Upper Neuse River Basin Association

Memorandum

To: Deborah Amaral, NC Ecosystem Enhancement Program

From: Chris Dreps, Upper Neuse River Basin Association

Date: February 18, 2005

Re: *Revised* Little Lick Creek Local Watershed Plan
Memorandum #1—Initial watershed characterization, existing water quality data, stakeholder process and project goals.

This memorandum is a revision of the first in a series of memoranda to be completed for the Little Lick Creek Local Watershed Plan. The Upper Neuse River Basin Association (UNRBA) will provide the NC Ecosystem Enhancement Program (NC EEP) with regular memoranda in order to (1) report progress made by the various partners on project tasks and (2) provide NC EEP with a format for feedback to the UNRBA.

This memorandum details the results of the work completed under Task 1, Baseline Watershed Assessment, including:
Subtask 1.1 Compile and review existing watershed data
Subtask 1.2 Perform an initial characterization of the water quality, habitat, and aquatic biota data
Subtask 1.3 Evaluate potential future subwatershed conditions
Subtask 1.4 Recruit and convene community stakeholders.

1. Background

The North Carolina Ecosystem Enhancement Program has contracted with the Upper Neuse River Basin Association to perform a Local Watershed Plan in the Little Lick Creek Watershed (Hydrologic Unit Code 03020201050020) in eastern Durham, North Carolina. This Technical Memorandum presents six sections:

1. Background
2. A watershed characterization for the Little Lick Creek watershed, including a detailed subwatershed delineation of the watershed;
3. A summary of findings from the NC Division of Water Quality's stream data analysis and monitoring recommendations for Little Lick Creek;
4. An analysis of current land use in the watershed;
5. A review of Durham's ordinances, rules and programs affecting watersheds; and
6. A brief description of the Little Lick Creek Stakeholder process and initial planning goals.

2. Natural Features of the Watershed

The Technical Memorandum first presents a general characterization of the Little Lick Creek Watershed. This characterization describes the natural features of the watershed, including geography, geology, soils, topography, surface hydrology, floodplains and wetlands, and habitat and species.

2.1 Geography

The Little Lick Creek hydrologic unit is a 25.2 square mile area that includes the Little Lick Creek Watershed and several small streams that flow directly into Falls Lake. For this study, we will focus only on the Little Lick Creek Watershed, which has an area of 20.8 square miles. Figure 1 is a map of the Little Lick Creek Watershed.

Little Lick Creek's headwaters rise to the west of Highway 70 at the edge of the City of Durham. From there, the creek flows to the north-east and is crossed by NC Highway 98, the main artery between Durham and Wake Forest. The creek flows several miles through newly developing suburbs, a golf course, and a few remaining farms before it is joined by its major tributary, Chunky Pipe Creek. From there, the creek flows into the federally protected land that forms Falls Lake State Recreation Area. Just past this junction, Patterson Waterfowl Impoundment dams Little Lick (an effort by the federal government to create wildlife habitat to mitigate for bottomland hardwood forests lost when it created Falls Lake). From here, the creek slowly flows into Falls Lake near Rollingview State Recreational Area.

2.2 Geology

The Little Lick Creek watershed lies over Durham Triassic Basin, a geologic formation within the larger Deep River Basin Triassic formation. The Durham Triassic Basin formed from rifting of the Super continent Pangaea during the Mesozoic period 200 million years ago. The land masses that are now Africa and North America separated, and the separation left rift valleys many miles wide and thousands of feet deep. These rifts filled over time with sediment deposited by the huge Appalachian Mountains. These compacted sediments now form the parent material of the Triassic Basin (Clark et al 2001).

Figure 2 shows the geology underlying Little Lick Creek. The geology is mainly unconsolidated Triassic Basin-formed sedimentary rock. The sedimentary parent material is a mix of various other parent materials, and thus its characteristics vary greatly within the basin. The alluvium underlying the stream valleys is made of eroded Triassic material. The soils created by the weathering and eroding of this parent material are generally clay and are often considered poor quality soils with low nutrient levels (USDA 1971).

Intrusions of stronger, less erosive metamorphic diabase material rise through the softer Triassic material. These diabase sills were formed during the creation of the Triassic rift valleys, when magma escaped to the surface. Diabase sills are common in the nearby Eno River Watershed, and they form soils distinct from the surrounding Triassic sandy-clay soils. These areas may support locally rare vegetation. In addition, Diabase areas likely provide streams with a relatively rocky substrate compared with the surrounding Triassic material. For these reasons, it may be valuable to explore whether these areas support rare, valuable, and intact habitat. If so, these areas may offer potential land protection sites.

2.3 Soils

The Durham County Soil Survey identifies 17 soils series in the Little Lick Creek watershed (USDA 1971). Of these, ten soil series are prevalent enough for discussion at a watershed scale and two series, White Store and Chewacla, comprise 69 percent and 9 percent, respectively, of the total soils in the watershed. Figure 3 and Table 1 demonstrate the soils in Little Lick Creek.

Series	Description
Chewacla	Consists of nearly level, somewhat poorly-drained soils on flood plains. Formed in fine loamy material washed from upland soils. Flooded very frequently for very brief periods. Depth to seasonal high water table in winter and early in spring. Acidic. Chewacla is the floodplain soil of Little Lick Creek.
Altavista	Consists of nearly level and gently sloping, moderately well-drained soils on low stream terraces. Formed under forest vegetation in alluvial deposits. Located just upland and adjacent to Chewacla soils. Flooded infrequently for brief periods. 2.5 feet to seasonal water table. Acidic.
Cartecay	Consists of nearly level, somewhat poorly-drained soils on flood plains. Formed in coarse loamy material washed from soils on uplands. Flooded very frequently for only brief periods. Permeability moderately rapid. Acidic.
White Store	Consists of gently sloping to moderately steep, moderately well-drained soils on uplands. These soils are found on the upland divides between drainage features. White store soils formed under forest vegetation, in material weathered from Triassic Mudstone. Water capacity medium. Permeability very slow. Erosion hazard with runoff. Strongly acidic. The predominant soil series in Little Lick Creek's watershed.
Creedmoor	Consists of gently sloping and sloping, moderately well-drained soils on uplands, esp. rounded divides. Formed under forest vegetation in residuum from Triassic Mudstone. Permeability very slow. Depth to seasonal water table 1.5 feet. Strongly acidic.
Granville	Gently sloping and sloping, well-drained soils on uplands. On rounded divides. Formed under forest vegetation in residuum from Triassic Sandstone. Permeability moderate. Strongly acidic.
Iredell	Consists of nearly level to sloping, moderately well-drained soils on uplands. On broad flat areas and rounded divides. Formed under forest vegetation in residuum from basic diorite rock. Permeability slow.
Mayodan	Consists of nearly level to moderately steep, well-drained soils on uplands. Rounded divides. Formed under forest vegetation in residuum from Triassic Mudstone. Permeability is moderate. Acidic. Primarily found in the headwaters of Little Lick Creek's watershed.
Pinkston	Consists of gently-sloping to moderately steep, well-drained or excessively-drained soils on uplands. Formed under forest vegetation in residuum from Triassic Sandstone. In Little Lick Creek, these soils are located along upland streams. Permeability moderately rapid. Erosion hazard from runoff.
Wehadkee	Consists of nearly level, poorly-drained soils on narrow flood plains. Formed in fine loamy alluvium washed from soils on uplands. Flooded very frequently for short periods. Permeability moderate. Seasonal water table at or near surface late in the winter and early in spring. Acidic.

Table 1: Little Lick Creek Soils

The watershed's upland areas are almost completely covered by the White Store soil series. These soils are low in natural fertility and organic matter content. White Store

and other upland soils in the watershed formed under forest cover in material weathered from Triassic Mudstone. Therefore, permeability is very slow, and the available water capacity is medium. According to the Durham Soil Survey, "the major limitations are the erosion hazard resulting from runoff, the very slow permeability, the steep slopes, the high shrink-swell potential, and a perched water table."

Little Lick Creek's large, broad flood zone is predominated by Chewacla Soils. These soils formed as upland soils weathered over time and washed to low-lying areas. These soils support lowland hardwood forests. They have also been used for farming row crops.

