lake Nutrient Management Strategy.
For more information, please visit: www.unrba.org

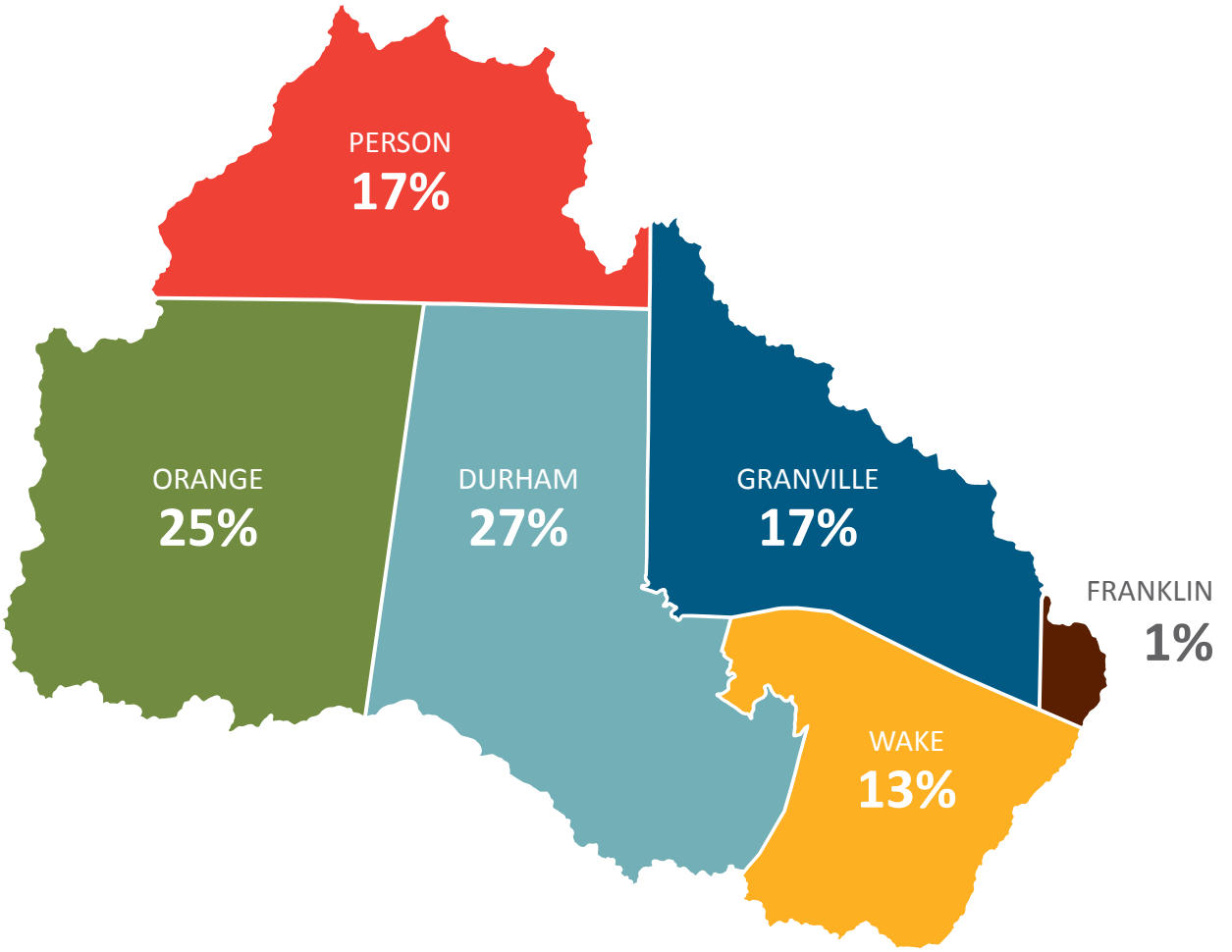


FIGURE 2.2: The Upper Neuse Watershed Percentage by County

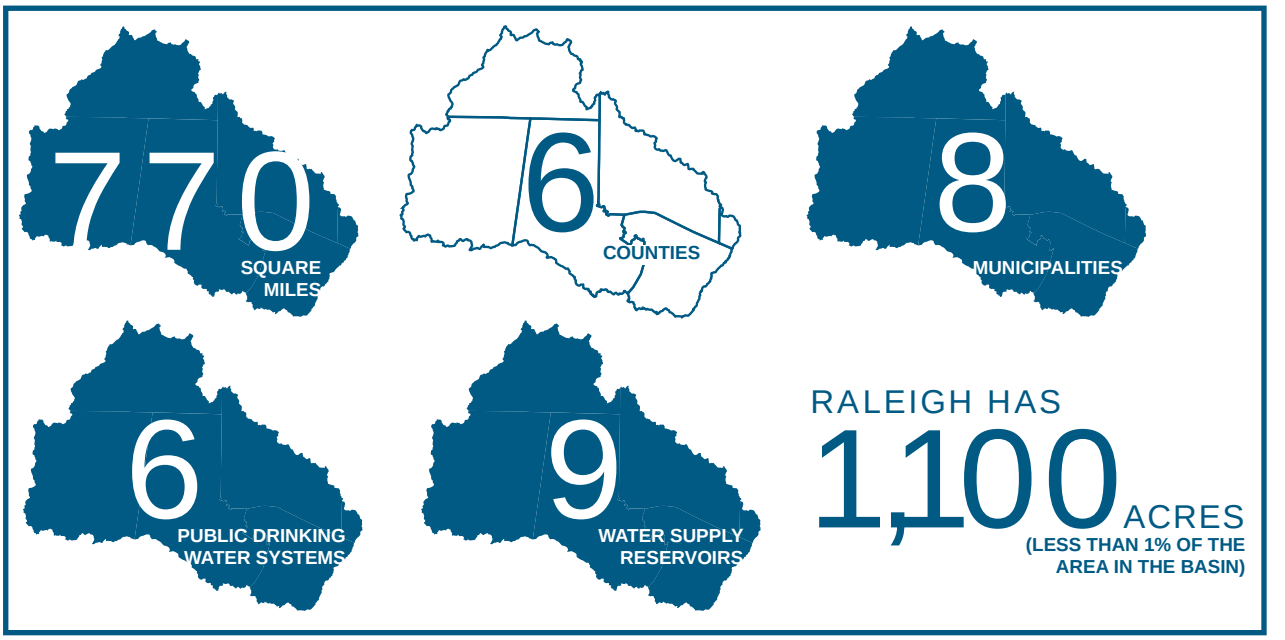


FIGURE 2.3: The Upper Neuse Watershed Percentage by The Numbers

3 THE UPPER NEUSE CLEAN WATER INITIATIVE

VOLUNTARY LAND CONSERVATION TO PROTECT WATER QUALITY

Land trusts work with landowners, state and local governments, and other conservation organizations to protect drinking water sources across North Carolina. In the Piedmont, one of the most effective efforts is the Upper Neuse Clean Water Initiative. The Conservation Trust for North Carolina (CTNC) coordinates this partnership of nonprofit organizations (Ellerbe Creek Watershed Association, Eno River Association, Tar River Land Conservancy, Triangle Greenways Council, Triangle Land Conservancy, and The Conservation Fund) and local governments that seeks to protect the lands most critical for ensuring the long-term health of drinking water supplies in the Upper Neuse River Basin.

In 2005, the Upper Neuse Initiative partners, subject-matter experts, and local stakeholders began development of a conservation plan (FIGURE 3.1) that identified important lands to conserve to protect water quality and served as a framework to leverage funding from multiple partners and sources to support the program's goals.

Achieving this goal would provide tangible water quality benefits within the watershed... Broad support from stakeholders in the watershed will help turn this ambitious vision into a reality.

Since the first conservation plan and priority model was developed, the partners have followed a project review process whereby applicants submit project proposals for priority lands to CTNC and the City of Raleigh. A review group vets the projects and submits them to the Raleigh City Council for funding approval.

