Lake Rhodhiss Watershed Restoration Plan

Prepared By
Western Piedmont Council of Governments

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Special Thanks to this group which directed staff resources and $30,000 in matching funding over a two-year period to support the Lake Rhodhiss Project which has regional implications but did not directly fall within each of the participating local governments jurisdictions.

and

Land and Lakes, Resource Conservation and Development
for spearheading and overseeing this Project

Overview / Executive Summary

Currently several streams within the Rhodhiss watershed are listed as impaired by the North Carolina Department of Water Quality (DWQ) and the US Environmental Protection Agency (EPA). Since the 1950s, degraded surface water quality conditions have been documented in the Lake Rhodhiss Watershed by state and federal agencies. Primarily noted are streams influenced by Lenoir and Morganton, the most urban areas in the watershed. More streams have been added every two years since 1998, when the impaired water list was initiated. According to state staff this may be more of a reflection of increased ambient monitoring rather than continued degradation in recent years.

In 2006, Lake Rhodhiss itself was added to the national impaired waters 303d list. The impairment was triggered by pH values exceeding numerical standards. High pH and other water quality indicators relate back to excessive nutrient loading, especially phosphorus. The lake is currently more euthrophic (fertile, biologically active) than desirable for a drinking water source. Thankfully there is no human health concerns based upon this water quality condition. In fact, according to NC Wildlife Resource Commission (WRC) biologists, Lake Rhodhiss offers some of the best sports fishing and highest fish growth rates in the Catawba River chain of lakes as a direct result of its fertility.

A primary concern is increased algal growth, which can result in taste and odor issues in drinking water. In 2002, due to water customer complaints, water treatment plants on Lake Rhodhiss and downstream in Lake Hickory increased water treatment and installed carbon filtration systems to remove these taste and odor issues at a significantly increased cost.

Nearly a decade ago, DWQ referenced the need to develop a nutrient management plan for Rhodhiss Lake (NC DWQ, 1999). In the 2004 Catawba Basinwide Plan, DWQ recommended that a locally developed watershed management plan for Lake Rhodhiss be produced as a first step towards reducing future nutrient loadings to the reservoir. In 2005, Land and Lakes Resource, Conservation and Development, a non-profit natural resource management organization headquartered in Catawba County, applied for a grant to begin this process. In 2007, the funding was secured from multiple sources to develop a watershed restoration plan for the

Lake Rhodhiss watershed. Most notably, funding came from Federal 319 allocations, NC Clean Water Management Trust Fund, and local governments' contributions through Water Quality dues managed by the Western Piedmont Council of Governments. In addition, a significant amount of in-kind technical and input assistance was received from various agencies, non-government organizations and local governments.

This project, generally referred to as the Lake Rhodhiss Project (or simply the 319 Project) had four main components: Stream Monitoring to determine Nutrient Loading; Application of Best Management Practices (BMP's) on wholesale ornamental nurseries to control pollutants; Watershed Restoration Plan Development as a roadmap for improving water quality conditions within the watershed; and Education and Outreach to better inform the general public and elected officials about water quality in the region.

Western Piedmont Council of Governments (WPCOG) staff worked primarily on the later two objectives. The following document is the culmination of this effort to develop a watershed restoration plan. WPCOG worked with local stakeholders to understand better the condition of the watershed and identify opportunities for reducing inputs of nitrogen and phosphorus into the lake from both point and non-point sources as well as agriculture and non-agriculture. This current planning document builds upon earlier work done by WPCOG and it partners to reduce nutrient loading in Lake Rhodhiss.

Work to improve conditions in the watershed has been ongoing proactively by many different players in the watershed for well over a decade. The Muddy Creek Initiative and the Lower Creek Planning Project are two shining examples. This is a large watershed, however, and coordination between many of these groups has been lacking in some cases. This plan has attempted to build on the good work done to date in an overarching comprehensive manner. Because of the large geographic scope of this watershed plan, this report may not resemble other watershed plans done on a much smaller scale that can include site specific project recommendations. We know we must focus on smaller subwatershed or catchment areas as we move forward, not only because we have limited resources but also because we must focus efforts to achieve a measureable improvement over time. We have attempted to include EPA's Nine-Elements in the plans development. In addition, effort has been made to include information that can be valuable to others who will continue to refine and implement the recommendations found in the following pages, and much of this data has be relegated to the appendices. Some of the sections still have significant information that, while unnecessary for a trained watershed manager, may be useful to others who are new to this endeavor.

An even larger scale Catawba Basin (Watershed) Plan is being developed concurrently for the NC portion of the Catawba River Basin as part of NCDENR Division of Water Quality's 5-year cyclical basin-wide planning process. The newest report is due out in late 2009 and will provide further guidance to improve water quality in Lake Rhodhiss.

For some time there has been debate over who was/is primarily responsible for the water degradation of Lake Rhodhiss and its surrounding tributaries. Persons in agriculture tended to point fingers in the direction of developers; developers often tended to place responsibility on farmers/ranchers; sometimes both groups pointed their fingers in the direction of the Waste Water Treatment Plants, and they in turn pointed back.

The monitoring done as part of this overall grant-funded project and the latest modeling indicate that Waste Water Treatment Plants in the Rhodhiss watershed, particularly those located adjacent to the lake, are the major source of nutrients to the system. This plan recommends that expeditious steps be taken to limit the nutrient input from these sources, even if significant plant modifications are necessary. The large capital costs and going O&M expenses associated with WWTP nutrient removal systems is a reality. Federal and State resources should bear part of the burden for this drinking water source protection issue. Though most of the other reservoirs in the system are more developed and urban, it should not be overlooked that Lake Rhodhiss is one of the uppermost reservoirs in a chain of lakes that serves a large and growing urban population in two states. If the nutrient loading that is affecting its water quality is not addressed adequately there will likely be future impacts beyond the Lake Rhodhiss Watershed. We all know "*Water Flows Downstream"*. The 2004 Catawba Basin Plan noted that the main factor driving water quality in Lake Hickory was water coming from its upstream neighbor, Lake Rhodhiss.

This plan is organized in the following manner: first is a section on the Background of the Catawba River Basin, Lake Rhodhiss and its Watershed; this is followed by a section of information on each of the nineteen (19) subwatersheds in the Rhodhiss Watershed. Next is included a section on the planning process, which discusses how GIS information, modeling and monitoring data was used to indentify sources and prioritize the watersheds for further restoration efforts. In the next two sections the plan recommends fifteen (15) Non-Agricultural, and (2)

Agricultural Non-Point Source (NPS) strategies that should be implemented to reduce the contribution of nutrients to the lake from NPSs. Lastly, we have included a section on Point Source strategies focused on the four Waste Water Treatment Plants (WWTPs) in the watershed. WWTPs are identified as the primary source of nutrients to Lake Rhodhiss and five strategies are recommended to significantly reduce nutrient loading when fully implanted within the next 10-15 years. Overall the Plan has twenty-two (22) recommendations.

The approach taken in developing this plan follows the principle, "You can't build a house with just a hammer alone." Our advisory teams have agreed that you can't build a watershed restoration strategy focusing on Waste Water Treatment Plants alone. An integrated strategy which employs all available (and appropriate) tools is the key to a successful restoration effort.

Billboard on I 40 in Burke County in 2008 for new lakefront residential development

Section A
Introduction and Background Information

Lake Rhodhiss

Lake Rhodhiss is a 3,515-acre reservoir located on the Catawba River in western North Carolina. This lake lies within Burke and Caldwell Counties and is a run-of-the-river reservoir located on the Catawba River downstream of Lake James and upstream of Lake Hickory. It was impounded in 1925 by Duke Energy for generating hydroelectric power. Three municipalities, Granite Falls, Lenoir, and Valdese have public water intakes located along the lake. Water from the lake is also used for waste assimilation, drinking water, industrial water supply, recreation and habitat for fish and wildlife species.

Map A-1: Lake Rhodhiss

Duke Energy

Water Quality Impairment

Lake Rhodhiss is listed on the 303d List of Impaired Surface Waters for pH values greater than the state water quality standard of 9.0 standard units.

Rhodhiss Lake has long been recognized as a nutrient rich reservoir (US EPA, 1975). Dating back to 1981, Lake Rhodhiss has been consistently found to be eutrophic by the NC Division of Water Quality (DWQ) (NC DENR, 1998). While levels of nutrients are adequate to support nuisance levels of algae, the lake's short retention time prevents elevated algal levels from occurring on a regular basis (NC DENR, 1999).

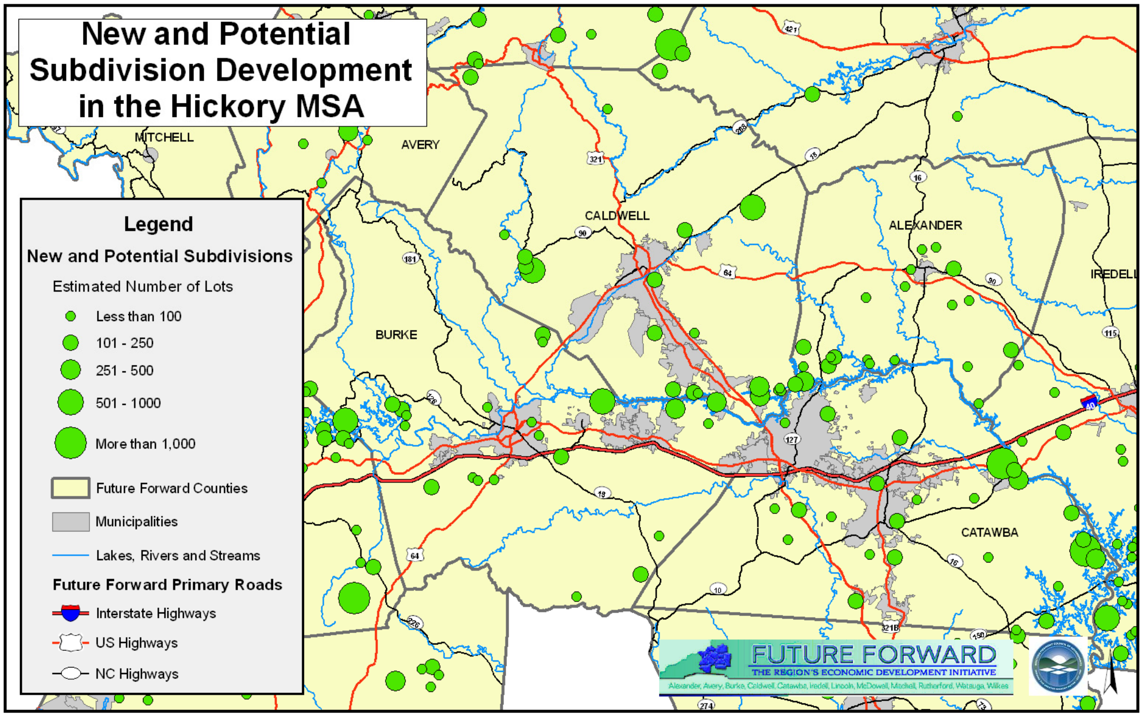
Although the lake received a use support rating of Fully Supporting by DWQ in 1999, nutrient loading to the lake was a concern. Field monitoring by DWQ between 1997 and 2002 documented several violations of the state's water quality standard for percent oxygen saturation. Monitoring by DWQ in 2002 identified frequent violations of the state water quality standard for two parameters, percent dissolved oxygen saturation and pH, resulting in DWQ designating Lake Rhodhiss as impaired for high pH. This designation was issued because of problems linked to eutrophication resulting from excessively high nutrient concentrations in the Lake. The impaired surface water classification became official in 2006.

Lake Rhodhiss Watershed

The watershed area of Lake Rhodhiss is 710 square miles in size, and the lake has the greatest watershed: surface area ratio of any North Carolina impoundment along the Catawba. Topography and soils vary considerably within the watershed. The northern portion of this watershed is very rural and undeveloped and contains substantial federal land holdings. Urban areas are generally confined to Lenoir, Morganton and Marion, as well as the I-40 and US 70 corridors between Morganton and the unincorporated Icard area of Burke County. Development activities are concentrated along these corridors.

Map A-2: Lake Rhodhiss Watershed

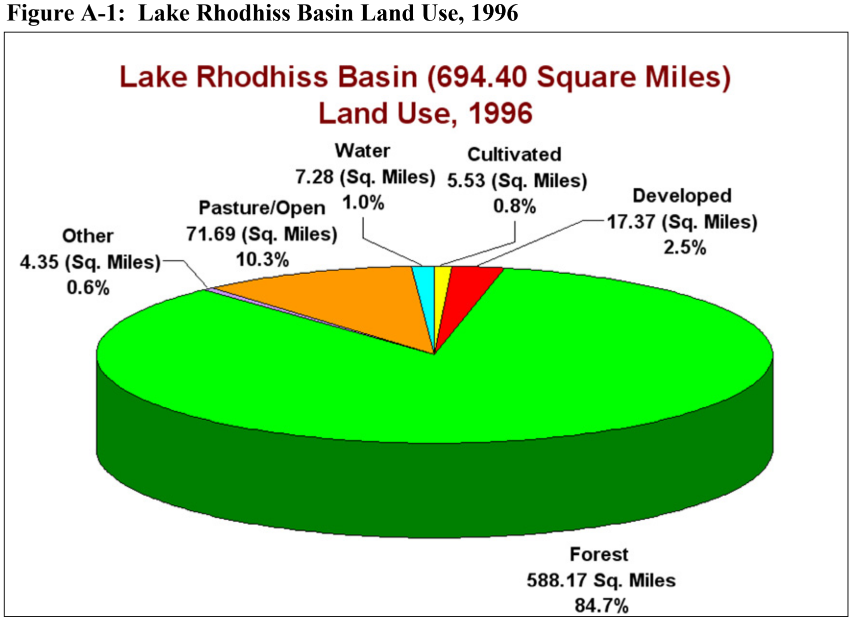
Map A-3: New and Potential Subdivision Development



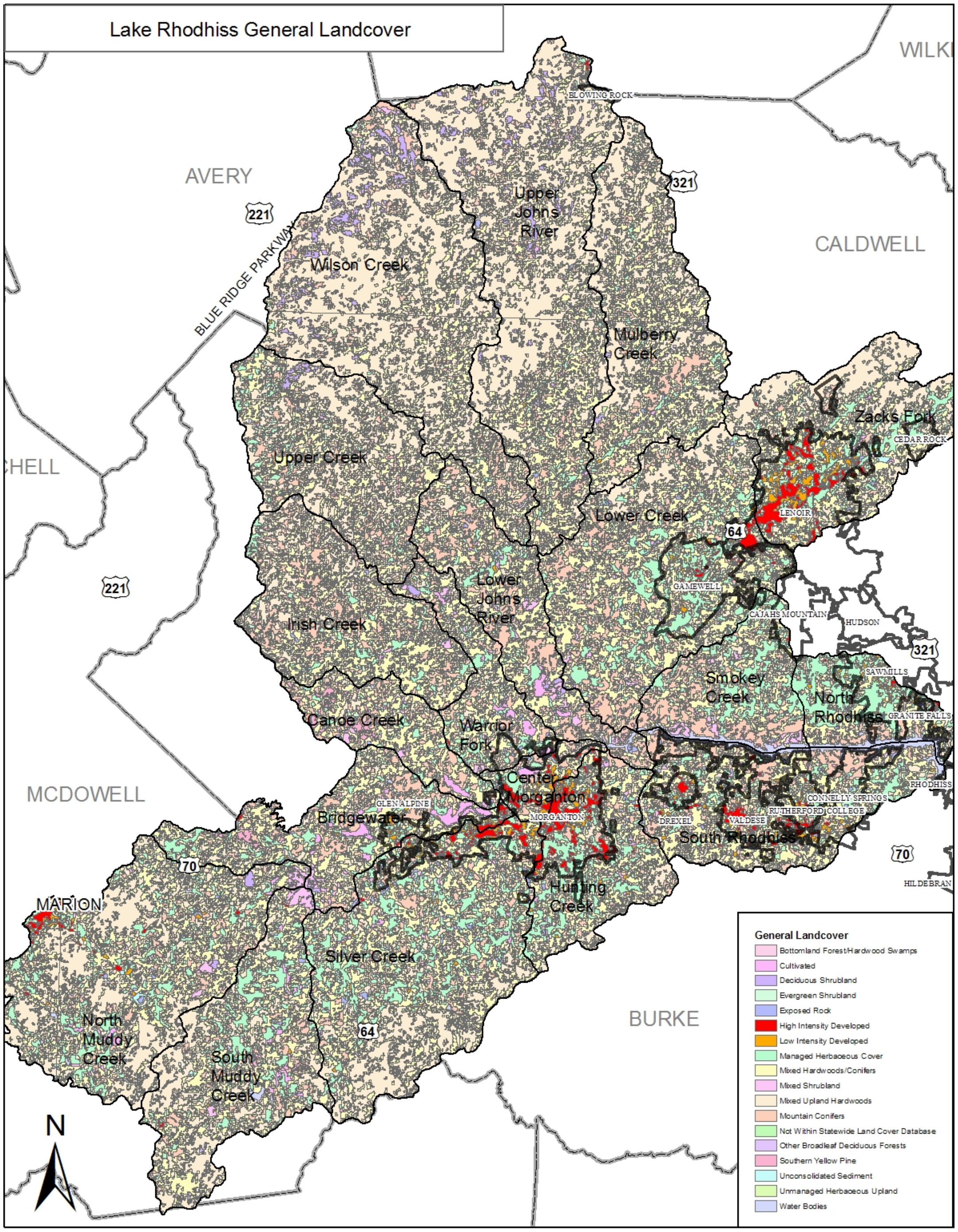
Land Use and Land Cover

The major land cover categories are forest (85%), agriculture (11%) and urban (3%). Forested areas dominate the watershed north and west of Lenoir.

Figure A-1: Lake Rhodhiss Basin Land Use, 1996

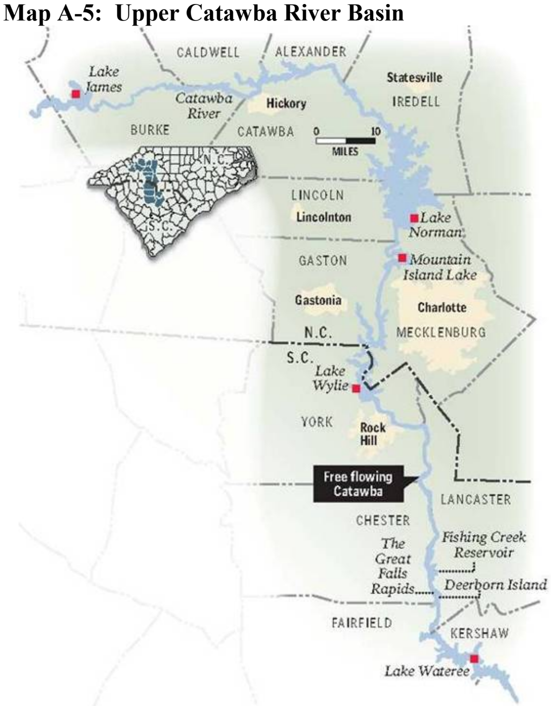


Map A-4: Lake Rhodhiss General Landcover



Upper Catawba River Basin

Map A-5: Upper Catawba River Basin



The Catawba River Basin forms the headwaters of the Santee-Cooper River system, which flows through South Carolina to the Atlantic Ocean. The basin is the eighth largest river basin in the state covering 3,279 square miles in the south central portion of western North Carolina. The Catawba River has its source on the eastern slopes of the Blue Ridge Mountains in McDowell County, and flows eastward, then southward, to the state line near Charlotte. The headwaters of the river are formed by swift flowing, cold water streams originating in the steep terrain of the mountains. Although the topography of the upper basin is characterized by mountains, smaller hills give way to a rolling terrain near the state line. As the basin enters the Inner Piedmont, land use shifts from forest to agricultural and urban uses. Urban areas are not numerous in the upper basin. Development has occurred only along the US 70 – I-40 Corridor which roughly parallels the Catawba River along the river's southern bank, especially Lake Rhodhiss and Lake Hickory. The area is branded the Greater Hickory Metro area, or alternatively the Upper Catawba Valley. The lower portion of the basin contains many cities, including the Charlotte metropolitan area.

The Catawba River basin has the greatest population density of the state's 17 river basins. About 312 people per square mile reside within this area, which is 2.5 times the statewide average population density. Anticipated population growth is expected to be strong during the first quarter of the century, with Mecklenburg County alone projected to add 250,000 new residents by 2020. However, it should be noted that populations in the Lake Rhodhiss watershed show the lowest growth rates in the Basin and are significantly less than those found in Mecklenburg and adjacent counties.

In response to population growth during the past twenty years, the character of the basin's landscape has undergone a slow, but apparent physical transformation as new homes, businesses and roads have gradually replaced open areas. For example, between 1982 and 1992 lands classified as urban increased by 35% while cultivated cropland declined by 38%. Forest and pasturelands also declined by about 5% during this period.

As the region grows it has become more urban in nature, and increased pressures are placed on the basin's water resources. This is particularly true for streams which serve as early collection points for receiving and transporting runoff from the myriad of activities occurring within the watershed. Not surprisingly more streams identified as impaired by DWQ are located in the Charlotte area than elsewhere in the basin, although streams draining smaller urban areas such as Gastonia, Hickory and Lenoir are, to a lesser degree, experiencing water quality problems as well. The impaired waters list found in Appendix F shows the increasing number of streams or stream sections added two year cycle.

Population estimates for the three counties in the Rhodhiss Watershed predict slow growth compared to their surrounding counties. Table A-1 highlights in yellow the three counties that contain the Rhodhiss Watershed.

Table A-1: Population Estimates by County

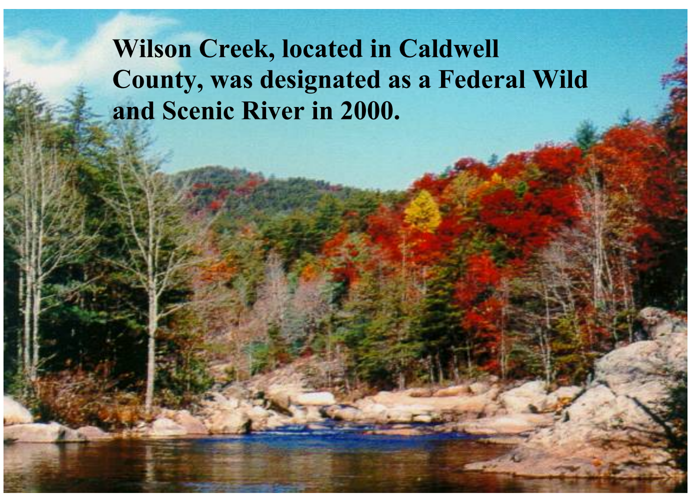
State	County	2000 Population	2008 Population	Change	% Change	2025 Population
North Carolina	Alexander	33,603	36,957	3,354	10.0	40,126
North Carolina	Burke	89,148	89,274	126	0.1	107,353
North Carolina	Caldwell	77,415	80,038	2,623	3.4	92,792
North Carolina	Catawba	141,685	154,972	13,287	9.4	190,678
North Carolina	Gaston	190,365	205,014	14,649	7.7	282,160
North Carolina	Iredell	122,660	154,169	31,509	25.7	225,980
North Carolina	Lincoln	63,780	74,552	10,772	16.9	109,049
North Carolina	McDowell	42,151	44,570	2,419	5.7	54,589
North Carolina	Mecklenburg	695,454	877,173	181,719	26.1	1,166,740
South Carolina	Chester	34,068	32,618	-1,450	-4.3	35,440
South Carolina	Fairfield	23,454	23,415	-39	-0.2	25,920
South Carolina	Kershaw	52,647	58,901	6,254	11.9	71,390
South Carolina	Lancaster	61,351	75,913	14,562	23.7	81,830
South Carolina	York	164,614	217,448	52,834	32.1	269,790
Totals	**Totals**	**1,792,395**	**2,125,014**	**332,619**	**18.6**	**2,753,837**

North Carolina and South Carolina State Data Centers

Section B
Current and Historical Conditions

Subwatersheds

Land use varies widely within the Lake Rhodhiss Watershed, and as a consequence so do water quality conditions in individual streams. Many headwater tributaries situated in northern Burke and Caldwell Counties are located within the Pisgah National Forest. These streams are generally high gradient, cold water tributaries, with good to excellent water quality conditions. Some of these streams have received a supplemental classification of High Quality Waters or Outstanding Resource Waters (such as Wilson Creek) by DWQ.


Wilson Creek, located in Caldwell County, was designated as a Federal Wild and Scenic River in 2000.

In subwatersheds that have experienced more development, particularly near Lenoir, Marion and Morganton, stream water quality conditions are lower.

The watershed contains 14 stream sections that currently appear on DWQ's draft 303d list submitted biannually to the US EPA (See Appendix G). Stream sections that appear on this list are considered to have impaired water quality which means these streams do not meet water quality standards including designated uses, numeric and narrative criteria and anti-degradation requirements (NC DENR, 2008).

Degraded water quality conditions have been documented in several streams located in the Lenoir and Morganton areas by the state of North Carolina since the 1950s. Currently several streams within the watershed are listed as impaired by DWQ including Hunting Creek, Irish Creek, Lower Creek and its tributaries of Bristol, Greasy, Husband, Spainhour and Zack Fork Creeks.

Other streams within the watershed, while not officially classified as impaired, are also recognized as experiencing water quality problems like Muddy and Silver Creeks. Duke Power Company estimates that between 14,000 and 23,000 tons of sediment each year enter the Catawba River from Muddy Creek under typical flow conditions. Because of these concerns the NC Clean Water Management Trust Fund has previously awarded funding to a local chapter of Trout Unlimited in Morganton to identify sediment sources and reduce the sediment loads carried by this stream.

Subwatershed boundaries used in this study are the 14-digit hydrologic units developed by the USDA-National Resources Conservation Service (USDA-NRSC, 1995). This system was selected because these subwatersheds are delineated strictly on a watershed basis and therefore are well suited for hydrologic modeling. This particular nomenclature is well known and employed by many state and federal resource agencies. The Rhodhiss Lake watershed is comprised on 19 subwatersheds that range in size from 1,411 hectares to 19,191 hectares.

From this point forward in this report, the term watershed will be used to refer to the entire 181,250 hectares (or 1,812.5 km2) project area. The term subwatershed will be employed to denote one or more of the 19 individual catchments that collectively comprise the Rhodhiss Lake watershed.

1. Bridgewater Subwatershed

The Bridgewater subwatershed is Hydrologic Unit Code (HUC Code) 3050101030060, and is approximately 27.74 square miles. Within this subwatershed is a portion of the Town of Glen Alpine. The Bridgewater subwatershed is located in Burke County, with a portion in McDowell County.

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks around the middle level among the other subwatersheds with respects to developed land use. The Bridgewater subwatershed ties for seventh place among the other 19 subwatersheds with respect to both percentage of impervious surface and agriculture.

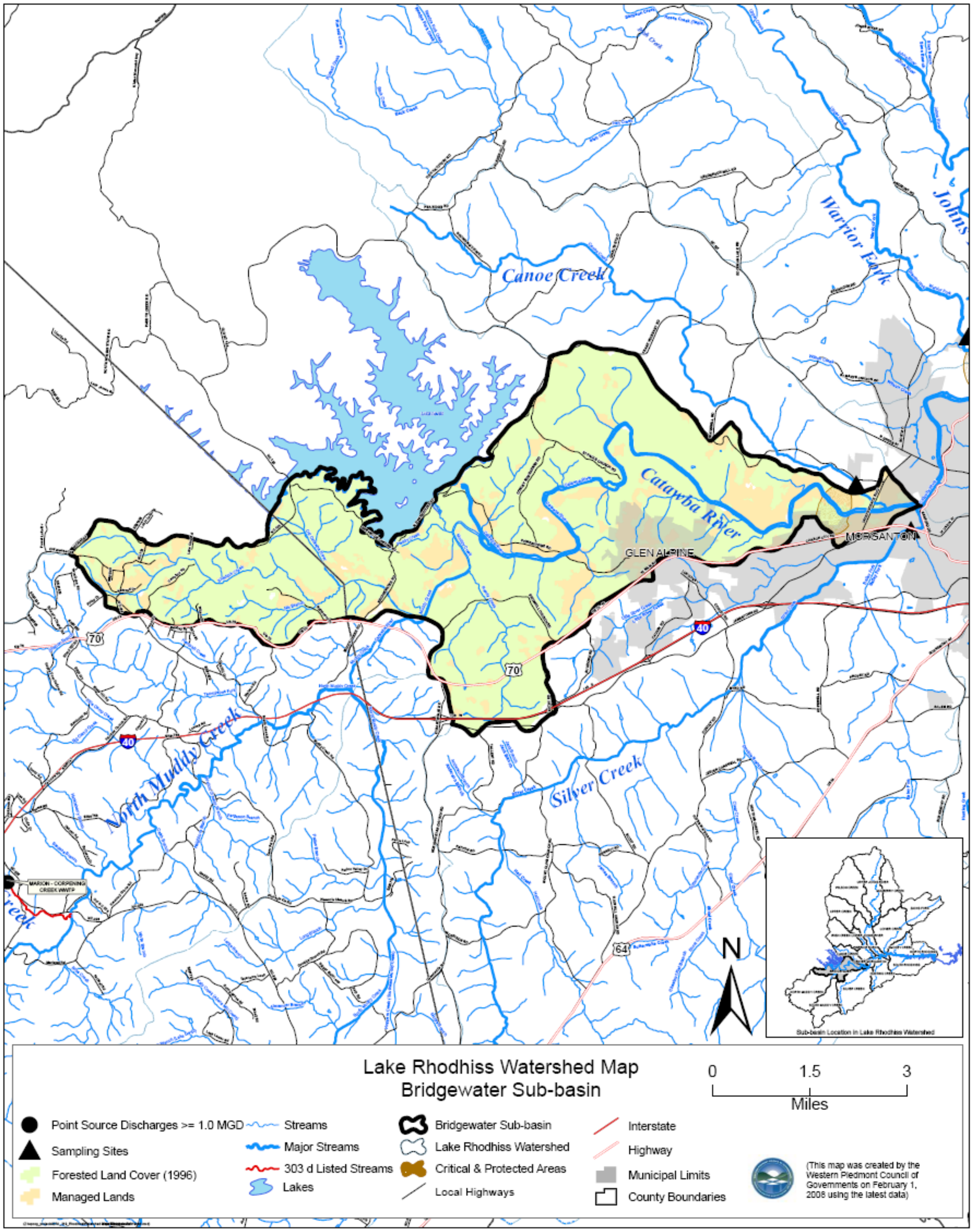
Table B-1: Bridgewater Subwatershed	
HUC Code:	3050101030060
County:	Burke/McDowell
Municipalities:	Yes
Population (2000):	4972
Population Density (2000):	184/Sq.Mile
Acres:	17,755
Square Miles:	27.74
Permitted Facilities:	2
NPDES WWTP:	(1) (Morganton)
Other NPDES Permits:	2
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	29
P Exp Coefficient	22
N Exp Coefficient	348
% Impervious	3.5
% Agriculture	16
% Households Sewered	18.8
Land Use Percentages (1996)	
Forest:	78.4% (21.21sq.mi.)
Pasture/Open:	11.3% (3.05sq.mi)
Water:	2.3% (.61sq.mi.)
Cultivated:	4.8% (1.3sq.mi.)
Developed:	2.8% (.75sq.mi.)
Other:	.5% (.13sq.mi.)
Total Length of Streams:	83.77 miles
Impaired Water Bodies:	No

Agricultural operations in the subwatershed include 350 acres of ornamentals, representing eight different operations that all located in the floodplain, 100 acres of grain, corn/soybeans, with most corn tilled conventionally, 500 cattle with limited pasture, and small horse operations located near Glen Alpine, which suffer from overgrazing.

According to Map A-3: New and Potential Subdivision Development, there were two developments of less than 100 units, and one development of 101 to 250 units at the time of that study.

There were 29 possible contamination sources and two facilities with National Point-source Discharge and Elimination System (NPDES) permits. Morganton's wastewater treatment plant is very close to this subwatershed, and may be having an effect. The Bridgewater subwatershed ranked 15th among the 19 subwatersheds with respects to its phosphorus coefficient of 22 kg/km/yr, and 11th with its nitrogen coefficient of 348 kg/km/yr.

Map B-1: Bridgewater Subwatershed



2. Canoe Creek Subwatershed

Table B-2: Canoe Creek Subwatershed	
HUC Code:	3050101030070
County:	Burke
Municipalities:	Yes
Population (2000):	2411
Population Density (2000):	161/Square Mile
Acres:	9831.33
Square Miles:	15.36
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	7
P Exp Coefficient	23
N Exp Coefficient	330
% Impervious	0.7
% Agriculture	8.5
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	90.5% (13.58sq.mi.)
Pasture/Open:	6.9% (1.03sq.mi.)
Water:	.1% (.01sq.mi.)
Cultivated:	2% (.3sq.mi.)
Developed:	.1% (.02sq.mi.)
Other:	.4% (.07sq.mi.)
Total Length of Streams:	21.6 Miles
Impaired Water Bodies:	No

The Canoe Creek subwatershed is HUC Code 3050101030070, and is approximately 15.36.74 square miles. Within this subwatershed is a small portion of the City of Morganton. The Canoe Creek subwatershed is located entirely within Burke County.

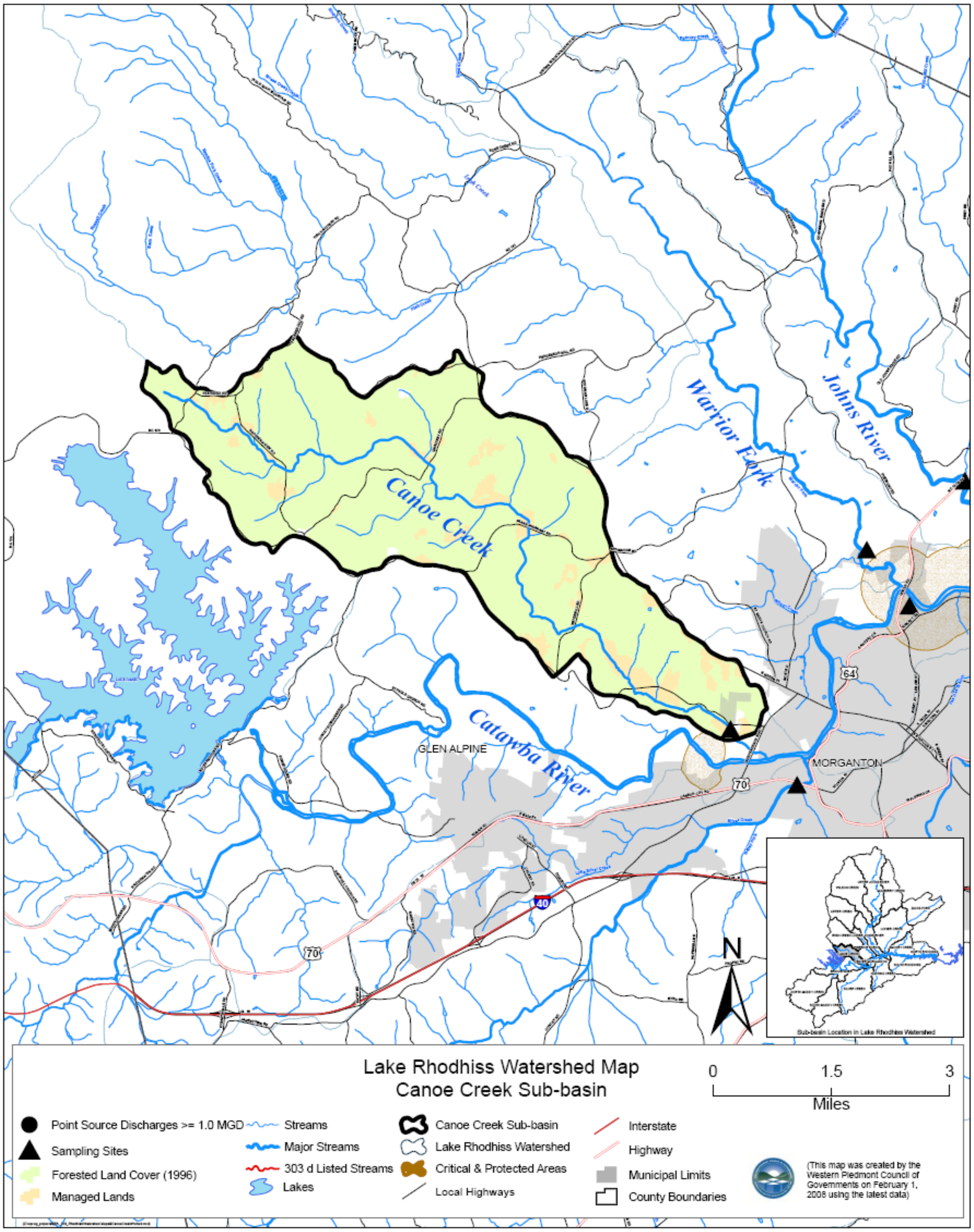
Land cover for the subwatershed is primarily forest and open space or pasture, and ranks around the middle level among the other subwatersheds with respects to developed or impervious surface. The Canoe Creek subwatershed ties for seventh place among the other 19 subwatersheds with respect to both percentage of impervious surface and agriculture.

Agricultural operations in the subwatershed include 40 acres of ornamentals, 60 acres of grain (corn/beans), 200 head of cattle, 300 acres of pasture/hay land, and an old hog operation with two waste storage ponds that were closed in 2002.

According to Map A-3: New and Potential Subdivision Development, there were two developments of less than 100 units, and two developments of 101 to 250 units at the time of that study.

There were few possible contamination sources and no NPDES permits. The Canoe Creek subwatershed ranked 12th among the 19 subwatersheds with respects to its phosphorus coefficient of 23 kg/km/yr, and 12th with its nitrogen coefficient of 330 kg/km/yr.

Map B-2: Canoe Creek Subwatershed



3. Center Morganton Subwatershed

The Center Morganton subwatershed is HUC Code 3050101060040, and is approximately 5.73 square miles. Within this subwatershed is a major portion of the City of Morganton. The Bridgewater subwatershed is located entirely in Burke County.

Table B-3: Center Morganton Subwatershed	
HUC Code:	3050101060040
County:	Burke
Municipalities:	Yes
Population (2000):	4853
Population Density (2000):	771/Sq.Mile
Acres:	3666.27
Square Miles:	5.73
Permitted Facilities:	1
NPDES WWTP:	1 (Morganton)
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	21
P Exp Coefficient	51
N Exp Coefficient	622
% Impervious	24.8
% Agriculture	18.1
% Households Sewered	69.3
Land Use Percentages (1996)	
Forest:	54.2% (3.04sq.mi.)
Pasture/Open:	14.8% (.83sq.mi.)
Water:	5% (.28sq.mi.)
Cultivated:	3.4% (.19sq.mi.)
Developed:	21.8% (1.22sq.mi.)
Other:	.7% (.04sq.mi.)
Total Length of Streams:	14.5 Miles
Impaired Water Bodies:	No

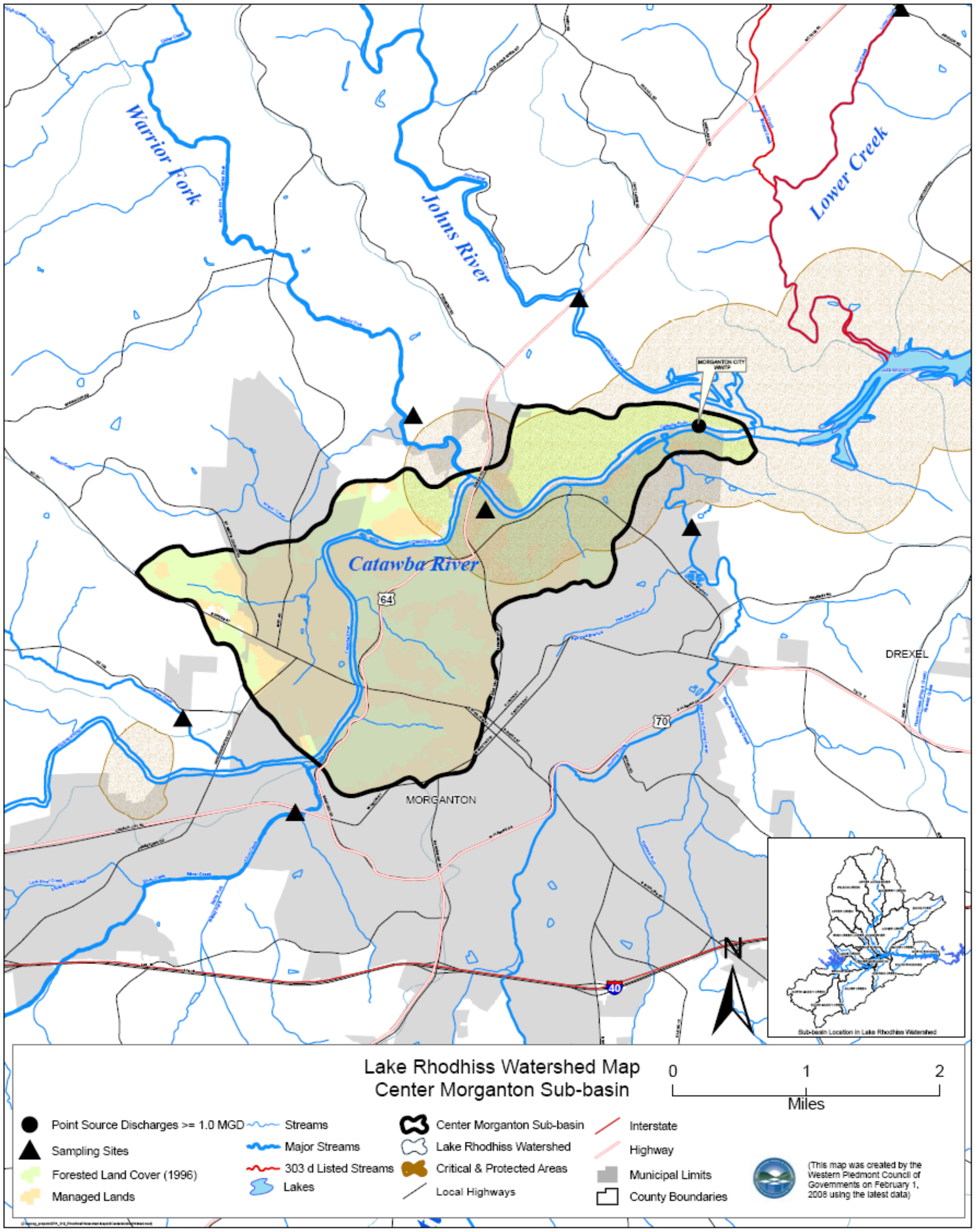
Land cover for the subwatershed has a higher percentage of developed land use than the other subwatersheds, and ranks highest among the other subwatersheds with respects to developed or impervious surface. The Center Morganton subwatershed ranks 4th among the other 19 subwatersheds with respects to agriculture.