Initial field observations of Little Lick Creek and its tributaries confirm that they are almost devoid of bedrock substrate in most areas. These streams are greatly impacted by the increased flows accompanying urban development because the sand and clay substrate material erodes easily. This response is likely magnified on steeper slopes. Data from the in-stream fieldwork will help project partners to verify this assertion. These findings will help to inform several recommendations, including restoration, stormwater management, and steep slopes protection.

2.4 Topography

Light Detection and Ranging (LIDAR) data created for the NC Division of Emergency Management's Floodplain Mapping Program provide a very detailed representation of Little Lick Creek's surface topography. LIDAR's primary use for use in NC Flood Insurance Rate Maps; however, the USGS has developed a detailed digital elevation model for use in the Upper Neuse (Terziotti 2004). This digital elevation model is a 20-foot precision, the best data currently available for watershed modeling in the Upper Neuse. The Little Lick Creek Local Watershed Plan is the first project for which these data have been used.

The digital elevation model data show that the watershed's general topography is flat, with few areas of steep gradient. The highest point in the watershed is over 426 feet above sea level at the headwaters near US Highway 70 and Miami Boulevard. The lowest point, at the Falls Lake Reservoir is about 246 feet above sea level. This is a difference of only about 180 feet in elevation over a straight-line distance of about 6.6 miles, or a gradient of about 27 feet per mile.

2.5 Surface Hydrology

On average, the region receives about 45 inches of rainfall annually. Average annual rainfall at National Weather Service's RDU Airport site for 2002-2004 has been over 46 inches per year. A study from nearby Duke Forest has shown that, under forested conditions, over 70% of this water would be evaporated or transpired. Only about 5% of water in Duke Forest would become surface runoff, and over 20% would infiltrate to groundwater (Schafer et al 2002). These results may vary somewhat based on soil type differences, but the findings of the Schafer study offer a general understanding of the forested hydrologic cycle in Durham County.

Figure 4 is a map of surface water hydrology features in the watershed. The US Geological Survey and TJCOG used the LIDAR-derived Upper Neuse digital elevation model to delineate the watershed and subwatersheds. Little Lick Creek is a fifth-order stream draining an area of 20.8 square miles. The watershed has about 73 miles of streams (Terziotti 2004). The watershed therefore has a drainage density of 3.51 miles/square mile.

Figure 4 divides the watershed into 13 subwatersheds. Ten of these subwatersheds are surface water drainage areas of 3rd order streams flowing to Little Lick Creek. Three subwatersheds comprise the upper, middle, and lower sections of the creek. The Chunky Pipe Creek subwatershed is a fourth-order system that flows into the main stem of Little Lick Creek on federally owned land between Mineral Springs and Patterson Roads. Chunky Pipe Creek is the only named tributary of Little Lick Creek. We will use these 13 subwatersheds as the analysis and management units for this project. Table 2 lists these subwatersheds and Appendix 1 describes the process used for their delineation.

Subwatershed Number	Total area	
	(acres)	(miles^2)
1	1,328	2.08
2	920	1.44
3	910	1.42
4	1158	1.81
5	999	1.56
6	1168	1.82
7	967	1.51
8	867	1.35
9	1172	1.83
10	773	1.21
11	926	1.45
12	960	1.50
13	1230	1.92
Total Area	13,376	20.9

Table 2: Little Lick Creek Subwatersheds

Little Lick Creek's hydrology is strongly affected by two impoundments, Falls Lake Reservoir and the Patterson Road Waterfowl Impoundment. The entire Little Creek system is a tributary of the Falls Lake Reservoir, created in the early 1980's to provide flood storage and drinking water for Raleigh. The Little Lick Creek arm of the reservoir backs up into Lower Little Lick Creek (subwatershed 10). This impoundment of water has changed the hydrology of this portion of the creek from what was a medium-sized, meandering piedmont stream into a shallow, lentic system subject to eutrophication.

When Falls Lake was impounded, the new reservoir drowned over twenty-five stream miles of piedmont bottomland hardwood forest. In an attempt to mitigate for the loss of habitat in these ecologically valuable lands, the US Army Corps of Engineers constructed a series of "waterfowl impoundments" in streams tributary to the reservoir. Little Lick Creek has one such impoundment just upstream of where Patterson Road crosses it in Lower Little Lick Creek (subwatershed 10).

Figure 5: Patterson Road Waterfowl Impoundment

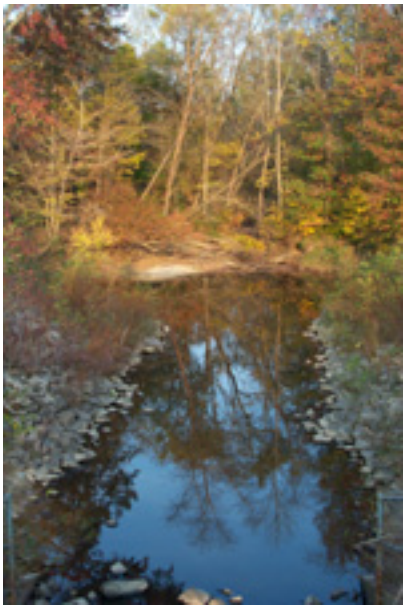

Figure 6: Patterson Road Waterfowl Impoundment

2.6 Floodplains and Wetlands

Lick Creek's abundant wetlands are due to a combination of the underlying Triassic Basin geology, low relief, sedimentary soils, and wide 100-year floodplains. Floodplains extend from Falls Lake upstream of NC Highway 98 and well into most of the tributaries (see Figure 4). These floodplains are as wide as 2100 feet near Falls Lake, and in most areas along the main stem of the creek measure over 1000 feet wide. There are several floodplains of 500 to 1000 feet in width upstream of NC Highway 98. These floodplains harbor the watershed's wetlands and likely contain the predominance of its biodiversity.

Falls Lake Wetland Functional Assessment data developed by the NC Division of Coastal Management for the NC Wetlands Restoration Program in 2002 offer a detailed snapshot of Little Lick Creek wetlands. These data were developed using National Wetlands Inventory, hydric soils, vegetation, elevation, and other data. The Functional Assessment data estimate 698 acres of wetland and categorize wetland types in the watershed. These categories are shown in Figure 4 and described in Table 3.

Wetland Type	Total area (acres)
Freshwater Marsh—Herbaceous areas that are flooded for extended periods during the growing season. Included are marshes within lacustrine systems, managed impoundments and occasionally along streams or rivers. Typical communities include wetland herbaceous species of sedges, millets, rushes, and grasses and shrub species such as button bush.	76
Bottomland Hardwood or Riverine Swamp Forest—Riverine forested or occasionally scrub/shrub communities usually occurring in floodplains that are semi-permanently to seasonally flooded. In bottomland hardwood systems, typical species include oaks (overcup, water, and swamp chestnut), sweet gum, green ash, sycamore, willows, river birch, and occasionally pines. In swamp forest systems, typical species include willows, black gum, green ash, and red maple.	599
Pine on Hydric Soils—Seasonally saturated, pine forests (usu. Loblolly) occurring on hydric soils that were not identified as wetlands during US Fish & Wildlife Service's National Wetlands Inventory. These areas may or may not be jurisdictional wetlands. Since this category is based primarily on soils data and 30 meter resolution satellite imagery, it is less accurate than the other wetland categories. The primary criteria for mapping these areas are hydric soils and a satellite imagery classification of 'pine forest'.	17
Human Impacted Area—Areas of human impact have physically disturbed the wetland, but the area is still wetland. Impoundments and some cutovers are included in this category, as well as other disturbed areas, such as power lines.	2
Cutover Wetland—Areas for which satellite imagery indicates a lack of vegetation in 1994. These areas are likely to still be wetlands; however, they have been recently cut over. Vegetation in these areas may be regenerating naturally, or the area may be in use for silvicultural activities.	4

Table 3: Little Lick Creek Wetlands

The Functional Wetlands Assessment data also provide scoping-level information about potential wetlands restoration in the watershed. A study presented to the NC Wetlands Restoration Program by UNRBA in 2002 used these data to identify wetlands in the watershed that had been drained and cleared or converted to pine forest. The analysis found that Little Lick Creek (the hydrologic unit) had the fourth-highest area of "potential wetland restoration sites" in the entire Upper Neuse Basin. These results should be further studied and field verified as part of the Little Lick Creek subwatershed analysis.