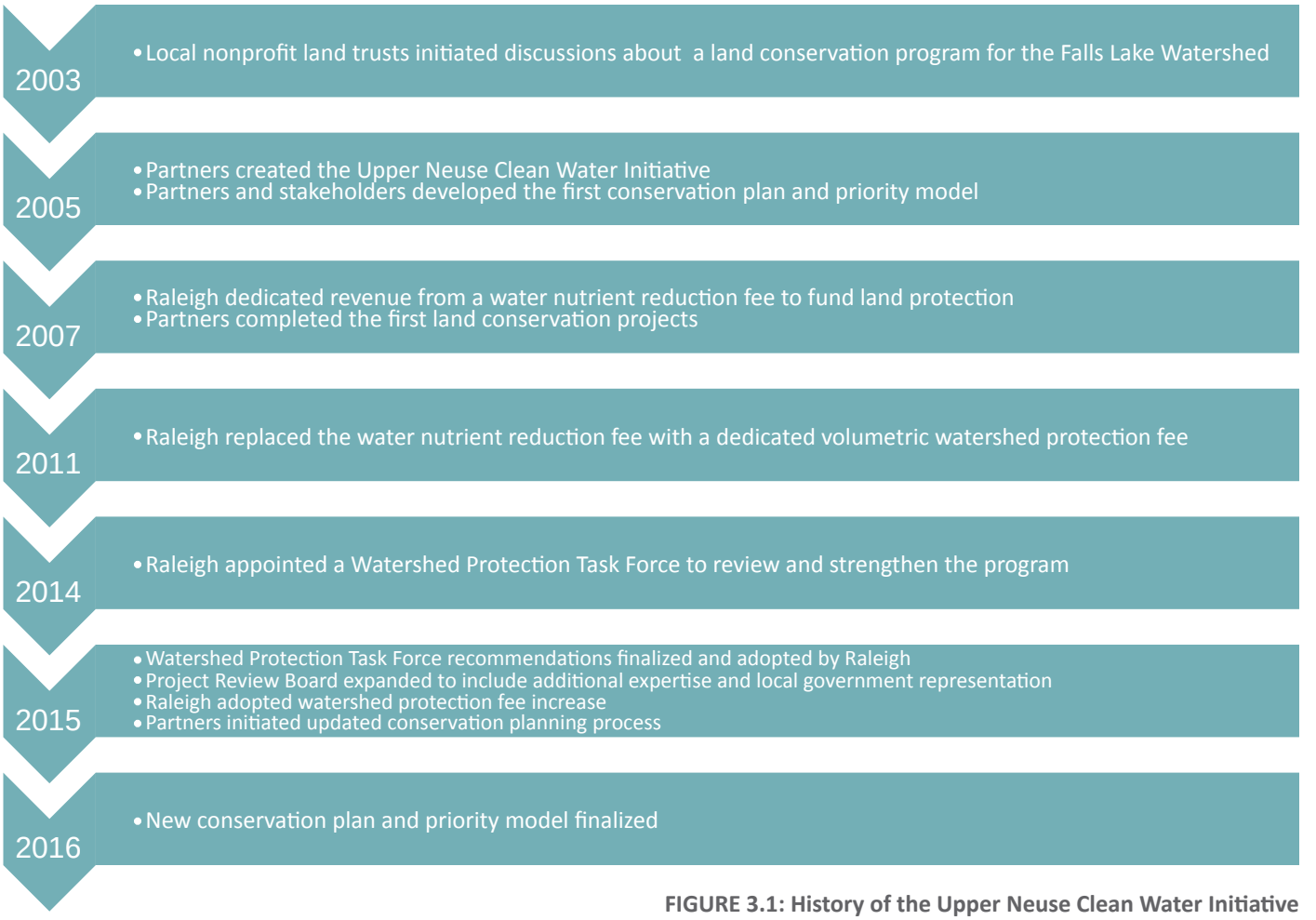


FIGURE 3.1: History of the Upper Neuse Clean Water Initiative

In 2015, the partners and stakeholders undertook a planning process to design an updated land conservation strategy that uses the latest and best available science and geographic data to help refine and refocus land protection priorities. Specifically, the goal was to develop a Watershed Protection Model that would:

1. **Use the best available data**
2. **Identify priorities for water quality and quantity protection based on the best available science**
3. **Set clear goals**
4. **Evaluate both the Falls Lake and Swift Creek watersheds**
5. **Look at future scenarios and water quality impacts**
6. **Incorporate stakeholders and partners in the development**
7. **Consider both riparian areas and uplands**
8. **Be used by various partners throughout the watersheds, and**
9. **Allow for model updates as new data sources become available**

MODEL GOALS

The result of the 2015 process is an enhanced GIS-based Watershed Protection Model that spatially identifies the most important locations to invest in land conservation based on four main goals:

1. **Protect water sources and conveyances**
2. **Conserve upland areas**
3. **Promote water infiltration and retention**
4. **Protect vulnerable areas**

FUNDING STRATEGY

The City of Raleigh's Public Utility Department invests a significant portion of revenue into its grey infrastructure including its system of treatment plants, pipes, valves, pumps, tanks and meters. The Watershed Protection Program and associated revenues provide the City with an opportunity to

invest upstream in its green infrastructure, a complex system of land, streams, rivers, and lakes that provide and protect critical source waters.