Agricultural operations in the subwatershed include 30 acres of turf grass, one golf course (Quaker Meadows) located north of the River, one large sand dipping operation, 10 acres of corn 10 acres of hay, and 20 horses. The area also includes Fairgrounds, Freedom High School, and the Morganton Greenway.

There were 21 possible contamination sources and one facility with a National Point-source Discharge and Elimination System (NPDES) permit which is Morganton's wastewater treatment plant.

The Center Morganton subwatershed ranked 2nd among the 19 subwatersheds with respects to its phosphorus coefficient of 51 kg/km/yr, and 2nd with its nitrogen coefficient of 622 kg/km/yr.

Map B-3: Center Morganton Subwatershed



4. Hunting Creek Subwatershed

The Hunting Creek subwatershed is HUC Code 3050101060050, and is approximately 25.53 square miles. Within this subwatershed is a major portion of the City of Morganton. The Hunting Creek subwatershed is located entirely in Burke County.

Table B-4: Hunting Creek Subwatershed	
HUC Code:	3050101060050
County:	Burke
Municipalities:	Yes
Population (2000):	15319
Population Density (2000):	615/Sq.Mile
Acres:	16336.7
Square Miles:	25.53
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	117
P Exp Coefficient	41
N Exp Coefficient	544
% Impervious	13.3
% Agriculture	22.1
% Households Sewered	41.1
Land Use Percentages (1996)	
Forest:	64.1% (15.98sq.mi.)
Pasture/Open:	22.2% (5.54sq.mi.)
Water:	.2% (.04sq.mi.)
Cultivated:	.8% (.19sq.mi.)
Developed:	11.5% (2.87sq.mi.)
Other:	1.2% (.29sq.mi.)
Total Length of Streams:	47.94 Miles
Impaired Water Bodies:	No

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks 2nd among the other subwatersheds with respects to developed or impervious surface. The Hunting Creek subwatershed ranks 3rd among the other 19 subwatersheds with respect to agriculture.

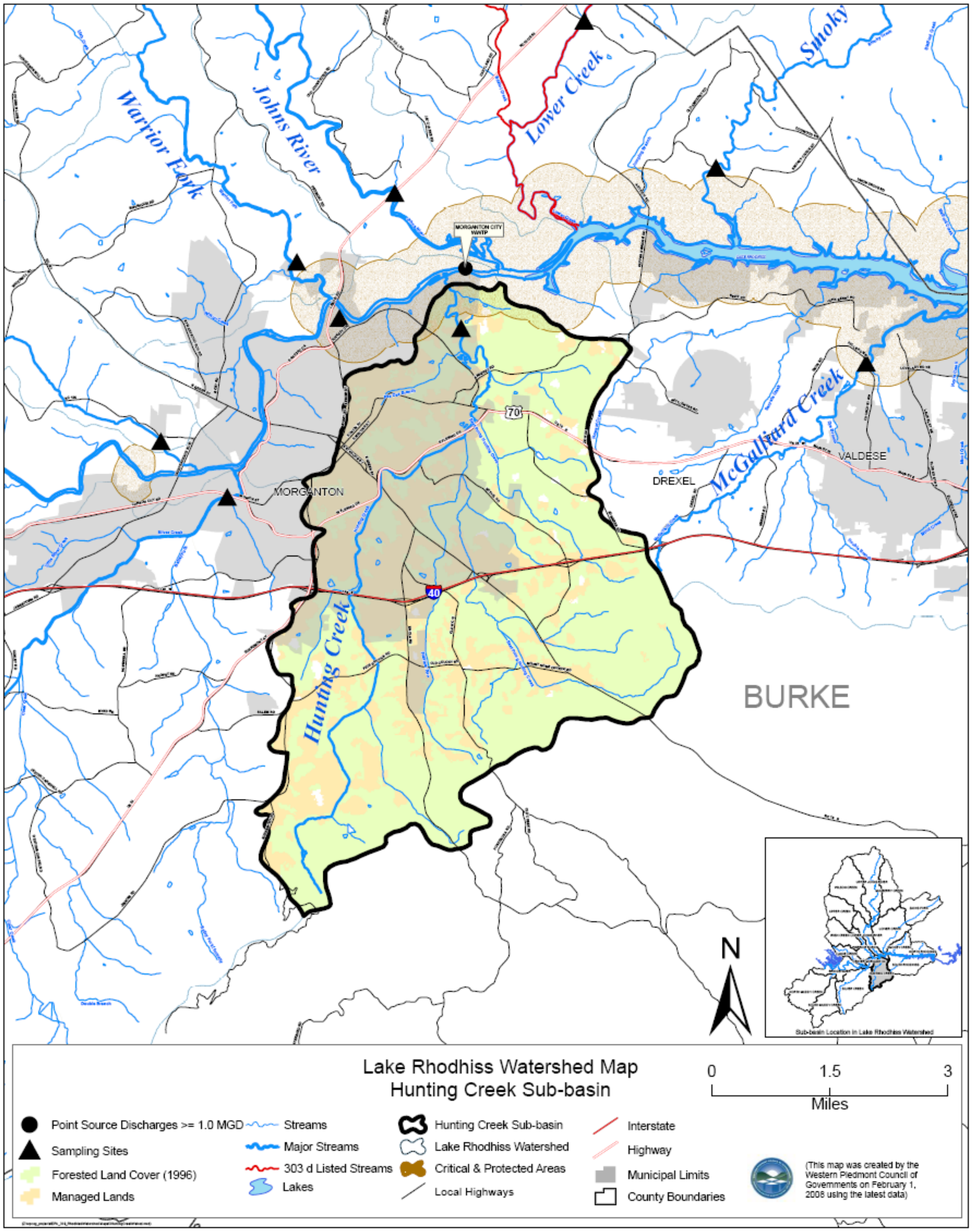
Agricultural operations in the subwatershed include two broilers with 65,000 birds, two medium horse operations both with compost facilities for wastes, 100 acres of grain crops, all no till, one dairy with 100 cattle and two waste storage ponds, 150 beef cattle, 200 horses, 400 acres of hay and pasture, two rock quarries. The subwatershed also contains a lot of state owned land, much of it vacant, as well as Bethel Park in Morganton, which is 20 acres.

According to Map A-3: New and Potential Subdivision Development, there were two developments of less than 100 units, and one development of 101 to 250 units at the time of that study.

There were 117 possible contamination sources and no facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Hunting Creek subwatershed ranked

4th among the 19 subwatersheds with respects to its phosphorus coefficient of 41 kg/km/yr, and 3rd with its nitrogen coefficient of 544 kg/km/yr.

Map B-4: Hunting Creek Subwatershed



5. Irish Creek Subwatershed

The Irish Creek subwatershed is HUC Code 3050101060030, and is approximately 34.39 square miles. There are no municipalities within the subwatershed. The Irish Creek subwatershed is located entirely in Burke County.

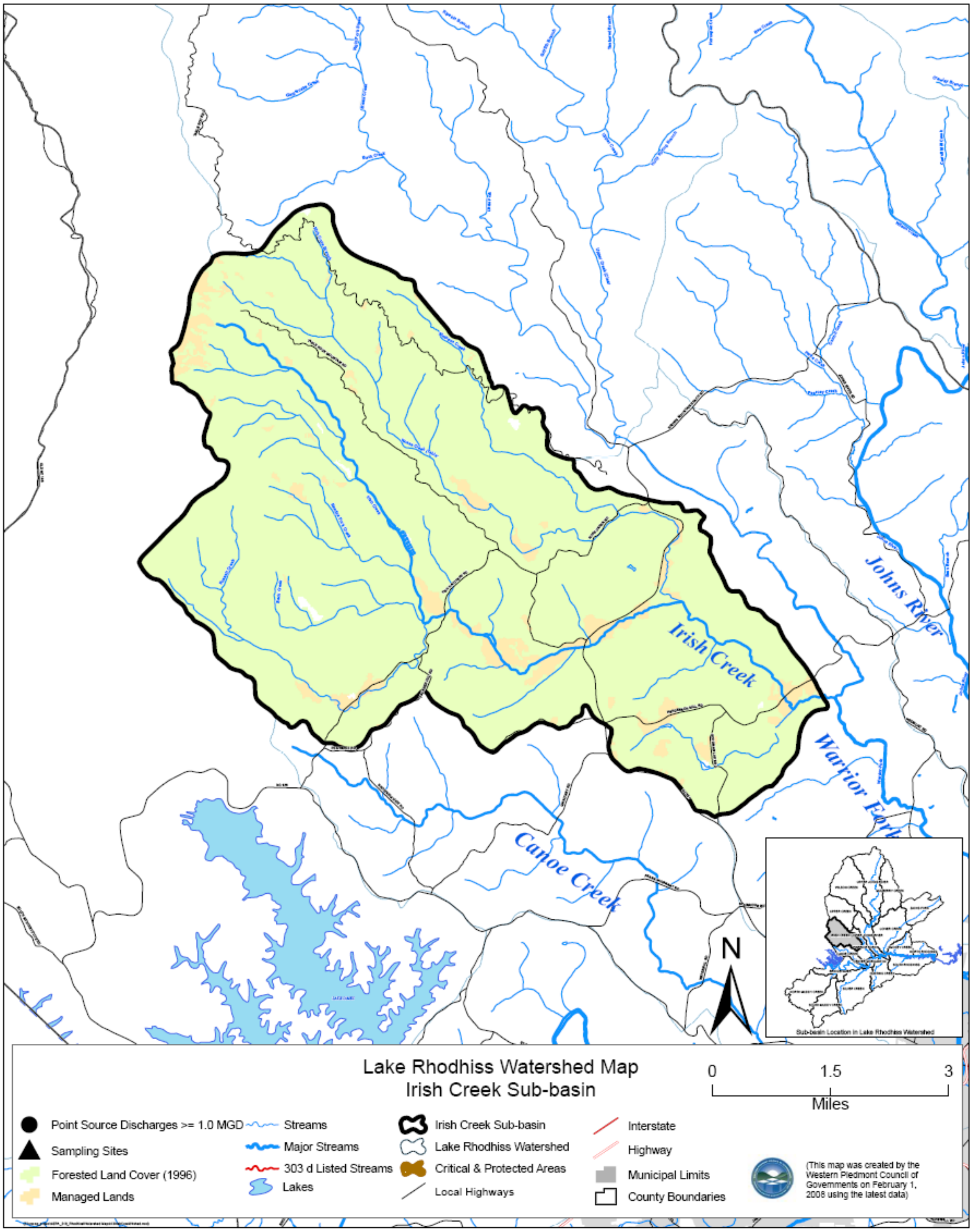
Table B-5: Irish Creek Subwatershed	
HUC Code:	3050101060030
County:	Caldwell
Municipalities:	No
Population (2000):	1485
Population Density (2000):	44/Sq.Mile
Acres:	22012.8
Square Miles:	34.39
Permitted Facilities:	1
NPDES WWTP:	0
Other NPDES Permits :	1
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	2
P Exp Coefficient	15
N Exp Coefficient	238
% Impervious	0.3
% Agriculture	5.7
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	94.1% (31.51sq.mi.)
Pasture/Open:	5.1% (1.72sq.mi.)
Water:	.1% (.03sq.mi.)
Cultivated:	.4% (.12sq.mi.)
Developed:	.0% (.01sq.mi.)
Other:	.3% (.09sq.mi.)
Total Length of Streams:	68.35 Miles
Impaired Water Bodies:	No

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks at a very low level among the other subwatersheds with respects to developed land use, as well as percentage of impervious surface and agriculture.

Agricultural operations in the subwatershed include 200 acres of ornamentals (with 30 acres located upland), 30 acres of grain crops (corn/wheat/sorghum), a little hay/pasture, and 100 cattle. The subwatershed also includes Table Rock Fish Hatchery, Table Rock Bottling Facility, and Rose Creek Campground.

There were only two possible contamination sources and one facility with a National Point-source Discharge and Elimination System (NPDES) permit. The Irish Creek subwatershed ranked 19th among the 19 subwatersheds with respects to its phosphorus coefficient of 15 kg/km/yr, and 14th with its nitrogen coefficient of 238 kg/km/yr.

Map B-5: Irish Creek Subwatershed



6. Lower Creek Subwatershed

The Lower Creek subwatershed is HUC Code 3050101080020, and is approximately 57.58 square miles. Within this subwatershed is the Town of Gamewell, and a portion of the City of Lenoir. The Lower Creek subwatershed is located in Burke County and Caldwell County.

Table B-6: Lower Creek Subwatershed	
HUC Code:	3050101080020
County:	Burke/Caldwell
Municipalities:	Yes
Population (2000):	13663
Population Density (2000):	243/Sq. Mile
Acres:	36853.8
Square Miles:	57.58
Permitted Facilities:	2
NPDES WWTP:	1 (Lenoir)
Other NPDES Permits :	1
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	39
P Exp Coefficient	37
N Exp Coefficient	423
% Impervious	3.5
% Agriculture	16
% Households Sewered	11.4
Land Use Percentages (1996)	
Forest:	80.7% (45.3sq.mi.)
Pasture/Open:	16% (8.97sq.mi.)
Water:	.1% (.05sq.mi.)
Cultivated:	.3% (.18sq.mi.)
Developed:	2.5% (1.42sq.mi.)
Other:	.4% (.25sq.mi.)
Total Length of Streams:	106.5
Impaired Water Bodies:	1 (Lower Creek)

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks around the middle level among the other subwatersheds with respects to developed land use. The Lower Creek subwatershed ties for seventh place among the other 19 subwatersheds with respect to both percentage of impervious surface and agriculture.

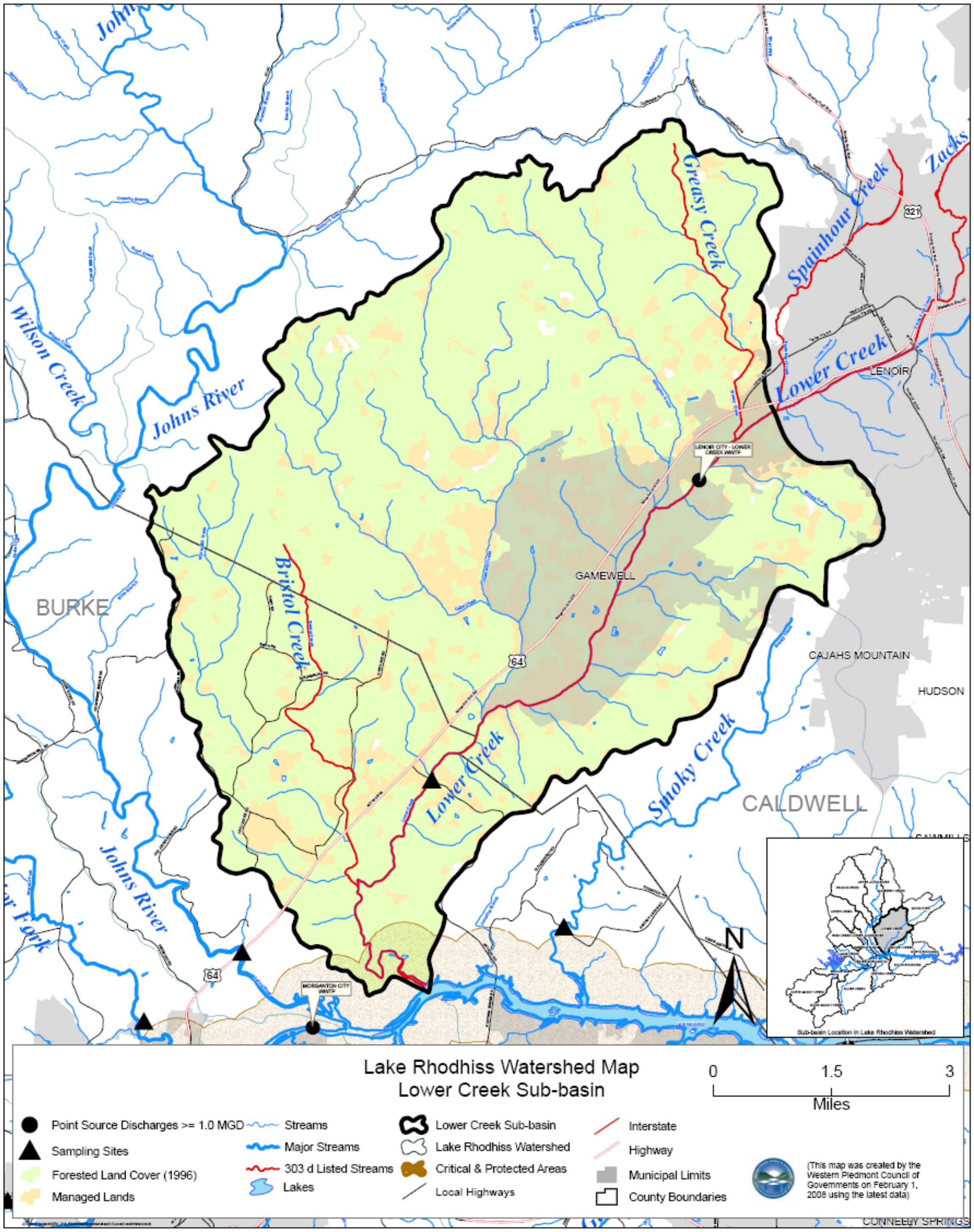
Agricultural operations in the subwatershed include one broiler with 20,000 birds, one dairy with 200 head and one waste storage pond, 200 acres of ornamentals 75% of which are located in the floodplain (shrubs and trees), 30 horse operations with 150 total horses which includes one large operation with 100 head, 100 acres of grain crops, one beef feedlot of 400 head located on 45 acres that has big problems with runoff, one quarry located along the bypass, three sand dipping operations, one golf course located near Husband Creek, and 400 acres of pasture/hay land. The subwatershed also includes Tuttle State Forest, which is 400-500 acres, Lenoir-Morganton Airport, Caldwell County Landfill, Antioch Speedway. The largest land disturbing activity is urban/suburban development. Also around 3,000 ft of Celia Creek, located in the subwatershed, has been channelized.

Current and Historical Conditions

According to Map A-3: New and Potential Subdivision Development, there was 1 development of less than 100 units, and one development of 101 to 250 units at the time of that study.

There were 39 possible contamination sources and two facilities with National Point-source Discharge and Elimination System (NPDES) permits. One of those facilities is Lenoir's wastewater treatment plant. The Lower Creek subwatershed ranked 6^{th} among the 19 subwatersheds with respects to its phosphorus coefficient of 37 kg/km/yr, and 9^{th} with its nitrogen coefficient of 423 kg/km/yr.

Map B-6: Lower Creek Subwatershed



7. Lower John's River Subwatershed

The Lower John's River subwatershed is HUC Code 3050101070040, and is approximately 26.88 square miles. There are no municipalities within the subwatershed. The Lower John's River subwatershed is located entirely in Burke County.

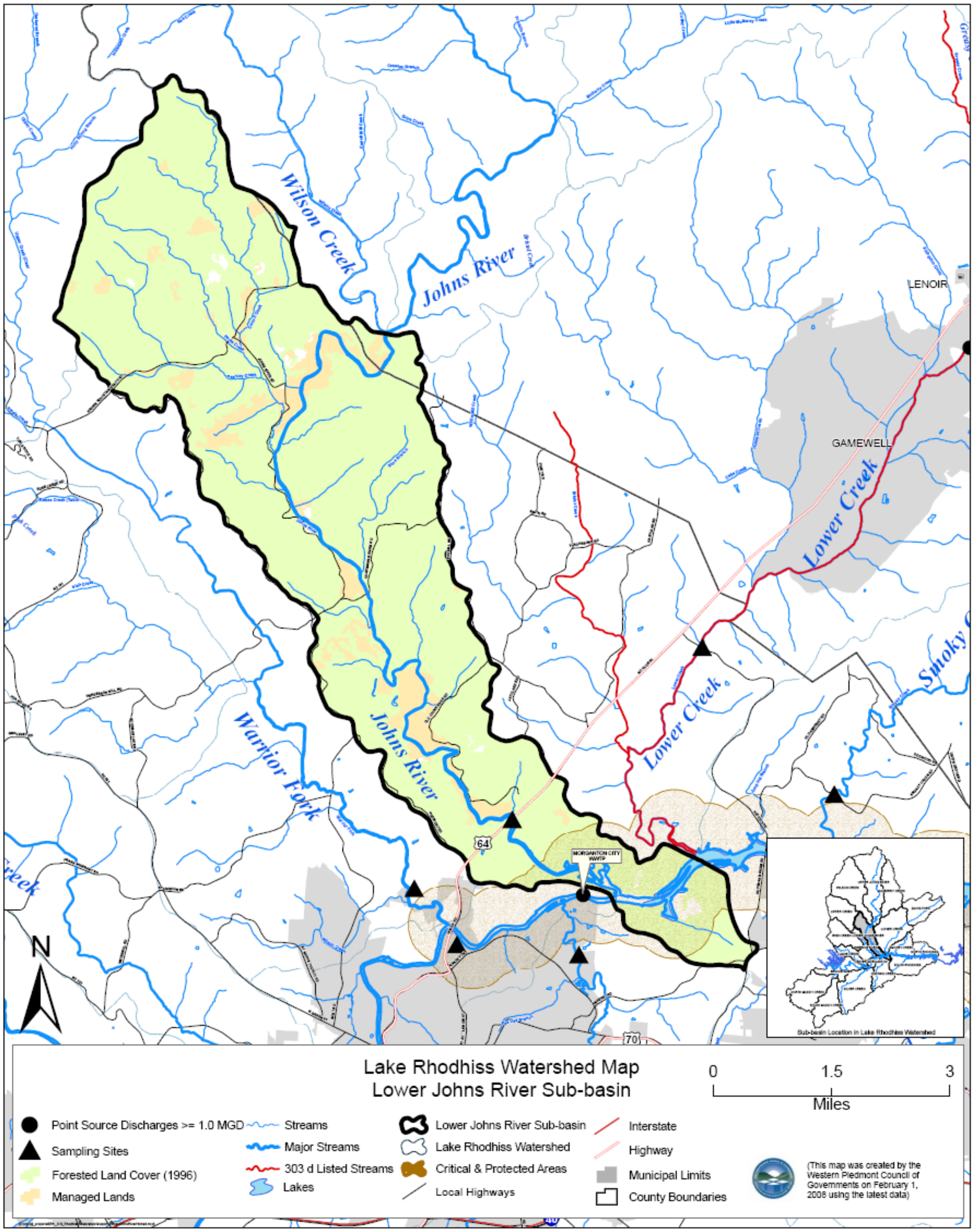
Table B-7: Lower John's River Subwatershed	
HUC Code:	3050101070040
County:	Burke/Caldwell
Municipalities:	No
Population (2000):	683
Population Density (2000):	26/Sq. Mile
Acres:	17205.5
Square Miles:	26.88
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	6
P Exp Coefficient	23
N Exp Coefficient	250
% Impervious	0.7
% Agriculture	8.3
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	89.7% (23.52sq.mi.)
Pasture/Open:	6.3% (1.65sq.mi.)
Water:	1% (.25sq.mi)
Cultivated:	2% (.53sq.mi)
Developed:	.3% (.07sq.mi.)
Other:	.8% (.21sq.mi.)
Total Length of Streams:	67.2 Miles
Impaired Water Bodies:	No

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks at a very low level among the other subwatersheds with respects to developed land use, as well as percentage of impervious surface and agriculture.

Agricultural operations in the subwatershed include Forest Service ATV trails located at the north end of the subwatershed, one broiler with 15,000 birds, two cattle farms with 180 total acres and 120 total beef cattle, 250 acres of pasture, 100 acres of ornamentals, and 100 acres of small grains that are primarily straight corn and conventionally tilled. Suburban development is occurring in the southern end of the Subwatershed.

There were six possible contamination sources and no facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Lower John's River subwatershed ranked 13th among the 19 subwatersheds with respects to its phosphorus coefficient of 23 kg/km/yr, and 16th with its nitrogen coefficient of 250 kg/km/yr.

Map B-7: Lower John's River Subwatershed



8. Mulberry Creek Subwatershed

The Mulberry Creek subwatershed is HUC Code 3050101070020, and is approximately 41.52 square miles. There are no municipalities within the subwatershed. The Mulberry Creek subwatershed is located entirely in Caldwell County.

Table B-8: Mulberry Creek Subwatershed	
HUC Code:	3050101070020
County:	Caldwell
Municipalities:	No
Population (2000):	1432
Population Density (2000):	36/Sq. Mile
Acres:	26571.6
Square Miles:	41.52
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	0
P Exp Coefficient	27
N Exp Coefficient	262
% Impervious	0.3
% Agriculture	4.7
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	95.9% (38.71sq.mi.)
Pasture/Open:	3.6% (1.45sq.mi.)
Water:	0% (0sq.mi.)
Cultivated:	.3% (.1sq.mi.)
Developed:	0% (.02sq.mi.)
Other:	.2% (.09sq.mi.)
Total Length of Streams:	98.92 Miles
Impaired Water Bodies:	No

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks at a very low level among the other subwatersheds with respects to developed land use, as well as percentage of impervious surface and agriculture.

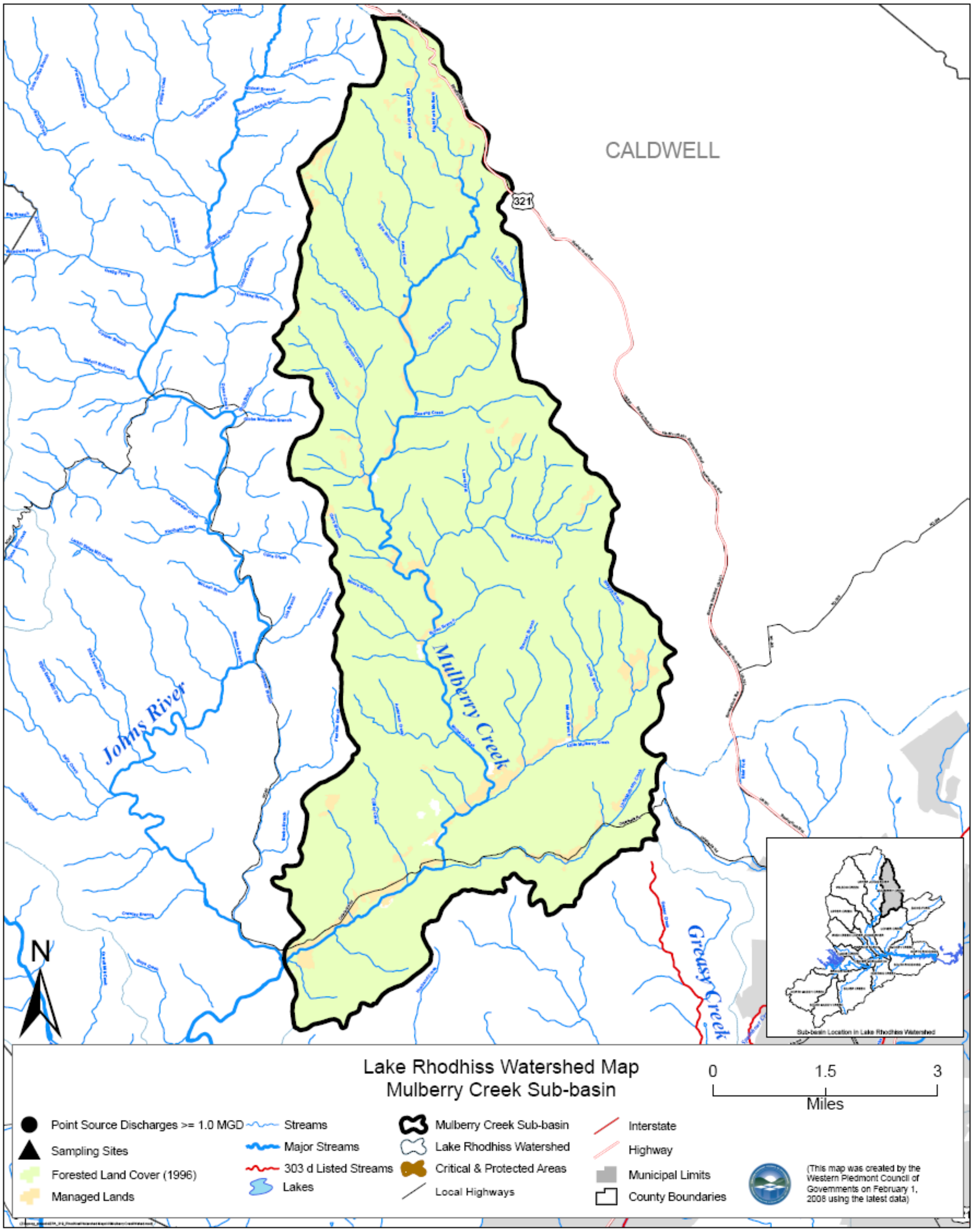
Agricultural operations in the subwatershed include one broiler with 40,000 birds, 300 acres of ornamentals all located within the floodplain, 30 acres of small grains, 100 cattle, 50 horses. The area also includes a 4-H Camp on Brown Branch Creek an active stream restoration project – 3,000 feet of restoration being supervised by the NC Wetlands Restoration Group. The area also includes part of 321 which was expanded to four-lanes in 2003.

According to Map A-3: New and Potential Subdivision Development, there were two developments of 101 to 250 units, and one development of 501 to 1,000 units at the time of that study.

There were no possible contamination sources and no facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Mulberry Creek subwatershed ranked

9th among the 19 subwatersheds with respects to its phosphorus coefficient of 27 kg/km/yr, and 13th with its nitrogen coefficient of 262 kg/km/yr.

Map B-8: Mulberry Creek Subwatershed



9. North Muddy Creek Subwatershed

The Lower Creek subwatershed is HUC Code 3050101080020, and is approximately 57.58 square miles. Within this subwatershed is the Town of Gamewell, and a portion of the City of Lenoir. The Lower Creek subwatershed is located in Burke County and Caldwell County.

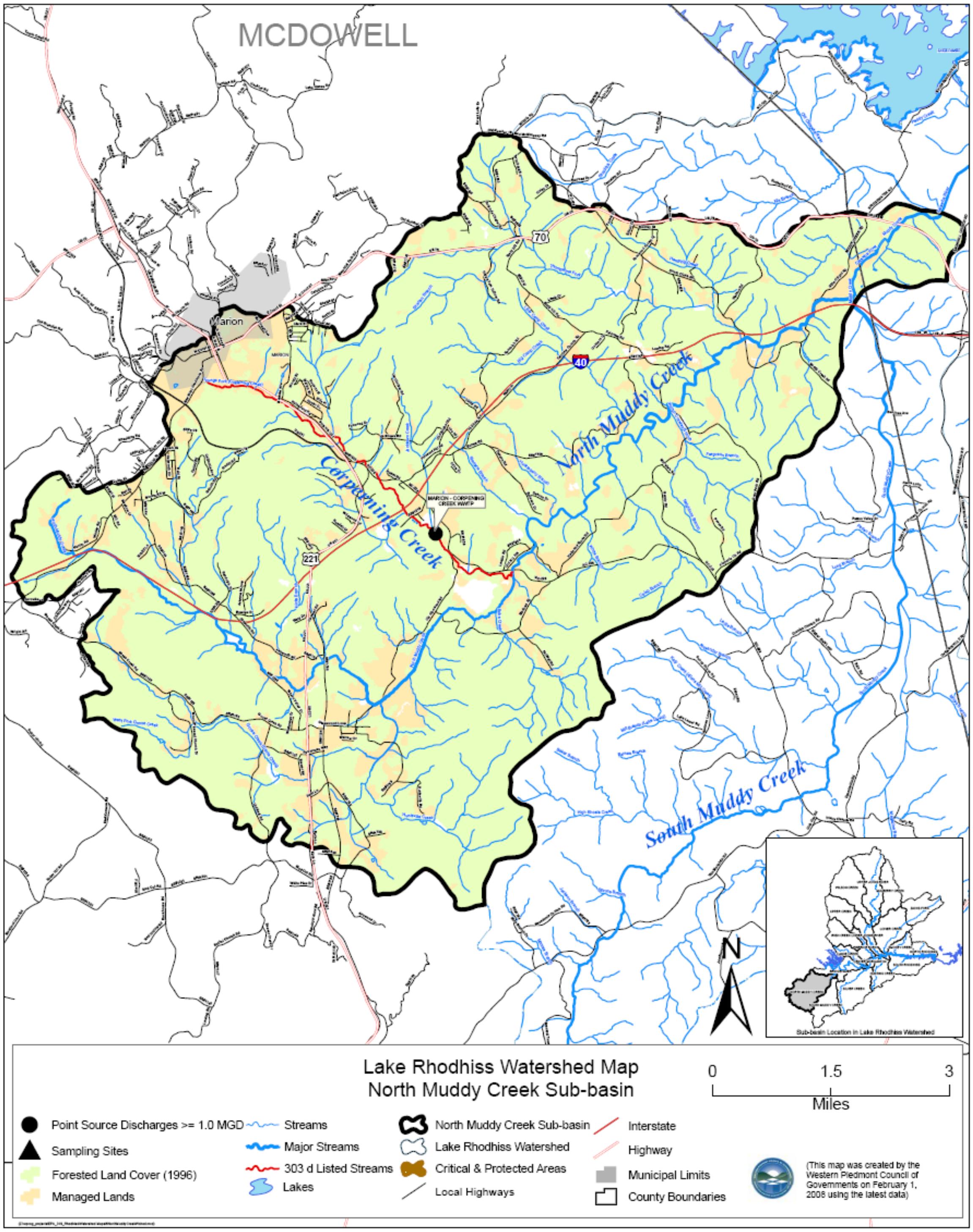
Table B-9: North Muddy Creek Subwatershed	
HUC Code:	3050101040010
County:	Burke/McDowell
Municipalities:	Yes
Population (2000):	12558
Population Density (2000):	220/Sq. Mile
Acres:	37513.2
Square Miles:	58.61
Permitted Facilities:	7
NPDES WWTP:	1 (Marion)
Other NPDES Permits :	6
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	73
P Exp Coefficient	26
N Exp Coefficient	369
% Impervious	3.3
% Agriculture	12.7
% Households Sewered	26.3
Land Use Percentages (1996)	
Forest:	83.5% (47.72sq.mi.)
Pasture/Open:	12.5% (7.14sq.mi.)
Water:	.3% (.15sq.mi.)
Cultivated:	.8% (.46sq.mi.)
Developed:	2.2% (1.24sq.mi.)
Other:	.8% (.43sq.mi.)
Total Length of Streams:	187.6 Miles
Impaired Water Bodies:	1 (Young's Fork)

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks around the middle level among the other subwatersheds with respects to developed land use. The Lower Creek subwatershed ties for seventh place among the other 19 subwatersheds with respect to both percentage of impervious surface and agriculture.

Agricultural operations in the subwatershed include Banner Greenhouses - 15-20 acres under roof, ornamentals and annuals grown and all potted, three poultry operations with broilers and pullets and 80,000 birds present at any one time, 100 acres of field grown ornamentals grown in the Glenwood area, and 100 acres of corn/grain. Most open land is pasture with less than 500 total cattle. Also included in the subwatershed are five flood control dams, a new industrial park located at NC 221, and one new quarry. Corpening Creek has problems related to the Corpening Creek WWTP (add info about project).

According to Map A-3: New and Potential Subdivision Development, there was one development of less than 100 units. There were 39 possible contamination sources and two facilities with National Point-source Discharge and Elimination System (NPDES) permits. One of those facilities is Lenoir's wastewater treatment plant. The Lower Creek subwatershed ranked 6th among the 19 subwatersheds with respects to its phosphorus coefficient of 37 kg/km/yr, and 9th with its nitrogen coefficient of 423 kg/km/yr.

Map B-9: North Muddy Creek Subwatershed



10. North Rhodhiss Subwatershed

The North Rhodhiss subwatershed is HUC Code 3050101100010, and is approximately 15.09 square miles. Within this subwatershed is a major portion of the Town of Sawmills, and a smaller portion of the Town of Granite Falls. The North Rhodhiss subwatershed is located entirely in Caldwell County.

Table B-10: North Rhodhiss Subwatershed	
HUC Code:	3050101100010
County:	Caldwell/Burke
Municipalities:	Yes
Population (2000):	8,186
Population Density (2000):	555/Sq. Mile
Acres:	9,647
Square Miles:	15.09
Permitted Facilities:	2
NPDES WWTP:	0
Other NPDES Permits :	2
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	17
P Exp Coefficient	61
N Exp Coefficient	668
% Impervious	8.8
% Agriculture	40.7
% Households Sewered	18.8
Land Use Percentages (1996)	
Forest:	47.5% (7sq.mi.)
Pasture/Open:	39.6% (5.8sq.mi.)
Water:	6.6% (.97sq.mi.)
Cultivated:	.1% (.02sq.mi.)
Developed:	5.6% (.83sq.mi.)
Other:	.6% (.09sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	No

Land cover for the subwatershed includes a higher percentage of developed land use than the other subwatersheds, and ranks 4th among the other subwatersheds with respects to developed or impervious surface. The North Rhodhiss subwatershed ranks 1st among the other 19 subwatersheds with respect to agriculture.

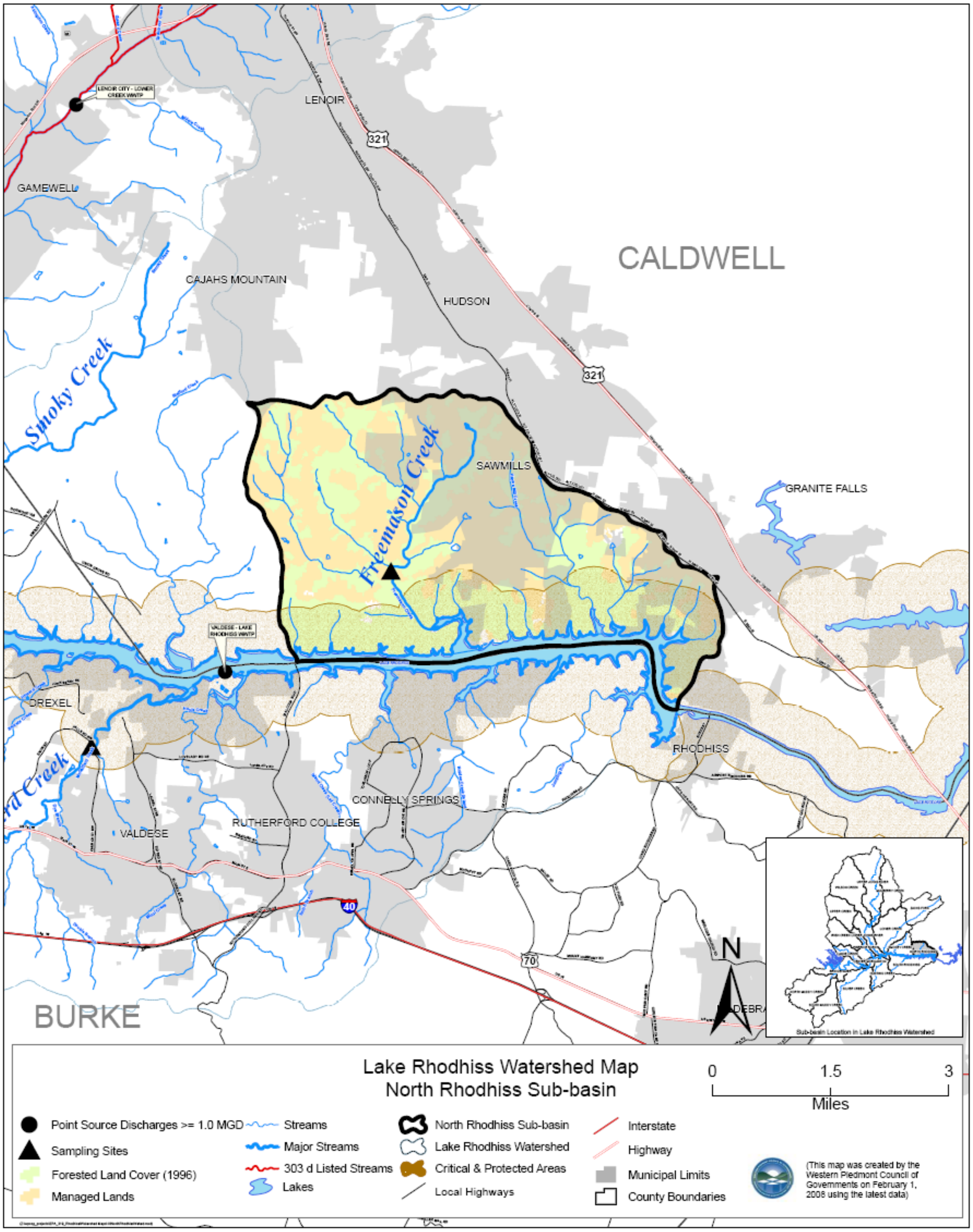
Agricultural operations in the subwatershed include 70 acres of grain crops – all upland, all no till, one dairy with 500 cattle, fairly well managed, one golf course, one paved racetrack (Tri County Speedway), 100 beef cattle, 50 horses, and 700 acres of hay and pasture.