2.7 Habitat and Endangered Species

Little Lick Creek contains a portion of the Falls Lake Shoreline and Tributaries Natural Heritage Area (Hall 1995). This area is of regional significance for its fauna, which include bald eagles, double-crested cormorants, and ospreys. The area's expanses of shallow water provide habitat for migratory shorebirds and post-breeding wading birds, and sub-impoundments like the one at Patterson Rd. provide significant wintering habitat for ducks and geese. Bottomland forest habitat along all the Falls Lake Tributaries might provide refuge for at least some species of forest interior animals (Hall 1995).

Historically, the Little Lick Creek Watershed must have contained lowland hardwood forest habitat of high quality. According to the Durham County Natural Heritage Inventory, the creek flowed into a Neuse River valley with "extensive tracts of swamp and alluvial forests…many of these stands were quite mature and high in quality" (Hall 1995). According to the same inventory, tributary Valleys, including Little Lick Creek, "once contained exemplary stands of swamp or alluvial forests." Much of this forest was cleared and flooded for Falls Lake's impoundment.

A 1973 study of vegetation, prior to the Falls Lake Project, confirms the assertion that Little Lick Creek once harbored special swamp and alluvial forest habitat (Moore 1973). This study singled out the "swamp forest extending southwest from Neuse River along Little Lick Creek to Durham County Rt. 1804 (Santee Rd.)." As late as the 1980's, people hunting in the creek's bottomlands report regular sightings of flying squirrels (a forest interior species) near NC Highway 98 and as far upstream as the Holder Road area (Holder 2004).

Prior to the impoundments, the Little Lick Creek Bottomlands might have had similar habitat conditions to those currently found in the nearby Lick Creek Bottomlands. The Lick Creek Bottomlands are given a high protection status by the NC Natural Heritage Program because the Lick Creek stands of bottomland hardwood forest are "among the most mature and diverse in the entire area: and support fauna of forest interior and bottomland species among the "best remaining around the edge of Falls Lake" (Hall 1995).

The impoundment of Falls Lake and the Patterson Rd. waterfowl impoundment fundamentally changed this habitat. According to Hall (1995), the most significant animals currently found in this area are "waterbirds that once would have passed through the area only during migration, if ever." However, some forest remains, and this forest may include special habitat. We will further examine this question as part of the evaluation of potential critical lands for protection.

The Natural Heritage Program has confirmed the presence of Douglass's Bittercress (*Cardamine douglassi*) and leatherwood (*Dirca palustris*), a species on the NC "watch list". *Cardamine douglassii* is a flowering plant found in nutrient-rich, mesic forests, especially in alluvial bottomlands and nutrient-rich seepages (Weakley 2004). It is found mainly in the tributaries of the Neuse, Meherrin, and, rarely, Cape Fear rivers. The North

Carolina Natural Heritage recognizes *C. douglassii* as rare and has proposed that it be listed as threatened or endangered.

Leatherwood (*Dirca palustris*) is a woody, deciduous shrub found in very rich forests, on slopes or bottomlands (Weakley 2004). *D. palustris* has a ½-inch long, tube-like, greenish-yellow flower. *D. palustris* is on the NC Watch List. The plant's curiously flexible twigs and tan-brown bark are extraordinarily tough. Native Americans used the twigs for cordage, hence its common name.

The Durham Natural Heritage Survey only cursorily studied sites in Little Lick Creek, and Hall recommends further study of the Little Lick Creek Lowlands. Table 4 shows terrestrial species listed in the Natural Heritage Inventory as occurring in the Falls Lake Shoreline and Tributaries Natural Heritage Area. Many of these species may occur in the Little Lick Creek Watershed.

Common Name	Scientific Name	Comment
bald eagle	*Haliaeetus leucocephalus*	NHP element species, big tree snag species
double-crested cormorant	*Phalacrocorax auritus*	NHP element species
osprey	*Pandion haliaetus*	Regionally rare, big tree snag species
red-shouldered hawk	*Buteo lineatus*	Forest Interior, big tree snag species
blue-grey gnatcatcher	*Polioptila caerulea*	Forest Interior indicator species
American redstart	*Setophaga ruticilla*	Forest Interior indicator species
ovenbird	*Seiurus aurocapillus*	Forest Interior, low-nesting species
ground skink	*Scincella lateralis*	Forest Interior indicator species
marbled salamander	*Ambystoma opacum*	Forest Interior indicator species
Cope's gray treefrog	*Hyla chrysoscelis*	Forest Interior indicator species
striped chorus frog	*Pseudacris triseriata*	Forest Interior indicator species
Zebra Swallowtail	*Eurytides marcellus*	Forest Interior indicator species
Falcate Orangetip	*Anthocharis midea*	Forest Interior indicator species
white admiral butterfly	*Limenitis arthemis*	Forest Interior indicator species
flat-disc snail	*Haplotrema concavum*	Forest Interior indicator species
white-tailed deer	*Odocoileus virginianus*	Forest/Edge species
Carolina chickadee	*Parus carolinensis*	Forest/Edge species
Kirtland's warbler	*Dendroica pinus*	Forest/Edge species
northern fence lizard	*Sceloporus undulatus*	Forest/Edge species
five-lined skink	*Eumeces fasciatus*	Forest/Edge species
dusky salamander	*Desmognathus fuscus*	Forest/Edge species
spring peeper frog	*Pseudacris crucifer*	Forest/Edge species
pickerel frog	*Rana palustris*	Forest/Edge species
southern leopard frog	*Rana utricularia*	Forest/Edge species
Juvenal's Duskywing	*Erynnis juvenalis*	Forest/Edge species
eastern tiger swallowtail	*Papilio glaucus*	Forest/Edge species
Gemmed Satyr	*Cyllopsis gemma*	Forest/Edge species
Eastern Tailed-Blue butterfly	*Everes comyntas*	Non-forest species
Pearl Crescent butterfly	*Phyciodes tharos*	
American painted lady	*Vanessa virginiensis*	
American beaver	*Castor canadensis*	
white-tailed deer	*Odocoileus virginiensis*	
great blue heron	*Ardea herodias*	
mallard	*Anas platyrhynchos*	
pine warbler	*Dendroica pinus*	
common mud turtle	*Kinosternon subrubrum*	
fence lizard	*Sceloporus undulatus*	
five-lined skink	*Eumeces fasciatus*	
ground skink	*Scincella lateralis*	
eastern newt	*Notophthalmus viridescens*	
northern cricket frog	*Acris crepitans*	

Table 4: Potential terrestrial species in the Little Lick Creek Watershed (Hall 1995). (Common names confirmed using http://animaldiversity.ummz.umich.edu/)

Aquatic habitats were especially hard hit by impoundment. Species that once freely migrated up and down river and between tributaries are now impeded by the reservoir. Lake species such as crappie and large-mouth bass prey on smaller native species in the

streams and amphibians in formerly isolated vernal pools. The Natural Heritage Inventory lists no water-quality sensitive aquatic species in the Falls Lake Shoreline and Tributaries Natural Heritage Area; however, absence of a species cannot be proven. Some of the aquatic species identified in the inventory and shown in Table 5 may occur in the Little Lick Creek Subwatershed.