The City of Raleigh has contributed to the Upper Neuse Initiative through a dedicated revenue source generated by a $0.10 per 1,000 gallons volumetric rate on water utility customers. In 2015, the rate was increased to $0.15 per 1,000 gallons. These small monthly allocations based on water use, and averaging only 60 cents a month per household in Raleigh, are used to fund purchases of properties and conservation easements. In addition to providing financing for land acquisition, the funds support landowner outreach, project negotiation, transaction and project costs, program administration, monitoring, and stewardship.

Generous financial support from local and state government agencies has been critical to the Upper Neuse Initiative's success. The City of Durham has a tiered rate system that generates about $200,000 per year for watershed protection, in addition to other funds dedicated for land protection, while Orange County, Wake County, Granville County, Durham County, City of Creedmoor, Town of Butner, Town of Hillsborough, and Durham Soil and Water Conservation District also have contributed funds to protect high priority lands.

The Clean Water Management Trust Fund has been a significant state funding partner, and the NC Attorney General's Environmental Enhancement Grants also have been leveraged. In addition, the U.S. Endowment for Forestry and Communities and the Natural Resources Conservation Service provided the Upper Neuse Initiative with a generous three-year grant in 2010 as part of the Endowment's Healthy Watersheds through Healthy Forests Initiative. The grant enabled the partner land trusts to work with forest landowners to place conservation easements on their properties, develop forest stewardship plans, and/or implement forest stewardship practices.

With the recent volumetric rate increase, the City of Raleigh is demonstrating its historic commitment to the Program and is now poised to increase annual spending, protect more acres per year and attract more leverage from partners. This funding along with financial support to complete the updated Watershed Protection Model signifies the City's desire to be even more strategic and cost effective.

There has been increasing uncertainty over funding available from the state and other partners to help complete watershed protection projects in the Upper Neuse. We hope this conservation strategy highlights the need to maintain and expand the leverage funding available for clean water investments from all water users in the watershed.

INITIATIVE RESULTS – 2007-2015

FIGURE 3.2: Initiative Impact on the Land

FIGURE 3.3: Initiative Impact on Pollutants

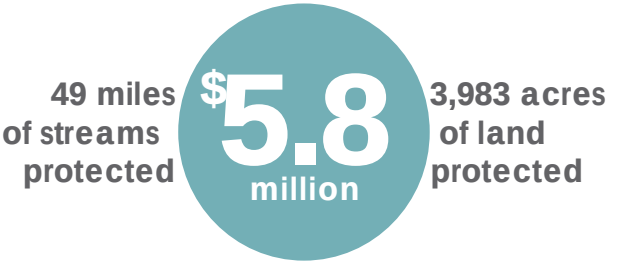


FIGURE 3.4: Raleigh Investment in Initiative

FIGURE 3.5: Funds Leveraged for Initiative

The nutrient avoidance calculations above are drawn from preliminary research by Cardno and the Center for Watershed Protection for the Upper Neuse River Basin nutrient credit program. The estimates are based on a study conducted in the Upper Neuse River Basin by the NC Forest Service, measuring flows and nutrient concentrations for six forested watersheds in two geologic areas. The study period represented dry and wet hydrologic conditions. Avoidance loads were calculated using the difference between loads found in the study and the loads allowable under the Falls Lake Rules (2.2 lb/ac/yr for nitrogen and 0.33 lb/ac/yr for phosphorus).

These calculations provide a conservative method of estimating the avoidance of nitrogen and phosphorous achieved through land protection, assuming that all conservation properties, if developed, would meet the allowable loads under the Falls Lake Rules.

2015 PLANNING PROCESS

The updated Watershed Protection Model project commenced with the Technical Advisory Team convening multiple times in early 2015 to evaluate and ultimately select 12 GIS data layers that best represented the Upper Neuse Initiative's goals and objectives. Project staff collected and organized the best available GIS data so that new GIS layers could be derived that were in a consistent format for the entire watershed (TABLE 3.1).

On June 26th 2015, a group of 26 stakeholders gathered at the Annie Louise Wilkerson Park in the Falls Lake Watershed to provide input and feedback on the Watershed Protection Model criteria and weightings.

Using a "dot map" exercise technique, the stakeholders reviewed maps, evaluated model scores, and assigned relative weights for the model criteria (TABLE 3.2). Stakeholders were asked to provide relative weights for the four watershed protection goals, and then the three objectives for each goal.