According to Map A-3: New and Potential Subdivision Development, there was one development of less than 100 units, two developments of 101 to 250 units, and one development of 251-500 units at the time of that study.

There were 17 possible contamination sources and two facilities with National Point-source Discharge and Elimination System (NPDES) permits. The North Rhodhiss subwatershed ranked

1st among the 19 subwatersheds with respects to its phosphorus coefficient of 61 kg/km/yr, and 1st with its nitrogen coefficient of 668 kg/km/yr.

Map B-10: North Rhodhiss Subwatershed



11. Silver Creek Subwatershed

The Silver Creek subwatershed is HUC Code 3050101050050, and is approximately 60.92 square miles. Within this subwatershed is a portion of the City of Morganton and a major portion of the Town of Glen Alpine. The Silver Creek subwatershed is located entirely in Burke County.

Table B-11: Silver Creek Subwatershed	
HUC Code:	3050101050050
County:	Burke
Municipalities:	Yes
Population (2000):	14,656
Population Density (2000):	246/Sq. Mile
Acres:	38,989
Square Miles:	60.92
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	24
P Exp Coefficient	20
N Exp Coefficient	360
% Impervious	4.4
% Agriculture	17.7
% Households Sewered	25.7
Land Use Percentages (1996)	
Forest:	76.8% (45.66sq.mi.)
Pasture/Open:	17.6% (10.49sq.mi.)
Water:	.1% (.08sq.mi.)
Cultivated:	.8% (.47sq.mi.)
Developed:	3.1% (1.85sq.mi.)
Other:	1.6% (.93sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	No

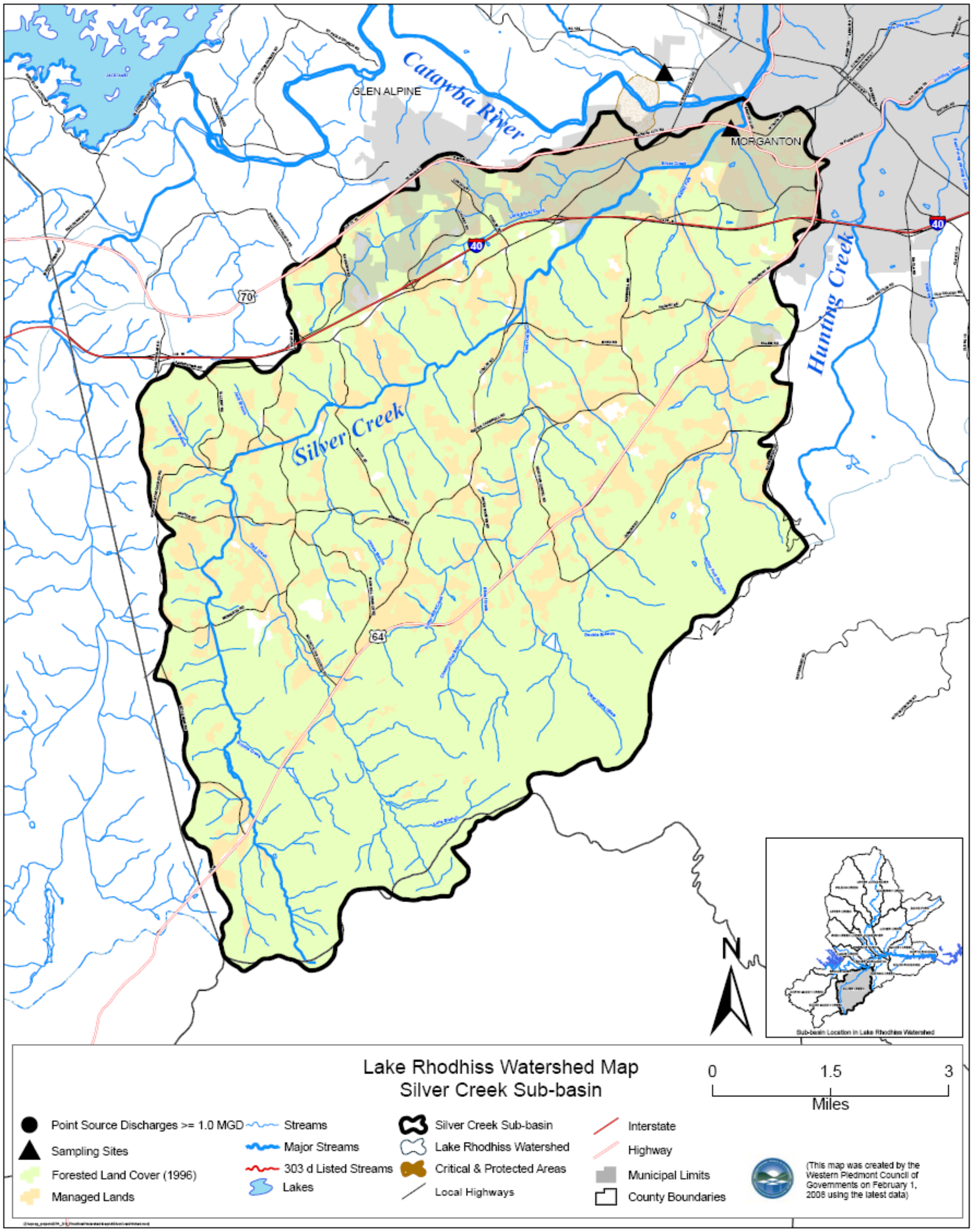
Land cover for the subwatershed is primarily forest and open space or pasture, and ranks 6th among the other subwatersheds with respect to developed land use. The Silver Creek subwatershed ranks 5th among the other 19 subwatersheds with respect to percentage of agriculture.

Agricultural operations in the subwatershed include one beef cattle feedlot, 100 acres of ornamentals - all located on within floodplains, 100 A of grain crops, located in floodplains and upland areas, nine broiler operations with 620,000 birds, most chicken wastes actually spread to land in the S. Muddy Creek watershed, one golf course, one Case Hatchery which hatches about 200,000 chicks per day, one hog operation with three waste storage ponds, no hogs being raised now, at least 500 beef cattle, most with access to streams, 600 acres of pasture, 600 acres of hay land, most ungrazed. The area also includes part of the Morganton Greenway.

According to Map A-3: New and Potential Subdivision Development, there were three developments of less than 100 units, and one development of 101 to 250 units at the time of that study.

There were 24 possible contamination sources and no facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Silver Creek subwatershed ranked 16th among the 19 subwatersheds with respects to its phosphorus coefficient of 20 kg/km/yr, and 10th with its nitrogen coefficient of 360 kg/km/yr.

Map B-11: Silver Creek Subwatershed



12. Smokey Creek Subwatershed

The Smokey Creek subwatershed is HUC Code 3050101080030, and is approximately 21.01 square miles. Within this subwatershed is a portion of the Town of Cajahs Mountain. The Smokey Creek subwatershed is located in Burke County and Caldwell County.

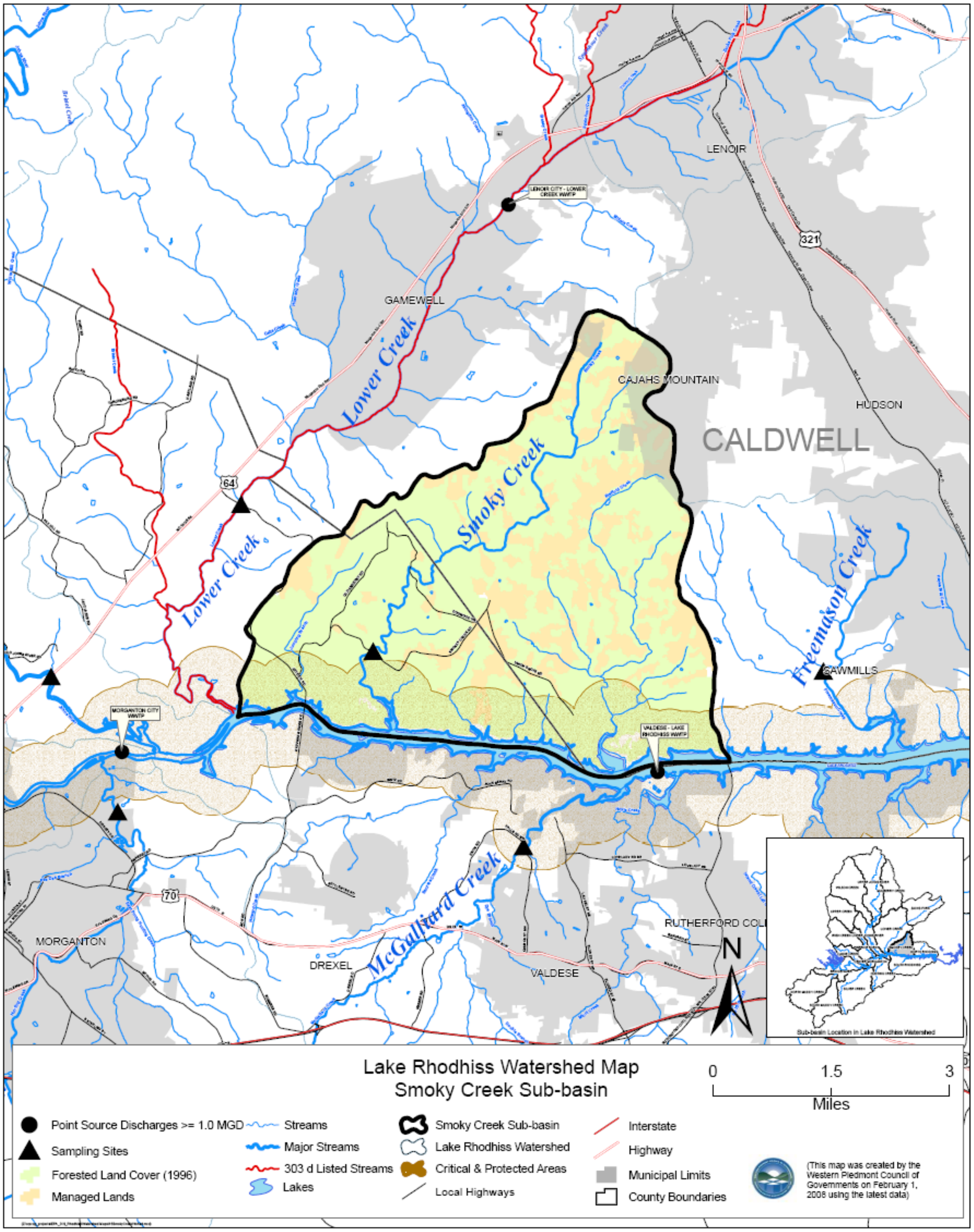
Table B-12: Smokey Creek Subwatershed	
HUC Code:	3050101080030
County:	Caldwell
Municipalities:	Yes
Population (2000):	6,097
Population Density (2000):	182/Sq. Mile
Acres:	13,446
Square Miles:	21.01
Permitted Facilities:	1
NPDES WWTP:	0
Other NPDES Permits :	1
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	11
P Exp Coefficient	37
N Exp Coefficient	461
% Impervious	2.4
% Agriculture	22.7
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	63% (21.14sq.mi.)
Pasture/Open:	24% (8.08sq.mi.)
Water:	12.3% (4.12sq.mi.)
Cultivated:	0% (.02sq.mi.)
Developed:	.4% (.15sq.mi.)
Other:	.3% (.09sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	No

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks around the middle level among the other subwatersheds with respects to developed land use. The Smokey Creek subwatershed ranks 2nd with respect to percentage of agriculture.

Agricultural operations in the subwatershed include one pullet operation with about 40,000 birds, 200 acres of grassland, 200 cattle, and 50 horses. The area has little or no floodplain.

There were 11 possible contamination sources and one facility with a National Point-source Discharge and Elimination System (NPDES) permit. The Smokey Creek subwatershed ranked 7th among the 19 subwatersheds with respects to its phosphorus coefficient of 37 kg/km/yr, and 5th with its nitrogen coefficient of 461 kg/km/yr.

Map B-12: Smokey Creek Subwatershed



13. South Muddy Creek Subwatershed

The South Muddy Creek subwatershed is HUC Code 3050101040020, and is approximately 40.04 square miles. Within this subwatershed is a portion of the Town of Marion. The South Muddy Creek subwatershed is located entirely in almost entirely in McDowell County, with a small portion in Burke County.

Table B-13: South Muddy Creek Subwatershed	
HUC Code:	3050101040020
County:	McDowell/Burke
Municipalities:	No
Population (2000):	2,850
Population Density (2000):	73/Sq. Mile
Acres:	25,624
Square Miles:	40.04
Permitted Facilities:	2
NPDES WWTP:	0
Other NPDES Permits :	2
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	7
P Exp Coefficient	19
N Exp Coefficient	262
% Impervious	0.6
% Agriculture	15.1
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	83.2% (32.52sq.mi.)
Pasture/Open:	13.8% (5.38sq.mi.)
Water:	.5% (.21sq.mi.)
Cultivated:	1.5% (.58sq.mi.)
Developed:	.4% (.14sq.mi.)
Other:	.7%(.27sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	No

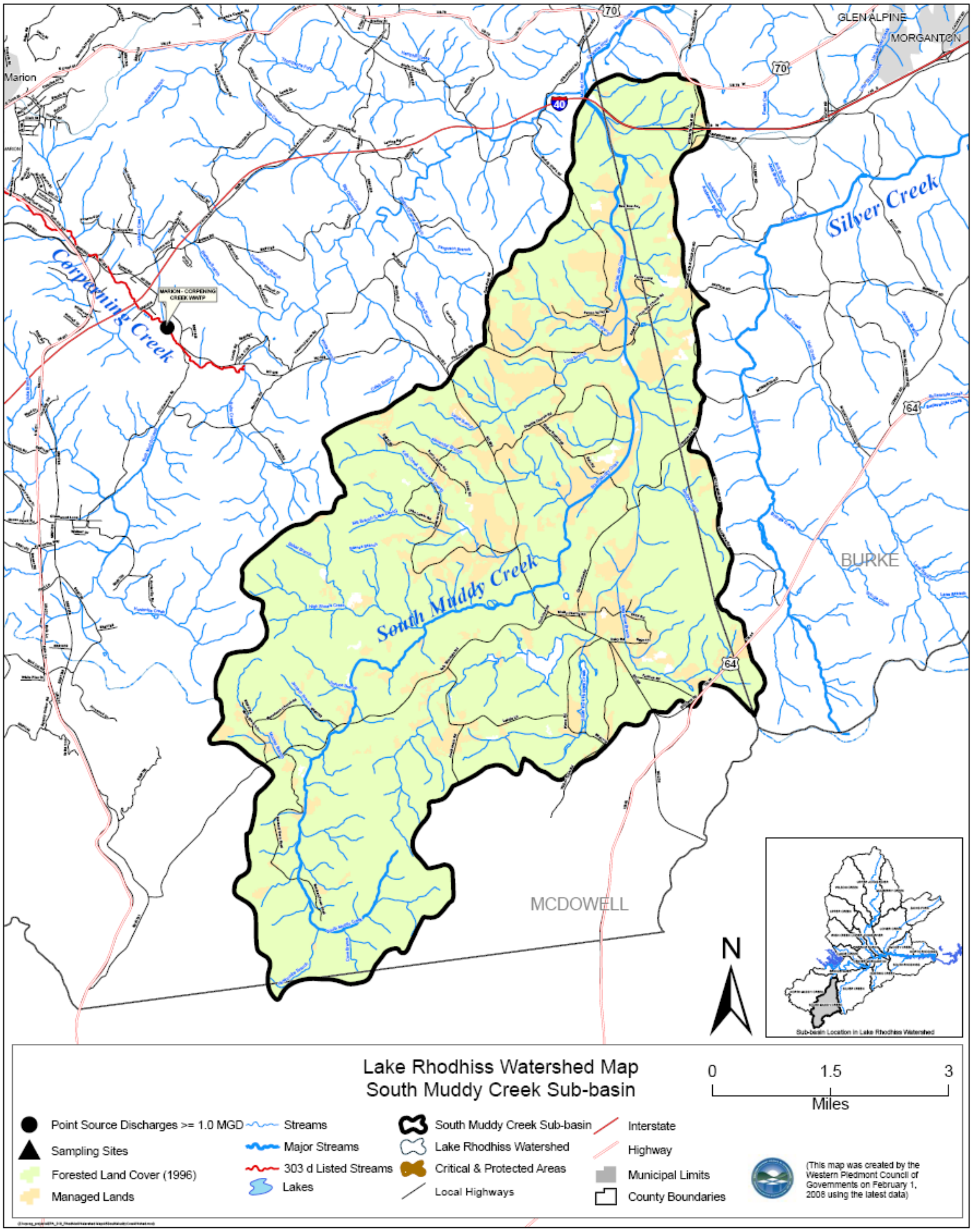
Land cover for the subwatershed is primarily forest and open space or pasture, and ranks low among the other subwatersheds with respects to developed land use. The South Muddy Creek subwatershed ranks 9th among the other 19 subwatersheds with respect to percentage of agriculture.

Agricultural operations in the subwatershed include one dairy with 200 animals, 300 acres of corn (mostly) and beans, 5 acres of rice, 300 beef cattle present, six poultry producers with 320,000 birds collectively present at a given time, and limited ornamentals composed of 10-20 acres of field grown shrubs. The rest of the open land is pasture and hay, and the majority of the hay land is grazed. Some lands are heavily fertilized from animal wastes, particularly chicken, and most agriculture is concentrated along creek bottoms. Also present in the area are four flood control dams, privately owned, constructed in the 1960s and 1970s with construction money from NRCS, and a Mecklenburg Scout Camp that is about 1,000 acres in size. The South Muddy channel has been straightened in several places probably dating back to the 1940s, why and by who is unknown.

According to Map A-3: New and Potential Subdivision Development, there was one development of less than 100 units, one development of 101 to 250 units, and one development of more than 1,000 units at the time of that study.

There were seven possible contamination sources and two facilities with National Point-source Discharge and Elimination System (NPDES) permits. The South Muddy Creek subwatershed ranked 18^{th} among the 19 subwatersheds with respects to its phosphorus coefficient of 19 kg/km/yr, and 15^{th} with its nitrogen coefficient of 262 kg/km/yr.

Map B-13: South Muddy Creek Subwatershed



14. South Rhodhiss Subwatershed

The South Rhodhiss subwatershed is HUC Code 3050101090010, and is approximately 38.03 square miles. Within this subwatershed are the towns of Connelly Springs, Drexel, Rutherford College, and Valdese. The South Rhodhiss subwatershed is located in entirely in Burke County.

Table B-14: South Rhodhiss Creek Subwatershed	
HUC Code:	3050101090010
County:	Burke
Municipalities:	Yes
Population (2000):	16,227
Population Density (2000):	522/Sq. Mile
Acres:	24,338
Square Miles:	38.03
Permitted Facilities:	1
NPDES WWTP:	1 (Valdese)
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	71
P Exp Coefficient	36
N Exp Coefficient	485
% Impervious	8.2
% Agriculture	12.6
% Households Sewered	35.6
Land Use Percentages (1996)	
Forest:	89.2% (27.71sq.mi.)
Pasture/Open:	0% (.02sq.mi.)
Water:	1.2% (.36sq.mi.)
Cultivated:	.2% (.06sq.mi.)
Developed:	7.6% (2.35sq.mi.)
Other:	1.8% (.56sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	No

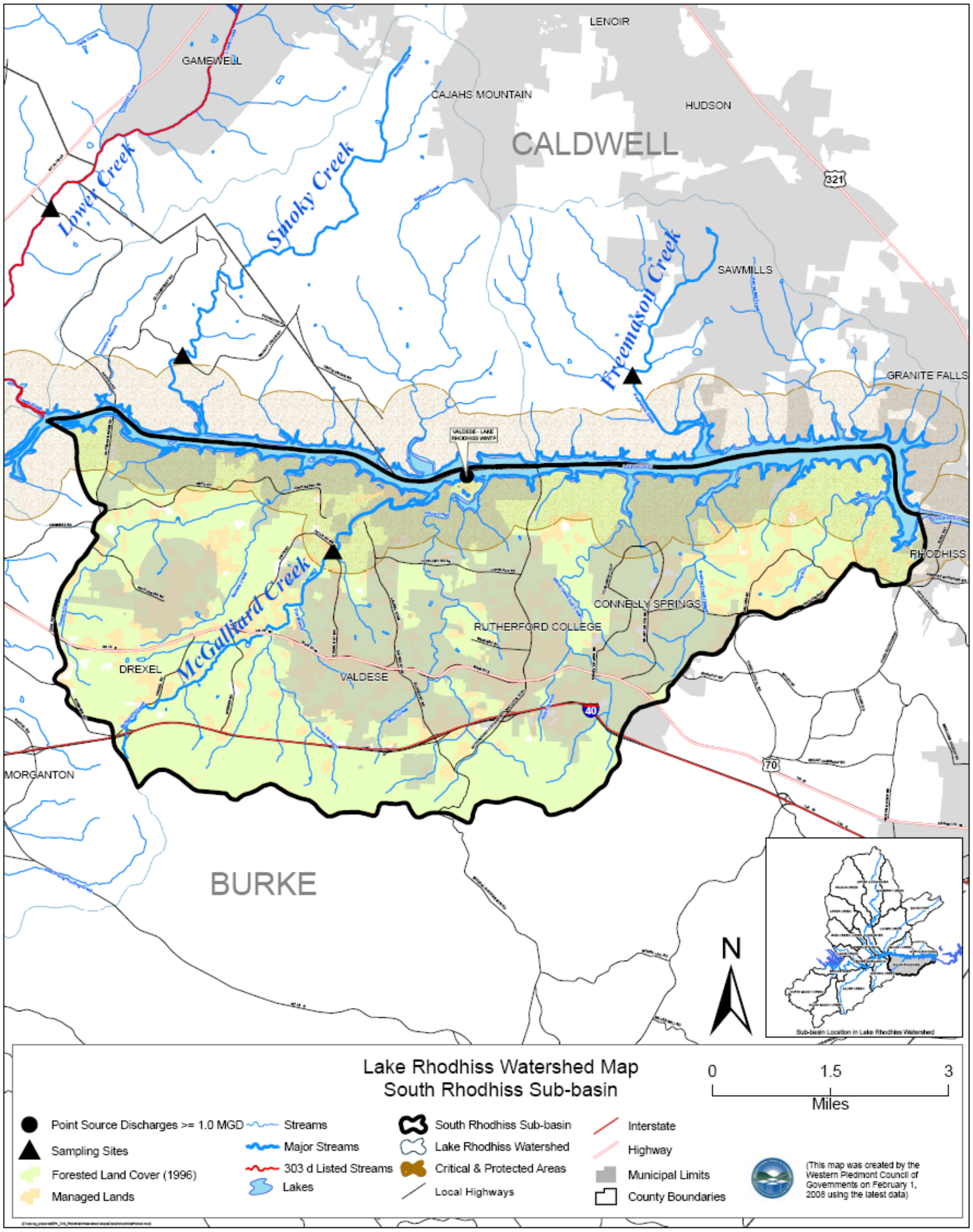
Land cover for the subwatershed is primarily forest and open space or pasture, and ranks 5thamong the other subwatersheds with respects to developed land use. The South Rhodhiss subwatershed ranks low among the other subwatersheds with respect to its percentage of agriculture.

Agricultural operations in the subwatershed include one broiler with 17,000 birds, 100 acres of grain crops which are all upland and all no till, one 5 acre container ornamental operation, 50 beef cattle, 100 horses, 400 acres of pasture and hay land.

According to Map A-3: New and Potential Subdivision Development, there was one development of 501 to 1,000 units at the time of that study.

There were 71 possible contamination sources and one facility with a National Point-source Discharge and Elimination System (NPDES) permit which is the Town of Valdese Wastewater Treatment Plant which serves multiple municipalities in the area. The South Rhodhiss subwatershed ranked 8th among the 19 subwatersheds with respects to its phosphorus coefficient of 36 kg/km/yr, and 4th with its nitrogen coefficient of 485 kg/km/yr.

Map B-14: South Rhodhiss Creek Subwatershed



15. Upper Creek Subwatershed

The Upper Creek subwatershed is HUC Code 3050101060010, and is approximately 37.04 square miles. There are no municipalities within the subwatershed. The Upper Creek subwatershed is located entirely in Burke County.

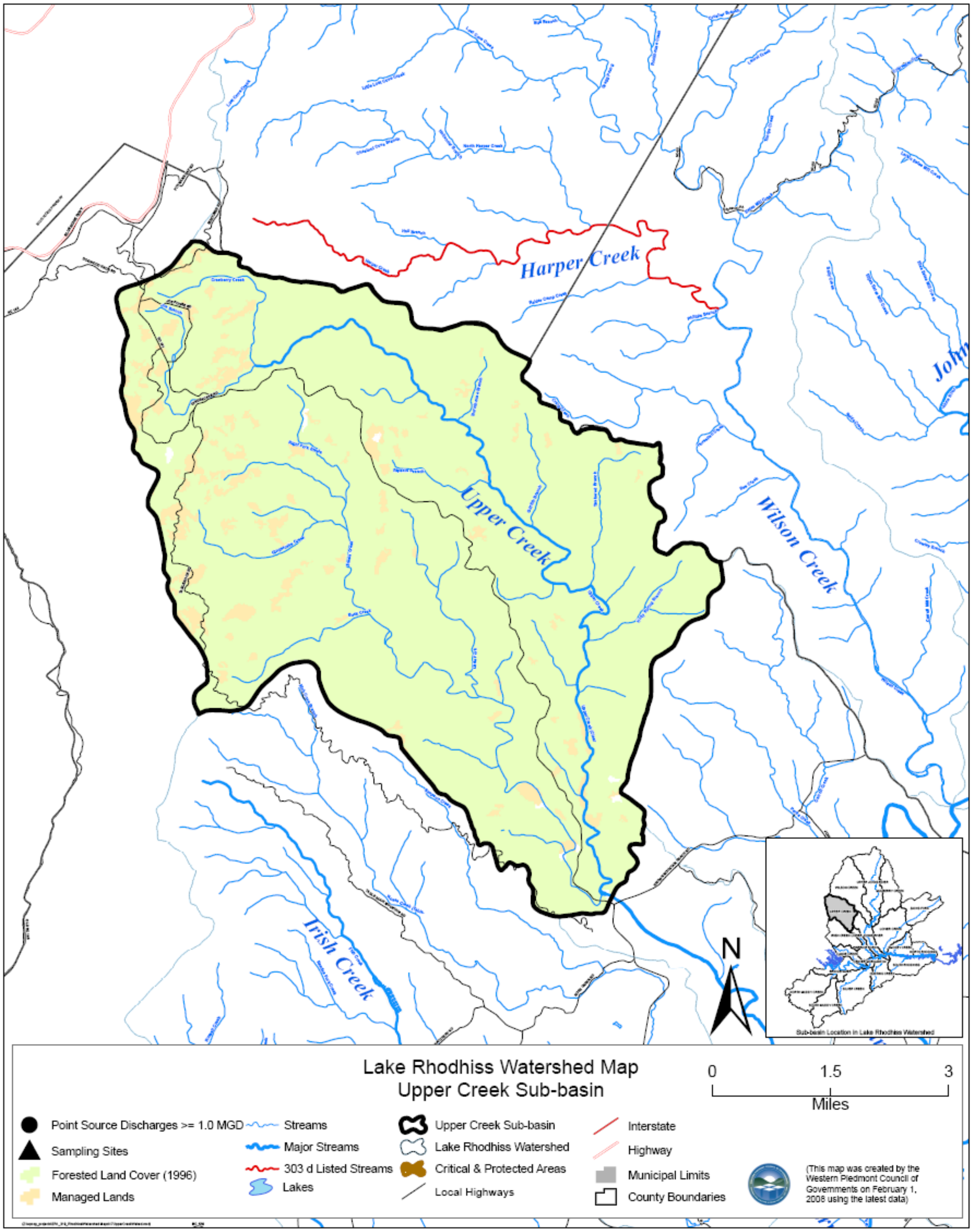
Table B-15: Upper Creek Subwatershed	
HUC Code:	3050101060010
County:	Burke
Municipalities:	No
Population (2000):	299
Population Density (2000):	8/Sq. Mile
Acres:	23,707
Square Miles:	37.04
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	1
P Exp Coefficient	23
N Exp Coefficient	241
% Impervious	>0.1
% Agriculture	5.6
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	94.2% (33.95sq.mi.)
Pasture/Open:	5.3% (1.91sq.mi.)
Water:	.1% (.02sq.mi.)
Cultivated:	.2% (.07sq.mi.)
Developed:	0% (.02sq.mi.)
Other:	.2% (.07sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	No

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks at a very low level among the other subwatersheds with respects to developed land use, as well as percentage of impervious surface and agriculture.

Agricultural operations in the subwatershed include 20 acres of small grains, 20 acres of ornamentals (10 acres of these are Christmas Trees), three campgrounds. The area contains no pasture.

There was only one possible contamination source and no facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Upper Creek subwatershed ranked 19th among the 19 subwatersheds with respects to its phosphorus coefficient of 23 kg/km/yr, and 14th with its nitrogen coefficient of 241 kg/km/yr.

Map B-15: Upper Creek Subwatershed



16. Upper Johns River Subwatershed

The Upper Johns River subwatershed is HUC Code 3050101070010, and is approximately 74.05 square miles. A small portion of the Town of Blowing Rock is in this subwatershed. The Upper Johns River subwatershed is located almost entirely in Caldwell County with small sections of Avery and blah Counties.

Table B-16: Upper Johns River Subwatershed	
HUC Code:	3050101070010
County:	Caldwell
Municipalities:	Yes
Population (2000):	1,437
Population Density (2000):	20/Sq. Mile
Acres:	47,389
Square Miles:	74.05
Permitted Facilities:	2
NPDES WWTP:	0
Other NPDES Permits :	2
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	11
P Exp Coefficient	20
N Exp Coefficient	233
% Impervious	0.2
% Agriculture	1.6
% Households Sewered	0.0
Land Use Percentages (1996)	98% (70.76sq.mi.)
Forest:	1.4% (1.01sq.mi.)
Pasture/Open:	0% (.01sq.mi.)
Water:	.2% (.15sq.mi.)
Cultivated:	.1% (.1sq.mi.)
Developed:	.3% (.21sq.mi.)
Other:	
Total Length of Streams:	
Impaired Water Bodies:	No

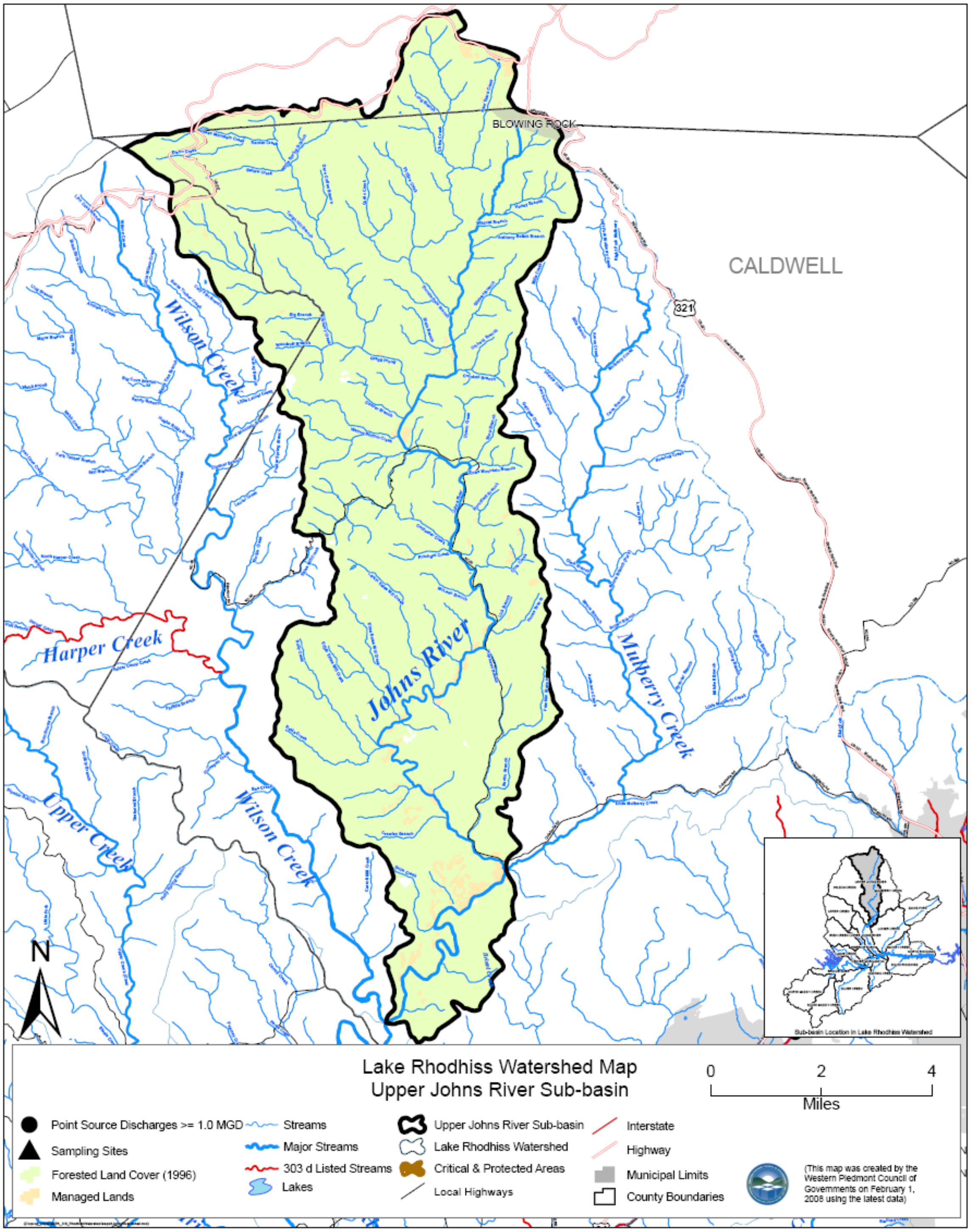
Land cover for the subwatershed is primarily forest and open space or pasture, and ranks at a very low level among the other subwatersheds with respects to developed land use, as well as percentage of impervious surface and agriculture.

Agricultural operations in the subwatershed include 300 acres of ornamentals.

According to Map A-3: New and Potential Subdivision Development, there was one development of less than 100 units at the time of that study.

There were only 11 possible contamination sources and two facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Upper Johns River subwatershed ranked 17th among the 19 subwatersheds with respects to its Phosphorus coefficient of 20 kg/km/yr, and 19th with its nitrogen coefficient of 233 kg/km/yr.

Map B-16: Upper Johns River Subwatershed



17. Warrior Fork Subwatershed

The Warrior Fork subwatershed is HUC Code 3050101060020, and is approximately 15.62 square miles. Within this subwatershed is a portion of the Town of Cajahs Mountain. The Smokey Creek subwatershed is located in Burke County and Caldwell County.

Table B-17: Warrior Fork Subwatershed	
HUC Code:	3050101060020
County:	Burke
Municipalities:	Yes
Population (2000):	2,810
Population Density (2000):	184/Sq. Mile
Acres:	9,997
Square Miles:	15.62
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	5
P Exp Coefficient	41
N Exp Coefficient	364
% Impervious	0.8
% Agriculture	16.4
% Households Sewered	26.0
Land Use Percentages (1996)	
Forest:	82% (12.5sq.mi.)
Pasture/Open:	12.4% (1.88sq.mi.)
Water:	.1% (.01sq.mi.)
Cultivated:	4.1% (.62sq.mi.)
Developed:	.3% (.05 sq.mi.)
Other:	1.2% (.19sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	No

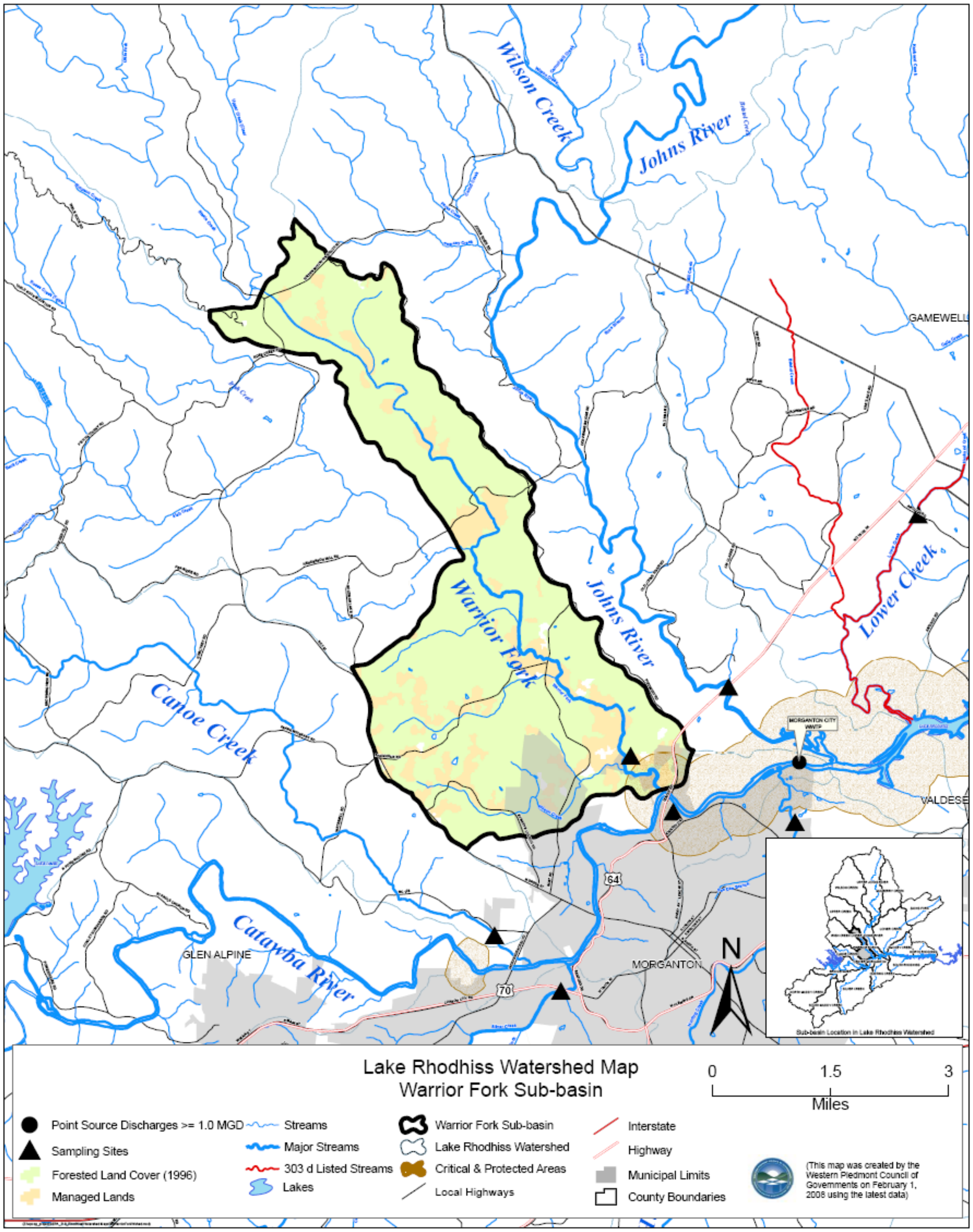
Land cover for the subwatershed is primarily forest and open space or pasture, and ranks low among the other subwatersheds with respect to developed land use. The Warrior Fork Subwatershed ranks 6th among the other subwatersheds with respect to it's percentage of agriculture.

Agricultural operations in the subwatershed include 80 acres of turf farm, 300 acres of ornamentals, 100 acres of small grains which are primarily corn, one broiler operation with 20,000 birds, as well limited horses and cattle

According to Map A-3: New and Potential Subdivision Development, there was one development of less than 100 units at the time of that study.