Common Name	Scientific Name	Comment
American eel	*Anguilla rostrata*	water-quality tolerant species
goldfish	*Carassius auratus*	water-quality tolerant species
common or European carp	*Cyprinus carpio*	water-quality tolerant species, invasive
white catfish	*Ameiurus catus*	water-quality tolerant species
yellow bullhead catfish	*Ameiurus natalis*	water-quality tolerant species
brown bullhead catfish	*Ameiurus nebulosus*	water-quality tolerant species
mosquitofish	*Gambusia affinis holbrooki*	water-quality tolerant species
green sunfish	*Lepomis cyanellus*	water-quality tolerant species
threadfin shad	*Dorosoma petenense*	Invading species
smallmouth buffalo fish	*Ictiobus bubalus*	Invading species
white sucker fish	*Catostomus commersoni*	Invading species
channel catfish	*Ictalurus punctatus*	Invading species
white perch	*Morone americana*	Invading species
striped sea-bass	*Morone saxatilis*	Invading species
white crappie	*Pomoxis annularis*	Invading species
black crappie	*Pomoxis nigromaculatus*	
longear sunfish	*Lepomis microlophus*	Invading species
sunfish	*Lepomis gulosus*	
redear sunfish	*Lepomis microlophus*	
redbreast sunfish	*Lepomis auritus*	
pumpkinseed	*Lepomis gibbosus*	
grass pickerel	*Esox americanus*	
chain pickerel	*Esox niger*	
golden shiner fish	*Notemigonus crysoleucas*	
creek chub	*Semotilus atromaculatus*	
bluehead chub	*Nocomis leptocephalus*	
creek chubsucker fish	*Erimyzon oblongus*	
redhorse	*Moxostoma macrolepidotum*	
slender redhorse	*Moxostoma pappillosum*	
margined madtom	*Noturus insignis*	
peacock sunfish	*Centrarchus macropterus*	
largemouth bass	*Micropterus salmoides*	
yellow perch	*Perca flavescens*	
greenside darter	*Etheostoma nigrum*	
a dragonfly	*Epitheca cynosure*	
a dragonfly	*Libellula lydia*	

Table 5: Potential aquatic species in the Little Lick Creek Watershed (Hall 1995). (Common names confirmed using http://animaldiversity.ummz.umich.edu/)

3. Water Quality and Aquatic Habitat Monitoring

Little Lick Creek is classified as a water supply watershed with nutrient sensitive waters (WS IV NSW) because it is in the Falls Lake watershed. Little Lick Creek is classified as "impaired" because it does not adequately support aquatic life (NC Division of Water Quality 2004). From the headwaters to 0.4 miles upstream of SR 1811 (Sherron Rd.), NC DWQ considers urban development as the likely source of impairment. From 0.4 miles upstream of Sherron Rd. to the reservoir, low dissolved oxygen is also considered a possible source of impairment.

3.1. Review of Existing Monitoring Data

The NC Division of Water Quality completed a review of existing monitoring data for this project and has summarized the data in a draft report called "Summary of Existing Water Quality Data: Little Lick Creek, Durham County" (NC Division of Water Quality 2005) This report is provided in Appendix 2.

The City of Durham Stormwater Services, NC Division of Water Quality, and the US Geological Survey have collected monitoring data on three different sites since 1982. Table 6 summarizes the data collected.

Agency	Monitoring type	Sites	# of samples	Years sampled
City of Durham	Benthic macroinvertebrate	Lynn Rd. SR 1815	Vary	2001-2004
City of Durham	Ambient water quality	Lynn Rd SR 1814 SR 1815	Vary	2000-2004
NC DWQ	Benthic macroinvertebrate	SR 1814 SR 1815	NC DWQ standards	1988, '91,'95, 2000 1988, '91, '95
NC DWQ	Habitat	Lynn Rd SR 1814 SR 1815	1 each	2000 & 2001
USGS	Ambient water quality	Upstream SR 1814 SR 1815	90 4	1982-1995 1993-2001

Table 6: Water Quality Monitoring Sites in Little Lick Creek.

Prior to 1995, there was a wastewater treatment plant in operation on Stallings Road (SR 1814). This plant operated from 1968 to 1995 and had a discharge capacity of 1.5 million gallons per day of treated effluent (Hazen and Sawyer 1990). The plant treated primarily residential, and a small amount of commercial wastewater. This plant was replaced with a pump station in 1995, and the effluent now goes to the North Durham Water Reclamation Facility on Ellerbe Creek. The non-operational plant still sits along the main stem of Little Lick Creek just downstream of Stallings Road.

The USGS conducted ambient water quality monitoring, and NC DWQ conducted benthic macroinvertebrate monitoring upstream and downstream of this site. Durham Stormwater Services has conducted benthic macroinvertebrate monitoring at the Lynn Rd. and Stallings Rd. sites and ambient water quality data monitoring at all three sites. In

addition, the NC Division of Water Quality conducted a habitat assessment for each site during 2000-2001. Appendix 2 offers a more detailed discussion of the data.

Findings from NC Division of Water Quality Data

The data and data methodologies from these studies vary, thus complicating data comparisons and conclusions. The draft conclusions from the NC Division of Water Quality's data analysis are listed below (p. 21 of Appendix 2).

- Benthic invertebrate data indicate that Little Lick Creek is biologically impaired.
- Despite the currently available data, it is not possible to draw scientifically defensible conclusions as to the causes of impairment in Little Lick Creek. The causes of impairment are not entirely clear and are exacerbated by inadequate data.
- Low dissolved oxygen during the summer months appears to be one factor contributing to the biological impairment of the creek.
- The causes for low oxygen conditions can not be determined from the available data.

NC DWQ Data Gaps

The NC DWQ review also identifies data gaps that should be filled. These are listed below.

- The contributions of other factors including disturbance, scour, sedimentation, and toxics (including but not limited to metals, pesticides, and petroleum hydrocarbons) are unknown and need to be examined.
- The points of origin of the major factors contributing to impairment also are unknown and need to be determined.
- Toxicity testing will be needed to evaluate the potential contributions of stormwater runoff and sediment toxicity to the biological impairment of Little Lick Creek.
- Ambient water quality and benthic macroinvertebrate data need to be collected regularly and consistently to be valuable in determining the causes of impairment and to be useful in planning potential restoration projects.

Findings from City of Durham Data

The City of Durham Stormwater Services Division is a partner in the project and conducts water quality and benthic macroinvertebrate sampling on a monthly basis. Although NC DWQ states that Durham's data are inadequate to make scientifically defensible conclusions regarding upstream versus downstream water quality, several observations warrant additional discussion. Although the data may be of good quality, sampling data were not sufficiently frequent or consistent for use in upstream-downstream comparisons.

Total copper exceeded the criteria of 7ug/L for aquatic life on 38 percent of all Durham Stormwater Services sampling dates. In addition, total fecal coliform exceeded the criteria for human health (200cfu/100mL) in 70 percent of the samples collected. According to NC DWQ's summary (Appendix 2), "these (Durham) data suggest…sewage contamination…potentially leaking sewage lines or septic fields. The

fecal coliform counts were particularly high when total phosphorous, total copper, and total suspended solids were also high. The highest counts were associated with the highest measured turbidities…suggest that high fecal coliform counts are associated with high levels of sediment suspended in the water column, as both total phosphorous and total copper occur largely in the insoluble fraction associated with suspended sediment. This suggests further that the high fecal coliforms are being washed into Little Lick Creek with contaminated soil." (NC Division of Water Quality 2005)

Durham City Stormwater Services' benthic marcroinvertebrate data and NC DWQ habitat ratings suggest mostly poor aquatic habitat conditions in Little Lick Creek. Table 7 (from page 19 of NC DWQ 2005) summarizes summertime collections for both sets of data.

Site Location	Collection Year**	DWQ Habitat Score	Temp.	D.O. (mg/L)	Total Taxa	Total EPT	EPT Diversity	Biotic Index	Biotic Rating	Bioclass Score	Bioclass rating
Lynn Road (upstream)	2001	79	22.6	4.8	22	2	Poor	7.19	Fair	1.5	Poor
	2002	--	20.1	1.9	17	0	Poor	8.95	Poor	0.5	Poor
	2003	--	24.5	4.2	25	1	Poor	7.7	Poor	1	Poor
	2004	--	22.6	5.6	17***	1	Poor	7.11	Fair	1.5	Poor
Mineral Springs Road (midstream)	1988	--			--	5		--			Poor
	1991	--			56	7		7.79			Poor
	1995	--			27	1		7.95			Poor
	2001	76	21.9	1.9	19	4	Poor	7.33	Fair	1.5	Poor
	2002	--	25.3	0.6	20	2	Poor	8.07	Poor	1	Poor
	2003	--	24.7	1.7	31	3	Poor	8.02	Poor	1	Poor
	2004	--			19***	1	Poor	7.09	Fair	1.5	Poor
Stallings Road (downstream)	1985	--			77	11		7.09			Fair
	1988	--			--	4		--			Poor
	1991	--			59	7		7.21			Fair
	1995	--			34	6		7.89			Poor
	2000	45	12.0	10.0	26	2		7.07			Poor

Table 7: Summary benthic macroinvertebrate summer collections on Little Lick Creek*

* A notation of "—" indicates that no data were available for these indices.