Once the weights were obtained, the 12 GIS layers were combined into a raster-based GIS suitability model to generate model values on a 30-meter by 30-meter pixel scale.

The stakeholders reconvened on August 27th, 2015 at the Triangle J Council of Governments office to review the model results and provide feedback on the proposed land conservation strategy. They also reviewed the project team's recommendations on establishing a minimum score for eligibility for the City of Raleigh's Watershed Protection Program.

Goal	Objective	Criteria	Data Layer(s)
Protect water sources and conveyances	Protect headwater streams	Headwater catchment size	USGS Hydrologic Units (HUCs)
	Support connected high quality water features	Percent conserved land by catchment	USGS NHD+, NC OneMap Managed Lands
	Protect riparian areas	Distance from streams	USGS NHD+ Flowline
Conserve upland areas	Protect uplands and pervious areas	Previous land cover types	USDA Cropland Layer (modified with USFWS wetlands + County GIS)
	Protect areas with minimal impervious surface	Imperviousness by catchment	USDA Cropland Layer (modified with County GIS)
	Protect uplands with forest cover	Percent forest land cover by catchment	USDA Cropland Data Layer (modified with County GIS)
Promote water infiltration and retention	Promote wetland protection	Wetland coverage, proximity	USDA Cropland Data Layer (modified with National Wetlands Inventory)
	Promote floodplain protection	Floodplain areas	NC floodplain mapping
	Protect groundwater recharge areas	Soil infiltration capabilities	NRCS SSURGO soils with hydrologic group attribute
Protect vulnerable areas	Protect wet/hydric areas	Presence of saturated soils	NRCS SSURGO soils with hydric attribute
	Protect steep slopes	Land surface slope	NC floodplain mapping (20-foot LiDAR DEM)
	Protect highly erodible soils	Soil surface runoff potential	NRCS SSURGO soils with erodibility attribute

TABLE 3.1: Watershed Protection Model Criteria and Data

Once there was concurrence on these issues, the raster suitability model values were then used to generate parcel specific scores through the use of a GIS technique called zonal statistics.

2015 MODEL RESULTS

The Watershed Protection Model spatially identifies the most important locations to invest in land conservation.

The stakeholders identified priority parcels as those with a score of mean or above (4.2 out of 10) that are also within 50 feet of an adjacent stream or reservoir.

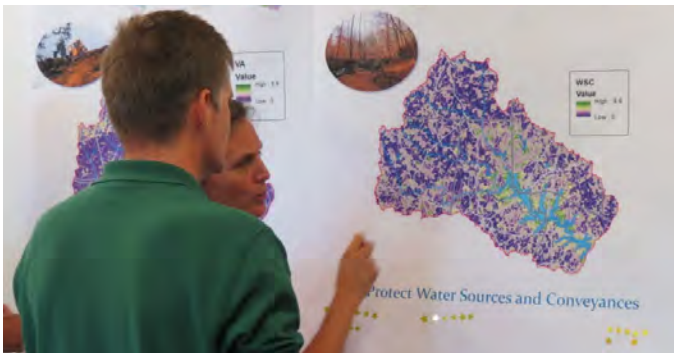
Using these criteria, over 17,000 parcels that encompass over 260,000 acres within the Upper Neuse watershed would be eligible for funding from the City of Raleigh's Watershed Protection Program. This corresponds to approximately 15% of the total parcels within the watershed and approximately 56% of the watershed's land area (SEE FIGURE 1.2).

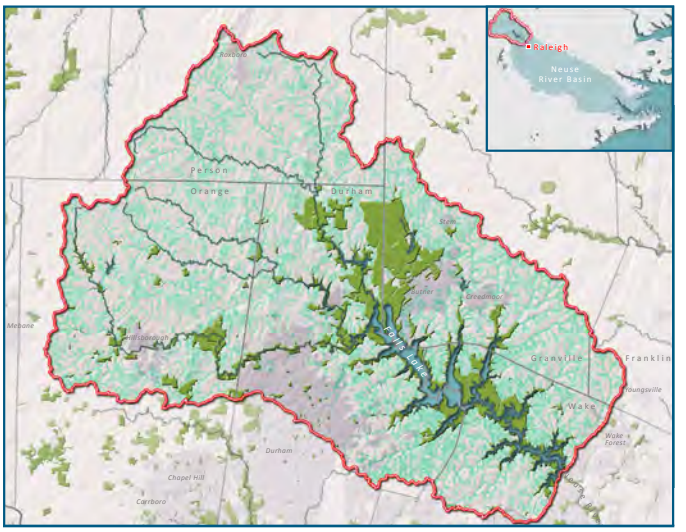
It is helpful to compare these results to the first conservation prioritization model developed in 2005. That model identified a little over 20,000 parcels (about 18% of all parcels) and close to 325,000 acres (about 69% of the watershed). Thanks to refined geographic data, the latest scientific data on the relationship between impervious surface, nonpoint source runoff, and water quality, and updated Model objectives and weights provided by stakeholders, the revised model is more refined and does a better job getting the most "bang for the buck" on potential land acquisition projects.