There were 5 possible contamination sources and no facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Warrior Fork subwatershed ranked 5th among the 19 subwatersheds with respects to its phosphorus coefficient of 41 kg/km/yr, and 9th with its nitrogen coefficient of 364 kg/km/yr.

Map B-17: Warrior Fork Subwatershed



18. Wilson Creek Subwatershed

The Wilson Creek subwatershed is HUC Code 3050101070030, and is approximately 69.05 square miles. There are no municipalities in this subwatershed. The Wilson Creek subwatershed is located almost entirely in Caldwell County with small sections of Avery and blah Counties.

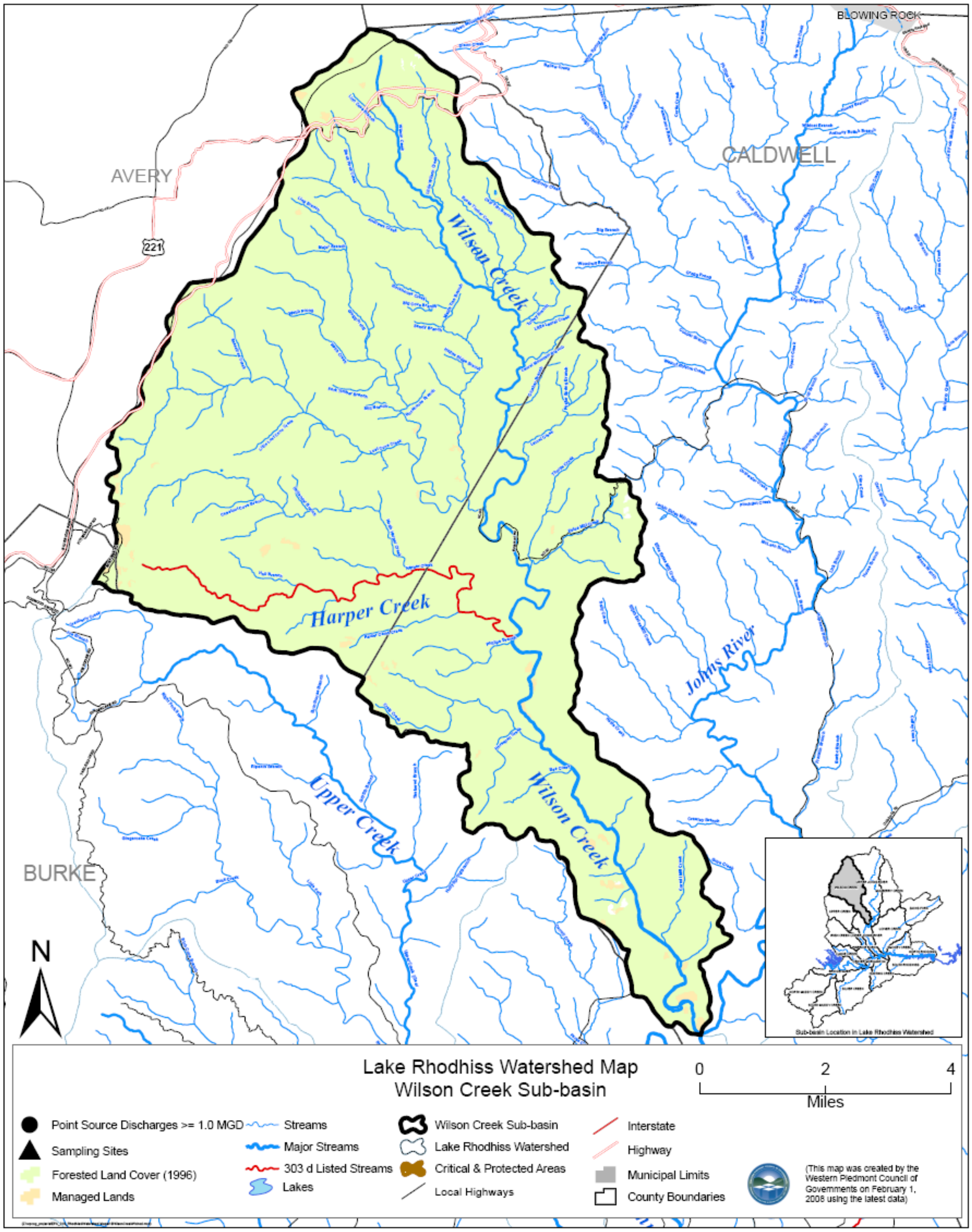
Table B-18: Wilson Creek Subwatershed	
HUC Code:	3050101070030
County:	Caldwell
Municipalities:	No
Population (2000):	700
Population Density (2000):	10/Sq. Mile
Acres:	44,189
Square Miles:	69.05
Permitted Facilities:	0
NPDES WWTP:	0
Other NPDES Permits :	0
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	0
P Exp Coefficient	24
N Exp Coefficient	240
% Impervious	0.1
% Agriculture	0.8
% Households Sewered	0.0
Land Use Percentages (1996)	
Forest:	99% (66.65sq.mi.)
Pasture/Open:	.8% (.55sq.mi.)
Water:	0% (.02sq.mi.)
Cultivated:	0% (.03sq.mi.)
Developed:	0% (.01sq.mi.)
Other:	.1% (.07sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	1 (Harper Creek)

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks at a very low level among the other subwatersheds with respects to developed land use, as well as percentage of impervious surface and agriculture.

Agricultural operations in the subwatershed include 40 acres of ornamentals, 20 acres of pasture, and very few horses.

There were no possible contamination sources and no facilities with National Point-source Discharge and Elimination System (NPDES) permits. The Wilson Creek subwatershed ranked 11th among the 19 subwatersheds with respects to its phosphorus coefficient of 24 kg/km/yr, and 18th with its nitrogen coefficient of 240 kg/km/yr.

Map B-18: Wilson Creek Subwatershed



19. Zacks Fork Subwatershed

The Zacks Fork subwatershed is HUC Code 3050101060050, and is approximately 25.53 square miles. Within this subwatershed is a major portion of the City of Lenoir, as well as the Town of Cedar Rock. The Zacks Fork subwatershed is located entirely in Caldwell County.

Table B-19: Zacks Fork Subwatershed	
HUC Code:	3050101080010
County:	Caldwell
Municipalities:	Yes
Population (2000):	16,256
Population Density (2000):	410/Sq. Mile
Acres:	25,978
Square Miles:	40.59
Permitted Facilities:	1
NPDES WWTP:	0
Other NPDES Permits :	1
NPDES Stormwater:	
Registered Animal Operations:	
Possible Contamination Sources:	137
P Exp Coefficient	48
N Exp Coefficient	394
% Impervious	11.8
% Agriculture	12.8
% Households Sewered	83.4
Land Use Percentages (1996)	
Forest:	75% (29.71sq.mi.)
Pasture/Open:	13% (5.15sq.mi.)
Water:	.1% (.05sq.mi.)
Cultivated:	.4% (.15sq.mi.)
Developed:	10.8% (4.27sq.mi.)
Other:	.7% (.3sq.mi.)
Total Length of Streams:	
Impaired Water Bodies:	2 (Spainhour, Zacks)

Land cover for the subwatershed is primarily forest and open space or pasture, and ranks 3rd among the other subwatersheds with respects to developed or impervious surface. The Zacks Fork subwatershed ranks 10th among the other 19 subwatersheds with respect to its percentage of agriculture.

Agricultural operations in the subwatershed include 75 acres of corn and small grains with no soybeans, all planted in stream bottoms, 20 small horse operations with about 100 total horses, 10 cattle operations with about 200 total cattle, and 500 acres of pasture/hay land. Also included in the area are 3 golf courses, and one quarry. Stream banks in the subwatershed are in poor shape throughout because of human encroachment moving up to the stream bank. This has led to poor bank stability. Also, much of the development in Lenoir has occurred within the floodplain, with a considerable amount of filling being done.

According to Map A-3: New and Potential Subdivision Development, there were two developments of 101 to 250 units at the time of that study.

There were 137 possible contamination sources and one facility with a National Point-source Discharge and Elimination System (NPDES) permit. The Zacks Fork subwatershed ranked 3rd among the 19 subwatersheds with respects to its phosphorus coefficient of 48 kg/km/yr, and 7th with its nitrogen coefficient of 394 kg/km/yr.

Map B-19: Zacks Fork Subwatershed

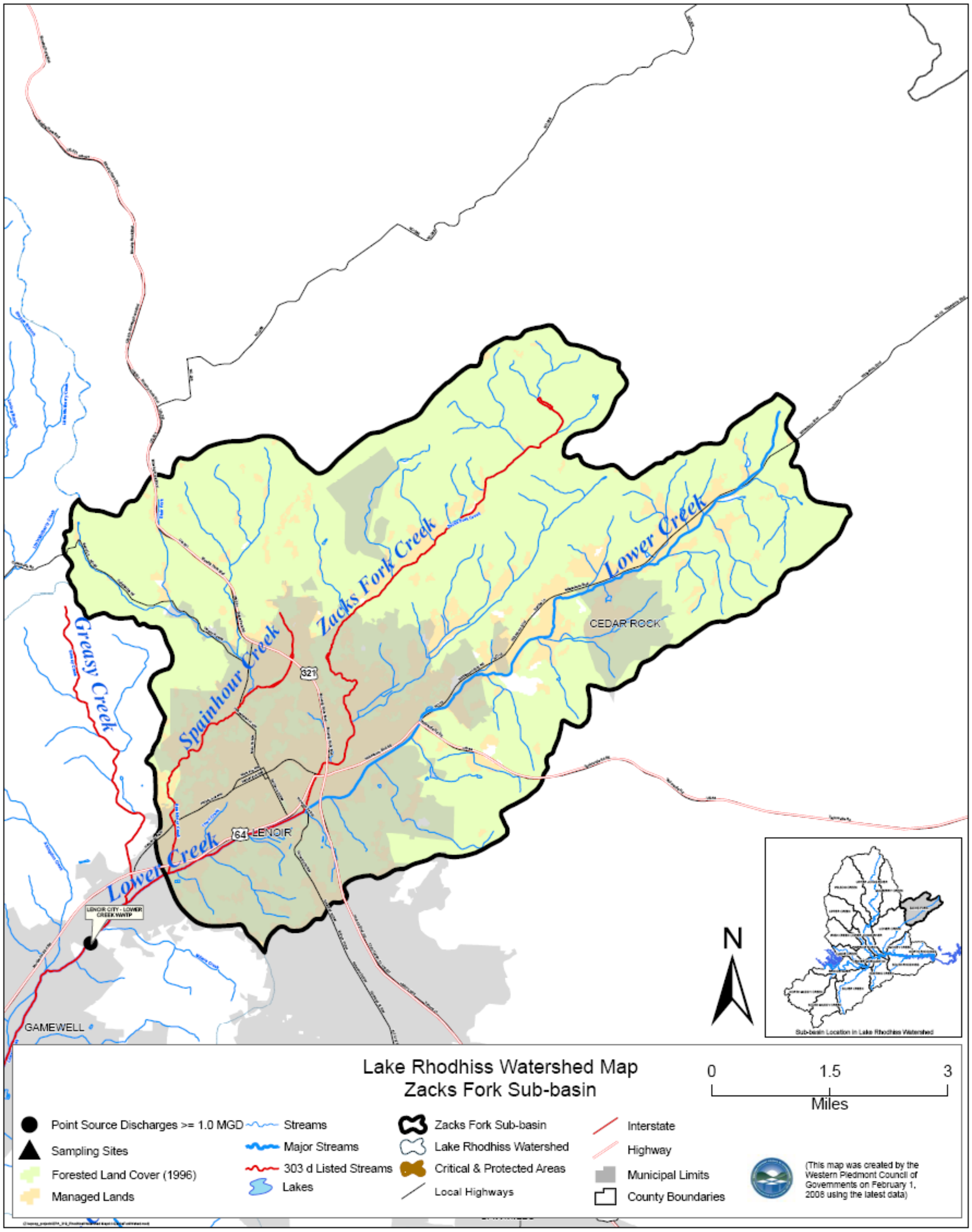
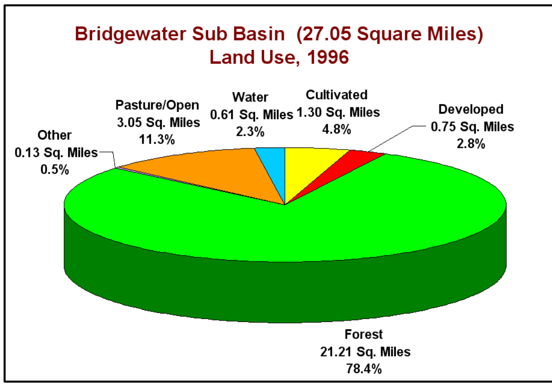
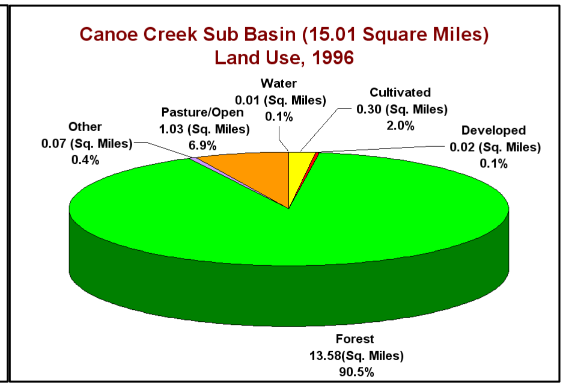
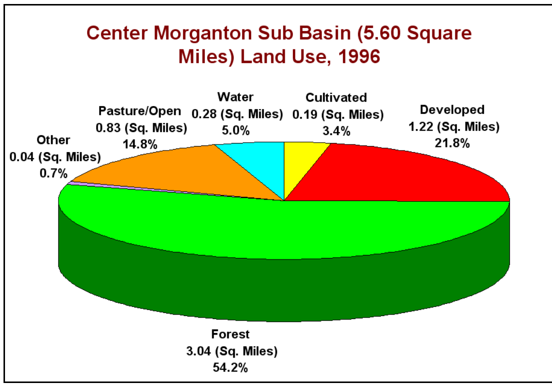
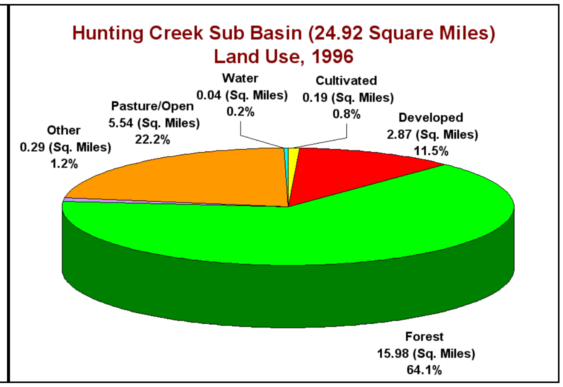


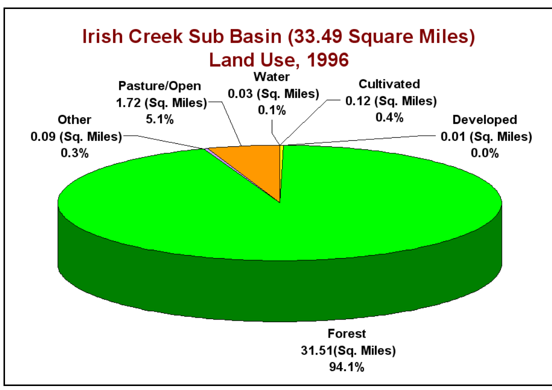
Figure B-1: Subwatershed Land Use

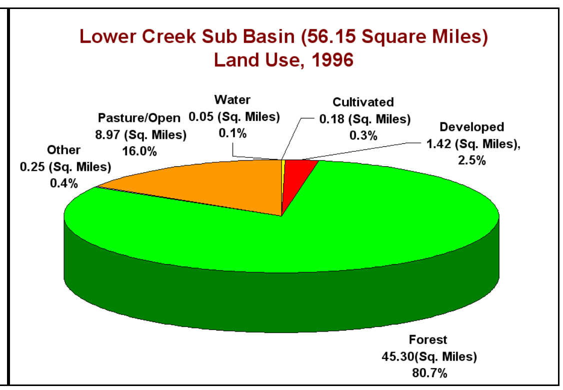


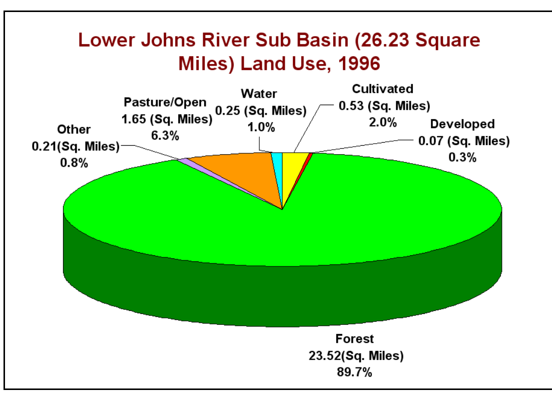


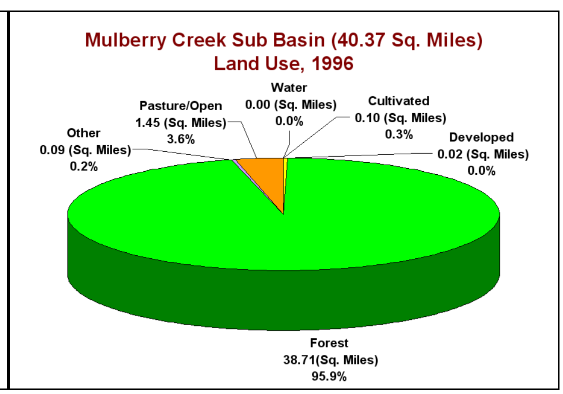


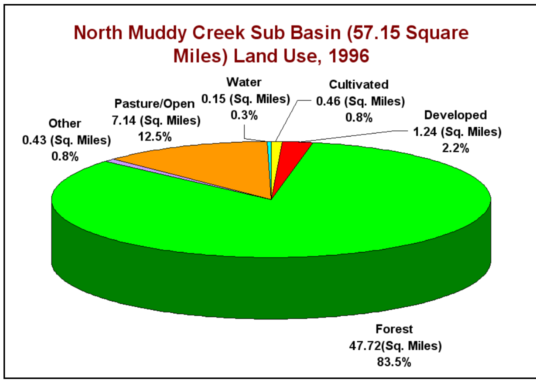


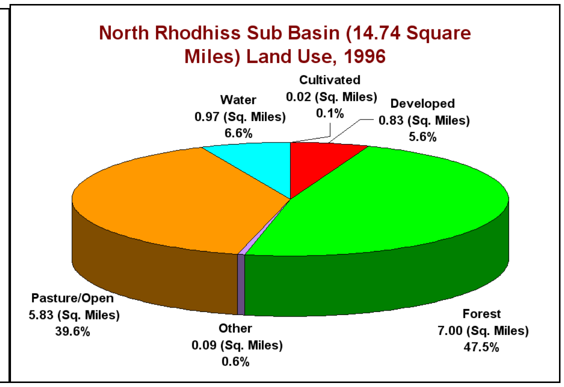


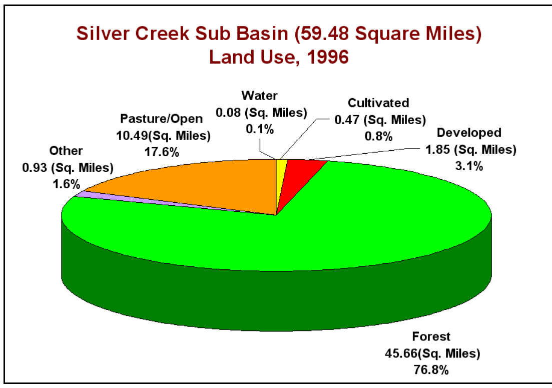


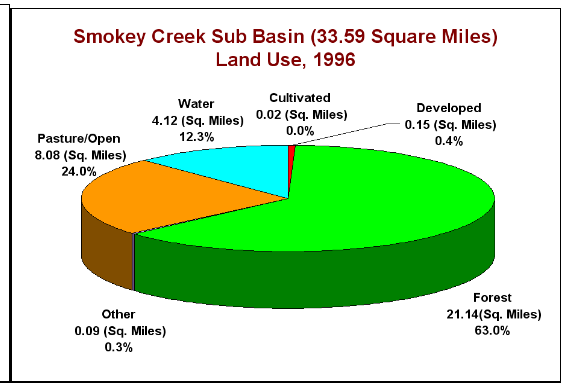


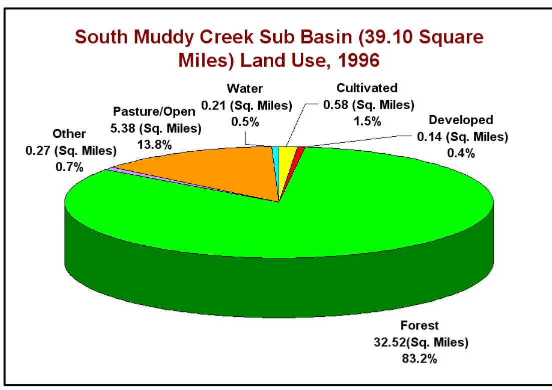


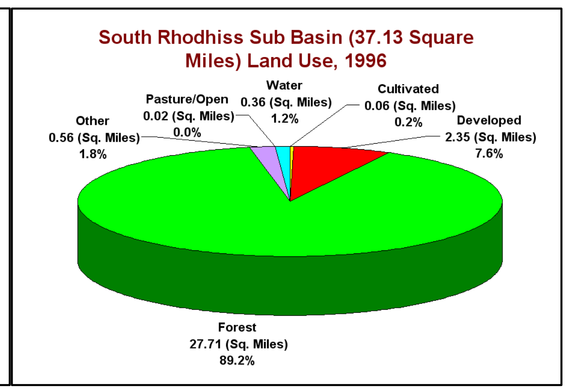

North Muddy Creek Sub Basin (57.15 Square Miles) Land Use, 1996
Water 0.15 (Sq. Miles) 0.3%
Cultivated 0.46 (Sq. Miles) 0.8%
Developed 1.24 (Sq. Miles) 2.2%
Pasture/Open 7.14 (Sq. Miles) 12.5%
Other 0.43 (Sq. Miles) 0.8%
Forest 47.72(Sq. Miles) 83.5%

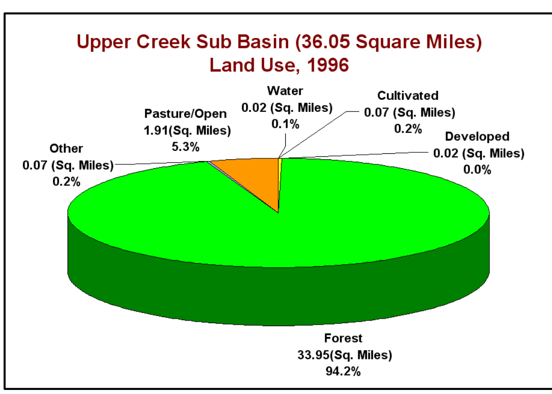

North Rhodhiss Sub Basin (14.74 Square Miles) Land Use, 1996
Cultivated 0.02 (Sq. Miles) 0.1%
Water 0.97 (Sq. Miles) 6.6%
Developed 0.83 (Sq. Miles) 5.6%
Pasture/Open 5.83 (Sq. Miles) 39.6%
Other 0.09 (Sq. Miles) 0.6%
Forest 7.00 (Sq. Miles) 47.5%

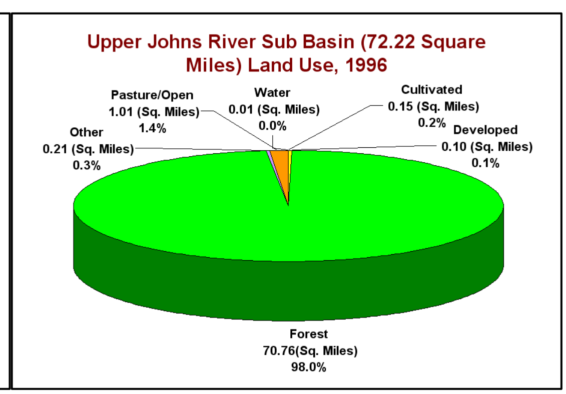

Silver Creek Sub Basin (59.48 Square Miles) Land Use, 1996
Water 0.08 (Sq. Miles) 0.1%
Cultivated 0.47 (Sq. Miles) 0.8%
Pasture/Open 10.49(Sq. Miles) 17.6%
Developed 1.85 (Sq. Miles) 3.1%
Other 0.93 (Sq. Miles) 1.6%
Forest 45.66(Sq. Miles) 76.8%

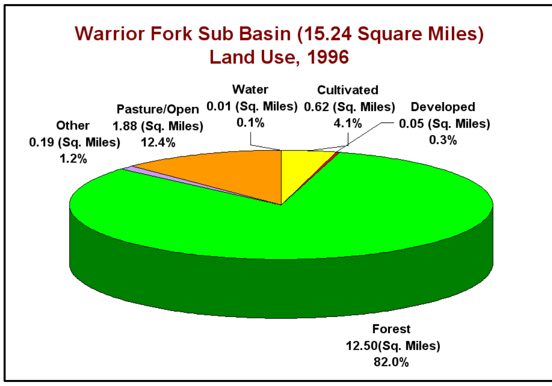

Smokey Creek Sub Basin (33.59 Square Miles) Land Use, 1996
Water 4.12 (Sq. Miles) 12.3%
Cultivated 0.02 (Sq. Miles) 0.0%
Developed 0.15 (Sq. Miles) 0.4%
Pasture/Open 8.08 (Sq. Miles) 24.0%
Other 0.09 (Sq. Miles) 0.3%
Forest 21.14(Sq. Miles) 63.0%

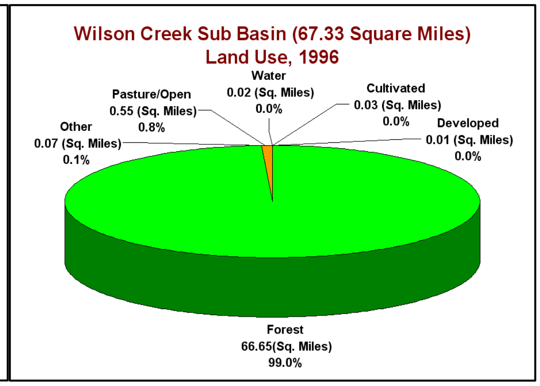

South Muddy Creek Sub Basin (39.10 Square Miles) Land Use, 1996
Water 0.21 (Sq. Miles) 0.5%
Cultivated 0.58 (Sq. Miles) 1.5%
Pasture/Open 5.38 (Sq. Miles) 13.8%
Developed 0.14 (Sq. Miles) 0.4%
Other 0.27 (Sq. Miles) 0.7%
Forest 32.52(Sq. Miles) 83.2%

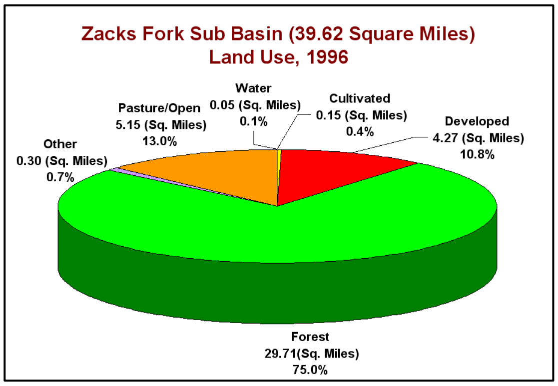

South Rhodhiss Sub Basin (37.13 Square Miles) Land Use, 1996
Water 0.36 (Sq. Miles) 1.2%
Cultivated 0.06 (Sq. Miles) 0.2%
Pasture/Open 0.02 (Sq. Miles) 0.0%
Other 0.56 (Sq. Miles) 1.8%
Developed 2.35 (Sq. Miles) 7.6%
Forest 27.71 (Sq. Miles) 89.2%


Upper Creek Sub Basin (36.05 Square Miles) Land Use, 1996
Water 0.02 (Sq. Miles) 0.1%
Cultivated 0.07 (Sq. Miles) 0.2%
Pasture/Open 1.91(Sq. Miles) 5.3%
Developed 0.02 (Sq. Miles) 0.0%
Other 0.07 (Sq. Miles) 0.2%
Forest 33.95(Sq. Miles) 94.2%


Upper Johns River Sub Basin (72.22 Square Miles) Land Use, 1996
Pasture/Open 1.01 (Sq. Miles) 1.4%
Water 0.01 (Sq. Miles) 0.0%
Cultivated 0.15 (Sq. Miles) 0.2%
Developed 0.10 (Sq. Miles) 0.1%
Other 0.21 (Sq. Miles) 0.3%
Forest 70.76(Sq. Miles) 98.0%

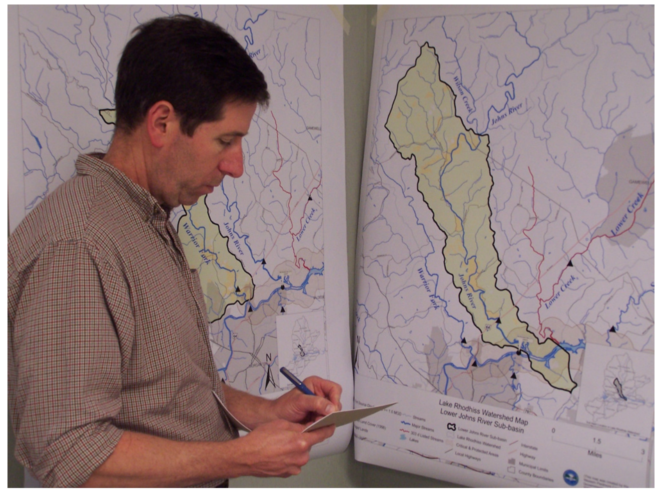

Warrior Fork Sub Basin (15.24 Square Miles)
Land Use, 1996
Water 0.01 (Sq. Miles) 0.1%
Cultivated 0.62 (Sq. Miles) 4.1%
Developed 0.05 (Sq. Miles) 0.3%
Pasture/Open 1.88 (Sq. Miles) 12.4%
Other 0.19 (Sq. Miles) 1.2%
Forest 12.50(Sq. Miles) 82.0%


Wilson Creek Sub Basin (67.33 Square Miles)
Land Use, 1996
Water 0.02 (Sq. Miles) 0.0%
Cultivated 0.03 (Sq. Miles) 0.0%
Pasture/Open 0.55 (Sq. Miles) 0.8%
Developed 0.01 (Sq. Miles) 0.0%
Other 0.07 (Sq. Miles) 0.1%
Forest 66.65(Sq. Miles) 99.0%


Zacks Fork Sub Basin (39.62 Square Miles)
Land Use, 1996
Water 0.05 (Sq. Miles) 0.1%
Cultivated 0.15 (Sq. Miles) 0.4%
Pasture/Open 5.15 (Sq. Miles) 13.0%
Developed 4.27 (Sq. Miles) 10.8%
Other 0.30 (Sq. Miles) 0.7%
Forest 29.71(Sq. Miles) 75.0%

Section C
Lake Rhodhiss Watershed Evaluation

Planning Process



The *Lake Rhodhiss Watershed Plan* was developed by the Western Piedmont Council of Governments using input from multiple groups such as the Catawba River Study Committee, a Technical Advisory Committee, and a Stakeholder Advisory Committee, and using data provided by NC DENR, Devine, Tarbell and Associates and the Western Piedmont Council of Governments.

The heart of the Lake Rhodhiss Watershed Restoration Plan consists of recommended strategies for education and outreach, planning and policy, restoration and retrofits, and research and monitoring, and can be applied to both agricultural and non-agricultural settings. These recommendations are described further in sections D-F and are focused on Non-Agricultural, Agriculture and Point Source areas, respectively. In Section G we have included all the recommendations together in summary and tabular form for quick reference

The Stakeholder Advisory Committee provided the major input. The Lake Rhodhiss Stakeholder Committee was made up of local government managers, planners, and wastewater treatment operators, as well as elected officials, environmental representatives, business representatives, and concerned citizens. The name and organization for each Stakeholder can be found in Acknowledgements Section at the beginning of this document. The Committee helped direct the development of the watershed restoration plan by providing feedback to Western Piedmont Council of Governments staff.

The Committee underwent an eight month process of education, discussion and strategic thinking to develop a draft plan. WPCOG staff developed meeting agendas, recorded minutes and facilitated all monthly meetings. Meeting were held mainly on Tuesday evenings at the Rutherford College Town Hall, a central meeting point in the watershed, and WPCOG staff had easy access to the facilities. All committee decisions were made by consensus.

Members of the Stakeholder Advisory Committee were given background information, including

The impaired status of Lake Rhodhiss,
Watershed Planning Process / EPA 9-Elements
The Watershed Modeling Results
The Watershed Monitoring Results
Maps and Characteristics of Subwatersheds
Waste Water Treatment Primer
Scoring Methodology for Prioritization Purposes.

Some of the questions that were discussed by the Stakeholder Advisory Group include:

What is happening in the Lake Rhodhiss Watershed that needs to be considered in the plan?
Who are other stakeholders who can/should help us with this project?
What does the data show are the problem areas?
Where are most important area to focus efforts? Prioritization
What are Point Source Strategies and Solutions? (WWTP Supervisor)
What are the Agricultural Non-Point Source Strategies and Solutions?
What are the Non-Agricultural Non-Point Source Strategies and Solutions?
Where can we apply these controls in priority areas?
Implementation Plan (What?, Who?, When?, How Much?)

The Stakeholder Advisory Group had their final meeting on July 28, 2009. Those present at the final meeting were satisfied with the final recommendations as presented.

The Technical Advisory Group included staff from Natural Resources Agencies: various DENR Divisions; Soil and Water Conservation Districts, Natural Resource Conservation Service, NC State University Cooperative Extension Service, Resource Conservation and Development, Land Trusts , Duke Energy, Trout Unlimited, Wildlife Resources Commission, local planners, and Waste Treatment Plant Supervisors.

This group meet as a whole a few times to develop the project and monitor it's progress. Most of the direction and input received took place as subsets of this group interacted with WPCOG staff, provided input, and direction as requested.

Education and Outreach Associated with the Planning Process

Two public meetings were held on weekday evenings in mid February at Burke County Agricultural Resource Center, Morganton, and Caldwell County Agricultural Resource Center (Library), Lenoir. The meetings served several important purposes:

1. Introduce the public to the project.
2. Identify local concerns and potential restoration sites from the public.
3. Identify property owners interested in participating in restoration projects.
4. Capture the names and addresses of individuals desiring periodic updates on the project.

A project website Lake Rhodhiss and Surrounding Watershed http://www.wpcog.org/rhodhiss/ was developed by the WPCOG and launched in early 2008. It has been updated throughout the project and will continue to be hosted and maintained by the WPCOG as long as the site remains useful.

Six television shows about the project or issues related to the project were taped and broadcast in the project area during the period of this project. Caldwell County Today film studio assisted with filming and airing five shows to date on local cable outlets in the region. "Our Gentle River and the Water Quality" Program was edited and aired as an introduction to local water resource issues; "Watershed Restoration Issues" was filmed in February 2007; "Protecting Waters Quality" was filmed in June 2007; "Carolina Yards and Neighbors" TV segment, filmed September 23, 2008- (Cooperative Extension Agent Kelly Groves introduced the public to actions local residents can take related to landscaping practices that protect water quality). Tributary Monitoring Segment, filmed September 30, 2008– (Dan McClure and Tony Gallegos discussed monitoring study and findings.) The filming of "Nursery BMPs" and the final recommendations and outcome of this project will be filmed in late summer soon after this plan is finalized.

Plan Adoption

The Lake Rhodhiss Watershed Plan has been regularly reviewed by the Catawba River Study Committee, which is the key interface that the Western Piedmont Council of Governments (WPCOG) uses to interact with local governments on the issue of water resources. Formed in 1986, this Committee is staffed by the WPCOG serves in an advisory role for 30 local governments within the Greater Hickory Metro on issues including water quality, water supply, water safety and recreation, and watershed issues within the Upper Catawba River Basin. The Catawba River Study Committee consists of individuals representing local governments, nonprofit organizations, educational institutions and businesses from Alexander, Burke, Caldwell, Catawba and McDowell Counties in Western North Carolina.

The restoration plan will be presented to all local governments within the watershed in late summer and fall of 2009 by staff at the Western Piedmont Council of Governments. The local governments will be asked to voluntarily adopt the recommendations and begin implementing the plan in areas for which they have authority.

The Lake Rhodhiss Watershed Restoration Plan is intended to be an evolving document, revised on a regular basis or as policies and economic conditions change. This is an umbrella plan encompassing a large geographic area. Key elements of the plan involve developing assessments for all subwatersheds and developing site specific recommendations in the years ahead. The parties responsible for implementing the plan should review the document periodically to determine its effectiveness and the need for revisions.

Assessment Resources

Multiple resources were used to develop the watershed restoration plan and prioritization of the subwatersheds. Key resources heavily relied upon past studies, GIS information, daily monitoring reports (DMRs) and watershed modeling and tributary monitoring associated with this project. The following sections present an overview of the methods and findings of the later two resources.

Watershed Model

The Generalized Watershed Loading Functions (GWLF) Model was applied to the Rhodhiss Lake watershed. The objectives of this effort were to estimate current sediment and nutrient loadings to this 1,423-ha reservoir located on the upper Catawba River from 19 subwatersheds comprising the watershed.

GWLF allows the user to estimate runoff, and sediment and nutrient loadings from watersheds with varied land-use characteristics. Contributions from point-source dischargers can also be accounted for as well as septic systems and manure applications to agricultural lands.

Two model simulations were performed: a baseline simulation representing conditions present for the year 2000, and a second model run for the year 2020 based on anticipated growth within the watershed. Ten-year model simulations were performed for both the baseline (2000) and the 2020 scenarios. Average annual sediment and nutrient loading estimates were generated and reported to minimize year-to-year variability in weather conditions.

Average annual sediment loading values for the baseline scenario ranged from 140,000 kg/yr for Center Morganton, a small, urban subwatershed, to 2,300,000 kg/yr for Wilson Creek, a large, predominantly forested watershed. High sediment loading values were generally associated with large (>100 km2) subwatersheds. Under the 2020 scenario, the model predicted that sediment loading would remain constant or decline for each of the watershed's 19 subwatersheds. For the entire watershed, annual sediment loading was predicted to decline by 3.4% (from 19,850,000 kg/yr to 19,170,000 kg/yr) by 2020 and this decline was attributed to the decrease in open and forested lands with a concomitant increase in paved surfaces associated with new development. Export coefficients were calculated to allow sediment loss among subwatersheds to be compared on an equal aerial basis. Subwatersheds exhibiting the highest sediment export coefficients were mixed-use catchments with proportionately more agricultural and urban, and less forested lands than other subwatersheds.

Subwatersheds exhibiting high nitrogen and phosphorus loadings for 2000 were catchments with sizeable wastewater treatment plants. About 21% of the total nitrogen and 48% of the total phosphorus entering Rhodhiss Lake in 2000 originated from four point-source dischargers. The contribution of these dischargers to total nitrogen and phosphorus loadings by 2020 is expected to increase to 31% and 62%, respectively.

Total nitrogen and phosphorus export coefficients were examined to identify subwatersheds with disproportionately high nutrient loadings attributed to nonpoint sources. This examination revealed that several urban subwatersheds in the Morganton and Lenoir areas were generally contributing the highest nutrient loads to the Lake during 2000. Subwatersheds showing the greatest percent increase in nutrient export coefficients by 2020, however, were catchments where residential growth is anticipated to be particularly strong over the next 20 years.

Because of the size and diversity of activities occurring within this watershed, developing strategies for managing sediment and nutrients entering Rhodhiss Lake will be a challenging task. This report, however, provides useful loading estimates, previously unavailable for the entire watershed, which can serve as an important first step for assisting local and state agencies to target specific subwatersheds contributing disproportionate loads of sediment and nutrients to Rhodhiss Lake, with appropriate best management practices.

Conclusions of Modeling Study

Because of the size and diversity of activities occurring within this watershed, developing strategies for managing sediment and nutrients entering Rhodhiss Lake remains a challenging task. Uncertainty exists concerning a variety of factors influencing loadings to Rhodhiss Lake, such as the bioavailability, transformation and assimilation of nutrients in route from each subwatershed to Rhodhiss Lake. In addition, lake response to future nutrient inputs under different conditions requires better understanding. Nevertheless, this report provides useful loading estimates, previously unavailable for the entire watershed, which can serve as an important first step for assisting local and state agencies for targeting specific subwatersheds contributing disproportionate loads of sediment and nutrients to Rhodhiss Lake, with appropriate best management practices.

The Generalized Watershed Loading Functions (GWLF) Model was applied to estimate sediment and nutrient loadings to Lake Rhodhiss from 19 subwatersheds (14-digit NRSC hydrologic units) comprising the watershed. This model is based on simple runoff, sediment and groundwater relationships combined with empirical chemical parameters. Two model simulations were performed: a baseline simulation representing conditions present for the year 2000, and a second model run for the year 2020 based on anticipated growth within the watershed. Sediment, along with nitrogen and phosphorus loads, was simulated annually over a ten-year period, and mean loads were calculated and reported. Export coefficients were calculated for all three parameters to allow constituent loss among subwatersheds to be compared on an areal basis.