**Collection dates: Stallings Road – 6/13/85, 2/15/88, 8/7/91, 2/14/95, 3/6/2000; Lynn Road – 8/8/02, 7/22/03, 7/22/04; Mineral Springs Road – 8/1/02, 9/3/03, 7/22/04. Information on the 2001 collection dates for these latter two sites was not provided.

***Taxonomic identifications were not complete when data for 2004 were received.

The data show clearly that biotic diversity is low in the main stem of Little Lick Creek. The EPT diversity rating is an abbreviation for Ephemeroptera (mayflies) + Plecoptera (stoneflies) + Tricoptera (caddisflies). In addition, almost all of the bioclass ratings (a combination of EPT diversity and overall biotic rating) are poor, with the exception of two fair ratings on the downstream site on Stallings Road in 1985 and 1991. However,

NC DWQ habitat scores from 2000-2001 show fairly good habitat conditions on the two upstream sites and poor conditions at the downstream site.

3.2. Point Sources Discharges

There are no major permitted point sources discharging facilities in the Little Lick Creek watershed. From 1968 until 1995, the City of Durham operated the Little Lick Creek wastewater treatment facility off of Stallings Rd. This package-type treatment facility had a capacity of 1.5 million gallons per day (Hazen and Sawyer 1990). In 1995, Durham removed the plant and replaced it with a pumping station on the same site and a 30-inch force main from the pumping station to the North Durham Water Reclamation Facility on East Club Boulevard in Ellerbe Creek.

An additional concern in Little Lick Creek is the overall number of on-site wastewater treatment systems. A GIS analysis of Durham parcels and public sewer system data indicate that of the 9,800 parcels currently in the watershed, about 3,300 are parcels without public sewer provision. These parcels are all being served by some type of on-site wastewater treatment system. The great majority of these are septic systems. The density of septic systems is among the highest in the entire Upper Neuse, and the NC Division of Water Quality (findings discussed above and in Appendix 2) suspects these systems may be polluting the stream.

Of the total 3,300 on-site systems, an estimated 440 are discharging sand filter systems. The County allowed the installation of sand filter systems during the 1960's and 1970's in areas where soils would not permit standard septic systems. This treatment type was abandoned when it became clear that the systems were difficult to manage and often allowed untreated wastewater to pass into the environment. The remaining filters are required to hold general NPDES discharge permits, and City, County and State officials hope to replace sand filters with cleaner methods over time.

Table 8 estimates the number of parcels served by public sewer lines and on-site septic systems in the Little Lick Creek Watershed. These estimates are based on a GIS-based analysis of Durham parcels, public sewer lines, and permitted discharging sand filter systems. Durham Planning provided the parcels data. Durham Public Works provided the public sewer data. Durham Environmental Services and Stormwater Services provided the data on discharging sand filter systems. The Center for Watershed Protection will use this information to model current levels of nutrient pollution by subwatershed.

The number of parcels without sewer is most likely an underestimate of the number of on-site wastewater treatment systems in the watershed. Durham County, which operates a sewer system in the watershed, does not require system owners to connect to the system once it is available. The City requires connection where a system owner has access, but according to City employees, this rule not regularly enforced. The data presented in Table 8 are preliminary, and Little Lick Creek Project Partners will conduct data searches and field work to improve the estimation of the number and location of systems.

Sub-watershed	Area (Acres)	Parcels with Sewer	Parcels without Sewer*	Parcels with Sand Filter Systems**
1	**1,328**	1190	268	82 (69)
2	**920**	470	439	60 (20)
3	**910**	365	264	32 (19)
4	**1158**	1369	361	56 (44)
5	**999**	1239	217	19 (18)
6	**1168**	1047	336	60 (47)
7	**967**	349	291	33 (20)
8	**867**	261	325	51 (29)
9	**1172**	22	145	2 (0)
10	**773**	20	223	29 (7)
11	**926**	0	209	15 (0)
12	**960**	0	97	1 (0)
13	**1230**	160	137	4 (4)
Total Area	**13,376**	**6492**	**3312**	**444 (277)**

Table 8: Summary of wastewater treatment type by subwatershed

*Parcels without sewer are assumed to treat wastewater with on-site wastewater systems

**Sand filter systems were estimated using GIS data from Durham Environmental Health and Stormwater Services. Number in parentheses indicates the number of systems for which City or County public sewer system is available.

4. Little Lick Creek Watershed Land Use

4.1. Watershed Population

Population in Little Lick Creek has grown rapidly during the last two decades. Various sources of data show almost a doubling of population during this period. A 1985 study of water and wastewater facilities showed the watershed's population to be 10,500 (Piatt and Co. 1985). A Triangle J Council of Governments study based on US Census data from 2000 showed the watershed population to be 17,071 (TJCOG 2000).

4.2. Watershed Land Uses

The great majority of residents in the Little Lick Creek watershed live in single-family, low-density neighborhoods. Figure 5 and Table 9 summarize watershed land uses in Little Lick Creek based on the most recent available parcels data from Durham City and County Planning Department.

Land Use Type	Area		
	Acres	Square Miles	Percent Total Land Use
Protected Natural Area	1,275	2.0	9.7%
Urban Green Space	502	0.8	3.8%
Institutional	175	0.3	1.5%
Industrial	115	0.2	1.0%
Commercial Retail	121	0.2	1.0%
Commercial Office	12	0	0%
Ag., Forest, Rural, and Undeveloped Land	6,813	10.6	51.5%
Residential: Medium Density	217	0.3	1.5%
Residential: Low Density	3011	4.7	22.8%
Roads	935	1.5	7.3%
Total Area*	13,176	20.6	100%

Table 9: Land Uses by Parcel in the Little Lick Creek Watershed
(Source: 2004 GIS parcels coverage of Durham City and County)
*Total area does not include surface water

This analysis shows that Little Lick Creek, although suburban, is very much undeveloped and in an active state of rural to urban transition. Low-density residential land occupies 23% of the total parcels area in the watershed. Agriculture, Forestry, Rural, and Undeveloped Land make up over 50% of the land uses. A more detailed look at the undeveloped land category reveals that over 40% are vacant residential, which means these parcels will be built as mostly small, residential lots. At the same time, about 30% of the total Agriculture, Forest, Rural and Undeveloped Land is assumed to be agricultural because it is under present use/agriculture or present use/forestry taxation.

However, agricultural lands are not zoned for agricultural use, and they are likely to convert to other uses.

4.3 Future Growth and Land Use Changes in Little Lick Creek

Little Lick Creek is growing very rapidly, and it is likely to continue growing for many years. Traffic Analysis Zone (TAZ) data developed by the Triangle J Council of Governments for regional transportation planning using 2002 census data provide the current and future estimates of the watershed's population. The UNRBA used these data and US Geological Survey's "Urban Imagery" aerial photography from the same year to estimate a population of approximately 18,253 people living in the watershed in 2002 (Since the urban imagery photography is slightly older than the base data (TAZ) used for the analysis, this is likely a slight underestimate). The same data predict that population will grow to over 25,000 by the Year 2010; to over 33,000 by the Year 2020; and to over 41,000 by the Year 2030.

What will be the predominant land uses in Little Lick Creek once the watershed is "built out" to the level allowed under current regulations? An analysis of future development based on the draft Durham Comprehensive Plan and Unified Development Ordinance (the UDO encodes the visions outlined in the Comprehensive Plan) reveals the future of development in the Little Lick Creek Watershed. Although still in draft form, these documents are in the final stages of development.

Table 10 and Figure 6 summarize future watershed land uses in Little Lick Creek based on the Comprehensive Plan, the UDO, and the most recent available parcels data from Durham City and County Planning Department.

Land Use Type	**Area**		
	Acres	Square Miles	Percent Total Land Use
Protected Natural Area	1,448	2.3	11.9%
Urban Green Space	406	0.6	3.1%
Institutional	259	0.4	2.1%
Industrial	342	0.5	2.6%
Commercial Retail	247	0.4	2.1%
Commercial Office	19	0	0%
Ag., Forest, Rural, and Undeveloped Land	0	0	0%
Residential: Medium Density	538	0.8	4.1%
Residential: Low Density	9,137	14.3	73.7%
Total Area*	12,396	19.4	99.6%

Table 10: Predicted Future Land Uses by Parcel in the Little Lick Creek Watershed
*The total area does not include roads.