Goal	Goal Weight	Objective	Objective Weight	Model Weight (Goal x Objective)	Points
Protect water sources and conveyances	29%	Protect headwater streams	37%	10.7%	1.1
		Support connected high quality water features	21%	6.1%	0.6
		Protect riparian areas	42%	12.2%	1.2
Conserve upland areas	31%	Protect uplands and pervious areas	32%	9.9%	1.0
		Protect areas with minimal impervious surface	32%	9.9%	1.0
		Protect uplands with forest cover	36%	11.1%	1.1
Promote water infiltration and retention	19%	Promote wetland protection	36%	6.8%	0.7
		Promote floodplain protection	36%	6.8%	0.7
		Protect groundwater recharge areas	28%	5.4%	0.5
Protect vulnerable areas	21%	Protect wet/hydric areas	18%	3.8%	0.4
		Protect steep slopes	35%	7.4%	0.7
		Protect highly erodible soils	47%	9.9%	1.0
				Total Points =	10.0

TABLE 3.2: Watershed Protection Model Weights and Points

Swift Creek is part of the Neuse River Basin. A parallel model was developed and run to update the land conservation priorities for the Swift Creek Watershed, from the upper portion of the watershed in Cary to the dam at Lake Benson, an area that is approximately 66 square miles or 42,362 acres. This prioritization used the resources of the Upper Neuse Initiative Technical Advisory Team and stakeholders and drew on previous studies of the Swift Creek Basin. By using the same prioritization system, eligible projects in the Upper Neuse and Swift Creek can be evaluated side-by-side. The results of this model are provided in a report under separate cover available upon request from the Upper Neuse Initiative.





LAND CONSERVATION STRATEGY

Given existing water quality concerns and potential water quality degradation from future land use changes, protecting drinking water supply resources through land protection is one key element of a comprehensive strategy of green and gray infrastructure investments that can help ensure clean water.

Other elements of a comprehensive strategy for clean water and nutrient reduction include restoration, land use regulation, best management practices, point source nutrient reduction strategies, and education on land use strategies that minimize pollution and runoff. It is important to have a portfolio of different investment strategies to optimize resource protection. This coordinated set of strategies highlights that both gray and green infrastructure investments are needed to design the most efficient and cost effective program to ensure drinking water quality and supplies.

The time is now to boost land conservation investments, since likely increases in land values over the next 30 years make a compelling case for protecting land earlier rather than later.

The Watershed Protection Model along with the Upper Neuse Initiative application process will help guide the level of investment the City of Raleigh is able to contribute to each project and will help facilitate identifying appropriate matching funds to implement the highest priority projects. Elements of the model also may be adapted to help identify potential restoration opportunities through subsequent efforts of the Upper Neuse Initiative.

The Model identifies eligible parcels, but specific Upper Neuse Initiative investment priorities are driven by willing landowners and an application process that confirms the conservation and water quality value of the property.

Based on projected funds available from the City of Raleigh's volumetric revenue source and potential matching funds, the historic success of the Upper Neuse Initiative, and an assessment of future opportunities for land conservation, the Upper Neuse Initiative partners have identified a goal of protecting 30,000 acres over the next 30 years, which corresponds to about 11% of eligible acreage within the watershed.

This would provide tangible water quality benefits within the watershed and is a feasible target within a voluntary landowner, market driven system.

Broad support from stakeholders in the watershed will help turn this ambitions vision into a reality.