Average annual sediment loading values for 2000 ranged from 140,000 kg/yr to 2,300,000 kg/yr. High sediment loading values were generally associated with large (>100 km^2) subwatersheds. An analysis of sediment export coefficients revealed that subwatersheds exhibiting the greatest export coefficients were mixed-use catchments with proportionately more agriculture and urban, and less forested lands, compared to other subwatersheds.

Subwatersheds exhibiting the greatest nitrogen and phosphorus loadings for 2000 were catchments with major wastewater treatment plants present (plant discharge > 1 MGD). An examination of nitrogen and phosphorus export coefficients revealed, however, that nonpoint source contributions of nutrients was greatest from urban and mixed-use subwatersheds. Despite the rural character of the watershed, the results from this study suggest that the chief nonpoint source contributors of nutrients to this impoundment are urban sources, rather than agricultural and silvicultural contributors

For a more detailed description of methodologies and assumptions see Lake Rhodhiss Non-Point Source Modeling Report 2004 or condensed version in Appendix B.

A weakness of the modeling efforts referenced above is that when done monitoring data for the major tributaries entering the lake did not exist to validate the accuracy of the model-generated estimates. Studies of two streams in the watershed, Lower Creek and Muddy Creek show that stream bank erosion is the largest contributor to sediment loading. Because of the affinity of phosphorus to bind to clay particles, in-channel erosion may also be a significant contributor to phosphorus loading. Since the GWLF Model accounts for loads attributed to sheet erosion only, the sediment and phosphorus loading figures contained in the WPCOG report may be significantly underestimated. For example, GWLF estimated sediment loading for Muddy Creek at 2,400 tons per year while Duke Power Company estimated sediment loading based on field measurements to range from 14,000 to 23,000 tons annually (DENR email correspondence April 2008). This discrepancy illustrates the importance of using fieldcollected data to validate model generated estimates. Fortunately, tributary monitoring was a major outcome of the overall Lake Rhodhiss Project and the results of this monitoring are found in the next section.

Major Tributary Monitoring

This section summarizes information found "Phosphorus and Nitrogen Loading and Export from Lake Rhodhiss" compiled by Jon Knight, PhD. This report was commissioned as part of the overall Rhodhiss Project. The final report was released in July 2009. Figures and tables and much of the text in this section are originally from this document.

Two methods were used to calculate annual tributary loading and watershed yield. The method utilizing the median concentration, probably underestimated the total nutrients entering the system from storm events. The flow-weighted method, by applying higher concentrations to higher hourly flows, may have overestimated the total mass transferred to the system since the duration of the high flow event was not considered in the calculations. The two methods probably bracket the actual loading values and the difference between the two methods probably reflects of the uncertainty of the loading estimates for the specific year.

The magnitudes of annual tributary loadings - the annual watershed yield of nutrients (kg per square mile per year) reflected the size of the watershed, but may also be influenced by activities within the subwatershed.

Nitrogen - If all of the subwatersheds exhibited identical sediment and nutrient dynamics, the magnitudes and trends of the annual loads and yields would follow the water contributions from each subwatershed. This appears to be the case with nitrogen loads from most subwatersheds. The contribution of nitrogen from each subwatershed parallels the magnitude of total annual discharge indicating that nitrogen, primarily as nitrate, remains in solution with little biological or chemical reactions impacting the amount of nitrogen.

The water yields and nitrogen yields also follow similar trends, except for Hunting Creek and Freemason Creek. These two watersheds have over twice the nitrogen yield as any other watershed. Both of these watersheds have different land uses. Hunting Creek is an urban watershed and the source of nitrate may be runoff from fertilizers. The Freemason Creek subwatershed is almost exclusively forest/wetland and exhibited the greatest nitrogen yield. With the exception of these two subwatersheds, nitrogen loading, in summary, appears to be primarily a function of the amount of water flowing through the subwatershed with little influence from the land use.

Phosphorus - Unlike nitrogen, sediment and phosphorus loadings exhibited very different patterns than the amount of water flowing through the watersheds. The patterns of sediment and phosphorus loading were very similar, again suggesting that phosphorus was associated with the suspended sediment fraction rather than the dissolved portion. Moreover, the mechanism of suspending sediment in the creeks also mobilized the phosphorus fractions.

The Bridgewater releases from Lake James exhibited moderate total suspended sediment and phosphorus loads due to the high volume of water passing through the lake. But, those hydro releases exhibited the lowest sediment and phosphorus yields from the watershed. These low yields were indicative of the characteristics of reservoirs to act as settling subwatersheds for many materials, particularly suspended sediment and associated adsorbed compounds, i.e. phosphorus (Duke Energy, 2007).

Johns River, Lower Creek, and Muddy Creek had the highest sediment loading rates and the greatest watershed yield of sediment; phosphorus loading from these watersheds also ranked 1, 2, and 3, respectively. However, the phosphorus yield from the Muddy Creek watershed was much less than the sediment yield would suggest. Muddy Creek and Lower Creek had the greatest proportion of agricultural activities, but the Johns River subwatershed had minimal agriculture. The percentage of developed land between the three watersheds was not consistent with the sediment or phosphorus loading.

Figure C-1: Rhodhiss Tributary Phosphorus Loading

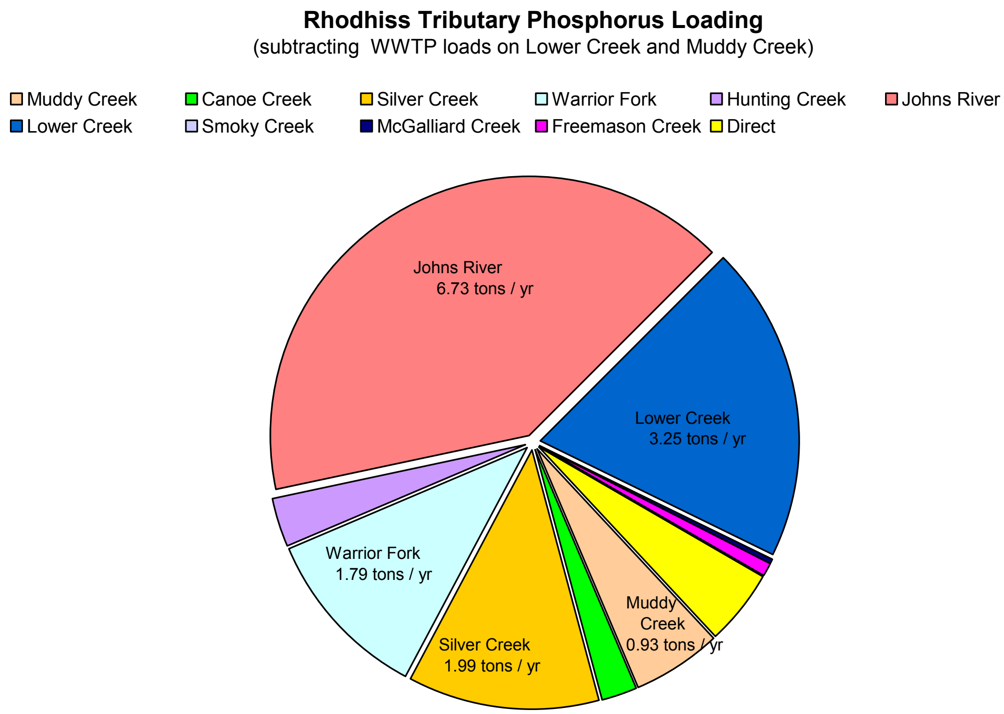


Figure C-2: Annual Water Contribution from the Tributary Inflows to Lake Rhodhiss

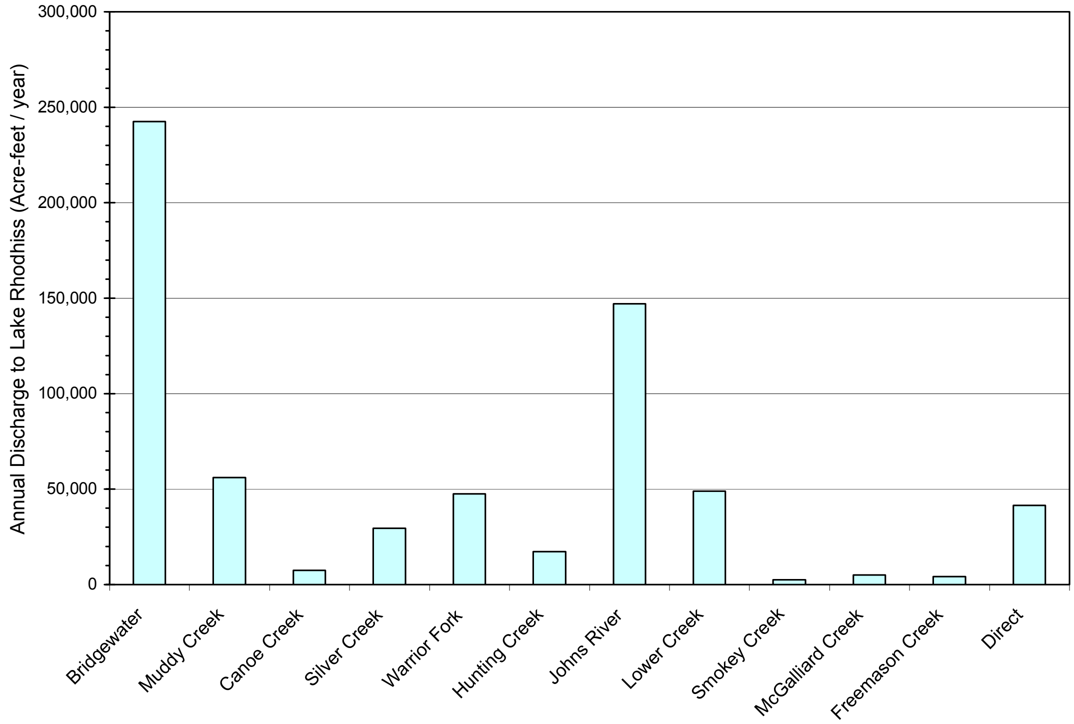


Figure C-3: Annual Water Yield of Tributary Basins

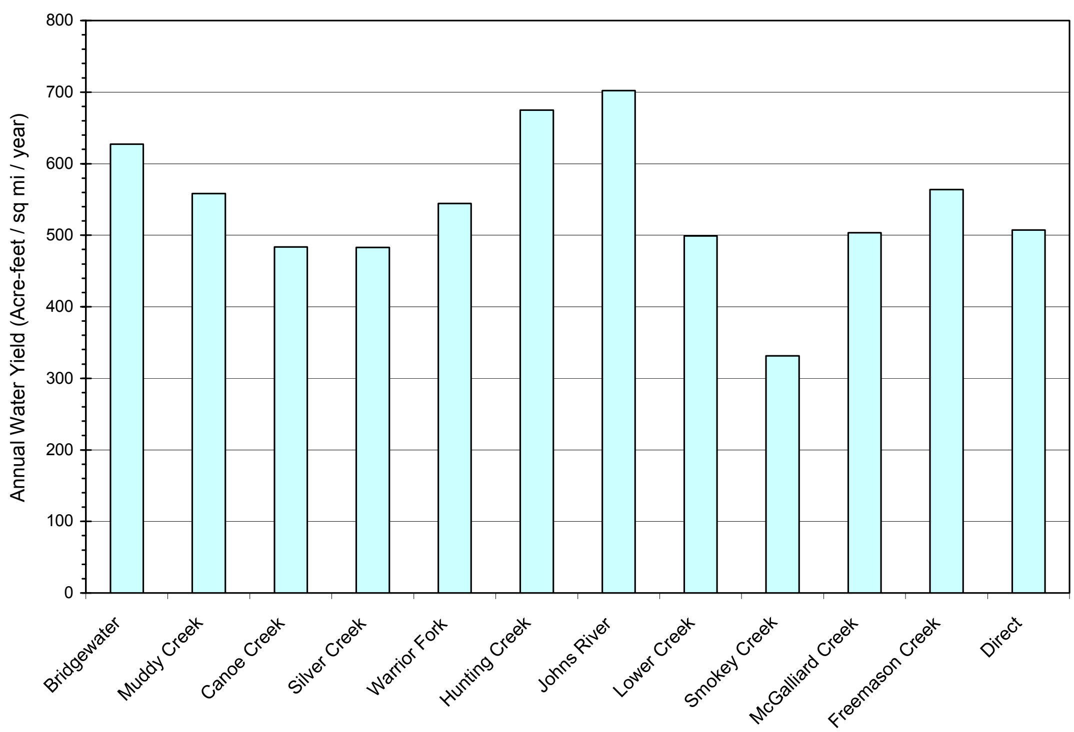


Figure C-4: Annual Suspended Sediment Loading from the Tributary Inflows to Lake Rhodhiss

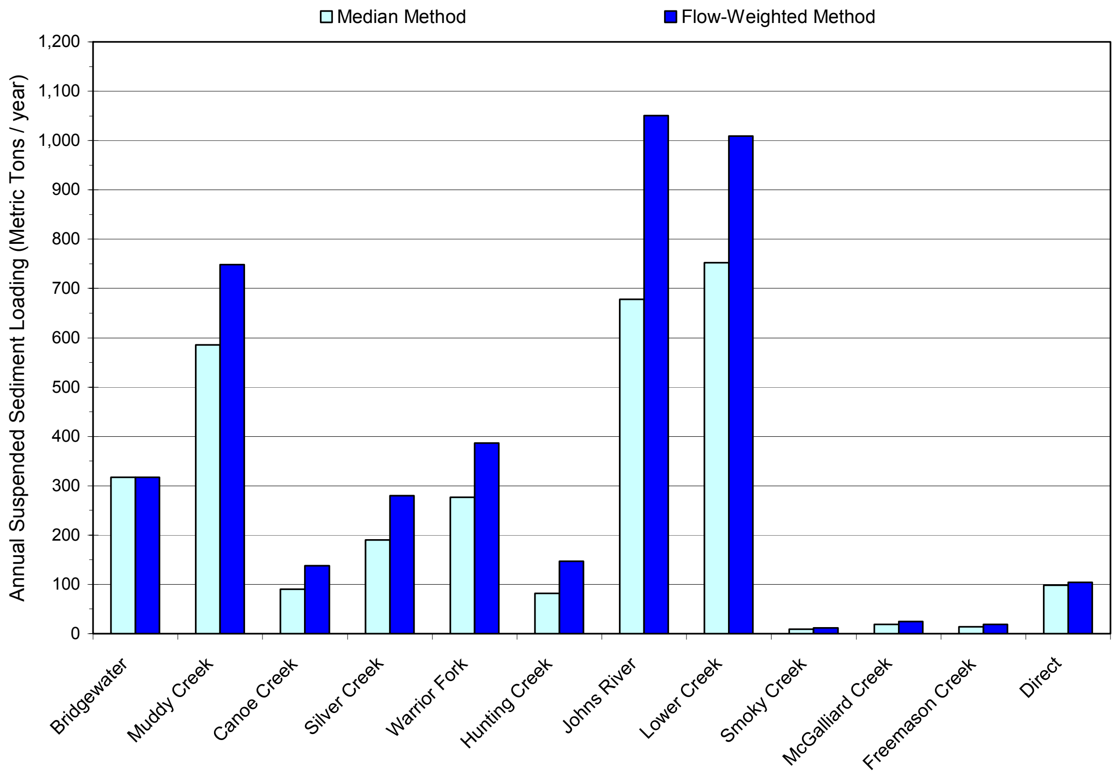


Figure C-5: Annual Watershed Yield of Suspended Solids

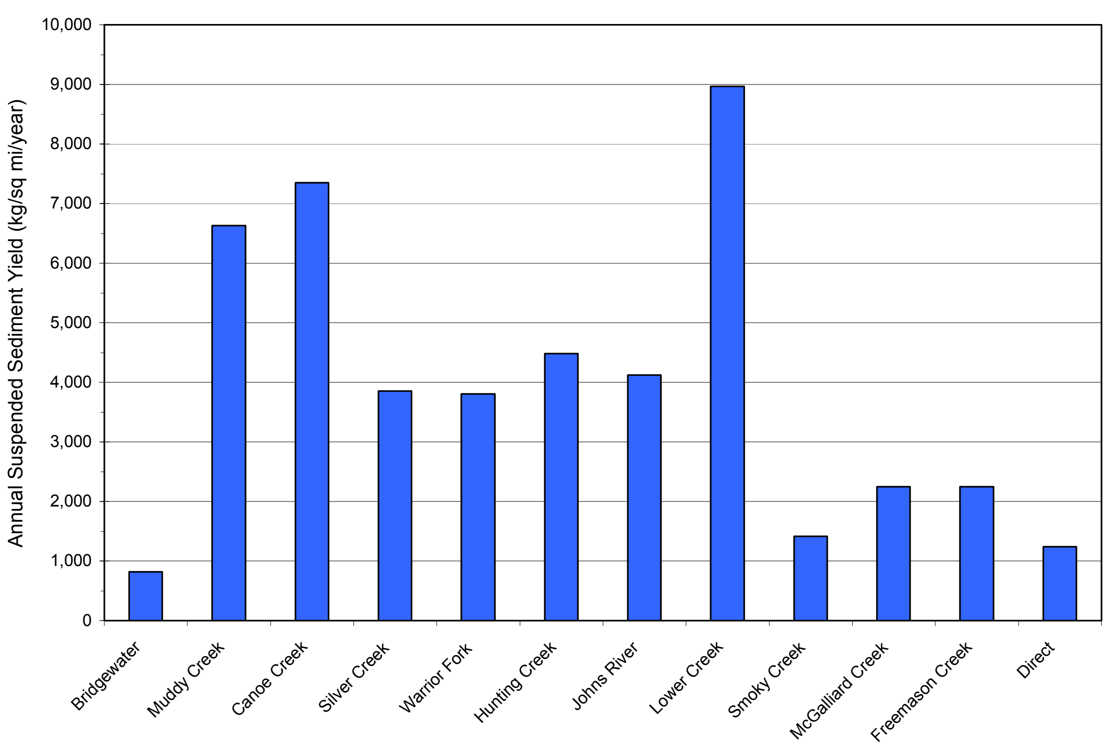


Figure C-6: Annual Nitrogen Loading from the Tributary Inflows to Lake Rhodhiss (WWTP Loads Subtracted from Muddy Creek and Lower Creek)

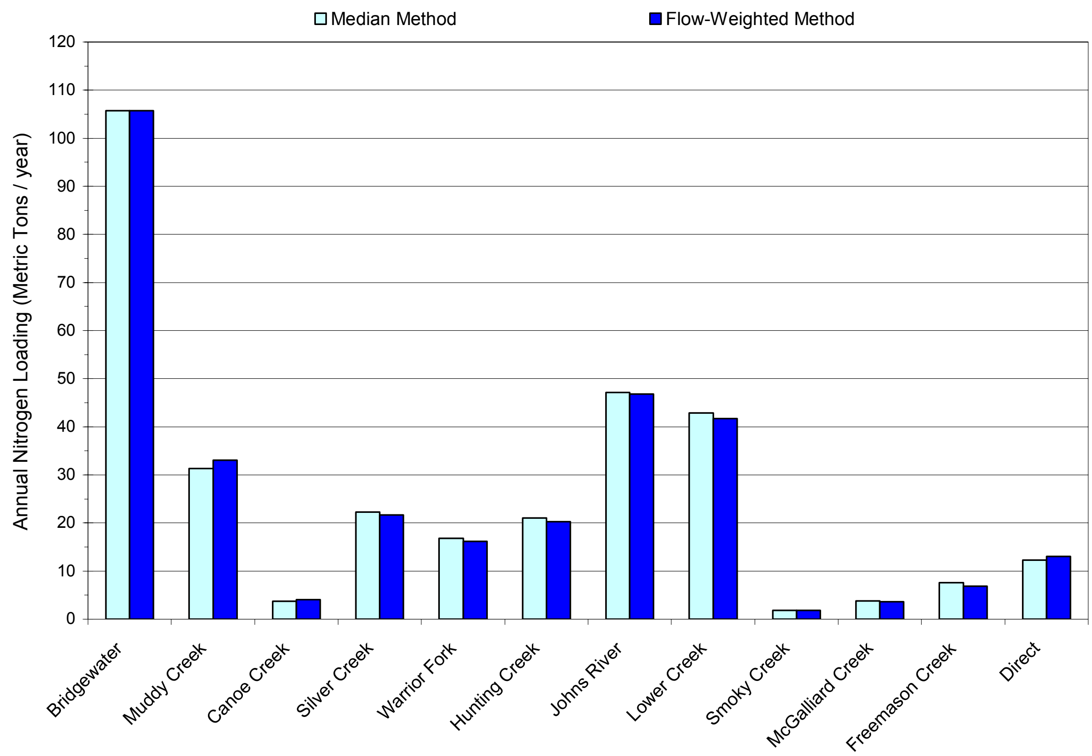


Figure C-7: Annual Watershed Yield of Nitrogen

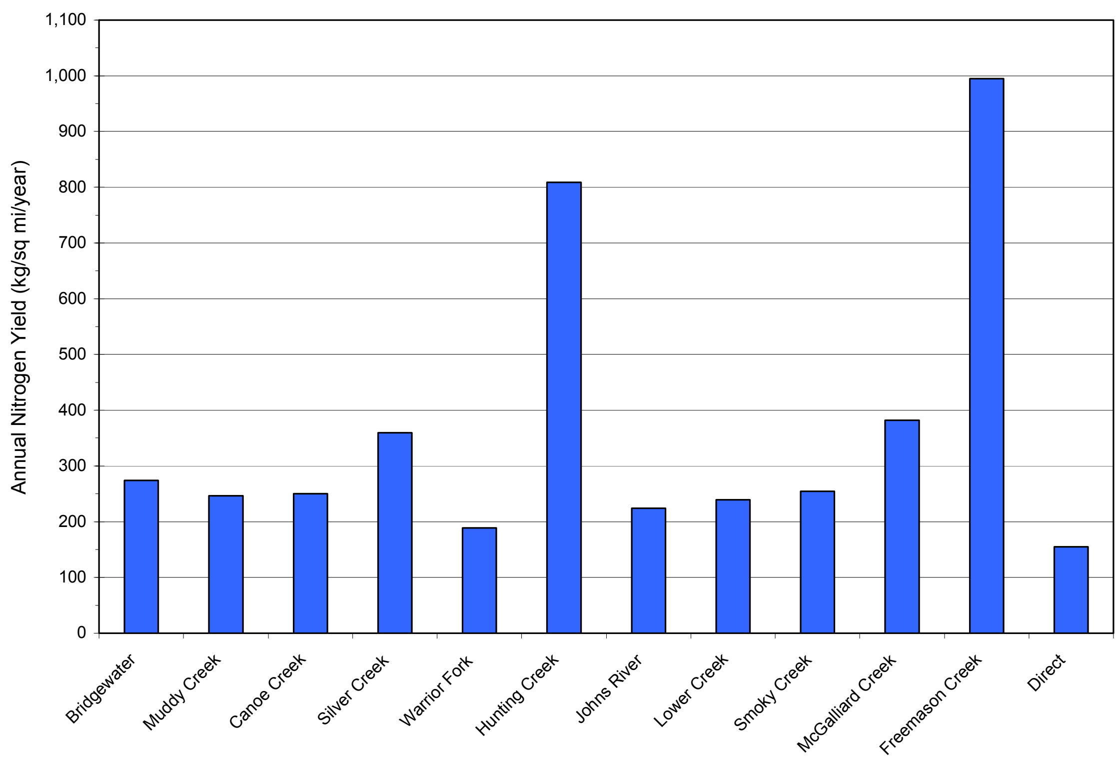


Figure C-8: Annual Phosphorus Loading from the Tributary Inflows to Lake Rhodhiss (WWTP Loads Subtracted from Muddy Creek and Lower Creek)

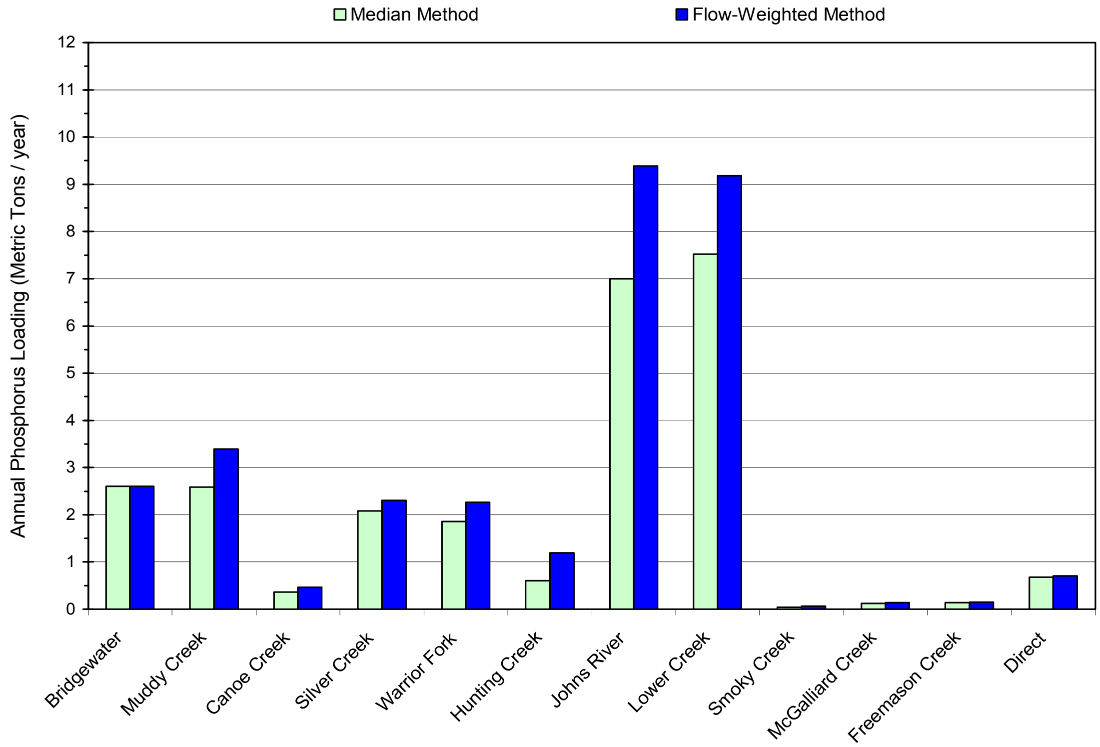
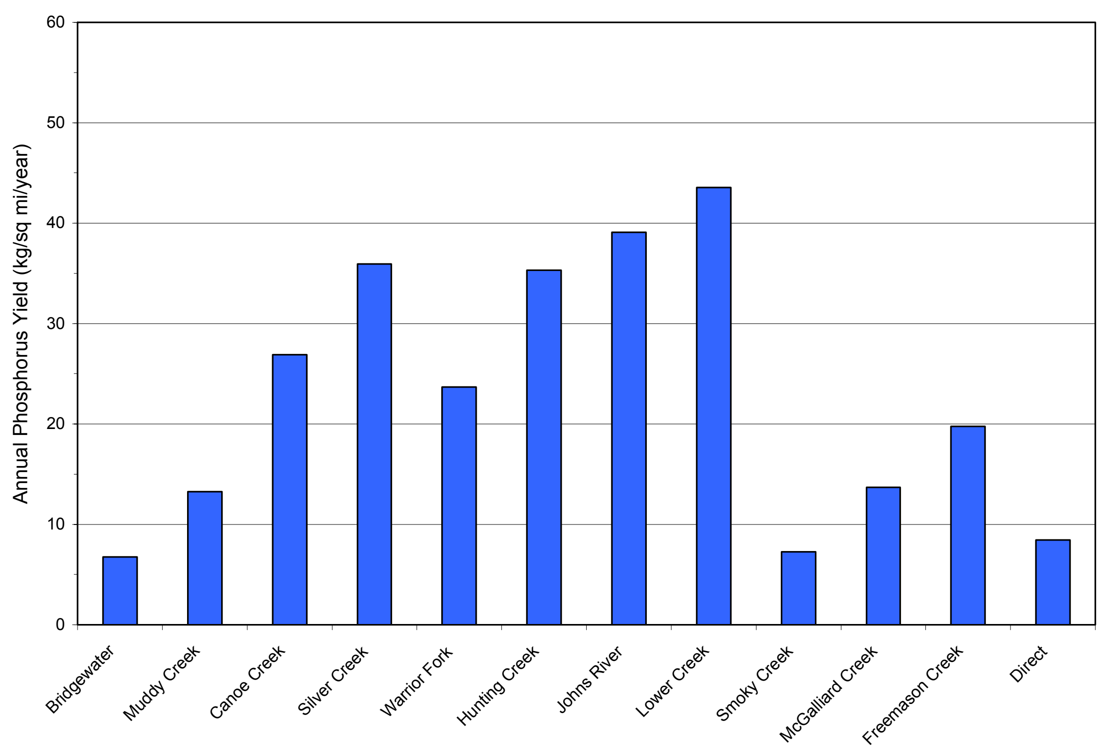


Figure C-9: Annual Watershed Yield of Phosphorus



Hunting Creek, the most urban of the watersheds, had moderate sediment loading but relatively low phosphorus loading, but higher than average sediment and phosphorus yields. The next most developed watershed, McGalliard Creek, had relatively low sediment and phosphorus loads and yields. Freemason Creek, which had similar proportions of agricultural and developed areas to the Johns River and Warrior Fork, had similar phosphorus yields as Warrior Fork, but half that of the Johns River. Silver Creek, which was the third most developed watershed, exhibited higher sediment and phosphorus loads than Hunting Creek, but similar watershed yields of sediment and phosphorus.

Based upon these data, no consistent trend between total sediment and phosphorus loading and/or watershed yields with gross land use was apparent. Rather than generalized land use patterns, the differences of actual nutrient loading between the subwatersheds was probably a result of localized, but significant activities within the subwatershed. Examples of such local activities may include:

- Erosion control and runoff events from individual fields;
- Construction and/or land disturbance and local control of runoff;
- Storm drainage systems, especially road runoff;
- Topography and associated erosion rates;
- Stream bank scouring and/or stabilization;
- Soil types and associated permeability;
- Amount and timing of fertilizer application relative to runoff characteristics and events;
- Retention ponds from developments or construction activities.

Waste Water Treatment Plant Loading

The total annual nitrogen and phosphorus loading of the wastewater treatment plants were 191.59 metric tons and 36.04 metric tons, respectively (Table C-1). However, the impact on Lake Rhodhiss from these facilities probably varies greatly. For example, the Marion and Lenoir WWTP discharged relatively low amounts of nutrients in the headwaters of Muddy Creek and Lower Creek, respectively. The nitrogen and phosphorus have a relatively long period of time to interact with inorganic and organic material that has washed into the creek. The extended travel time allows significant processing by physical, chemical, and biological activity until the nutrients reach Lake Rhodhiss. Phosphorus, to a large extent, is probably adsorbed on the clays from Muddy Creek and probably not to the same extent from Lower Creek. Morganton WWTP and, in particular, Valdese WWTP, discharge directly into Lake Rhodhiss. The nutrients, especially phosphorus, are readily available to the algae in the lake, whereas phosphorus washed in from the watersheds was usually associated with the suspended sediment and not quite as available to the lake algae.

Table C-1: Annual Point Source Loading from Waste Water Treatment Plants

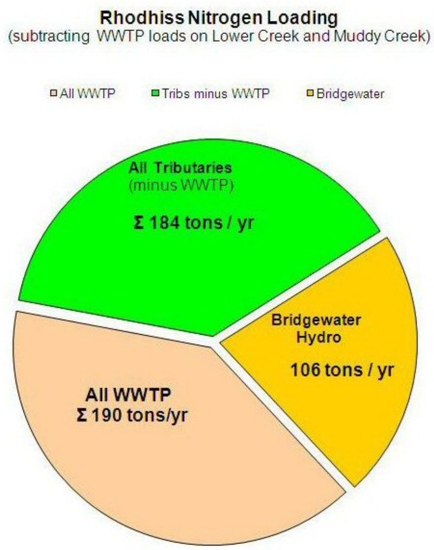
Facility	Total Nitrogen (metric tons/yr)	Total Phosphorus (metric tons/yr)
Morganton WWTP	142.21	20.03
Valdese WWTP	23.23	10.27
Lenoir WWTP	18.76	4.08
Marion WWTP	7.39	1.65
Total	191.59	36.04

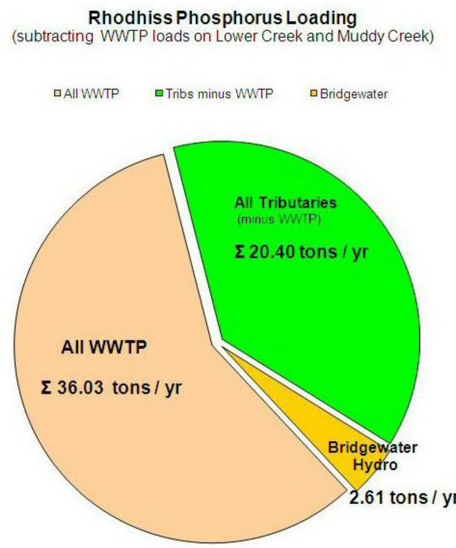
Point vs. Non-point Source Loading

The accounting for all of the nitrogen and phosphorus entering Lake Rhodhiss is summarized in Figure 10. All of the tributaries (non-point sources) and all of the wastewater treatment plants (point sources) contributed equal amounts of nitrogen, mostly as nitrate. Bridgewater releases from Lake James contributed about 20% of the nitrogen entering Rhodhiss.

Phosphorus loading, however, was dominated by the point sources. During the year-long study, 61% of the phosphorus entered Rhodhiss from point source discharge. Of this amount, 85% entered directly (or almost directly) into Lake Rhodhiss.

Figure C-10: Point vs. Non-Point Source Loading





Nutrient Budget for Rhodhiss Lake

The annual total of inflowing water, sediment, nitrogen, and phosphorus were calculated to estimate the total loads to Lake Rhodhiss. In addition, the total releases from the Rhodhiss Hydro into Lake Hickory were also calculated (Table C-2). The net result was, on the average, a loss of 4% of the water from evaporation. In addition, the lake retained 12% of the inflowing sediment, 35 % of the nitrogen, and 38% of the phosphorus. The suspended solids with associated adsorbed phosphorus, was lost from the water column to the lake bottom through coagulation and settling. Nitrogen was probably lost by biological de-nitrification reactions. The net result was the Lake Rhodhiss retained a significant portion of the material derived from the watersheds and processed some of the nutrients discharged from the wastewater treatment plants.

Table C-2: Nutrient, Suspended Sediment, and Water Budget for Lake Rhodhiss, 2007-08

Inflows	Water (1000 acre-ft per yr)	Suspended Sediment (metric tons per yr)	Nitrogen (metric tons per yr)	Phosphorus (metric tons per yr)
Bridgewater Hydro	243	317	106	2.6
All Tributaries	407	3356	184	20.4
Point Sources	N/A	N/A	192	36.0
Total Inflow	**649**	**3673**	**481**	**59.0**

Outflows	Water (1000 acre-ft per yr)	Suspended Sediment (metric tons per yr)	Nitrogen (metric tons per yr)	Phosphorus (metric tons per yr)
Rhodhiss Hydro	623	3226	310	31.6
Total Outflow	**623**	**3226**	**310**	**31.6**

A compilation of the nutrient loadings (nitrogen and phosphorus) from both the median method and the flow-weighted method used in this study are compared basin by basin to the other estimates of loading made by the USEPA (1973), Giorgino & Bales (1997), and Struve (2003).

The reported loading values from the various sources differed significantly (Tables C-3 and C-4) from each other, but most significantly from this study. A brief discussion is warranted summarizing the various approaches used to estimate the Lake Rhodhiss nutrient budget.

Advantages of this study were:

- This is the only study that measured both the nutrient concentrations and the flow from all of the non-point sources (tributaries) to Rhodhiss. These measurements, especially creek stage, were made at high frequencies that captured all of the low flows and storm events for a 1-year period of time.
- This study used actual DMR data collected at the wastewater treatment facilities, rather than estimates based on per capita waste.
- This study was conducted as a comprehensive approach where all inflows and outflows were conducted simultaneously with the same frequency of sample collection associated with creek stage measurements.
- This is the only study that measured the actual nutrient concentrations throughout a storm event in multiple systems.

Disadvantages that occurred during this study were:

- The year was an extreme low-flow year (drought) that may have reduced the loading due to low flows and altered normal nutrient concentrations.
- The low flow conditions contributed to minimal sampling of higher flows, potentially altering the median concentrations in the creeks.
- The concept of nutrient loading is relatively simple, namely the mathematical product of the amount of water (flow) and the amount of nutrient (concentration).

Monitoring Findings

- The study year, April 2007 – April 2008, was an extremely low flow year (drought) which probably contributed to lower nutrient loading than would have occurred during an average or above average water year.
- Nutrient (nitrogen and phosphorus fractions) were similar to NCDWQ historical values, with some concentrations slightly higher (low flows not diluting point source effluents) and some streams exhibiting lower concentrations (decreased non-point sources from reduced scouring and runoff)
- Phosphorus concentrations were very closely coupled with suspended sediment concentrations. Nitrate concentrations dominated the nitrogen speciation. Concentrations varied little between creeks and between flow (Freemason Creek and Hunting Creeks had significantly higher nitrate concentrations). Since nitrate concentrations varied little, nitrogen loading was primarily a function of the flow rates.
- Flow patterns in all streams and creeks exhibited small variations in base flow (ground water was the major contributor). All creeks had rapidly rising and falling hydrographs during storm events. (Hunting Creek exhibited the greatest rate of rise and fall of water.)
- The majority of the all nutrient loading occurred during storm events and provided "pulses" of nutrients to Lake Rhodhiss.
- Generally, the streams with the largest watershed exhibited the greatest nutrient loading. However, total loading (metric tons per year) nor nutrient yields (kg per square mile per year) could be related to generalize land use patterns.
- Unlike previous estimates, the point source nutrient loading was greater than the contributions of nutrients from all of the watersheds.

- Unlike the "pulsed" inputs of nutrients from the watersheds due to storm events, the Morganton and especially the Valdese WWTP facilities provide a continuous supply of nutrients to Lake Rhodhiss.
- The inflow of water to Lake Rhodhiss was 4% greater than the outflow, the similarity of these measurements, including the 4% attributable to evaporation, provided a high level of confidence in the accuracy of the individual flow measurements.
- Lake Rhodhiss retained significant amounts of sediment and phosphorus while probably loosing nitrogen by dentrification.

Comparisons Modeling and Monitoring

Comparing water quality data from different studies is problematic because project goals, sampling sites, methodologies and data analysis typically differ. Tables C-3 and C-4 present loading estimates for several subwatersheds in the Rhodhiss Lake watershed from three independent studies. One important distinction in examining these data is that results reported by the US EPA and USGS are based on monitoring data, while estimates generated for this study are based on modeling and have not been verified with field collected samples. Because the US EPA sampling sites for the Johns River and Lower Creek occurred near these streams' confluence with Rhodhiss Lake, loading data generated for Zacks Fork from this study was combined with loads generated from Lower Creek to yield a single loading estimate for this larger catchment for comparison purposes. Likewise modeled loads from the Upper Johns were combined with loads generated from the Lower Johns to yield loading estimates for the Johns River.

Historical sediment loading data for the Rhodhiss Lake is scant despite the importance sediment can have on adversely affecting water quality and aquatic life. Annual sediment loading estimates reported by the USGS (1997) for Lower Creek were about three higher than similar loading estimates predicted by the GWLF Model. The estimates generated by these two studies, however, do not lend themselves to comparison because of the differences in methodologies employed. The USGS loading estimate was based on in-stream monitoring data. Thus contributors to sediment loading accounted for in the USGS study would include sheet erosion, in-channel or stream bank erosion, and perhaps the movement of some bed (i.e., stream bottom) materials. In contrast, GWLF accounts only for sediment loading attributable to sheet erosion. One would therefore expect sediment loading estimates based on monitored data to be higher than loading estimates generated by the GWLF model. A second important variable is weather. The

USGS value is based on field samples collected over a 12-month period and weather conditions during this study, particularly rainfall, may not have been representative of an "average" year.

Nitrogen and phosphorus loading data were available for several streams in the watershed based on results reported by US EPA (1975). Loading estimates generated in this study generally compared favorably to results reported earlier by US EPA. Nutrient loading estimates were within an order of magnitude of one another except for phosphorus loading from Hunting Creek where the value reported by US EPA exceeded that predicted by the GWLF Model by a factor of 23. Despite the discrepancy in sediment loading, values reported by the USGS for nitrogen and phosphorus loading in Lower Creek were very similar to those predicted by GWLF.