This analysis shows that Little Lick Creek will be a heavily suburban watershed. All agricultural lands are assumed to convert to other uses, primarily residential. Seventy-four percent (74%) of the watershed will be residential lots of greater than 1/8-acre. These lands will be analyzed in greater detail for use in the Watershed Treatment Model. A slightly higher amount of protected land is predicted, primarily because residential lots currently under development are using a cluster development option that protects a large portion of the site as open space to be managed by the homeowners.

In addition, Figure 6 shows the location of the planned Northern Durham Parkway and East End Connector. The Northern Durham Parkway will create a new road right through the heart of the Little Lick Creek Watershed. In the southern portion of the watershed, the road will follow a tributary of subwatershed 3 until it connects with Mineral Springs Rd. and crosses Highway 98. From there, the road will go north-northwest along a new alignment on its way to a junction with I-85. The East End Connector, an alternative to the now defunct Eno Loop, will connect the Durham Freeway (Highway 147) with Highway 70 in subwatershed 1 of Little Lick Creek.

What will being over 70% urban mean for watershed management efforts in Little Lick Creek? If this build out occurs, entities with influence over watershed management will have to consider various management strategies to protect watershed functions. The strategies might include improved stormwater management requirements for all new development, conservation subdivisions, improved monitoring and enforcement, citizen education and stewardship programs. These approaches will be discussed in detail in a future memorandum on watershed management strategies.

5. Ordinances, Rules, and Programs in Little Lick Creek

What level of watershed protection do Durham City and County's current ordinances, rules, and programs provide Little Lick Creek in this time of rapid development? A key element in the Little Lick Creek Local Watershed Plan is to assess the watershed protection practices in Durham City and County. By understanding these practices, we can assess strengths and weaknesses and plan for more effective watershed management.

This section summarizes key findings from draft "Watershed Program Reviews" (WPR) done for both Durham City and County. The WPR is a survey of the ordinances, rules, and programs that influence protection of the Little Lick Creek watershed. The Center for Watershed Protection designed the WPR, and the UNRBA adapted it for use in this project. This review is not a critique, but rather a part of a comprehensive watershed management strategy. See Appendices 4 and 5 for draft versions of the Durham City and County WPR. The reviews were completed in December 2004, but are living documents to consult and update throughout the project.

The summary is presented in the form of seven of the Center for Watershed Protection's eight tools of watershed planning, listed in Table 11. The following sections describe how Durham City and County currently practice each technique.

Watershed Protection Technique	Description
1. Watershed Planning	The application of regulatory measures and/or planning techniques that are designed to maintain or limit future impervious cover, redirect development where appropriate, and protect sensitive areas.
2. Land Conservation	Programs or efforts to conserve undeveloped, ecologically sensitive areas, or areas of historical or cultural value
3. Aquatic Buffers	The protection, restoration, creation, or reforestation of stream, wetland, or lake buffers.
4. Better Site Design	Local ordinances and codes that incorporate techniques into new and re-development sites to reduce impervious cover and/or direct runoff onto pervious surfaces
5. Erosion and Sediment Control	The use of erosion control, sediment control, and dewatering practices at all new development and redevelopment sites.
6. Stormwater Management	The incorporation of structural practices into new or re-development or the existing landscape to help mitigate the impacts of stormwater runoff on receiving waters
7. Non-Stormwater Discharges	Locating, quantifying, and controlling non-stormwater pollutant sources in the watershed. Operation and maintenance practices that prevent or reduce pollutants entering the municipal or natural drainage system (e.g. illicit discharges, sand-type wastewater filters)
8. Watershed Stewardship	Education and outreach programs targeted toward fostering behavior that prevents or reduces pollution over a range of uses and activities. Direct community involvement in protecting the resource (e.g. citizen stream watch or stream monitoring)

Table 11: Common Watershed Protection Techniques (Center for Watershed Protection)

5.1 Watershed Planning

Large areas of the Little Lick Creek watershed are subject to various watershed protection regulations. The watershed contributes to the Falls Lake water supply watershed and is designated by the state as a Water Supply Watershed – IV (WS IV). Durham's Zoning Ordinance encodes the state's rules governing WS IV watersheds through a regulatory overlay. Almost the entire watershed falls within this watershed protection overlay. The code defines critical area (Falls A) as land within one-mile of the normal pool elevation of the lake and the protection area (Falls B) as the land between the critical area and a distance 5 miles from the normal pool elevation (Durham City/County Zoning Ordinance 5.5.4). Figure 7 shows Falls A shaded in red and Falls B in green.

Critical area lands (Falls A) lie within county and federal (US Army Corps of Engineers) jurisdiction. The portion within Durham County can only be developed for residential uses, except that commercial, office, light industrial and research uses are permitted on certain grandfathered lands. In Falls A, the County requires a minimum density of 2 acres and a maximum impervious surface of 9% for new development. The County allows a maximum of 40 percent impervious cover for other uses; however, any development over 25% impervious cover requires a major special use permit. The land within federal jurisdiction is protected from private development and is managed by the North Carolina Wildlife Resources Commission.

The protected area (Falls B) lies within both City and County jurisdiction. Within the City's Urban Growth Area (UGA), residential, commercial, office and industrial uses are permitted. New development in the Falls B UGA is subject to minimum densities of 20,000 square feet and maximum impervious area limits of 24%. Inside the UGA, developers are allowed a high-density option of up to 70% impervious area over 5% of the total watershed area if they use stormwater controls.

New development in Falls B but outside the UGA is subject to stricter rules. Here, industrial uses are not permitted, but commercial and office uses are. New development is subject to minimum densities of 80,000 square feet and maximum impervious surface areas of 12%. However, there is reason to believe that Falls B protected area will not maintain its current level of protection. First, the City commonly annexes land within the UGA, and the draft versions of Durham's Comprehensive Plan and Unified Development Ordinance extend the UGA throughout the protected area of Little Lick Creek Watershed. If the City eventually annexes all the land within the future UGA, large portions of subwatersheds 9, 10, and 13 could be developed at much higher densities and with more types of uses than are currently allowed. It should be noted, however, that sewer and stormwater requirements are greater within city limits. The question is whether additional requirements will be enough to offset the impacts of the additional future development.

Both Durham City and County offer flexibility to protect natural resources through the practice of clustering residential development. The clustering option allows for increased densities, but requires overall site imperviousness not to exceed that which would occur on a conventional site (Durham Zoning Ordinance 5.5.10). The existing rules do not

specify a minimum open space requirement. The draft Unified Development Ordinance would allow "conservation subdivisions" where a minimum of 40% of the site would be protected in perpetuity in exchange for allowing additional density on the developed portion of the site.

Finally, there is no agricultural zoning in the watershed, or in the county. The lack of land use protection for farms virtually ensures that growth pressures will eventually lead owners of agricultural properties to allow those properties to be converted to other uses.

5.2 Land Conservation

There is a great amount of protected land in the watershed. However, the great majority of that land is located on federally-owned land around the Falls Lake Reservoir. Durham City operates a relatively small amount of parkland in the watershed in the form of CR Woods, Birchwood, and Twin Lakes Parks (see Figure 1).

Durham City and County protect steep slopes over 25%, stream buffers (described in section 5.3), and floodplains. Durham's floodplains protection policy (Comprehensive Plan 7.1.3a and Zoning Ordinance 11.2.1) prohibits development in the floodway (National Flood Insurance Program minimum criteria), but allows parking, utilities, passive recreation, crossings, and limited fill (up to 10%) in the floodway fringe, the area of the floodplain not in the active floodway. The proposed Unified Development Ordinance (UDO) may include additional protection for floodplains.

Durham has other regulations to encourage land preservation, including:

- Subdivision review to protect historic sites "to the maximum extent possible" (Subdivision Ordinance 6B and 7C);
- Voluntary Farmland Protection Ordinance and Farmland Advisory Board to oversee Voluntary Agricultural Districts; and
- Sites listed in the Durham Natural Heritage Inventory (Hall 1995) must be shown on preliminary plats and must be protected to the "maximum extent possible" (Subdivision Ordinance 5A).