4 SUPPORTING MATERIALS

MODEL LAND COVER REFINEMENT

The Conservation Strategy is based on a raster based GIS analysis of the watershed. The raster analysis was completed for a 30*30 meter grid of the entire watershed. Each individual objective was represented by a data layer. These raster data layers each had a classification system from 0-10 to provide a ranking of suitability. The individual data layers and their corresponding classifications and values are shown in the table below (TABLE 4.1). Several of these layers and corresponding classifications were based on an updated land cover layer. This land cover layer was developed from the USDA's cropland data layer (CDL) from 2013. The CDL was chosen as a base layer over the NLCD (National Land Cover Dataset) on which it is based, for its superior representation of the extent of cropland. This layer was updated with major primary and secondary state roads buffered to 15 meters. In addition, the layer was updated with improved wetland location information from the National Wetlands Inventory (NWI). NWI wetland types 'Freshwater Emergent Wetland', 'Freshwater Forested/Shrub Wetland', and 'Riverine' were used. The addition of the roads and wetland areas resulted in approximately 20 square miles of land being reclassified. An accuracy assessment comparing several random grids across the watershed found the reclassification to be on average 94% accurate compared to aerial imagery. The improved land classification raster data set is shown below (FIGURE 4.1). The partnership hopes that the model will be continually updated with new land cover data as it becomes available.

We hope this conservation strategy highlights the need to maintain and expand the leverage funding available for clean water investments from all water users in the watershed.

RASTER LAYER SCORING

Goal:	Protect water sources and conveyances		
Objective:	Protect headwater streams		
Approach:	Threshold for headwater catchment size	Classes	Score
	Smaller catchments denote source water areas	Drains <= 0.7 hectares	10
Data source:	USGS Hydrologic Units (HUCs)	Drains > 0.7 hectares	0
Objective:	Support connected high quality water features		
Approach:	Percentage of conserved land by catchment	Classes	Score
	Protect land within intact catchments	80 to 100%	10
Data sources:	USGS NHD+	50 to 80%	8
	NC OneMap Managed Lands	30 to 50%	5
		10 to 30%	3
		0 to 10%	0
Objective:	Protect riparian areas		
Approach:	Distance from streams based on buffer research	Classes	Score
	Proximity to stream = more water quality benefit	< 100 feet from stream	10
Data source:	USGS NHD+ Flowline	100 to 300 feet from stream	8
		> 300 feet from stream	0
Goal:	Conserve upland areas		
Objective:	Protect uplands and pervious areas		
Approach:	Land cover value for stormwater retention	Classes	Score
	Pervious land cover reduces surface runoff	Deciduous Forest	10
Data sources:	USDA Cropland Layer	Mixed Forest	10
	(modified with USFWS wetlands + County GIS)	Evergreen Forest	10
		Wetlands	10
		Open Water	10
		Grassland/ Pasture	8
		Crops	5
		Developed/ Open	5
		Developed/ Low	1
		Developed/ Med	0
		Developed/ High	0

TABLE 4.1: Raster Layer Scoring

Objective:	Protect areas with minimal impervious surface		
Approach:	Catchment imperviousness based on research	Classes	Score
	Higher quality in less impervious catchments	0 to 10%	10
Data sources:	USDA Cropland Layer	10 to 25%	7
	(modified with County GIS)	25 to 60%	3
		60 to 100%	0
Objective:	Protect uplands with forest cover		
Approach:	Percent forest land cover by catchment	Classes	Score
	Thresholds from High Rock Lake Study	48 to 100%	10
Data sources:	USDA Cropland Data Layer	37 to 48%	5
	(modified with County GIS)	0 to 37%	0
Goal:	Promote water infiltration and retention		
Objective:	Promote wetland protection		
Approach:	Wetland coverage, proximity	Classes	Score
	Closer to wetlands = higher value for water quality	< 50 ft or contains wetland	10
Data sources:	USDA Cropland Data Layer	> 50 ft from wetland	0
	(modified with USFWS NWI)		
Objective:	Promote floodplain protection		
Approach:	Floodplain areas	Classes	Score
	Protect land to absorb flood waters	AE, AO, or A	10
Data source:	NC floodplain mapping (LIDAR)	0.2% annual chance	10
		X	0
Objective:	Protect groundwater recharge areas		
Approach:	Infiltration / runoff potential	Classes	Score
	Divert stormwater to increase groundwater supply	A high infiltration	10
Data source:	NRCS SSURGO soils with hydrologic group attribute	B moderate infiltration	8
		B/C low-moderate infiltration	5
		C low infiltration	5
		C/D very low infiltration	2
		D lowest infiltration	2