Table C-3: Comparison of Annual Nitrogen Loading Estimates to Lake Rhodhiss from Various Sources

Note: All values are Metric Tons per year		This Study		USEPA (1975)	Giorgino & Bales (1997)	Struve (2003)
		Median Method	**Flow-Weighted Method**			
Inputs	**Total of Tributaries** (non-point Source)	**290**	**289**	**1205**	**1007**	**613**
	Catawba River			723.93		
	Catawba River - Site 20				878.50	
	Bridgewater	105.73	105.73	Included in Catawba River	Included in Site 20	24.44
	Muddy Creek	23.96	25.65			82.93
	Canoe Creek	3.74	4.01			13.13
	Silver Creek	22.24	21.68			56.79
	Warrior Fork	16.80	16.17			14.74
	Hunting Creek	21.03	20.28	168.42		35.96
	Johns River	47.14	46.79	125.05		154.33
	Lower Creek	24.11	22.95	106.65	128.81	63.23
	Smokey Creek	1.84	1.84	9.45		24.03
	McGalliard Creek	3.82	3.65	15.98		
	Freemason Creek	7.56	6.84	14.72		
	Other					143.19
	Direct (unmeasured drainages)	12.32	13.02			
	Hoyle Creek	included in Direct	included in Direct	6.54		
	Howard Creek			9.03		
	Stafford Creek			11.68		
	Bristol Creek			13.59		
	Total of WWTP (point Source)	**192**	**192**	**123**	**310**	**167**
	Morganton	142.21	142.21	46.34	163.20	
	Marion	7.39	7.39	11.34	33.60	
	Lenoir	18.76	18.76	50.01	48.48	
	Valdese	23.23	23.23		64.72	
	Valdese #1			3.61		
	Valdese #2			7.22		
	Drexel			4.87		
Outlet	Rhodhiss Hydro	**310.06**	**310.06**	**1268.72**		

Table C-4: Comparison of Annual Phosphorus Loading Estimates to Lake Rhodhiss from Various Sources

<table>
<tr><th colspan="2" rowspan="2">Note: All values are Metric Tons per year</th><th colspan="2">This Study</th><th rowspan="2">USEPA (1975)</th><th rowspan="2">Giorgino & Bales (1997)</th><th rowspan="2">Struve (2003)</th></tr>
<tr><th>Median Method</th><th>Flow-Weighted Method</th></tr>
<tr><td rowspan="28">Inputs</td><td>Total of Tributaries (non-point Source)</td><td>20</td><td>26</td><td>159</td><td>120</td><td>51</td></tr>
<tr><td>Catawba River</td><td></td><td></td><td>63.77</td><td></td><td></td></tr>
<tr><td>Catawba River - Site 20</td><td></td><td></td><td></td><td>105.47</td><td></td></tr>
<tr><td>Bridgewater</td><td>2.61</td><td>2.61</td><td rowspan="5">Included in Catawba River</td><td rowspan="7">Included in Site 20</td><td>1.55</td></tr>
<tr><td>Muddy Creek</td><td>0.93</td><td>1.74</td><td>5.95</td></tr>
<tr><td>Canoe Creek</td><td>0.37</td><td>0.47</td><td>0.92</td></tr>
<tr><td>Silver Creek</td><td>2.08</td><td>2.30</td><td>3.10</td></tr>
<tr><td>Warrior Fork</td><td>1.86</td><td>2.27</td><td>1.66</td></tr>
<tr><td>Hunting Creek</td><td>0.61</td><td>1.20</td><td>63.48</td><td>2.74</td></tr>
<tr><td>Johns River</td><td>7.00</td><td>9.39</td><td>7.16</td><td>13.93</td></tr>
<tr><td>Lower Creek</td><td>3.45</td><td>5.11</td><td>5.76</td><td>14.57</td><td>5.51</td></tr>
<tr><td>Smokey Creek</td><td>0.04</td><td>0.06</td><td>0.32</td><td></td><td>1.94</td></tr>
<tr><td>McGalliard Creek</td><td>0.13</td><td>0.14</td><td>11.65</td><td></td><td></td></tr>
<tr><td>Freemason Creek</td><td>0.14</td><td>0.15</td><td>0.62</td><td></td><td></td></tr>
<tr><td>Other</td><td></td><td></td><td></td><td></td><td>13.48</td></tr>
<tr><td>Direct (unmeasured drainages)</td><td>0.68</td><td>0.71</td><td></td><td></td><td></td></tr>
<tr><td>Hoyle Creek</td><td rowspan="4">included in Direct</td><td rowspan="4">included in Direct</td><td>3.83</td><td></td><td></td></tr>
<tr><td>Howard Creek</td><td>0.87</td><td></td><td></td></tr>
<tr><td>Stafford Creek</td><td>0.49</td><td></td><td></td></tr>
<tr><td>Bristol Creek</td><td>0.68</td><td></td><td></td></tr>
<tr><td>Total of WWTP (point Source)</td><td>36</td><td>36</td><td>41</td><td>48</td><td>48</td></tr>
<tr><td>Morganton</td><td>20.03</td><td>20.03</td><td>15.45</td><td>16.88</td><td></td></tr>
<tr><td>Marion</td><td>1.65</td><td>1.65</td><td>3.78</td><td>2.62</td><td></td></tr>
<tr><td>Lenoir</td><td>4.08</td><td>4.08</td><td>16.68</td><td>4.44</td><td></td></tr>
<tr><td>Valdese</td><td>10.27</td><td>10.27</td><td></td><td>24.40</td><td></td></tr>
<tr><td>Valdese #1</td><td></td><td></td><td>1.21</td><td></td><td></td></tr>
<tr><td>Valdese #2</td><td></td><td></td><td>2.41</td><td></td><td></td></tr>
<tr><td>Drexel</td><td></td><td></td><td>1.63</td><td></td><td></td></tr>
<tr><td>Outlet</td><td>Rhodhiss Hydro</td><td>31.58</td><td>31.58</td><td>106.66</td><td></td><td></td></tr>
</table>

Even though attempts were made in 1973, 1993, and 2003 to estimate nutrient contributions to Lake Rhodhiss, no systematic, direct approach to measure nutrient concentrations and flows in most of the tributaries and point-source discharges had been attempted. As Struve (2003) pointed out, loading estimates are lacking for most streams in the watershed for a couple of reasons, namely, time and expense collecting and analyzing nutrient samples over a wide range of conditions, and, primarily, the cost of stream gages to measure stage at high frequency intervals and develop rating curves to calculate flow at those stage measurements. The reasonable cost of installing temporary stream gages, the development of rating curves for those gages, and routine and storm event nutrient sampling allowed direct loading measurements of 10 tributaries to Lake Rhodhiss.

Priority Subwatersheds

Methodology

The Stakeholder Advisory Committee decided that in order to make better use of the agricultural and Non-agricultural recommendations it was important to focus on a few of the subwatersheds that are more impaired, or may need special attention. In order to do this a priority scoring methodology was used using much of the data that was available, including the modeling study. The monitoring data was not yet available. Future revisions to the watershed plan may better incorporate data that has recently come available to determine if adjustments need to be made.

The goal of the subwatershed priority scoring was to provide the stakeholder group with some recommendations, and to better funnel all of the data presented into a usable data set. Variables used are shown in Table C-5.

For each variable (see list in formula below), each subwatershed was "scored" from 1 to 19 using an interval ranking scheme. Using population density, for example, a score was given to each subwatershed based on there population density which ranged from 8 to 771 persons per square mile. In this case subwatersheds were scored based on there population density.

0 to 40.9 persons per square mile = score of 1
41 to 81.9 persons per square mile = score of 2
82 to 122.9 persons per square mile = score of 3
123 to 163.9 persons per square mile = score of 4
164 to 204.9 persons per square mile = score of 5
205 to 245.9 persons per square mile = score of 6
246 to 286.9 persons per square mile = score of 7
287 to 317.9 persons per square mile = score of 8
318 to 368.9 persons per square mile = score of 9
369 to 409.9 persons per square mile = score of 10
410 to 450.9 persons per square mile = score of 11
451 to 491.9 persons per square mile = score of 12
492 to 532.9 persons per square mile = score of 13
533 to 573.9 persons per square mile = score of 14
574 to 614.9 persons per square mile = score of 15
615 to 655.9 persons per square mile = score of 16
656 to 706.9 persons per square mile = score of 17
707 to 747.9 persons per square mile = score of 18
748 or more persons per square mile = score of 19

Once the score for each variable was calculated a multiplier was used to weight some variable more heavily than others. The number of impaired water bodies was also added to the final formula. The formula thus used to tabulate the total score for each subwatershed is:

Total Score for Each Subwatershed =

1 X Population Density Score +
0.5 X Other NPDES Permits Score +
1 X Possible Contamination Sources Score +
5 X Phosphorus Exp Coef. Score +
2 X Nitrogen Exp Coef Score +
5 X % Imperious Surface Score +
2 X % Agricultural Land Use Score +
2 X % Households Not Sewered Score –
1 X % Forest Land Use Score Score+
1 X % Developed/Urban Land Use Score+
Number of Impaired Water Bodies

Table C-5: Variables used for Priority Scoring.

Sub-watershed	Pop Density	Other MPDES Permits	Possible Contaminant Sources	Phosphorus Exp Coef	Nitrogen Exp Coef	Impervious Surface	Agricultural Land Use	Households Not Sewered	Forest Land	Developed Land	Impaired Water Bodies
Bridgewater	5	1	5	20	12	15	16	30	-12	3	0
Canoe Creek	4	1	1	20	10	5	8	38	-16	1	0
Center Morganton	19	4	4	75	34	95	18	8	-3	19	0
Hunting Creek	16	1	17	55	28	55	22	20	-7	11	0
Irish Creek	2	3	1	5	2	5	6	38	-18	1	0
Lower Creek	6	3	6	50	18	15	16	34	-13	3	1
Lower Johns River	1	1	1	20	2	5	8	38	-16	1	0
Mulberry Creek	1	4	1	30	4	5	6	38	-18	1	0
North Muddy Creek	6	9	11	25	12	15	12	28	-13	2	1
North Rhodhiss	14	1	3	95	38	35	38	30	-1	5	0
Silver Creek	7	3	4	15	12	20	18	28	-11	3	0
Smokey Creek	5	3	2	50	20	10	22	38	-6	1	0
So. Muddy Creek	2	1	1	10	4	5	16	38	-14	1	0
South Rhodhiss	13	1	11	45	22	35	12	22	-16	7	0
Upper Creek	1	4	1	20	2	5	6	38	-18	1	0
Upper Johns River	1	1	2	15	2	5	2	38	-19	1	1
Warrior Fork	5	1	1	55	12	5	16	28	-13	1	0
Wilson Creek	1	1	1	20	2	5	2	38	-19	1	0

Once the final score was tabulated the subwatersheds were broken down into 4 categories based on the amount of impairment in the watershed

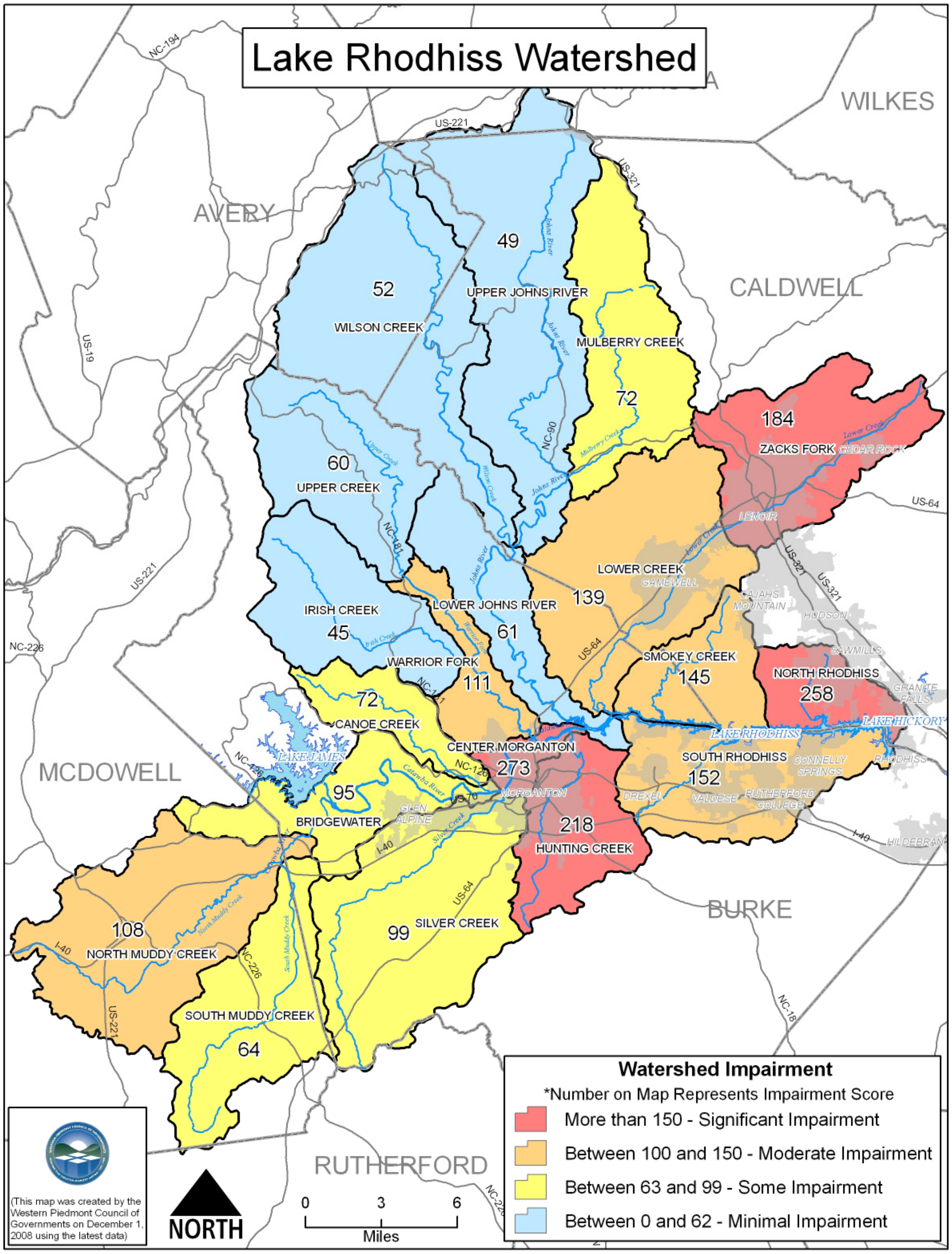
Category	Score	Description
1	Between 0 and 62	Minimal Impairment
2	Between 63 and 99	Some Impairment
3	Between 100 and 150	Moderate Impairment
4	More than 150	Significant Impairment

Table C-6: Subwatershed Scoring Summary.

Subwatershed	Total Score	Category	Description
Bridgewater	95	2	Some Impairment
Canoe Creek	72	2	Some Impairment
Center Morganton	273	4	Significant Impairment
Hunting Creek	218	4	Significant Impairment
Irish Creek	45	1	Minimal Impairment
Lower Creek	139	3	Moderate Impairment
Lower Johns River	61	1	Minimal Impairment
Mulberry Creek	72	2	Some Impairment
North Muddy Creek	108	3	Moderate Impairment
North Rhodhiss	258	4	Significant Impairment
Silver Creek	99	2	Some Impairment
Smokey Creek	145	3	Moderate Impairment
So. Muddy Creek	64	2	Some Impairment
South Rhodhiss	152	3	Moderate Impairment
Upper Creek	60	1	Minimal Impairment
Upper Johns River	49	1	Minimal Impairment
Warrior Fork	111	3	Moderate Impairment
Wilson Creek	52	1	Minimal Impairment
Zacks Fork	184	4	Significant Impairment

The Center Morganton scored the highest with a total score of 273, placing it in the “Significant Impairment” range. North Rhodhiss scored the second highest with a total score of 258, and along with Hunting Creek and Zack’s Fork, made out the other three Subwatersheds with a score that placed them in the “Significant Impairment” range. Those subwatersheds that scored within the “Moderate Impairment” range included South Rhodhiss, Smokey Creek, Lower Creek, Warrior Fork, and North Muddy Creek. Likewise, those that scored within the “Some Impairment” range included Silver Creek, Bridgewater, Canoe Creek, Mulberry Creek, and South Muddy Creek. All other Subwatersheds showed total scores that put them in the “Minimal Impairment” range.

Map C-1: Lake Rhodhiss Subwatershed Impairment Scoring



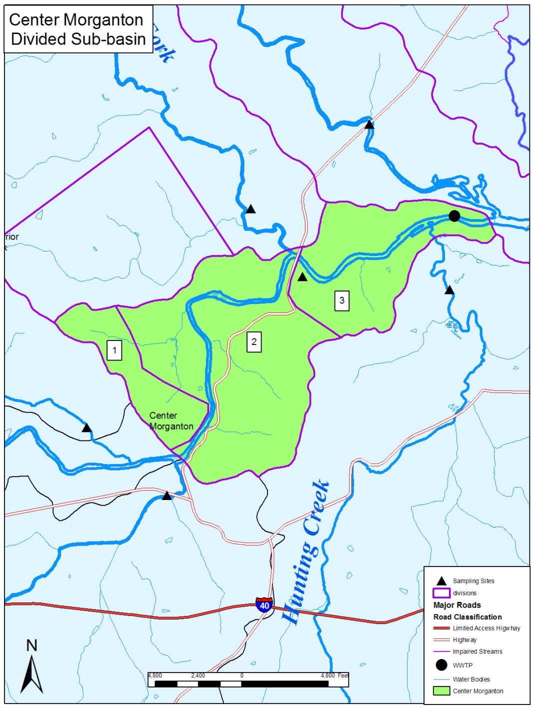
The Stakeholder Advisory Committee chose four subwatersheds as priority subwatersheds. There were a few subwatersheds that scored high; but localized plans had already had started in those subwatersheds to improve the water quality. These were Hunting Creek, Muddy Creek, and Lower Creek, with Zack's Fork being a part of the larger Lower Creek Plan. The Committee agreed that these were problem areas that needed to be addressed, but because of the already occurring projects, did not choose them as one of the four priority areas. It was decided that there would be two subwatersheds chosen for agricultural based projects, and two subwatersheds chosen for more urban, or non-agricultural, projects.

The two subwatershed chosen for the agricultural based projects were Warrior Fork and the Lower Johns River subwatershed. Warrior Fork had a significant amount of agriculture taking place, and its score, plus orthos of the property provided to the Committee indicated that it should be a priority. The Lower Johns River was actually chosen because it scored low and orthos and land use indicated a near pristine subwatershed. The Committee felt that a good strategy would be to institute a more conservation-based approach to preserve the subwatershed before it can be negatively affected by agricultural factors.

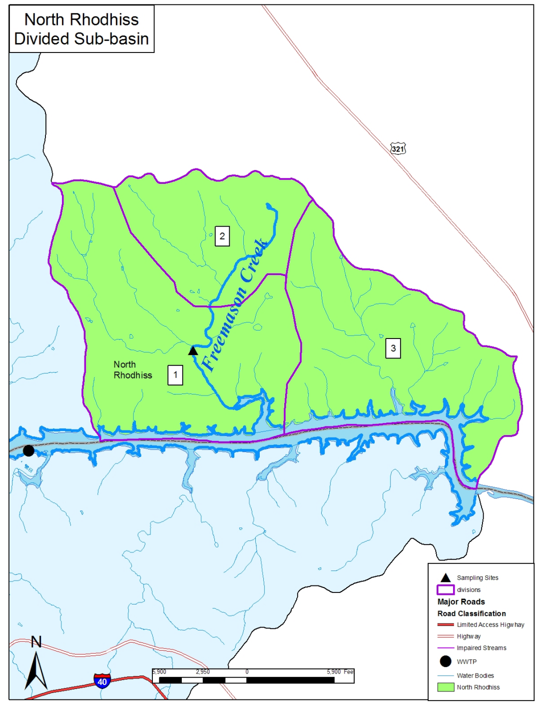
The two subwatershed chosen for the non-agricultural based projects were Center Morganton and North Rhodhiss. These two were chosen because they were the only two, besides those mentioned above, that had a priority score that showed significant impairment. Both subwatersheds are highly urbanized, and present many opportunities for project implementation.

For future projects the Stakeholder Advisory Committee also divided the subwatersheds, except for the Lower Johns subwatershed, into smaller sections that can be studied independently. These divisions were based on multiple factors such as land use, topography, roads, and past monitoring. The idea would be to implement projects in these smaller areas, and to monitor the progress afterward.

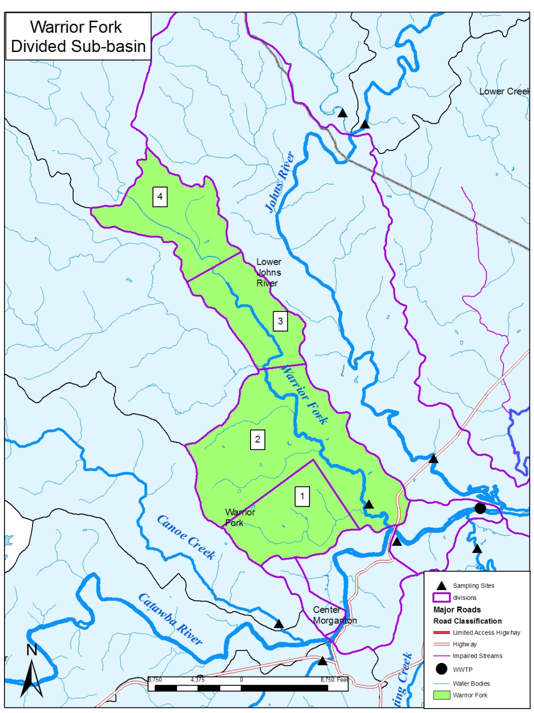
Map C-2: Center Morganton Divided Subwatershed



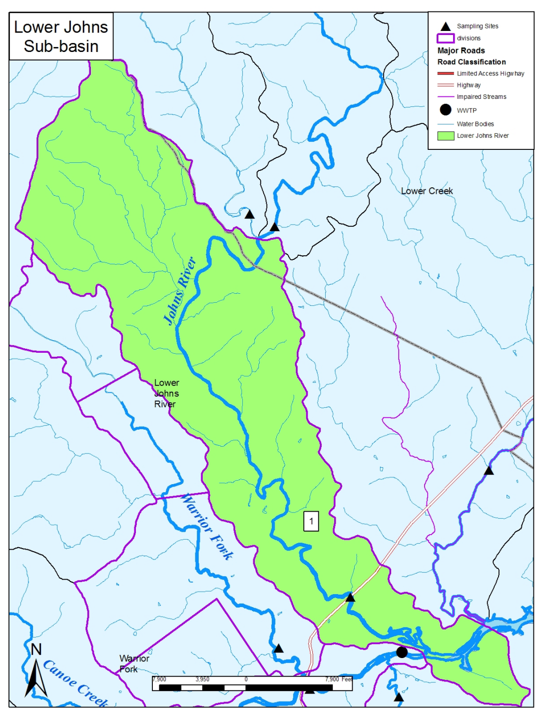
Map C-3: North Rhodhiss Divided Subwatershed



Map C-4: Warrior Fork Divided Subwatershed



Map C-5: Lower Johns Divided Subwatershed



Section D
Non-Agricultural Non-Point Source Strategies

Many strategies, if implemented by local governments within the watershed, can have a positive effect upon water quality. A successful strategy for watershed management should include the following elements:

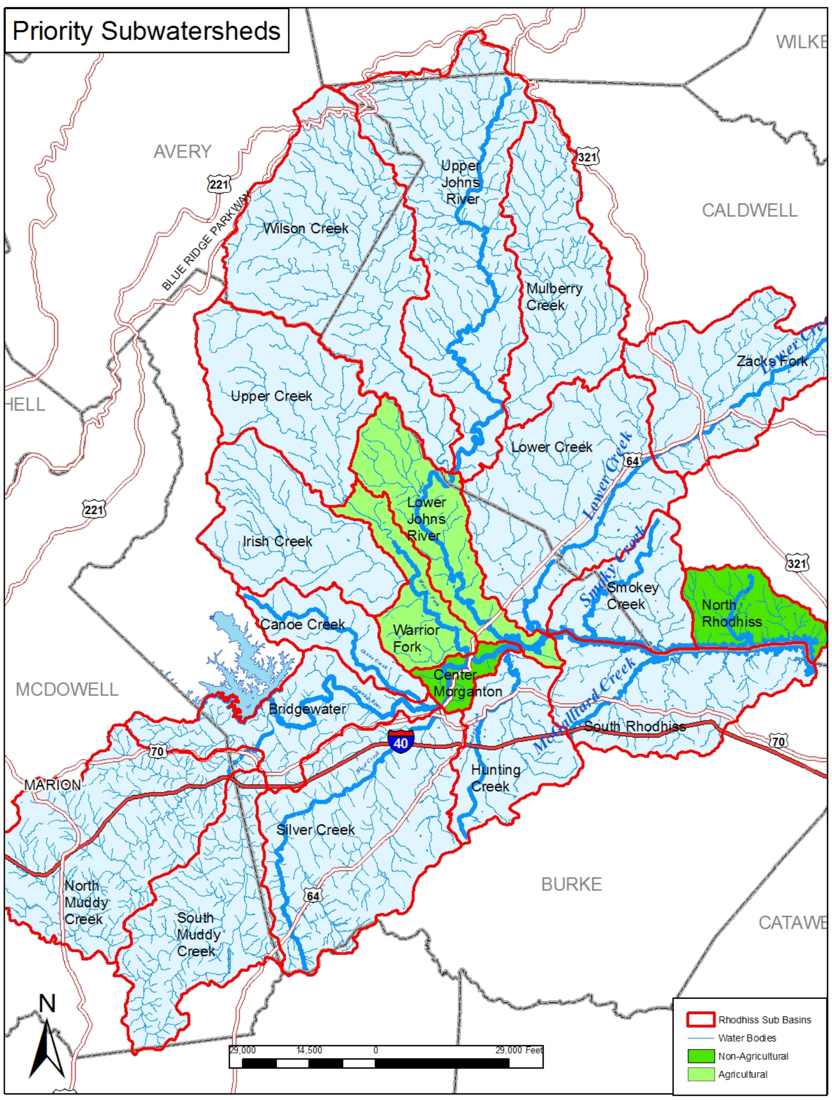
- A public education program which stresses the value of water resources and their sensitivity to developmental activities;
- Comprehensive regional planning which identifies and preserves sensitive areas, while encouraging growth in areas with infrastructure and resources to support it;
- The encouragement of planning techniques such as Low Impact Development and Smart Growth to minimize the impact of growth upon hydrology, water quality and aquatic habitat;
- Preservation of sensitive areas such as high-quality wetlands and water supply sources to ensure they continue to function in a manner that will sustain future growth;
- Planning and management of stormwater on a watershed-wide basis, considering the impact of development upon the overall watershed;
- The adoption of Stormwater Management BMPs, such as grassed swales, bio-retention areas and porous pavement into subdivision codes;
- Incorporation of a comprehensive review of the impact that all proposed developments will have upon hydrology, water quality, and aquatic habitat within the watershed; and
- Assessment of the incremental cost of water resources management (including comprehensive site plan review) to the entity that stands to gain economically from the development.

On the following pages are the non-agricultural recommendations that incorporate these principles and other practices that should be implemented in the Lake Rhodhiss watershed. Many of the strategies suggested are institutional in nature such as: ordinances, codes, regulations, and other instruments adopted by political jurisdictions in order to minimize the negative impacts that developmental activities have upon hydrology, water quality, and aquatic habitat, or which serve to protect or even improve these attributes within the watershed. Section G of this plan offers a summary in tabular form of each recommendation.

Focus Areas for Efforts

Most of the following recommendations will apply to the entirety of the Rhodhiss Watershed. However, the initial areas to focus efforts addressing Non-Agricultural, Non-Point strategies should be concentrated in Center Morganton and North Rhodhiss subwatersheds whenever possible. These two priority areas were chosen by the Advisory Committee using information and strategies outlined in Section C. Both are highly developed areas in comparison with the other subwatersheds. Center Morganton is almost entirely urbanized, while The North Rhodhiss subwatershed is a mix of both urban and agricultural. Specific strategies should be focused on these two areas initially, with the idea that those strategies that are most effective can

Map D-1: Priority Subwatersheds



be replicated in all other subwatersheds with similar characteristics.

Non-Agricultural Recommendations

Following is an overview of the fifteen recommendations to address Non-Agricultural NPS nutrient loading in the Rhodhiss watershed. Followed this overview, each recommendation is more fully described. Each strategy includes some background information, references to work ongoing or to be initiated in the watershed. For information regarding responsible parties, timelines, costs, resources needed, etc, see the Action Plan in Section G.

1. **Subwatershed Plans:** Develop individual site specific restoration plans for each of the nineteen subwatersheds, beginning with priority subwatersheds. Model plans after work developed for Muddy, Lower, and most recently Hunting Creek subwatersheds. Incorporate Nine Elements identified by EPA. Identify site specific BMPs to be implemented.

2. **Regional Coordination:** Establish a regional partnership to oversee all of the ongoing efforts in the Watershed to update plans and better coordinate existing efforts of implementing recommendations.

3. **Green Development Practices**: Develop a list of green policies to be presented to local governments that aid in watershed protection (reduced or impervious parking, low-impact development (LID), etc.). Garner local support for such initiatives and encourage their implementation.

4. **Education and Outreach:** Increase awareness and concern for water resource issues in the region through comprehensive education and outreach efforts.

5. **Best Management Practices:** Encourage the use of appropriate BMPs within the watershed that are the most beneficial in removing nutrients.

6. **Stormwater Management:** Fully implement and enforce stormwater BMP practices throughout the region in conjunction with current Phase II Programs.

7. **Sedimentation and Erosion Control:** Review current policies related to sedimentation and erosion control regulatory and oversight processes and implement corrective action for deficiencies.

8. **Secure Adequate Funding:** Seek opportunities to continue and enhance funding for acquisition of buffers, stream restoration, wetland enhancement, education and outreach efforts, monitoring, BMP retrofits and overall watershed improvements in vital areas

9. **Onsite Residential Sewage Treatment Systems:** Continue to operate and adequately fund the Unifour Septic Tank Repair Program. Work with local and state environmental health professionals to identify and correct failing systems.

10. **Geographic Information System (GIS):** Maintain access to best available GIS information to aid in watershed planning and assessment. Continue updating and analyzing GIS layers related to land use/land cover characteristics and changes in the subwatershed.

11. **Instream Substrate Disturbances:** Restrict the use of suction dredges for recreational gold mining in tributaries to Lake Rhodhiss.

12. **Riparian Buffers:** Develop and promote incentives for non-agricultural, smaller property owners who voluntarily establish and maintain buffers along streams within the watershed.

13. **Long Range Land-Use Plans:** Review current comprehensive land-use plans relative to potential impact on nutrient loading and encourage updates to consider water quality impacts.

14. **Greenways Adjacent to Streams:** Encourage development of greenways along riparian corridors.

15. **Water Quality Monitoring:** Continue water quality monitoring to identify problem areas and document improvements. Incorporate a volunteer monitoring component.

1. Subwatershed Plans

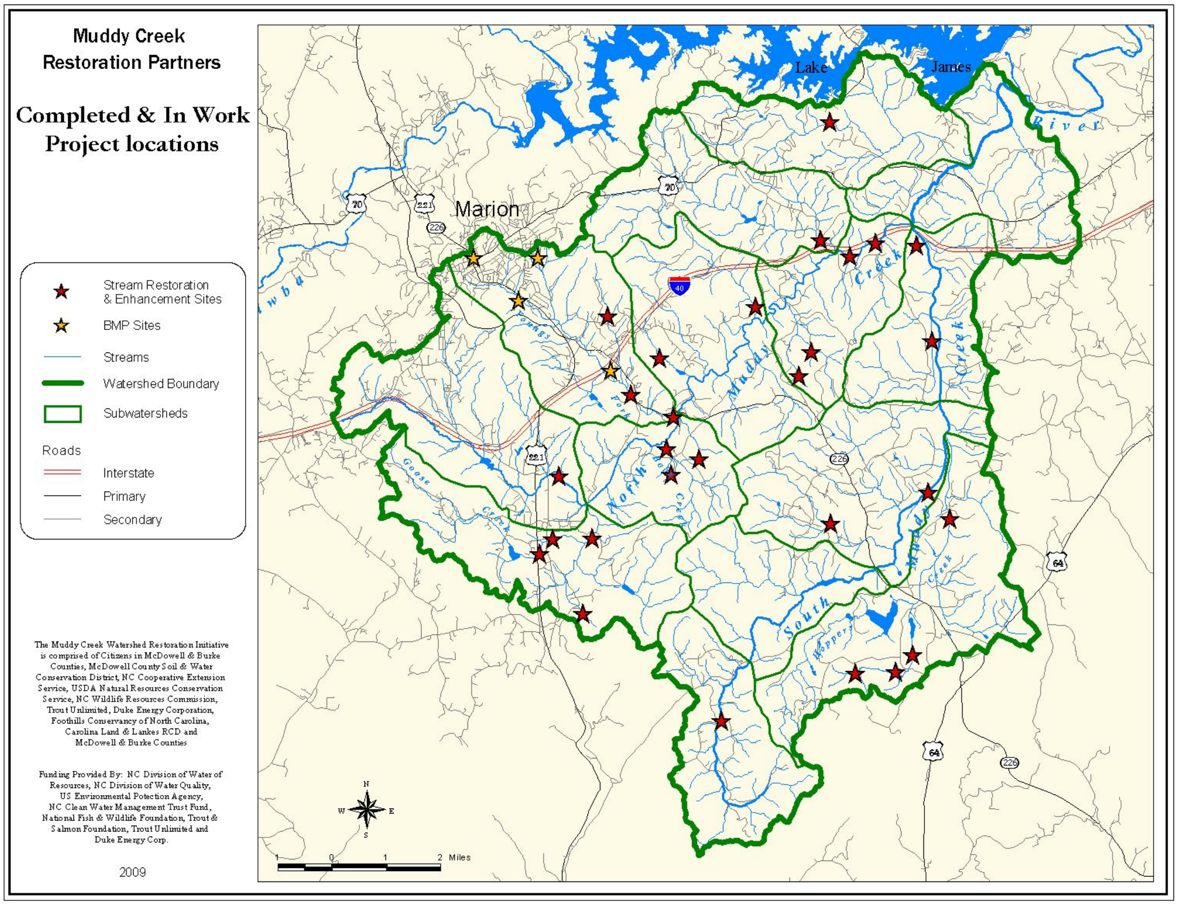
There are currently three subwatershed plans currently in progress. This includes the Muddy Creek, Lower Creek (which also includes Zack's Fork) and Hunting Creek. Any of these subwatersheds could have been a priority subwatershed if plans were not already taking place there.

Muddy Creek Watershed Restoration Initiative has been ongoing since 1998. Members of the partnership include the McDowell Soil and Water Conservation District, McDowell County, Burke County, City of Marion, NC Cooperative Extension Service, Natural Resources Conservation Service, NC Wildlife Resources Commission, Duke Energy Corporation, Trout Unlimited, Foothills Conservancy of North Carolina, Carolina Land and Lakes RC&D, and Equinox Environmental.

Activities accomplished by the initiative include natural channel design restoration, riparian reforestation, and livestock exclusion on 51,200 feet of stream in the Muddy Creek watershed. There is a total of 23 miles (120,000 feet) of stream restoration or enhancement completed or in the process of being completed, one farmland preservation easement protecting 115 acres of farmland and one mile of stream, and five stormwater BMP's completed, or in the process of being completed.

Goals and objectives for the partnership include writing an updated subwatershed plan, monitoring to evaluate improvements to watershed conditions, gaining new partners, making greenway connections, utilizing better stormwater management techniques, encouraging farmland preservation and more stream conservation.

Map D-2: Muddy Creek Restoration Initiative

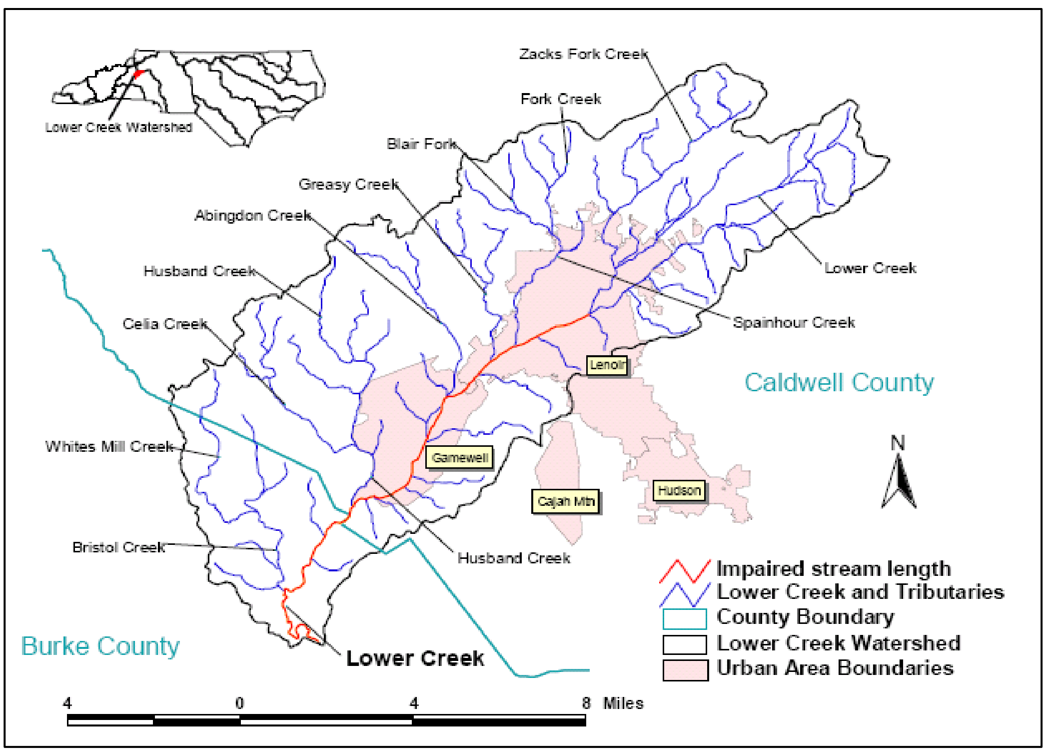


Lower Creek Watershed Enhancement Effort. In 1998, the Western Piedmont Council of Governments published the Lower Creek Watershed Project, which documented water quality problems and named watershed protection and urban stormwater recommendations. This effort included a study of fecal coliform bacteria levels, stormwater outfall mapping, and benthic macroinvertebrate monitoring. Stakeholders were involved in early stages of identifying problems areas and potential management strategies.

In 2003, the North Carolina Ecosystem Enhancement Program (EEP) started follow-up planning in the Lower Creek watershed. The plan expanded on the efforts of the previous work, developing more information on the health of streams in the watershed and identifying causes of degradation. Its goals were to: (1) to assess stream quality in the watershed, identifying key sources of degradation and pollution, and (2) to develop a comprehensive strategy to address watershed needs. The plan is the result of three years of effort involving in-stream data collection on water quality, habitat, and channel stability, Geographic Information System (GIS) data analysis, and development of ecologically and locally relevant management strategies to restore and preserve stream health. A Technical Advisory Committee (TAC) aided the planning team in reviewing data, identifying plan recommendations, and developing implementation priorities. The TAC, comprised of natural resource and planning staff from Lenoir, Caldwell and Burke Counties, non-profit organizations, and regional and state government entities, was essential to the development of a subwatershed plan that incorporates priorities of the local community.

The Lower Creek Advisory Team (LCAT) was formed in August of 2006 at the end of the EEP local watershed planning (LWP) initiative. The LCAT was established as a subgroup of Caldwell County Pathways and represents a continuation of the Lower Creek Technical Advisory Committee (TAC) that supported earlier phases of the LWP effort. The LCAT mission, as determined at its first official meeting in September 2006, is: *"To restore and protect Lower Creek and its tributaries, while increasing public awareness of local water quality issues".*
Further information on the Lower Creek Watershed Enhancement Effort can be found on their website at: http://204.211.224.29/lowercreek2/.

Map D-3: Lower Creek Watershed Enhancement Effort



Hunting Creek Watershed Restoration Project. Equinox Environmental Consulting is working with the CLLRC&D and the Hunting Creek Partners to develop a local watershed plan for the 25.5 sq mi Hunting Creek Watershed. It is a 2 year project funded by the 319 program and CWMTF with the intention of improving the impaired section of Hunting Creek, ultimately removing it from the state impaired list in the long term. Over the next two years they will be collecting fish and chemical data in addition to walking the entire impaired section of Hunting Creek looking at potential impacts. They also will be identifying potential stormwater BMP opportunities to implement throughout the watershed. An additional component of the project is developing a land cover classification dataset for the 25.5 sq mi watershed by digitizing land uses as seen in 2005 aerial orthophotos.

The Rhodhiss watershed plan covers an area of 3,515 acres, hence, the recommendations for this plan cannot specifically apply to many of the smaller projects that could be addressed. Therefore, one of the primary recommendations for this Watershed, is that more localized watershed plans, or subwatershed plans, be completed in each of the nineteen subwatersheds in the Watershed, starting with the priority subwatersheds listed in Section C. Those are Center Morganton, North Rhodhiss, Warrior Fork, and Lower Johns subwatersheds.

The Regional Oversight Group (Recommendation 2) will oversee the development of individual site specific restoration plans for each of the nineteen subwatersheds. These plans will be modeled after work developed for Muddy, Lower, and most recently Hunting Creek subwatersheds. These plans will incorporate the Nine Elements as identified by EPA, and will identify site specific BMPs to be implemented in each subwatershed.