In addition, the draft UDO allows developers to cluster development on conservation subdivisions. The protected lands on this type of development would be "configured to provide greater stream buffers; to buffer parking areas; to preserve ponds, wetlands and minor drainage ways; to preserve slopes over fifteen (15) percent, to preserve wildlife habitat and corridors, and to preserve other environmentally sensitive areas."

The UNRBA, TJCOG, and Durham City/County Planning will conduct an analysis of lands critical for the protection of water quality and aquatic habitat in Little Lick Creek. This analysis will be based on NC EEP, Durham, and other relevant criteria and will include a more detailed review of the policies affecting land conservation in the watershed.

5.3 Aquatic Buffers

Table 12 shows the stream buffer requirements within the Little Lick Creek Watershed. The minimum stream buffer, under the Neuse River buffer regulations, is 50 feet around any perennial or intermittent stream in Durham. In addition, the City and County have the following requirements.

Watershed Protection Zone	Perennial	Intermittent
Falls A	150 feet	*County:* Outside of the UGA, 100 feet; inside of the UGA, 150 feet.
Falls B	100 feet	50 feet (100 feet with High-Density Option)

Table 12: Stream Buffer Requirements for New Development in Durham

The requirements differ from the area within ½-mile of the lake shore (Falls A) and the area within 5 miles of the shore (Falls B). The rules also differ from perennial to intermittent streams in the Little Lick Creek Watershed. In addition, there is no development allowed within a 1000-foot natural vegetated buffer around the Falls Lake Reservoir.

Protected stream buffers must remain in "natural undisturbed vegetation", except that crossings by streets, driveways, culverts, railroads, recreational features, intakes, docks, utilities, bridges or other facilities are allowed with design provisions. Stormwater control structures are considered utilities. Clearing and re-vegetating the stream buffer for the purposes of improving its pollutant removal efficiency may be permitted in certain cases.

The Zoning Ordinance requires wetland buffers of 25 feet, but there are many activities exempting this buffer, and wetlands themselves are not fully protected from destruction under state or local law.

5.4 Erosion and Sediment Control

The major ordinance governing sediment and erosion control in Durham is the Sediment and Erosion Control Ordinance. Durham City is subject to the federal National Pollutant Discharge Elimination System (NPDES). The City fell under Phase I and will be subject to Phase II. The City must implement the minimum requirements of Phase II in 2005. The NPDES sediment and erosion control minimum measure requires sediment and erosion control on all disturbed sites greater than 1 acre. The Durham Sediment and Erosion Control Ordinance has stronger thresholds, requiring sedimentation and erosion control plans for sites over 12,000 square feet in Little Lick Creek.

Agriculture and Forestry are exempted from the Sediment and Erosion Control Ordinance; however, these activities have access to several assistance programs, including Durham County Soil and Water Conservation District, Natural Resource Conservation Service, and Durham Cooperative Extension Service.

Durham County Engineering oversees sediment and erosion control in the Little Lick Creek watershed. The department currently has three sediment and erosion control staff positions responsible for all plan review and inspections in the County. According to staff, sites are visited about once per month, and specific complaints are investigated. There are no minimum inspection requirements such as inspections during or immediately after storms. The County Engineer may revoke permits.

Durham County Sediment and Erosion Control staff oversees all projects in the City and County. This division is currently understaffed. The Engineering department is working to hire additional staff. During fieldwork, Project Partners from Center for Watershed Protection and Durham City and County will review practices on active development sites. Observations will lead directly to recommendations in the plan.

5.5 Stormwater Management

Stormwater Rules

Developments within the City and County portions of Little Lick Creek must comply with the Neuse rules (1-year, 24-hour storm peak matching and nitrogen reduction). In addition, all developments must comply with the Durham Stormwater Ordinance. The Durham Stormwater Ordinance requires best management practices for peak flow matching (for 2-year or 10-year, 24-hour storm) for developments that increase runoff by more than 10%. The Stormwater Ordinance also requires additional volume control in certain cases, including development that increases stormwater runoff volumes to downstream receiving waters by 10% or more.

All new developments in Little Lick Creek must comply with the Neuse minimum buffer and nitrogen reduction rules. The minimum buffer requirement is 50 feet, although Durham requires larger buffers in most of Little Lick Creek (discussed in section 5.3). The nitrogen reduction rules mandate nitrogen loading limits of 3.6 lbs/acre/year to 6 lbs/acre/year for new residential development or 3.6 lbs/acre/year to 10 lbs/acre/year for new non-residential development. New development cannot exceed the upper limits, and all nitrogen loading in excess of the 3.6 lbs/acre/year but under the upper limits require payment into to a state-controlled "nitrogen offset fund." This fund can pay for practices recommended in the Little Lick Creek Local Watershed Plan.

In the City, development must also comply with federal NPDES program minimum measures. Under Phase I, the city was required to develop and implement a stormwater management program including public education, illicit discharge detection and elimination, storm sewer system and land use mapping, and analytical monitoring. Durham developed a utility, Durham Stormwater Services, to fund and manage these requirements. Durham City must comply with NPDES Phase II requirements, which add several minimum measurements to the existing stormwater requirements. These are (several of these measures are addressed in other parts of Section 5):

- Public Education and Outreach (see Section 5.7)
- Public Involvement/Participation (see Section 5.7)
- Illicit Discharge Detection and Elimination (see Section 5.6)
- Construction Site Runoff Control (see Section 5.4)

- Post-construction Stormwater Management
- Pollution Prevention/Good Housekeeping

See the NC statutes (15A NCAC 2H .0126) for the detailed regulations. The Phase II post-construction stormwater management rule requires that new development and re-development sites over 1 acre in size meet new requirements. "Low-Density Projects" of no more than 2 units per acre or 24% built-upon area will have stormwater management plans. In addition to meeting all existing Durham requirements, stormwater management on these sites will transport stormwater through vegetated conveyances to the maximum extent practicable, and all built-upon area will be at a minimum of 30 feet landward of all perennial and intermittent surface waters (shown on 1:24,000 scale or USDA Soil Survey Maps).

"High-Density Projects" exceeding the 2 units/acre threshold must develop stormwater management plans to meet all the requirements described for low-density projects and:

- Control and treat the difference in stormwater runoff volume leaving the project site between the pre and post development conditions for the 1-year, 24-hour storm. Runoff volume drawdown time shall be a minimum of 24 hours, but not more than 120 hours; and
- All structural stormwater treatment systems used to meet the requirements of the program shall be designed to have an 85% average annual removal for Total Suspended Solids.

The Little Lick Creek Watershed Plan will consider the influence of the Phase II requirements on development in the Little Lick Creek Watershed. One issue to consider is how stormwater will be managed in Durham County. The County is not designated as a Phase II community by the state, so it will not have to meet the requirements. An important consideration is whether sites developed in the Urban Growth Area will be required to meet City of Durham standards.

Another consideration is whether the new residential development will fall under the NPDES-defined low- or high-density threshold. The Little Lick Creek Local Watershed Plan will analyze, by subwatershed, whether future residential development in the suburban tier will be required to meet NPDES standards for low- or high-density projects.

Stormwater Programs

The City and County have separate stormwater management programs. All new developments in the City must submit a stormwater impact analysis that determines whether the development will be subject to quantity, peak flow, or quality requirements. The City has a stormwater utility which receives payments, citywide, in excess of $6 million per year and employs 59 positions. The staff include maintenance (16), litter control (14), street sweeping (10), water quality monitoring and investigations (5), plan review and best management practice annual inspections (3), engineering inspections (1), flooding and drainage issues (5), public education (1), impervious surface delineation (1), GPS surveying (1), and program management (2).

Durham County is currently developing a stormwater program in its County Engineering Department. The County is hiring a stormwater manager position. This staff person will oversee plan review, inspections, and other stormwater-related issues in the county. Because new developments requiring stormwater management in the County are almost always annexed into the City by the time the development is built, the County currently does not conduct post construction inspections. However, the County expects to have areas of development in the future requiring stormwater and inspections. County Engineering staff conducts inspections during construction.