TABLE 4.1 Continued: Raster Layer Scoring

Goal:	Protect vulnerable areas		
Objective:	Protect wet/hydric areas		
Approach:	Hydric soil presence/ absence	Classes	Score
	Hydric soils capture and retain water	Containing hydric soils	10
Data source:	NRCS SSURGO soils with hydric attribute	Not containing hydric soils	0
Objective:	Protect steep slopes		
Approach:	Land surface slope	Classes	Score
	Steeper slopes more susceptible to runoff	26 to 100%	10
Data source:	NC floodplain mapping 20ft LIDAR DEM	13 to 25%	5
		0 to 12%	0
Objective:	Protect highly erodible soils		
Approach:	Soil surface runoff potential	Classes	Score
	Protect areas more likely to export sediment	High	10
Data source:	NRCS SSURGO soils with erodibility attribute	Very High	8
		Medium	5
		Low	3
		Very Low	1
		NA	0

TABLE 4.1 Continued: Raster Layer Scoring

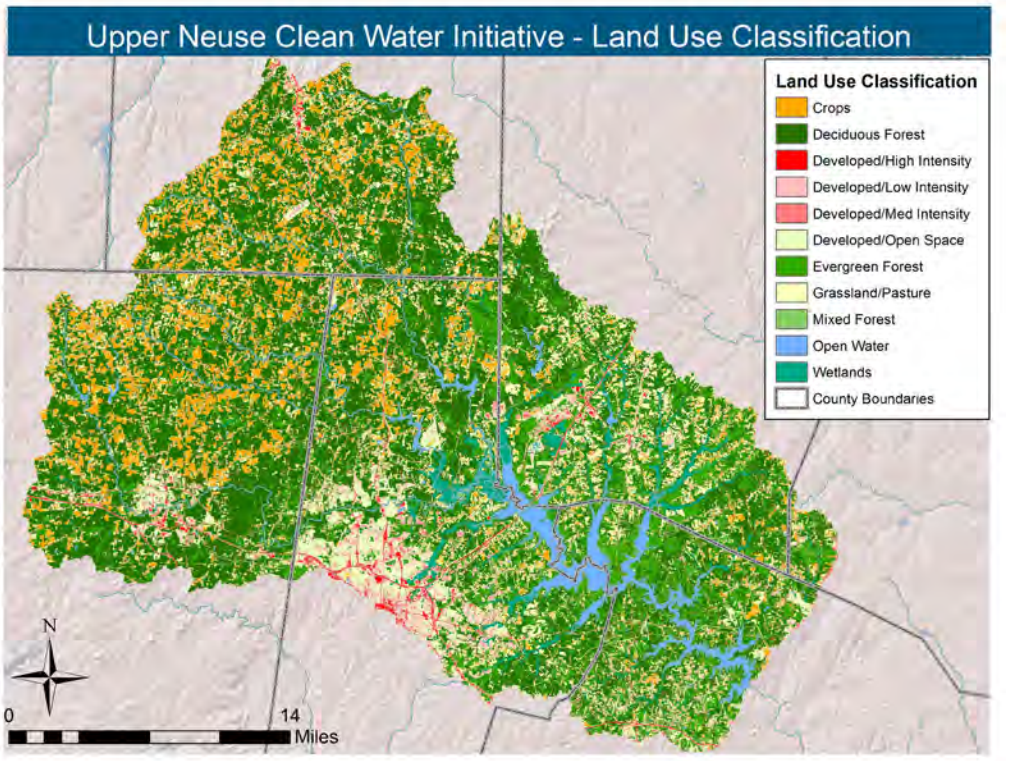


FIGURE 4.1: Land Cover Refinement

ADVISORS AND STAKEHOLDERS

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Caitlin Burke	Conservation Trust for NC
Leigh Ann Hammerbacher	Triangle Land Conservancy
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Carl Stearns	Raleigh Public Utilities GIS
Silvia Terziotti	USGS South Atlantic Water Science Center
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TABLE 4.2: Technical Advisory Team

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Matthew Starr	Upper Neuse RiverKeeper
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TABLE 4.3: Watershed Protection Review Board

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Randy Cahoon	Creedmoor Stormwater Program Director
John Cox	Watershed Protection Review Board
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Doug Durbin	Cardno
Amy Edge	Tar River Land Conservancy
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TABLE 4.4: Stakeholder Participants - June & Aug. 2015

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THE CONSERVATION FUND

The City of Raleigh
PUBLIC UTILITIES DEPARTMENT

TAR RIVER
LAND CONSERVANCY

tlc
TRIANGLE LAND CONSERVANCY

THE CONSERVATION FUND

The City of Raleigh
PUBLIC UTILITIES DEPARTMENT

CONSERVATION TRUST FOR NORTH CAROLINA