2. Regional Coordination

In order to better coordinate the recommended and ongoing projects and resources in the Lake Rhodhiss watershed, it is important that a regional partnership, or Regional Oversight Group, is established to oversee all of the ongoing efforts in the Watershed. The Regional Oversight Group would also be responsible for updating this plan and better coordinating existing efforts of implementing recommendations as well as sharing technical resources and expertise, and jointly seeking funding.

The Technical Oversight Committee, organized as part of Rhodhiss Project, has discussed the need and possible structure of such a group, as well as the concerns over purpose and functions of such as group. The Regional Oversight Group would exist as not-for-profit, non-partisan group made up municipalities, industries and citizens with and interest in the watershed.

It could possibly be part of the NC Division of Water Qualities NPDES Discharge Monitoring Coalitions Program, similar to the Yadkin Pee Dee River Basin Association.

3. Green Development Practices

Two important conclusions drawn from *Protecting Water Resources with SMART GROWTH* (EPA 2004): (1) Development without specific guidance/boundaries around water resources will almost certainly result in negative impact upon hydrology, water quality, and aquatic habitat; and (2) Protection of water resources and growth are not necessarily mutually exclusive.

Developmental activities that minimize impervious cover, reduce the utilization of closed stormwater conveyance systems and incorporate stormwater management BMPs have less impact upon the natural environment and are referred to as “Low Impact Development” (LID) measures. LID measures are designed to more closely replicate the natural hydrologic system, including infiltration, storage, recharge, and evapotranspiration, thereby allowing development while minimizing the impact upon hydrology, water quality, and aquatic habitat.

LID measures have been successfully implemented in areas undergoing rapid urbanization such as Prince George’s County, MD, Boston, MA and the Puget Sound Region, WA (see technical resources on LID in Appendix C). In addition to utilizing techniques such as cluster development to maximize open spaces, LID incorporates stormwater management measures like grassed swales, bio-retention cells, and permeable pavement to control and/or treat the runoff produced by urbanization. Given the amount of rural area currently within the Lake Rhodhiss Watershed and the current pace of development, the incorporation of LID measures in this development can appreciably mitigate the impact upon resources within the watershed.

Many LID measures – such as narrower pavement width on subdivision streets and the use of grass swales, rather than traditional curb and gutter – conflict with current subdivision standards (NCDOT, 2000), requiring some changes in ordinances to accommodate this type of development. In addition, since the incorporation of LID measures often results in greater development expense (either in construction cost, fewer lots per acre, or both) many jurisdictions have utilized incentives (such as greater overall density allowances) to promote this type of development. Other jurisdictions have mandated that LID measures be utilized in the development of particularly sensitive areas. Since LID can minimize impacts to hydrology, water quality, and habitat, the cost of promoting these measures can be justified by their environmental benefits (EPA, 2004).

Local and county governments should also examine current regulations to ensure that they do not encourage impervious cover. For example, development regulations sometimes specify a large amount of parking lot for commercial and residential facilities that can be minimized with creative methods, such as shared parking.

Both Caldwell and Burke Counties promote the protection of environmentally sensitive areas in certain instances, such as in the Lake James small planning area in Burke County and any area proposed as a "planned unit development" in Caldwell County. Both counties should amend their subdivision ordinances to specify LID and to require open space, setting aside sensitive areas, including floodplains and steep slopes, from development.

In cooperation with the Regional Oversight Committee, a list of green policies will be developed and, with recommendation from that group, be presented to local governments for adoption. This will require staff to review the current local government land-use ordinances and town policies to find out what issues are not being addressed by the ordinances, as well as reviewing the ordinances with local government staff to determine need and possibilities. Finally the changes would be presented to the local governments governing board for adoption.

4. Education and Outreach

The importance of not only educated and interested, but engaged and enthusiastic stakeholders cannot be understated. If one has all the best data and information in a watershed, but does not have willing stakeholders/players in the watershed, it is very difficult to implement measures to bring about improvement. A detailed, more theoretical discussion of the importance of education and outreach is found in Appendix II.

It should be noted that in addition to developing this Watershed Restoration Plan a public education effort is also a component of this project.

There have already been many educational/outreach efforts by several organizations in the watershed to make folks aware of the problems and potential solutions. Some examples include:

- The 6th annual *Catawba Riverfest* in 2008 attracted over 800 visitors to tour lake-side environmental education booths;
- Lenoir has hosted a *Go With the Flow Festival* in spring on its Greenway since 2007;
- Regional *Earthday Events* in Morganton and Hickory have been coordinated regionally since 2008;
- Regular production of TV programs focusing on Watershed Issues on local cable TV, Caldwell County Today and distributed to other surrounding TV outlets;
- Environmental film nights;
- Various Workshops.

Yet, the following education/outreach activities are ongoing as funding allows but they are not as funded, targeted, coordinated or planned as is desirable.

Table D-1: Education/Outreach Activities

• Websites with relevant information
• Newspaper Articles and Press Releases
• Brochure/Announcement – General Mailing(s)
• TV PSA
• Radio PSA/Talks Show
• Letters (electronic) to Targeted Sectors
• Workshops/Meetings within watershed (e.g., civic centers, schools, churches, etc.)
• School Programs
• Tours of watershed/management measures
• Stream Cleanups/Volunteer Monitoring

As part of the EPA's NPDES Phase II Stormwater Regulations (EPA, 1999), a public education and outreach program is required that will help citizens understand the impact their actions (and the actions of others, such as developers and contractors) have upon the watershed. The EPA recommends that such a program inform individuals and groups how to become involved in local stream restoration activities and give guidelines for minimum measures to accomplish this requirement (EPA, 2000).

A defined public education program is essential to the development of a responsible public attitude toward watershed management. As citizens understand the importance of hydrology, water quality, and aquatic habitat to their quality of life, as well as the consequences of their actions upon these attributes, they will pay greater attention to activities that might have detrimental consequences. Several of the major municipalities in NC have established successful stormwater public education programs and can be contacted regarding the details of their programs. In addition, the Regional Councils of Governments have helped to coordinate efforts for there local area governments.

In 2007, the Lower Creek Technical Advisory Committee recommended the following four elements for a public education program in the subwatershed:

> **Establish a Clear Water Contractor Program.** Clear Water Contractor programs have been applied to a number of areas in western North Carolina. RiverLink (http://www.riverlink.org/), a watershed group that seeks to revitalize the French Broad River watershed, provides Clear Water Contractor workshops to contractors on appropriate sedimentation and erosion control measures to apply during site preparation and development.. Caldwell and Burke Counties should each establish its own Clear Water Contractor program. Once Caldwell County has assumed an erosion and sedimentation control program, it could offer developers reduced erosion control permit fees if their staff attended the training. Burke County could offer incentives for participation, providing quicker review of development plans (e.g., subdivision plats) for those who complete the course.

Identify and quantify the economic effects of poor water quality in the watershed. Economic effects of poor water quality should be quantified and shared with decision-makers and citizen groups. The Western Piedmont Council of Government (WPCOG) has developed slides that cover drinking water, wastewater, property loss/degradation and other costs.

Develop a brochure outlining steps citizens can take to protect water quality in the watershed. The WPCOG has developed a brochure that will be used by local governments in Burke and Caldwell Counties to assist them with meeting the new NPDES Phase II stormwater requirements. The brochure focuses on steps citizens can take to protect Lake Rhodhiss as a drinking water source. This should be shared with area citizens.

Establish a local watershed council. A watershed council could serve as a local voice for issues affecting the Rhodhiss watershed. However, this will only be effective if it is staffed and developed with local citizens. Local government or resource agency staff could potentially play a vital role in supporting such a council from a technical standpoint once a citizen-based group with a leader is established. This council could oversee a watershed stewardship program, which can be a very effective tool for gaining stakeholder consensus, engaging interested parties to keep "watch" over activities affecting the lake, and identifying a champion for various watershed improvement projects. The NCDENR supports such an organized watershed stewardship approach through its Stream Watch Program.

A watershed council such as the current Lower Creek Advisory Team, in addition to keeping watch over current activities within the watershed, serves as the catalyst for ensuring that the recommendations made in this Watershed Plan are followed through and serve as an essential part of a coordinated watershed management strategy.

5. Best Management Practices

Non-Agricultural Strategies

Effective stormwater management is essential for the protection of streams and Lake Rhodhiss. The City of Lenoir has been highly developed both commercially and industrially over many decades. As the surrounding area continues to experience growth, some of the agricultural and forested areas in the watershed will be developed over the next several decades.

A best management practice (BMP) is a practice or combination of practices providing the most effective and practicable means (including technological, economic, and institutional considerations) of controlling point or non-point source pollutants at levels compatible with environmental quality goals. A stormwater BMP is a technique, measure, or structural control used to manage the quantity and improve the quality of stormwater runoff in the most cost-effective manner. These stormwater BMPs may provide flow control, pollutant removal or pollution source reduction, either individually or in combination.

Land management BMPs impact both the quantity of stormwater runoff and the amount of pollution entering water bodies as a result of land development activities. Improvements in land management are necessary to reduce the delivery of pollutants to water resources and prevent flooding and stress of channels downstream of the development. In general, these practices serve to promote infiltration of rainwater, slow runoff velocities and filter out particulate matter and other pollutants in stormwater runoff. Minimization of impervious surfaces and the protection of natural riparian buffers are two core strategies within this category of management practices.

BMPs that increase stormwater retention time, promote infiltration and provide filtration should all be incorporated into the compliance strategy for post-construction stormwater management regulations. Site plan review for new developments should address storm water quality as well as storm water quantity issues.

It is important to develop individual subwatershed plans in the larger Rhodhiss Watershed in order to determine specific places to encourage the use of appropriate Non-Point Source BMPs within the watershed that are the most beneficial in removing nutrients. The Regional Oversight Committee should encourage those responsible for the individual subwatershed plans to continue to utilize and refine those plans. It is also important that the agricultural community and support agencies continue to support and promote adoption of BMPs through technical and financial assistance programs.

6. Stormwater Management

Rain that falls and strikes impervious surfaces is almost immediately converted to runoff. The initial slug of runoff generally carries heavy loads of sediment and other pollutants with it. Engineered structures such as curb and gutter systems, storm drains and culverts efficiently and rapidly collect this water from streets and parking lots and pipe it directly into streams. Relatively small storms (greater than or equal to 0.25 in.) may be sufficient to generate runoff volumes that cause levels in streams to rise rapidly or "flash." As the rain continues, increasing volumes of runoff erode stream banks and valuable habitat and biota alike may be swept away as scouring occurs. Over time, as development increases within the watershed, the probability of flooding on an annual basis increases as the runoff generated increases each year, until during large storm events, the amount of runoff exceeds the stream channel's natural capacity to adequately handle these large volumes of water.

An (urban) stormwater management BMP is designed to limit the hydrologic (increased runoff) and water quality impacts of changed land uses, primarily from residential or commercial development. These practices utilize measures such as detention, settling, infiltration, and filtration to decrease the peak stormwater flow rate (thereby reducing downstream erosion and flooding) and remove pollutants (e.g. oil and grease, metals, nutrients, sediment) from the stormwater.

Wet Detention Ponds. Stormwater detention ponds excavated below the normal groundwater table contain water at nearly all times. Storage area is available above this normal water level where, during storm events, stormwater is temporarily detained and released downstream at controlled rates to limit downstream flow. The detention time within the wet pond facilitates the settling of sediments (along with other pollutants that attach to these sediments). Such facilities are 70% or more effective in the removal of suspended solids (NC Cooperative Extension Service, 1999). Larger, more regional, ponds are generally more effective and maintainable than small ponds designed to handle stormwater from small (<20 acre) sites.

Bio-Retention Areas. Bio-retention areas combine stormwater management with landscaping to retain stormwater (particularly from small, more frequent rain events) in order to enable infiltration and evapotranspiration by plants within the area. These types of facilities are well-suited to parking lots, where traditionally drainage is collected in a closed system and conveyed offsite. Utilization of a bio-retention area provides a means to control runoff to pre-development levels by retaining runoff from impervious areas in a facility designed to replace the function of the vegetation and soil areas that have been rendered impervious through development.

Reinforced Grass Swales. The historic function of drainage design was to collect and convey stormwater runoff downstream as quickly as possible, resulting in both increased flow rates and velocities, and reduced infiltration and evapotranspiration of runoff. Historically, drainage systems minimized the amount of overland flow, quickly channeled runoff into closed systems for conveyance away from the site and were dominated by curbs, gutters, inlets and piped systems. Using grassed swales for collecting and conveying of stormwater runoff enables overland flow to enter the swale along its entire length, promoting infiltration through the channel walls and providing a degree of filtration through the grass media, which removes sediments and other pollutants. Turf Reinforcement Matting enables the grass to become established and protects the channel walls from erosion. From the standpoint of managing both stormwater quality and quantity, open channels are superior to a closed system.

Level Spreaders in conjunction with Riparian Buffers. Forested or grassed vegetated buffers along streams provide a combination of filtration, depression storage, infiltration, and evapotranspiration, which both reduces the quantity of runoff (as compared to a closed channelized system) and removes many pollutants, including sediments and nutrients. Care must be exercised in grading these buffer areas to maintain overland (sheet) flow of runoff and minimize the potential for runoff to become channelized. Channelized flow is prone to develop erosive velocities and minimizes the filtering effect provided by sheet flow through the buffer area. Maintaining slopes of 2% or less and ensuring that an established bed of ground vegetation is maintained will serve to prevent such channelization within buffer areas.

Constructed Wetlands - Constructed stormwater wetlands are designed for temporarily storing stormwater runoff in shallow pools that create growing conditions suitable for emergent and riparian wetland plants. The runoff storage, complex microtopography and emergent plants in the constructed wetland together form an ideal matrix for the removal of urban pollutants. In North Carolina, constructed stormwater wetlands include two basic designs: extended detention wetlands; and, for smaller sites and in combination with other BMPs, pocket wetlands. When designed and constructed to the NC DENR guidelines (NC DENR, 1999), these structural BMPs are assumed to achieve 85% removal of total suspended solids.

These five stormwater management practices are examples of BMPs that have general application throughout the areas of this local watershed undergoing development, as well as in those areas where redevelopment is occurring. More detail on these BMPs can be found in the technical resources listed in NC DENR Stormwater BMPs Manual (updated on DENR website http://h2o.enr.state.nc.us/su/bmp_forms.htm). An excellent starting point for additional information on urban stormwater BMPs is the website of Dr. Bill Hunt (N.C. State University, Stormwater Engineering Group): http://www.bae.ncsu.edu/people/faculty/hunt/ .

The Stormwater Working Group (SWWG), an active subcommittee of the Catawba River Task Force, was formed to work cooperatively and synergistically to assure consistent implementation of program components throughout our region and to share expertise and other resources. This staff level group supported by the WPCOG has worked without project specific funding to support this endeavor, such as: facilitating meetings; assistance in preparing annual reports; developing workshops; arranging speakers and seminars; preparing outreach materials and presenting to various groups and at events. The SWWG has been voluntarily assisting Phase II Stormwater communities in the region for nearly a decade. The Stormwater Programs are not all fully funded and staffed, so ongoing training for Stormwater Staff and Public Service personnel is needed.

In order to better fully implement stormwater permits and management plans throughout the region in conjunction with current Phase II Programs it is recommended that there be better coordination between ongoing projects and resources in the Rhodhiss watershed. In order to do this, it is important to develop an organizational structure that works best to achieve collaboration and allows coalition members to remain independent organizations.

7. Sedimentation and Erosion Control

Sedimentation and Erosion Control programs provide legal basis for the regulation of construction activities to ensure that sedimentation and erosion is minimized. However, this regulatory control is only as effective as is the associated monitoring of construction and enforcement of the ordinance. The challenge faced by many local governments, particularly those experiencing rapid development, is providing an adequate level of construction monitoring with a modest staff of erosion and sediment control inspectors. In fact, during the field investigations conducted as part of this planning process, numerous examples of sediment-laden waters downstream of construction activities were observed.

Caldwell County developed a local sediment and erosion control ordinance in compliance with the State's Sedimentation Pollution Control Act of 1973 (SPCA) and assumed responsibility for implementation of the requirements of the SPCA within all of Caldwell County in October 2007. In early 2009, in an effort to reduce costs by eliminating staff necessary to operate the program, Caldwell County returned administration of the Sediment and Erosion Control Program to the state.

Currently, Burke County does not intend to assume a local sediment and erosion control program and depends on the State's Division of Land Resources program to enforce state regulations.

In order to determine if Sedimentation and Erosion Control Ordinances are being effectively enforced, there needs to be a review of current policies related to sedimentation and erosion control regulatory and oversight processes and a plan implemented to promote corrective action for deficiencies. This will require the formation of an advisory group, as well as staff that can gather the current policies, interview the appropriate personnel, compare the findings, and identify the deficiencies and recommend corrective actions.

Some local governments have increased development review and processing fees to fund additional field resources for Sedimentation and Erosion Control monitoring. In addition, when the public becomes aware of the cause and effect of construction-related erosion and sedimentation problems, they will be more likely to become involved in identifying construction sites that are the source of such problems, thus enforcement actions may be taken. It is also important to educate grading contractors and heavy equipment operators on the regulations. It is recommended that each jurisdiction establish an Sedimentation and Erosion Control "hot-line" where calls can be taken from the public. In this way, the monitoring resources of the state and local jurisdictions can be more effectively leveraged into action.

8. Secure Adequate Funding

All of the recommendations listed in this Plan, with the exception of regional coordination, generally require some type of funding. Funding sources can include Federal agencies like the US EPA or USDA; State agencies like the North Carolina Division of Water Quality; as well as a combination of local resources. Ultimately, it will be up to the Regional Oversight Group to provide coordination of grant applications, instruct staff to write and administer the grants, and to increase the awareness of available grants.

Steps in acquiring funding include identifying funding sources most appropriate for each recommendation in the Plan, identifying project partners, developing pre-proposals for grant applications, and obtaining letters of support from partners as needed.

9. Onsite Residential Sewage Treatment Systems

Water quality in western North Carolina is threatened by the discharge of untreated residential wastewater into streams, either through leaking septic tank systems or straight piping. Often, the homes identified as having wastewater disposal problems are located in low-income areas of the state and citizens cannot afford to make the necessary repairs. The Western Piedmont COG organized a program that targets straight piping situations or faulty septic tanks and provides a grant or a loan to repair the home so that it meets compliance with NC environmental standards. The money lent out to fix septic tanks was supplied by a grant from the NC Clean Water Management Trust Fund. The low-interest loans are repaid over five years, perpetuating the repair program and helping NC citizen make repairs to their home they would have been unable to afford otherwise. Approximately, 300 home systems were repaired or replaced through this program, approximately 50% in the Rhodhiss watershed. There is obviously a need for a program of this nature, as attested to by the regular calls for assistance from homeowners and the local environmental health inspectors. There have been No new loans or grants since November 2007.

The WPCOG will continue to operate and try to acquire adequate funding for the Unifour Septic Tank Repair Program, and will plan to restructure the existing program to more efficiently distribute funding and administer the program.

10. Geographic Information System (GIS)

To better make determinations about sources of pollution in the Rhodhiss Watershed, as well as the nineteen subwatersheds, it is important to have the best up-to-date GIS information for planning and assessment. In order to do this the Plan recommends acquiring adequately funded and trained GIS professionals to secure necessary datasets, hardware and software, analysis raw data, develop layers, and run analysis. Current and high resolution GIS layers available for use with watershed planning projects will promote nutrient reductions through increased understanding and linkage with monitoring data.

The Western Piedmont Council of Governments (WPCOG) currently has six full-time and four part-time GIS staff, with four of those at the analyst level. Similarly, a few of the larger local governments have GIS staff and most departments are growing.

11. Instream Substrate Disturbances

The use of suction dredges for recreational gold mining in tributaries to Lake Rhodhiss is a potential threat to water quality. The suction dredge is the best method for the small miner to recover gold from underwater deposits. This activity is generally done as a recreational activity to collect gold from the sediments. Dredging is a relatively inexpensive method of mining for small one or two man mining operations. Typically suction dredge mining increases the suspended solids/turbidity in the stream, and can thus may cause an increase in nutrients bound to the sediments and transported to Lake Rhodhiss.

The resulting increased turbidity can be adverse to aquatic life habitat in the water column and in the stream bed. Harvey and Lisle (1998) reviewed some of the potential impacts of suction dredge mining, focusing on aquatic habitat impacts on fisheries. Their review discussed many of the issues of concern, and concluded, "Suction dredging and associated activities have various effects on stream ecosystems, and most are not well understood."

It is argued that suction dredges do not add pollution to the aquatic environment. They merely re-suspend and re-locate the bottom materials (overburden) within the river or stream. It has also been suggested that this activity can also have some positive effects to the substrate and stream system. Currently this issue is being actively discussed, studied and litigated in some Western States. Outcomes of the Western US problem may have some relevance to our situation, minus the mercury component.

The magnitude of the impacts of suction dredge mining seems to be site-specific and depends on a variety of factors including stream characteristics, and dredge characteristics and operation. If suction dredge mining is allowed, it could be regulated by permitting and required monitoring to help ensure that the potential adverse impacts are controlled to a sufficient degree to protect water quality and beneficial uses. The permitting of suction dredge mining could include a sufficient permit fee to cover the cost of adequate monitoring/management of the activities.

Before anything else can be done, it will be important to

- assess the current extent of gold dredging activity,
- determine potential extent of future dredging activity,
- study the extent of nutrients introduced by the activity
- compare the natural movement of materials by stream processes

- evaluate the activities impact on aquatic biological communities,
- analyze alternatives,

Once these objectives have been completed, it will be time to make recommendations for action. The result of this could be restrictions on the use of suction dredges for recreational gold mining in the watershed.

Other instream substrate disturbances related to livestock in the stream are addresses in the Agricultural section. Larger scale dredging activities are permitted and ongoing in the main stem of the Catawba to increase boat access to areas affected by sediment accumulation. Using heavy equipment for dipping for sand is another activity whose extent of use and impacts remain to be well understood.

12. Riparian Buffers

Riparian buffers have been shown to improve water quality and protect stream banks from erosion. The State of North Carolina has adopted Riparian Buffer Rules (15A NCAC 02B.0243) which require a 50-foot vegetated buffer along the Catawba River (below Lake James) and along the mainstem lakes within the Catawba River Basin, which includes Lake Rhodhiss. Burke County has adopted a buffer ordinance that requires all woody vegetation within 65 feet of Lake Rhodhiss be protected. Caldwell County's draft stormwater management ordinance specifies the preservation of 50 ft buffers on perennial streams and 30 ft buffers on intermittent stream for land under development.

As areas of previous agricultural usage are developed, it is important that attention be given to the preservation or re-establishment of vegetated buffer areas. In the interim, while agricultural activities continue to be significant in these areas, agricultural best management practices (BMPs) should be encouraged (See Section E).

Significant threats to both water quality and aquatic habitat were identified in the Watershed Assessment Report. These threats can be mitigated, in part, through the extension of the requirement for vegetated buffer strips along perennial and intermittent streams within the watershed.

It is recommended that each local government having jurisdiction over the Lower Creek local watershed adopt and enforce ordinances that extend the protection of 50-foot vegetative buffers to the perennial and intermittent streams that comprise the watershed, and to encourage more streamside areas left undeveloped or restored with functioning buffers. It is also important to develop and promote incentives for non-agricultural, smaller property owners who voluntarily establish and maintain buffers along streams within the watershed and to educate landowners on the environmental and tax benefits of establishing riparian buffer.

13. Long Range Land-Use Plans

Because of the importance of the water supply from Lake Rhodhiss and the agricultural, industrial and commercial activities occurring within this watershed, land use plans can be an essential tool for preserving drinking water quality.

Some local governments in Burke, Caldwell and McDowell Counties have recently or are developing or revising their comprehensive land use plans. In addition, Caldwell County is developing its stormwater program in response to EPA's Phase II Stormwater Management Permit requirements. It is therefore an opportune time to reexamine the institutional measures regulating land development aspects that have an impact on stream health.

The EPA includes watershed-based zoning in its guidance on Post-Construction Storm Water Management (EPA, 2003). In that guidance material, Watershed-Based Zoning is defined to include a mixture of land use and zoning options with the following nine steps:

1. Conduct a comprehensive stream inventory.
2. Measure current levels of impervious cover.
3. Verify impervious cover/stream quality relationships.
4. Project future levels of impervious cover.
5. Classify subwatersheds based on stream management "templates" and current impervious cover.
6. Modify master plans/zoning to correspond to subwatershed impervious cover targets and other management strategies identified in Subwatershed Management Templates.
7. Incorporate management priorities from larger watershed management units such as river basins or larger watersheds.
8. Adopt specific watershed protection strategies for each subwatershed.

9. Conduct long-term monitoring over a prescribed cycle to assess watershed status.

Most of the work in the first five steps has been completed as a part of this planning process. GIS files have been established with attributes such as impervious cover, land use, and zoning layers for each of the 19 subwatersheds that comprise the Lake Rhodhiss watershed. Steps 6 through 8 could be spearheaded by a local stakeholder group including representatives from the planning departments of Caldwell, Burke and McDowell Counties and their municipalities. This stakeholder group can review the current comprehensive land-use plans relative to the steps listed above, note the needed changes, and present suggestions/recommendations to the governing board of the local government for adoption.

14. Greenways Adjacent to Streams

> *"People do not care about what they cannot see."*

Greenways are useful for recreational, educational, wildlife, and transportation purposes, but they can also be used to establish much needed riparian buffer along waterways in the Rhodhiss Watershed. An additional benefit is increased public access to the waterways which in turn provide more eyes to report potential problems and an increased public awareness. Often easements or fee-simple purchase of riparian buffers on waterways can be turned into greenways, and can sometimes be the catalyst for protection of the waterways. There are two major Greenway projects in the watershed, one in Morganton, and the other in Lenoir.

City of Morganton Greenways. In the early 1990's, the City of Morganton acquired large amounts of property along the Catawba River, which meanders nearly eight miles through the corporate limits of the city. The City was able to acquire six miles of river front through an aggressive grant writing campaign in the early 1990s. With this river frontage, Morganton was able to develop an extensive regional bikeway and pedestrian greenway system along its river front to provide recreation to its citizens and users from areas well outside the City of Morganton. It has been highlighted numerous times in regional and national conferences.

The two main sections of the City of Morganton greenway include the Catawba River Greenway and the Freedom Trail Greenway. The Catawba River Greenway Park offers at total of 3.8 miles of paved, fully accessible walking trail. The Catawba River

Greenway runs along the Catawba River from the Rocky Ford Access area off Lenoir Road/NC 18 N. to the Greenlee Ford Access adjacent to the Catawba River Soccer Complex Loop located off Greenlee Ford Road.

City of Lenoir Greenways. The Lenoir Greenway includes a 7.3 mile system of paved trails that allow for walking, biking, jogging, skating, and more on 25 acres. A major section of the trail is the Town Creek Greenway which consisted of two phases. The first phase was a ½ mile walking and bike trail located on Broadway (Highway 11) that connects to Rock Spring Park.

Phase II of the Town Creek Greenway system was completed in 2006. The additional trail will began at the Rock Springs Park area, run along the creek through the Wampler Keith Park and commence at the Lenoir City Middle School property. It ends adjacent to the new Lenoir City Swimming Pool Complex. Phase II added approximately 1.25 miles of trail to the greenway which made the total length 1.75 miles one way.

Encouraging greenways adjacent to streams could be done in conjunction with recommendation 3: "Green Development Practices". In addition, GIS can be used to help map out undeveloped riparian corridors appropriate for potential greenway locations. It is also important to educate the public and local government officials on the benefits of greenways to the environment and to the public.

15. Water Quality Monitoring

The Regional Oversight Group will continue water quality monitoring to identify problem areas and document improvements. This will be done by utilizing previous monitoring locations, as well as adding new monitoring sites as needs occur.

Collection of water quality data will occur periodically, with pre- and post- monitoring at restoration and BMP sites. A cost effective way to accomplish the monitoring would be to incorporate a volunteer monitoring component, though training, coordination and quality control of volunteers would be needed. Lenoir Rhyne University's Reese Institute for the Conservation of Natural Resources has some student macroinvertebrate sites that can utilized for monitoring water quality as well.

The NPDES Discharge Monitoring Coalition Program, developed by DWQ, is being reconsidered in fall 2010 and could form the basis for what will become the Regional Oversight Group. The NPDES Discharge Monitoring Coalition Program was developed to utilize NPDES in-stream monitoring requirements to create an effective program for assessing water quality within a watershed. Permit holders voluntarily develop a monitoring program with DWQ that is designed to evaluate the coalition's interests and their specific watershed issues. In order to better utilize existing resources, the monitoring locations are coordinated with the State's existing ambient and biological monitoring networks. This integrated management of monitoring resources reduces duplication and provides a more complete picture of watershed conditions.

Estimated Load Reductions from Urban Management Recommendations

Many of the activities will only very indirectly reduce nutrient loading to the lake:

- Subwatershed Planning;
- Coordination;
- Education and Outreach;
- Securing Funding;
- GIS data;
- Reviewing Plans; and
- Monitoring

Yet they are essential an indirectly are anticipated to help with the nutrient loading to the Lake. Many of the above recommendation will act to encourage good environmental stewardship and as those practices are implemented, we expect to see a resultant loading reduction. Estimates for what that reduction would be are at best guesses and best not calculated as reductions to nutrient loading at this time.

Several other recommendations:

- Use of BMP's,
- Stormwater Program Implementation,
- Residential Septic System Repair,
- Restriction of Instream Gold Mining, and
- Riparian Buffers

could result in reductions in nutrient loading directly attributable to the practice implements. Table D-2 presents the Total Suspended Solids (TSS), Total Nitrogen (TN), and Total Phosphorus (TP) removal efficiencies of the BMPs discussed in this Section. These removal efficiencies assume the BMPs are designed in accordance with the *NCDENR Stormwater BMP Manuel*.

Table D-2: BMP Ability for Stormwater Quantity Control

BMPs	Quality Control	TSS Removal Efficiency	TN Removal Efficiency	TP Removal Efficiency
Bioretention w/o IWS	Possible	85%	35%	45%
Bioretention with IWS	Possible	85%	60%	60%
Stormwater wetlands	Yes	85%	40%	40%
Wet detention basin	Yes	85%	25%	40%
Sand filter	Possible	85%	35%	45%
Filter strip	No	25-40%	20%	35%
Grassed swale	No	35%	20%	20%
Restored riparian buffer	No	60%	30%	35%
Infiltration devices	Possible	85%	30%	35%
Dry extended detention basin	Yes	50%	10%	10%
Permeable pavement system	Possible	0%	0%	0%
Rooftop runoff management	Possible	0%	0%	0%

NCDENR Stormwater BMP Manuel

Section E
Agricultural Non-Point Source Strategies

Modeling and monitoring results have shown that the NPS contribution of nutrients from both non-agriculture and agriculture sources combined, is less than that contributed by the watersheds four WWTPs (Figures E-1, E-2 and E-3). However, both sources still contribute a significant portion perhaps half of nutrients and most of the sediments enter the lake are from these two NPSs and therefore need be addressed. Non-Agriculture inputs of nutrients were discussed in Section D. This section (E) will discuss the agricultural impacts and provide recommendations for minimizing nutrient loading which contributes to the lake's impairment.

Figure E-1 Phosphorus Loading Sources (Jon Knight, 2009)

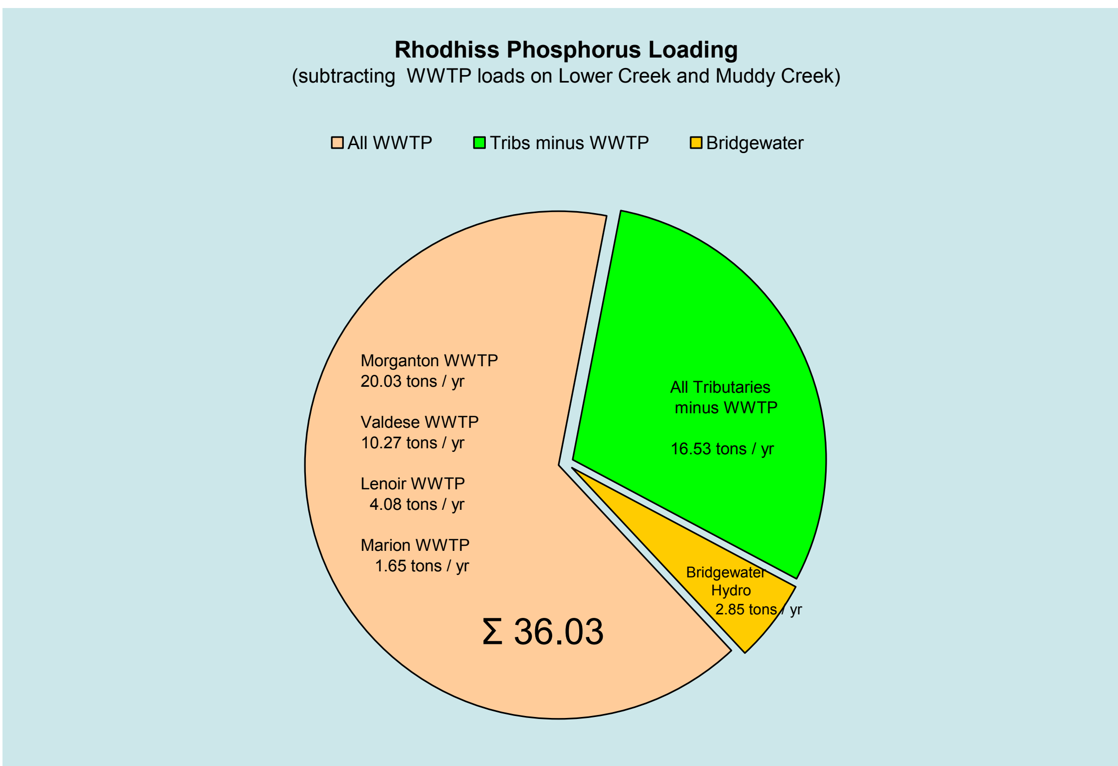


Figure E-2 Phosphorus Loading Sources (Jon Knight, 2009)

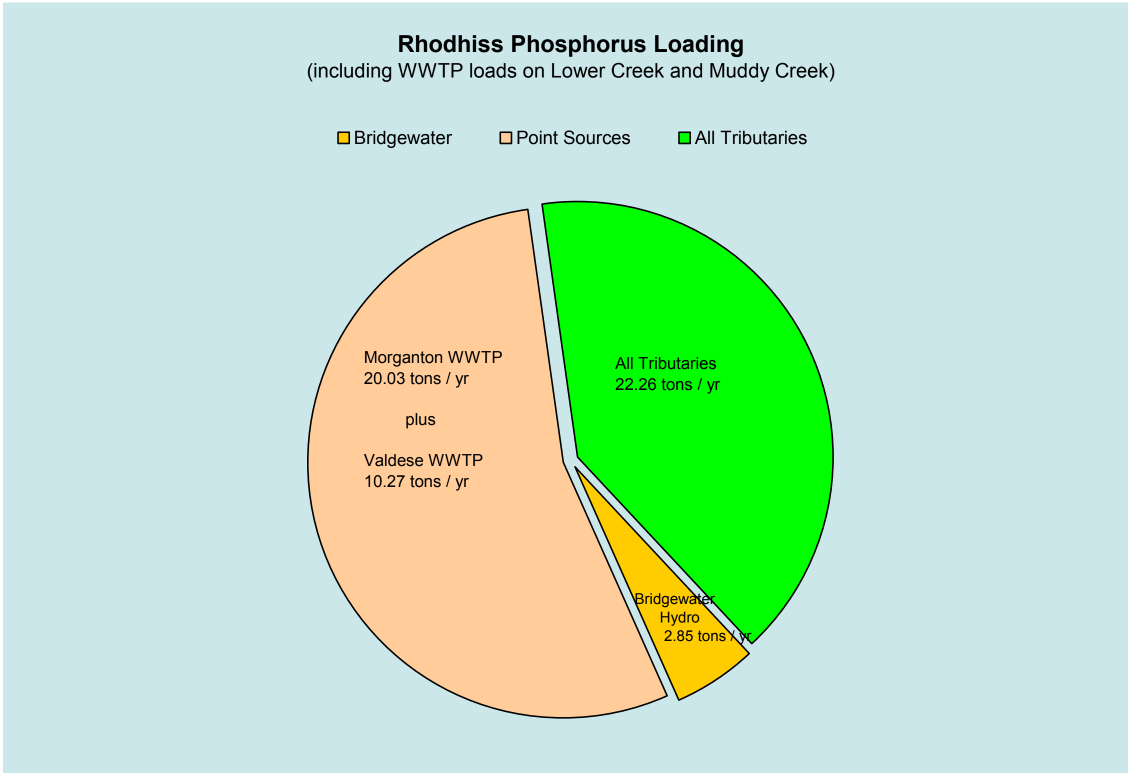
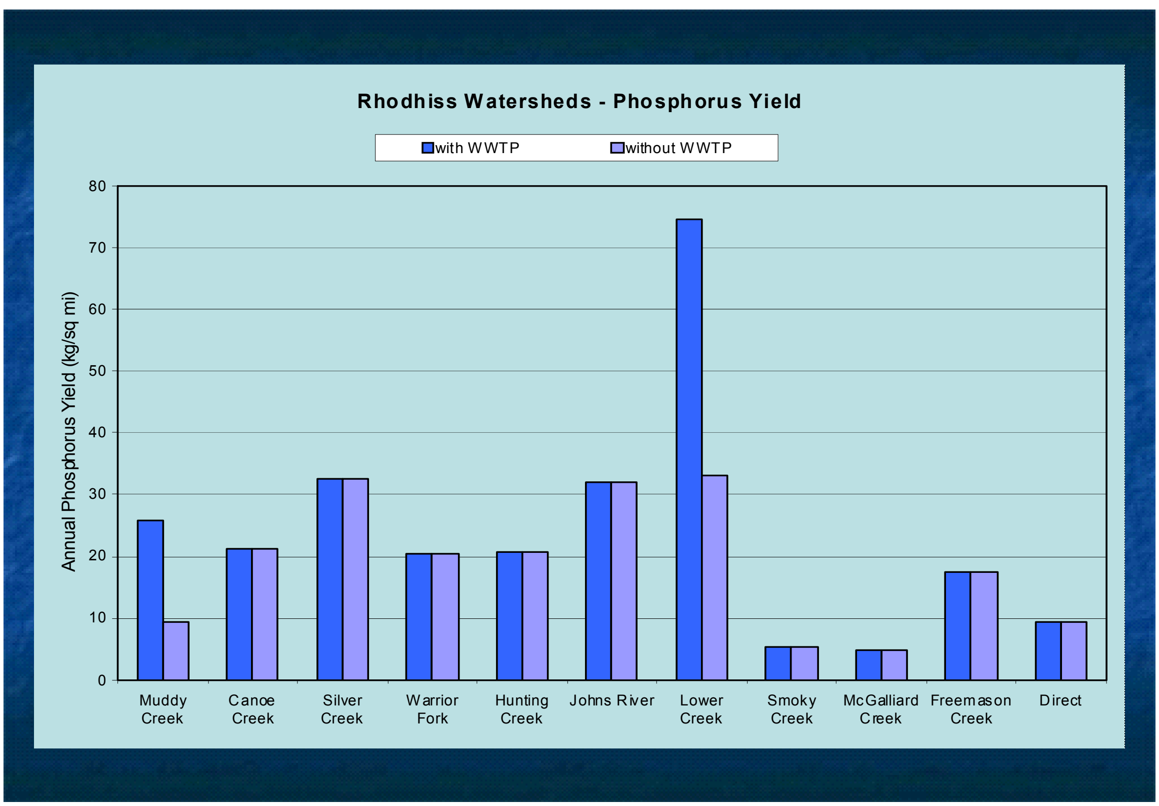
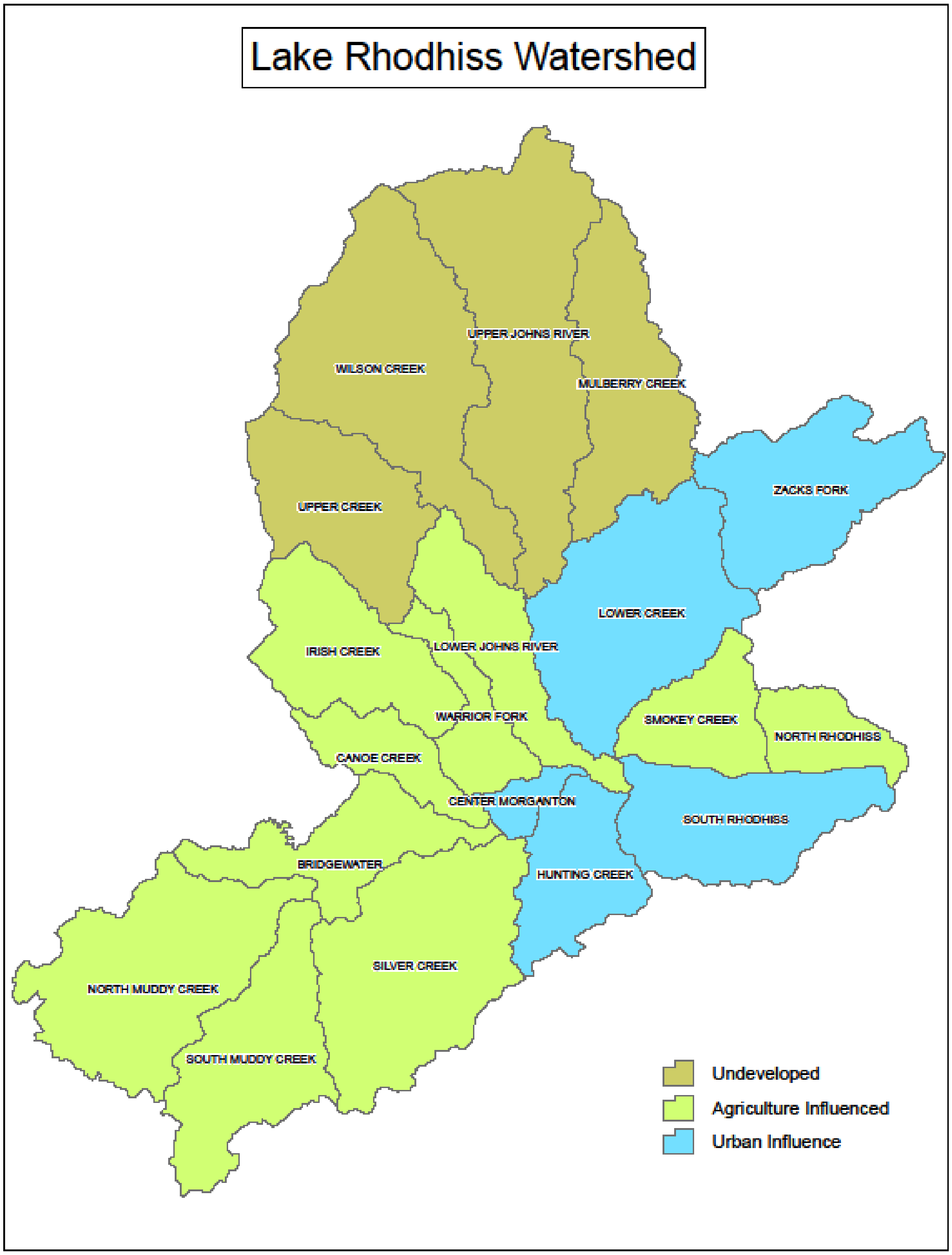


Figure E-3 Phosphorus Loading by Subwatershed (Jon Knight, 2009)



The following map serves as a general representation of the primary character or influences on each of the subwatershed in the Basin: Urban, Agricultural, Undeveloped (Forested).