5.6 Non-Stormwater Discharges

The federal NPDES minimum requirements include measures to prevent and control illicit discharges. Durham Stormwater Service Division of Water Quality performs illicit discharge investigations. Stormwater Services usually finds out about these discharges through its hotline or through field investigations. The majority of investigations occur in sewer system leaks, cross-connections from sewer to stormwater systems, failing septic systems, or intentional or accidental spills.

The County does not have an illicit discharge reduction program, although NPDES Phase II would have required this and, as already shown in Section 3.2 and Table 8 of this document, the County portion of the watershed has a high potential for illicit discharges from on-site wastewater systems. The County Health Department inspects septic systems on a complaint-driven basis, and there is no minimum required maintenance and inspection schedule. This means that a failing system could go undetected for a long period of time. It should be noted, however, that inspections are usually required as a condition of a loan on a home sale. These inspections will often reveal system failures.

On-site discharging sand filter systems potentially pose a serious water quality problem in Little Lick Creek. These systems consist of a settling tank, a sand filter, and chlorine treatment. The discharging sand filter only works effectively when the system owner prevents clogging and regularly replaces the chlorine tablet. For this reason, the failure rate for discharging sand filter systems is high, and failing systems dump untreated wastewater into surface waters.

The State of North Carolina requires homeowners with individual on-site discharging sand filter systems to have an NPDES general permit. The Durham County Health Department keeps track of these systems, and the City of Durham Stormwater Services has geographically referenced the database for mapping. However, because the state permits these systems, the County officially considers the state responsible for correcting any problems associated with them. The City of Durham requires owners of on-site discharging sand filter systems to connect to the sanitary sewer system where the system is available. Durham County has no such requirement.

Another potential source of illicit discharges in an urban watershed is solid waste. Solid waste disposal facilities are not permitted in the Falls B area, although recycling centers and drop-off sites are. In addition, commercial, office, industrial, and research uses that

manufacture, distribute, warehouse for distribution, store for on-site use or produce as a waste product any hazardous materials must submit Emergency Contingency Plans to reduce the chance of any discharges.

5.7 Watershed Stewardship

The City of Durham Stormwater Services Program has a Public Education Coordinator on staff. This person targets residents, teachers and students in the Durham School System, and businesses. Efforts include outreach, training programs, educational information development, and voluntary stream cleanups. Laura Webb Smith, the Public Education Coordinator, is on the Little Lick Creek Technical Team and has volunteered to begin contacting community groups that are interested in project presentations.

The City sponsors stream clean up projects. Ms. Smith is currently creating a teacher training program that may include stream monitoring. However, there are no official stream watch programs in the Little Lick Creek watershed. The State of North Carolina's Stream Watch Program (in NC DENR) can train and support citizens who want to begin a program.

There are several stream restoration projects underway in Durham, although none are currently underway in Little Lick Creek. Durham Soil and Water Conservation Service may be targeting a project in the Little Lick Creek or Lick Creek watershed. The Little Lick Creek Technical Team will discuss how any existing or planned projects will fit into strategies recommended in the Little Lick Creek Local Watershed Plan. Eddie Culberson, the District Director, is a member of the Little Lick Creek Technical Team.

6. Little Lick Creek Local Watershed Planning Process

The Upper Neuse River Basin Association and Triangle J Council of Governments have worked with partner organizations to recruit and convene watershed stakeholder groups to guide planning and facilitate other important project tasks. This section summarizes the process and stakeholder groups. Appendix 6 is the Little Lick Creek Local Watershed Plan Charter that the Technical Team adopted at its first meeting on January 18, 2005.

6.1 The Little Lick Creek Local Watershed Planning Group

The project will receive guidance from a Local Watershed Planning Group consisting of a Community Stakeholder Group, a Technical Team, and Project Partners. The primary purpose of the Local Watershed Planning Group as a whole is to develop watershed improvement and protection recommendations for the Little Lick Creek watershed. A broad coalition of community groups will also help assure the ongoing support necessary for LWP implementation. Appendix 6, the draft Charter, defines the group objectives in detail.

The following sections describe the Community Stakeholder Group, the Technical Team, and Project Partners.

The Community Stakeholder Group

The main role of the Community Stakeholder Group is to provide input into the process and to ensure that the local watershed planning process considers a broad, diverse range of community interests. The Community Stakeholder Group also has the critical role of helping the Local Watershed Planning Group understand and account for local watershed conditions and problems. UNRBA has sought local community stakeholders from particular interest groups (by contacting farmers, developers, churches, homeowners' associations, etc.) as well as from the community at large (via newspaper announcements).

Community Stakeholder group tasks include:

- Help identify intact and degraded watershed functions
- Provide feedback about general watershed planning goals and objectives
- Facilitate interactions with local landowners
- Involve local governments, constituents, and the community

Community Stakeholders are welcome at all local watershed planning meetings, and there are additional meetings geared specifically toward obtaining local input on the LWP. The Community Stakeholder Group provides input, at minimum, 1) when issues are articulated and goals are formulated; and 2) during project selection and ranking.

The Technical Team
The Technical Team comprises a group of resource professionals who contribute technical know-how to the project, attend planning meetings, review staff findings, and make recommendations that guide the watershed plan. Members of the Technical Team represent various interests within the watershed (e.g., agriculture, forestry, wildlife / habitat protection, local government, economic development, etc.), and are expected to participate in all meetings or send alternates to represent their identified interests. The Technical Team directly participates in the process of developing recommendations that will create a viable Local Watershed Plan. In addition, the Technical Team may present relevant issues for consideration when investigating potential projects and potential sources of agency / program funding.

Appendix 6, the Little Lick Creek Local Watershed Plan Charter and Ground Rules, lists the Technical Team members and their affiliations.

Project Partners
Project Partners are the governments and agencies working manage and financially support the project. Some partners, such as Durham City and County, hope to implement recommendations contained in the Local Watershed Plan. Project Partners include:

- Upper Neuse River Basin Association (UNRBA)
- Triangle J Council of Governments (TJCOG)
- Center for Watershed Protection (CWP)
- NC Division of Water Quality (NC DWQ)
- Durham City Stormwater Services (Durham Stormwater)
- Durham City/County Planning Department (Durham Planning)
- US Geological Survey (USGS)

Appendix 6 lists the people employed by Project Partners.

The Upper Neuse River Basin Association has been contracted by the NC EEP to facilitate stakeholder meetings and to manage the local watershed planning process, including creating meeting agendas, maintaining meeting records, and helping group members reach consensus amicably. Chris Dreps of the UNRBA will provide these services, with occasional support from Dr. Deborah Amaral of the NC EEP.

6.3 Potential Project Planning Goals

The Watershed Planning Group developed a draft set of planning goals to guide the Little Lick Creek Local Watershed Plan. Project partners agreed upon the initial goals at a meeting on October 25. The planning group reviewed these goals at the December 7 kickoff meeting and discussed their project-related interests. The UNRBA developed a draft list of potential project planning goals, and the Technical Team agreed on these goals at its January 18, 2005 meeting. Summaries of both meetings are available on the project website (www.unrba.org/littlelick).

The Little Lick Creek Local Watershed Planning goals include both short and long-term strategies to restore, manage and protect vital functions in the watershed. The goals are listed below.

- **Restore aquatic and riparian habitat**—in areas where impacts have occurred, implement projects that will provide measurable improvement to habitat in the stream and riparian system.
- **Improve water quality**—implement management strategies that will improve water quality in the stream system. In the long term, restore Little Lick Creek to a state of non-impairment. This project can help achieve the latter by taking initial monitoring and planning steps in conjunction with the NC Division of Water Quality.
- **Protect water quality and habitat in Falls Lake**—reduce nutrients, sediments, and toxic pollutants entering the lake through multiple short and long-term management strategies. Falls Lake is a critical resource to the region for both drinking water supply and recreation.
- **Protect lands critical for habitat and water quality**—protect habitat and water quality functions by protecting critical lands such as wetlands, floodplains,
- **Improve natural conditions for people living in the watershed—**search for opportunities to improve human use of managed natural areas and trails, improve aesthetics, and reduce destruction from flooding where these objectives align with the protection of water quality and habitat functions.
- **Foster community stewardship of the watershed—**educate and involve the local community in the creation of the plan, implementation of projects, and long-term stewardship of the watershed.

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