Map E-1 Subwatershed Primary Influence Map (Stakeholders Classification, 2008)



It is difficult even on the subwatershed scale to agree on the most appropriate classification for each watershed. All subwatersheds in the draining to Lake Rhodhiss have multiple land uses. It is clear that outside the urbanized centers the subwatersheds are influenced by agriculture and/or silvaculture operations. Although the Agricultural Technical Advisors (NRCS, SWCD, Cooperative Extension) generally agreed with the classifications of Stakeholder Advisory Group they noted such thing as:

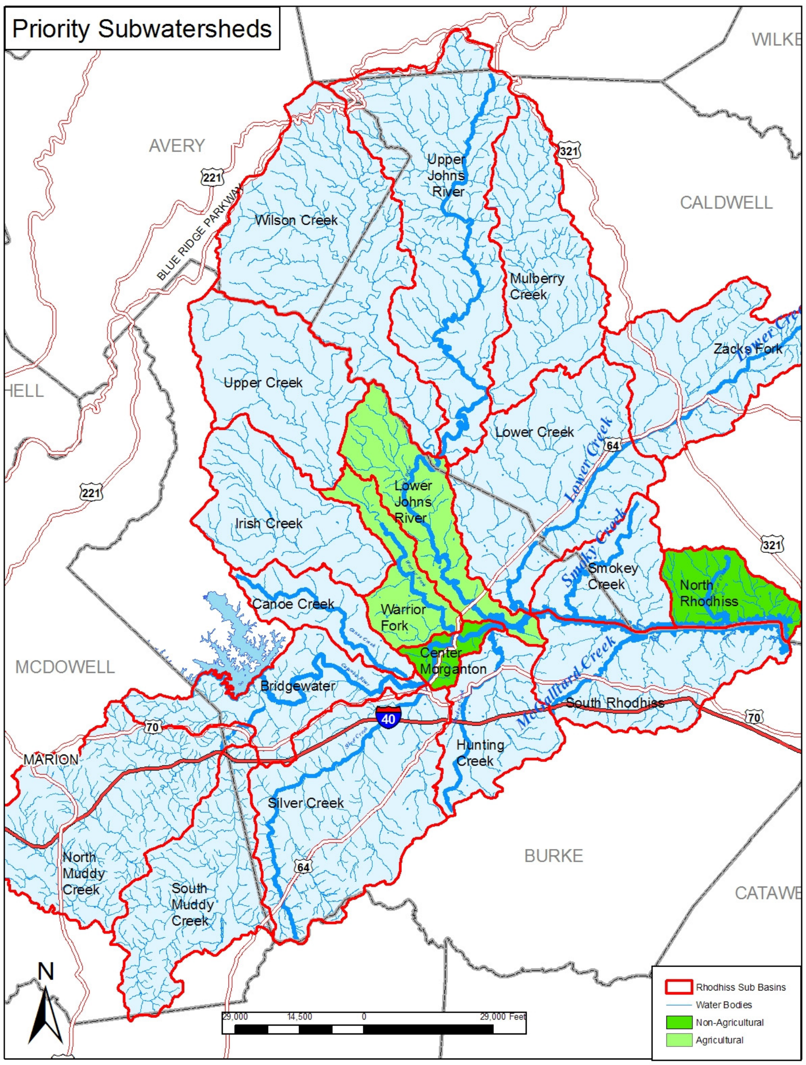
> In the Upper Johns and Mulberry Creek subwatersheds you will find a significant number of ornamental nurseries taking up the majority of the flood plain in the less mountainous topography of the in the lower 15% of each basin, yet on a whole we classified these as undeveloped.
>
> Likewise, Lower Johns could be classified as undeveloped with only four large farms in the floodplain but this is a very narrow strip of farmable land with the lower end near the lake primarily classifiable as wetlands or gamelands.
>
> Lower Creek and Zacks Fork although arguably the most urban influenced subwatersheds in Caldwell County, have over 1,000 acres of ornamental nurseries, with most of the stream channels manipulated to increase available land for cultivation or pasture in the flood plains. Livestock also exerts an influence in Zacks Fork with fewer BMP practices in place than is desirable.
>
> The lowest section of Silver Creek subwatershed is within the city limits and ETJ of Morganton and has sections or industrial, commercial and residential development, yet the majority of the watershed is still agricultural in nature. A concentration of poultry rearing operations in this subwatershed (16+) and associated livestock make this watershed distinct from others subwatershed designated primarily agriculturally influenced.

More detailed maps and information on each subwatershed characteristics is found in Section B of the Plan.

Agricultural Focus Areas

Using information and methodology outlined in Section C, a single primarily agriculturally influenced subwatershed was to selected by the Stakeholder Advisory Committee as an area to concentrate resources as we move forward with restoration efforts. The chosen subwatershed for increased use of agricultural NPS control strategies was initially Warrior Fork which is dominated by ornamental nurseries is near Morganton's urban center. Warrior Fork has not had groups outside of agricultural agencies or DENR work with the landowners in that area. It should again be noted that two major tributaries, Muddy and Lower, which drain five of the 19 subwatersheds have had be watershed planning and restoration work ongoing for over a decade each. Although work needs to and is continuing in those watersheds they were excluded from the prioritization process. It is our recommendation and hope that the successful though different models of cooperative partnerships and key players in Muddy and Lower be applied as applicable to other subwatersheds with similar characteristics and issues.

Map E-2: Priority Subwatersheds



When prioritizing watersheds, the Lower Johns River was identified as a watershed that showed merit to protect. It like Warrior Fork is near the Urbanized area of Morganton and flows directly into the Upper portion of the Lake from the north. Approximately 40% of the flow into Lake Rhodhiss come through the Johns River and four subwatersheds (Wilson Creek, Upper Johns. Mulberry Creek and Lower Johns).

Technical and Financial Assistance

Conservation assistance is provided by Soil and Water Conservation District (SWCD) Offices, Note: Burke and Caldwell Counties have an office in each county with individual Elected Boards but are covered by the same shared staff.

Significant conservation work has been done through USDA programs. The Natural Resources Conservation Service (NRCS) provides technical assistance and program administration for the Environmental Quality Incentives Program (EQUIP), Wildlife Habitat Incentives Program (WHIP) and Wetlands Restoration Program, while the Farm Services Agency administers the Conservation Reserve Program*. Land and Lakes, Resources Conservation and Development (RC&D) Council works as a non-profit organization in association with NRCS and SWCD program.

*More details about these programs and a web page link for each can be found in Appendix J.

Agricultural Strategies

There are multiple agricultural conservation practices or BMPs can be used to address site specific needs.

Agricultural BMPs that have proven effective in addressing nutrient loading sedimentation problems are promoted by the Natural Resources Conservation Service (see technical resources in Appendix __), which provides technical advice as well as limited financial assistance. Further assistance with technical support is available to the agriculture community through Soil and Water Conservation Districts and the Cooperative Extension Service County Agents and Specialists.

To compare agricultural conservation practices among the federal and state programs, BMP information is sometimes reported in the following six categories:

Erosion Reduction/Nutrient Loss Reduction in Fields

Erosion/nutrient management measures include planned systems for reducing soil erosion and nutrient runoff from cropland into streams to improve water quality. Practices include: critical area planting, cropland conversion, water diversion, long-term no-till, pastureland conversion, sod-based rotation, strip cropping, terraces and conservation cover.

Sediment/Nutrient Delivery Reduction from Fields

Sediment/nutrient management measures include planned systems that prevent sediment and nutrient runoff from fields into streams. Practices include: field borders, filter strips, grassed waterways, nutrient management strategies, riparian buffers, water control structures, stream bank stabilization and road repair/stabilization.

Stream Protection from Animals

Stream protection management measures are planned systems for protecting the water quality of streams and the structural integrity of stream banks. Such measures eliminate livestock access to streams by limiting their access to streams and providing an alternate watering source away from the stream. Other benefits include reduced soil erosion, sedimentation, pathogen contamination, and as well as reduced pollution from dissolved, particulate, and sediment-attached substances. Practices include: heavy use area protection, livestock exclusion (fencing), spring development, stream crossings, troughs or watering tanks, wells and livestock feeding areas.

Proper Animal Waste Management

A waste management system is a planned system in which all necessary components are installed for managing liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled livestock lounging areas, dry manure stacks, heavy use area protection, insect and odor control, stormwater management, waste storage ponds/lagoons, compost and waste application system.

Agricultural Chemical (agrichemical) Pollution Prevention

Agrichemical pollutions prevention measures involve a planned system to prevent chemical runoff to streams for water quality improvement. Practices include:

agrichemical handling facilities and fertigation / chemigation back flow prevention systems.

Wildlife and Forest Management

Wildlife and forest management practices are designed to develop and improve wildlife habitat and forest stands. Practices include: brush management, early successional habitat development/ management.

Agricultural Management

Livestock with direct access to streams were observed at several locations in rural portions of the Lower Creek watershed. Runoff containing sediment, chemicals and excess nutrients from crop fields may also contribute to the degradation of water quality and habitat. Applicable BMPs include:

Controlled Livestock Watering

Direct contact of pastured animals with surface water results in direct deposition of animal waste, stream bank erosion, and re-suspension of sediments and associated nutrients held in streambeds. The most effective means to separate livestock from contact with the stream is to utilize a combination of fencing off the riparian area and the provision of alternate watering locations (troughs or tanks) at least 100 feet away from the riparian area to provide a buffer between waste deposition and the watercourse.

Grazing Controls

Allowing livestock to graze up to the edge of stream banks promotes stream bank erosion, with attendant sedimentation. In addition, the proximity of livestock to the streambed opens the watercourse to pollution from nearby animal waste. As in the case of controlled watering, the most effective means to control grazing is through the installation of fencing along the riparian area, creating a vegetated buffer of at least 20 feet between the fence and the stream bank.

Stream bank Stabilization

Where stream banks have been eroded due to livestock activity, generally they can be stabilized to prevent further erosion utilizing bioengineering techniques, such as turf reinforcement matting and live staking. Where inadequate space is available to allow the stream bank slope to be reduced, "hard" measures utilizing rip-rap may be necessary. "Spot" repairs of eroded stream bank within agricultural areas should be recognized as a temporary fix to stop erosion and not as a substitute for a more comprehensive stream restoration in which aquatic habitat is also re-established.

Residue and Tillage Management, No Till/Strip Till/Direct Seed

Minimal cultivation of the soil leads to increased stubble and plant residue on the soil surface. No-till promotes a greater soil water-holding capacity, more efficient use of water by crops, and reduced loss of water from runoff and evaporation. It can be very effective in reducing loss of soil and nutrients from the field, which may reduce the amount of sediment and nutrients entering a stream.

Drip Irrigation

Conventional irrigation practices can cause high amounts of soil, carrying nutrients and other pollutants, to erode from fields and be transported into stream networks. Drip irrigation provides a more efficient use of water by reducing runoff, evaporation, and deep percolation. Drip irrigation may also reduce nitrogen loss from leaching.

Nutrient Management

Nutrient leaching through soil and the subsequent runoff of excess nutrients is an issue at many agricultural operations, including horticulture, row crops, and grasslands. The most significant BMP to address agricultural nutrient loss to streams is Nutrient Management – managing the amount, source, placement, form, and timing of nutrient application. Supporting practices vary by land use and include adequate ground cover from cover crops, conservation cover, residue and tillage management, and pasture/hayland planting; adequate filtration of surface water runoff from filter strips and forested riparian buffers; and irrigation water management.

A more detailed analysis beyond what is required by subwatershed of agricultural production and the BMPs installed or utilized would be beneficial. This is particularly important

Forestry BMP Practices

Controlling sediment export from forestry operations is very important. The relative infrequency of harvesting operations (25 or 50 year rotations for pine pulpwood or sawtimber, 60- to 80-year rotations for hardwood sawtimber) makes sediment export from this activity less of an immediate concern in terms of overall functional degradation factors, but when harvesting does occur it can be a significant source of sediment. The often large extent of the area affected can require an extensive network of roads and skid trails, which are the most significant source of sediment from timber harvesting operations. There is the potential for large amounts of sediment from these sites to enter streams, especially when the *Forest Practices Guidelines*, as promulgated in 15A NCAC II.0100-.0209, are not followed.

Sediment is the most common pollutant produced from timber harvests. Harvesting equipment and trees are dragged over the ground, which loosens the soil, and the equipment may also spill gas and oil on the ground. Canopy cover is reduced from timber harvesting, increasing the amount of rainfall reaching the ground surface and in turn increasing runoff. Several common BMPs that help minimize sediment yield from forest harvesting operations are listed below. Details on these and other forestry BMPs can be obtained from the NC Division of Forest Resources (NCDFR) *Best Management Practices Manual* (NCDENR,1989) and the NCDFR website: http://www.dfr.state.nc.us/water_quality/wq_bmpmenu.htm .

- Streamside management zones maintain or enhance a forested corridor along a stream channel so that it acts as a filter for sediment and nutrients released from upslope harvested areas.
- Water bars or diversions, turnouts, and timely seeding of critical cuts and fills control sediment yield from forest roads.
- Stream crossing stabilization is accomplished by orienting the crossing perpendicular to the stream. The use of stone, erosion control fabric, or other materials further stabilize stream banks and bed at sites that are frequently crossed with heavy equipment. The use of portable bridges (bridgemats) is the preferred method of crossing most streams.

Removing the furthest timber first, using water bars on trails, establishing trails on the contour, avoiding wet weather logging, and reshaping and vegetating trails after use are other practices that, if used appropriately and extensively, can minimize sediment yield from silviculture operations. An established program, administered by the NCDFR, is in place to provide assistance to landowners in the use of these BMPs. The NCDFR is responsible for enforcing the *Forest Practice Guidelines* (http://www.dfr.state.nc.us/water_quality/pdf/fpg.pdf), which are necessary to maintain the forestry exemption from state sediment and erosion control regulations.

Landowners who want to more actively manage their forestlands while still meeting some conservation objectives can practice sustainable forestry management. Appalachian Voices in Boone, NC has produced a sustainable forestry guidebook, well-respected by a variety of forestry professionals, entitled *Managing Your Woodlands, A Guide for Southern Appalachian Landowners* (Goslee, 2004).

The NC Division of Forest Resources (NCDFR) provides on-site forestry planning and consultation, free of charge, to forestland owners. The NCDFR administers the non-binding *Forest Stewardship Program* to provide landowners with cost-effective resource management planning. Participants in this program are eligible for cost-share assistance from NCDFR that can help with reforestation and timber stand improvements. Participants also receive recognition with a sign to post on their forestland. Resource management advice given through this program often can help boost long-term economic returns for the landowner. NCDFR also maintains a list of consulting foresters who can help woodland landowners with forest management plans and road and access designs to minimize impact on streams and riparian areas. (http://www.dfr.state.nc.us/tending/tending_consulting.htm). The private consulting foresters charge for their services.

Concerns about new logging operations to being in the GLOBE area of Caldwell county in the near future are of concern. The timber removal itself may become a source of additional soil erosion in the Upper Johns subwatershed. However, of potentially greater concern is the cutting of new roads in the steep terrain that may also contribute to increased soil erosion in this very undeveloped watershed. We recommend local groups stay informed and work with the Division of Forest Resources insure proper BMPs are employed to minimize any water quality impacts from this logging activity.

Proposed Agricultural Recommendations

1. **Green Nurseryman Coalition:** Cooperative Extension Soil and Water Conservation Service and NRCS should continue to work with the ornamental nursery industry to promote use of BMP's (drip irrigation, cover crops, soil testing, No till techniques). Identify ornamental nursery owners interested in projects that involve installation of BMP's for data and monitoring.

2. **Increase Riparian Buffers:** Educate property owners on tax incentives and their rights as landowners for establishing conservation easements on their property. Develop and promote incentives for property owners who establish and maintain buffers along streams with intensive agriculture activity. Purchase conservation easement or fee-simple acquisition along waterways within the watershed focusing on priority subwatersheds.

Target Audiences, Motivations, Barriers

Table E-1 lists the pollutant load reduction activities proposed in the Plan, and their related target audiences

Ornamental Plant Production

General recommendations for ornamental plant production include:

- **Conservation Cover** – permanent plant cover of the soil surface for the length of the crop cycle.
- **Filter Strip** – a strip of grass (that can include trees) between the crop and any surface water source.
- **Nutrient Management -** managing the amount, source, placement, form, and timing of nutrient application
- **Critical Area Planting** – establishment of plant cover on any severely eroding site, including ditch banks, access roads shoulders and banks, loading areas, etc.
- **Drip Irrigation** – injection liquid fertilization via watering lines

Table E-1 Agricultural Load Reduction Activities

LOAD REDUCTION ACTIVITY	TARGETED AUDIENCE
Restoration of unstable and eroding streams to reduce sediment loading (________ linear feet);	All landowners, and leasers
Revegetation of riparian areas to reduce sediment and nutrient inputs from crop land and pastures (_______ linear feet);	All landowners, and leasers
Conservation tillage to reduce sediment and nutrient inputs from land currently cultivated with minimal field residue (____ acres);	Crop growers - owners or leasers
Livestock exclusion to reduce sediment inputs due to cattle access to streams (_____ linear feet);	Livestock growers (Zack's Fork)
Use of soil sampling and analysis in ornamental nursery growing operations to reduce unnecessary fertilization (___ acres);	Ornamental Nursery owners or leasers
Use of ground cover in ornamental nursery growing operations to reduce erosion and uptake nutrients (___ acres);	Ornamental Nursery owners or leasers
Use of drip irrigation in ornamental nursery growing operations to reduce erosion (___ acres); and control fertilizer application	Ornamental Nursery owners or leasers
Use of in line fertilization with drip irrigation in ornamental nursery growing operations to reduce erosion and minimize nutrient application (___ acres);	Ornamental Nursery owners or leasers
Proper disposal animal wastes in poultry growing operations to reduce nutrient loading (___ acres);	Poultry Farmers owners or leasers

Estimated Load Reductions from Agricultural Strategies

Section F
Point Source Strategies

As documented earlier in this Plan, Lake Rhodhiss has levels of nutrients in quantities that have contributed to the Lake currently not meeting the water quality standards as defined by the Water Supply Protection Program. The input of nutrients from Non-Point Sources has been addressed in the *Non-Agricultural* and *Agricultural,* portion of the plan, Sections D and E respectively. Pollutant contributions and recommendations for reductions in discharges from Point Sources will be addresses in this section of the plan.

Although the term Point Source could be used to describe other dischargers (see Table F-1) this Plan will use the term Point Source as synonymous with Waste Water Treatment Plants (WWTP) unless specifically specified otherwise, since our water quality impairments of concern are linked to nutrients and WWTPs are the key point sources of nutrients in the study area.

Waste Water Treatment Plants

The follow 4 plants are located in the Lake Rhodhiss watershed:

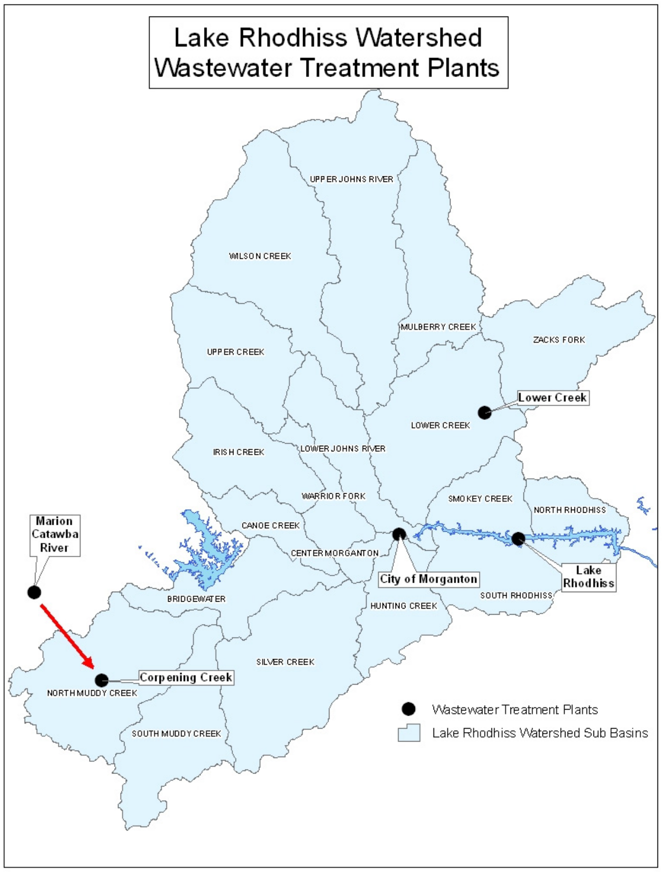
Valdese	Lake Rhodhiss	NPDES Permit NC0041696	Burke
Lenoir	Lower Creek	NPDES Permit NC0023981	Caldwell
Marion	Corpening Creek	NPDES Permit NC0031879	McDowell
Morganton	Catawba River	NPDES Permit NC0026573	Burke

Table F-1: Lake Rhodhiss Point Source Dischargers

Facility	NPDES No.	Subbasin	***PERMITTED*** Discharge (MGD) Apr. 2001 to Mar. 2002	***REPORTED*** Avg. Discharge (MGD) Dec. 2008 to Mar. 2009
Monte Carlo TP	NC00048755	Lower Creek	0.0050	Not Active
Quality Care Assisted Living	NC0047147	Zacks Fork	0.0052	Not Reported
Glenwood Elementary	NC0067130	North Muddy Creek	0.0075*	Not Active
Park Inn International	NC0040291	North Muddy Creek	0.1041	0.0014
Harmony Estates	NC0079481	North Muddy Creek	0.02*	0.0026
Nebo Elementary	NC0067148	Bridgewater	0.0075*	0.0034
Lenoir Lake Rhodhiss WTP	NC0044164	Smokey Creek	0.1260	0.185
Granite Falls WTP	NC0082546	North Rhodhiss	0.0441	0.0465
Colletsville Elmentary	NC0050075	Lower Johns	0.0058	0.0018
Sealed Air Corp.	NC0047627	Zacks Fork	Not Reported	Not Reported
Cedar Rock CC	NC0043231	Zacks Fork	0.0033	0.00462
Green Mt Park	NC0040274	Zacks Fork	0.0140	Not Reported
Baton Elementary	NC0030783	Smokey Creek	Not Reported	0.00367
NC Outward Bound	NC0040754	Irish Creek	Not Reported	0.000997
Morganton WTP	NC0060194	Bridgewater	0.0801	Not Reported
Jai-Ambe Co./Super 8 Motel	NC0060208	North Muddy Creek	0.019*	0.0038
Rocky Pass AC	NC0075353	North Muddy Creek	0.0020	0.00195
Sugar Hill Truck Stop	NC0029831	North Muddy Creek	0.0015	Not Reported
Pinnacle Rest Home	NC0035157	South Muddy Creek	0.0030	0.00184
Marion Travel Plaza	NC0086428	North Muddy Creek	0.0061	0.00165
SGL Carbon Corp.	NC0005258	Silver Creek	2.4639	1.1360
Corpening Creek WWTP	NC0031879	North Muddy Creek	0.7192	0.6861
Morganton WWTP	NC0026573	Center Morganton	3.3748	3.996
Valdese WWTP	NC0041696	South Rhodhiss	4.6830	2.1466
Lenoir WWTP	NC0023981	Zacks Fork	2.0266	9.082
TOTAL			**13.6677**	**17.305927**

*Indicates permitted discharge; all other values are actual discharge.
Source: North Carolina Division of Water Quality, Asheville Regional Office, 2009.
Color indicates a "skewed" flow amount because of malfunctioning flow meter
Several facilities are "Not Active" at present, and several have kept NPDES Permits but have no discharge

Map F-1: Lake Rhodhiss Watershed Treatment Plants



Within the Lake Rhodhiss watersheds communities, wastewater treatment often takes place in onsite systems, or septic systems. The use of small cluster systems which collect and transport residential sewage through a network to small decentralized treatment systems or to a central community treatment plants are not commonly utilized in the region. These systems and their impacts are discussed under Section D Non-Agriculture Non-Point Source of the Plan.

City of Marion

City of Marion is decommissioning the City's Catawba River wastewater treatment plant. The Catawba River Plant was built in the 1970's with an original capacity of 125,000 GPD. A second independent treatment was added in the 1980's to double the plant capacity to the current 250,000 GPD permitted capacity. The City of Marion investigated options available to treat the130,000 GPD of "strong" effluent in currently receives at the plant. After a study by McGill and Associates Consulting, a determination was made to decommission the plant and pump the effluent into the Corpening Creek Plant. The work associated with installing two pumping stations and 12,000 feet of 10 inch forced main is currently underway. This $1,460,000 project has a scheduled completion date of May 11, 2010. Therefore, the decommissioning of the Catawba River plant should occur on or before that date.

Corpening Creek Plant

The plant has a 3 MGD design capacity but current conditions limit the plant to 1.5 MGD treatment capacity. Corpening is currently treating 700,000 - 800,000 GPD. A $3,400,000 project is underway to restore the 3 MDG treatment capacity. The plant will serve the ~8,000 population of Marion area.

Lower Creek /Lenoir Plant

The Lower Creek Facility located at 1905 Broadland Road in Lenoir is permitted to treat 6 million gallons per day, and was upgraded in 1999 to a three-stage nutrient removal process. (The Gunpowder Creek Facility located at 450 Pine Mountain Road in Hudson is an advanced (SBR) Sequential Batch Reactor plant with a permitted capacity of 2 million gallons per day.) In addition the division is responsible for the administration of the Industrial Pretreatment Program and plant monitoring, using a very sophisticated laboratory located at the Lower Creek Plant. This plant is also home to a national EPA award winning biosolids handling facility. A total of fourteen certified operators and technicians work in this division.

The Lower Creek Wastewater Treatment Plant currently treats, on average, about 2.7 MGD, or at 45% of its permitted capacity (6.0 MGD). The process consists of mechanical filter screen, two 3-MGD capacity and two 6-MGD capacity influent pumps. Grit removal, using cyclonic "teacups" occurs after the pumps. The biological process is the Krüger A^2O, consisting of anaerobic, anoxic and oxic treatment. The anaerobic basins convert phosphorous to a more treatable form. The mixed wastewater moves into the anoxic zones, where nitrogen removal takes place. From there it flows into the oxic zones (or aeration), where centrifugal blowers provide air. At the end of the oxic zones, some of the aerated wastewater is pumped back to the anoxic zones for nutrient removal. After settling in two one-million gallon clarifiers, the effluent is treated with chlorine gas for disinfection and sulfur dioxide gas for de-chlorination. The final effluent is discharged into Lower Creek.

Return sludge is pumped back to the anaerobic basin. Wasted sludge is pumped into the sludge holding tank, which acts as a feed tank to the biosolids treatment. The sludge is pressed out for thickening (belt press), and fed into the RDP lime stabilization and pasteurization system, producing a Class A biosolids, which is given away or distributed on farmlands.

The last rebuild of the plant was completed in 1998. Prior to then, the WWTP had compliance problems with primarily the ammonia limit. Current effluent limits and results are:

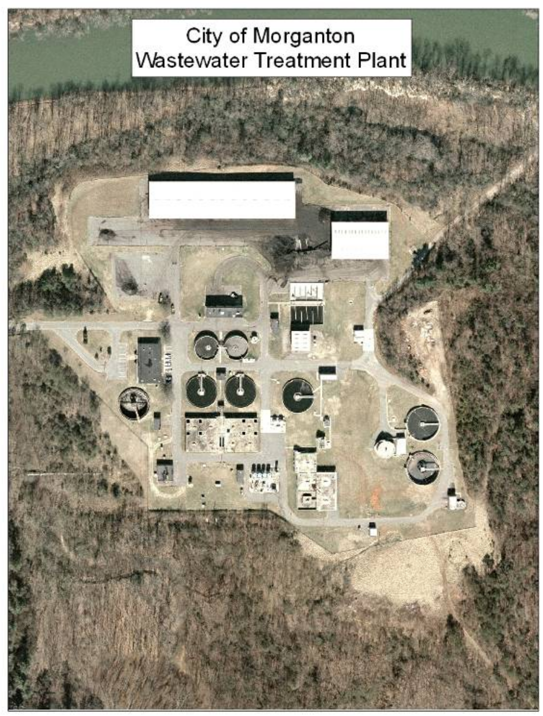
Table F-2: WWTP Effluent Limits and Results

PARAMETER	SUMMER, MONTHLY AVG. (mg/l)	WINTER MONTHLY AVG. (mg/l)	SUMMER, WEEKLY AVG. (mg/l)	WINTER WEEKLY AVG. (mg/l)	EFFLUENT ANNUAL AVERAGE (JUNE 2008 – MAY 2009)	WWTP REMOVAL
BOD5	22	30	33	45	4.6	98.5 %
TSS	30	30	45	45	11.2	96.4 %
Ammonia	2.0	4.6	6.0	13.8	0.50	97.6 %
Total N	---	---	---	---	6.48	83.0 %
Total P	---	---	---	---	0.35	79.2 %

Special Note: Currently, work is underway to potentially use treated wastewater to aide in cooling requirements in at a large internet server farm located in Lenoir. Implications for the water and wastewater treatment facilities could be enormous.

Morganton Plant

Catawba River Pollution Control Facility



In early 1972 a new wastewater treatment facility was located on the banks of the Catawba River. This facility was built with federal, state, and matching funds of $3 million dollars to provide Morganton with a pressure swing absorption activated sludge plant. Only fifteen percent of the three million dollars was the local government's share. State and Federal funds made up the lion's share of the cost. This facility had an influent structure, barscreens, grit tubes, aeration tanks, secondary clarifiers, centrifuges, and chlorine contact chamber. Design flows were for 8 MGD facility.

In the early 80's a third larger secondary clarifier was added to help capture secondary solids, and composting was adopted as a biosolids disposal method. The limits were basically 30/30 with no ammonia limits at this time.

In 1995 upgrade and expansion of this plant was needed because it basically had outlived its normal life expectancy. This new facility added two new primary clarifiers, a new secondary clarifier and a newer larger aeration tank. New aerated static pile compost area was incorporated into the new design. The 1995 project totaled fifteen million dollars and all of the cost was paid by the City.

With the new upgrade more stringent limits were imposed, including ammonia and tighter chlorine residuals, no nutrient limits however, were imposed. BOD & TSS limits are still at 30 and the new ammonia limit is 16 mg/l. Metal limits have fluctuated but currently cadmium and selenium are the only metal limits with concentrations of 15 and 52.6 micrograms/l for their limits respectively.

With the last two permits Morganton was given a permit to treat wastewater with design flows at 8, 10.5 or 13 MGD. The treatment load allowed to be discharged stays the same no matter what the flow limit is. That is, the greater the flow the lower the allowable concentration can be, so as to maintain number of pounds discharged to the receiving stream.

Lake Rhodhiss Plant/Valdese

The Town of Valdese operates the Lake Rhodhiss Wastewater Treatment Facility, a 7.5 MGD plant, to service the eastern region of Burke County. Wastewater from Burke County, Connelly Springs, Drexel, Rutherford College, Valdese, and some of Hildebran flows to the treatment facility. The facility is staffed by ten employees.

Plant was built in 1981 with grants and currently serves 6,000 people from Valdese, Rutherford College, Drexel and part of Burke County. The plant is permitted to treat 7.5 MGD. The plant staff consists of 10 people who are responsible for industrial pre-treatment, compost operations, four pump stations and jointly work with the County on two other pump stations.

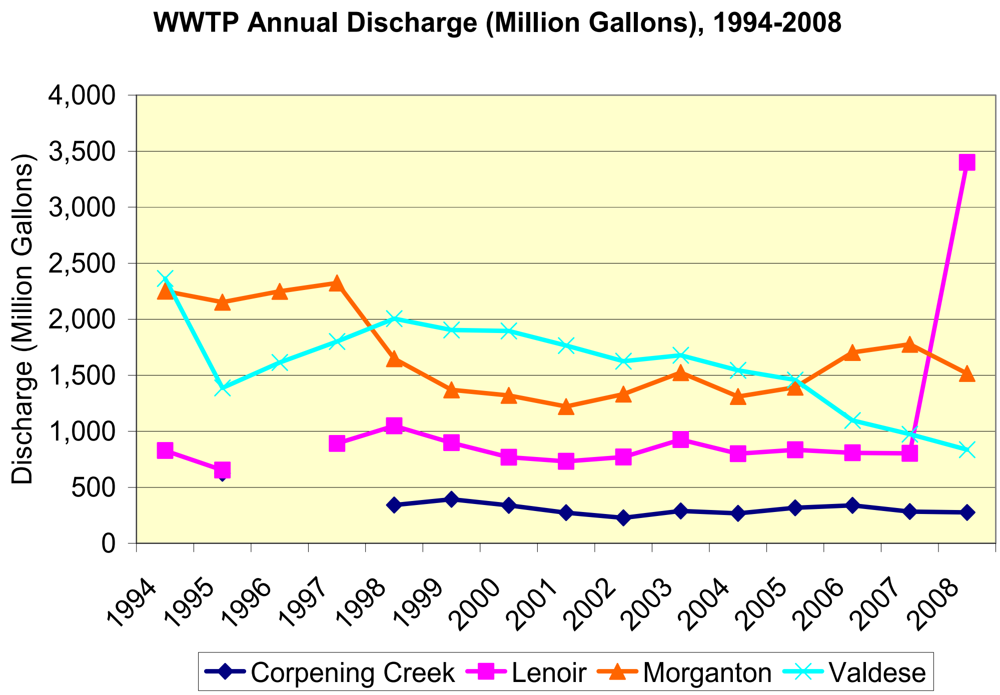
The Valdese plant went through a small upgrade in 2001 by adding new bar screens, VFD's for influent pumps #1 and #2, one rebuilt centrifuge, new controls for both centrifuges, a sulfur dioxide building and the necessary piping to feed sulfur dioxide to the system.

Valdese achieves beneficial reuse of biosolids through composting. All solids that are removed from the waste stream are dewatered and mixed with woodchips. The woodchips come from limbs and trees that the Town picks up from the residents. The woodchips and biosolids are mixed together. The compost is given away, free of charge to the public. Many landscapers and mulch yards take large quantities of the compost.

Plant Comparisons

The following section compiles information found in the Daily Monitoring Reports (DMRs) submitted to DENR as part of the NPDES license requirements for each permitee. DMR data is from 1994 up to 2008. The data is presented in a graphical way to better indicate changes over this time period in plant operation and to allow for comparisons.

Figure F-1: WWTP Annual Discharge

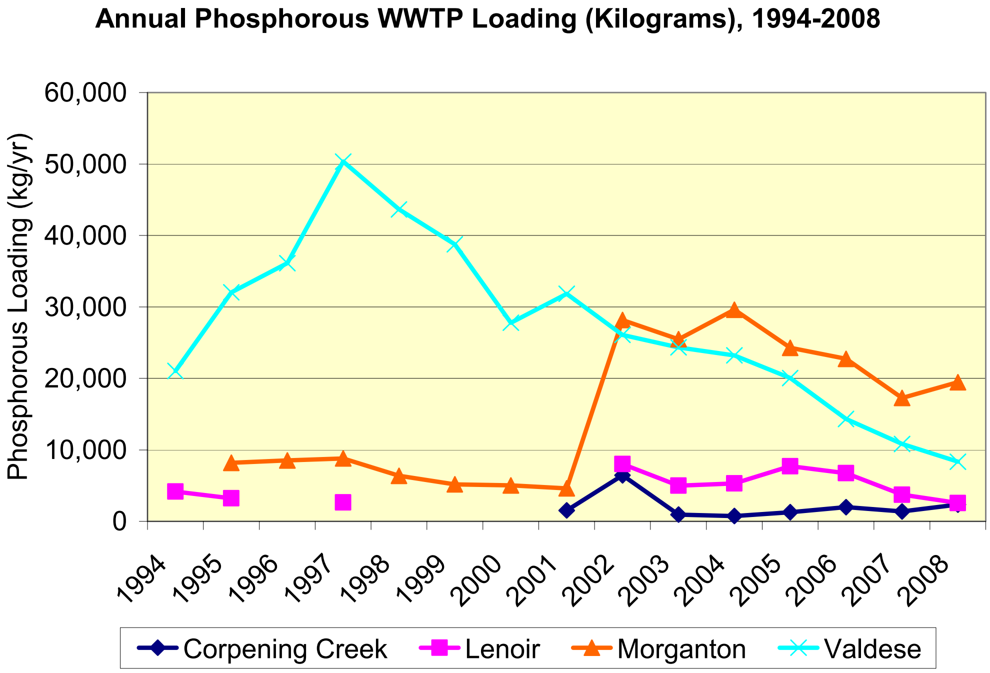


Source: NC Division of Water Quality, Asheville Office.

It should be noted that by comparing current discharge to permitted discharges that each plant is operating near 50% capacity.

The next several figures compare raw nutrient loads contributed by the four WWTP.

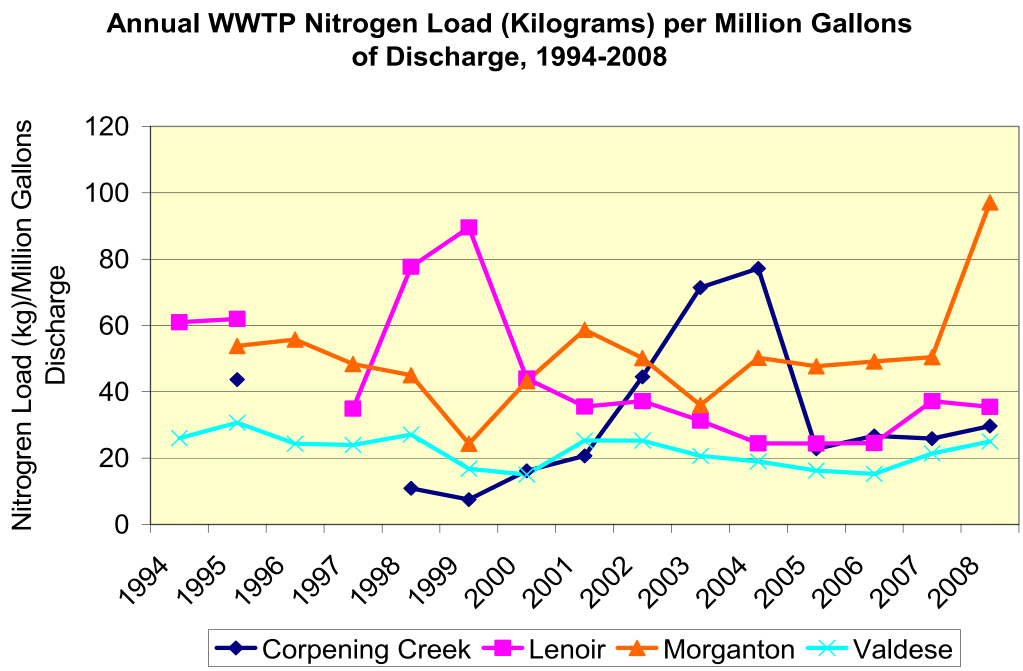
Figure F-2: Annual Phosphrus WWTP Loading



Source: NC Division of Water Quality, Asheville Office.

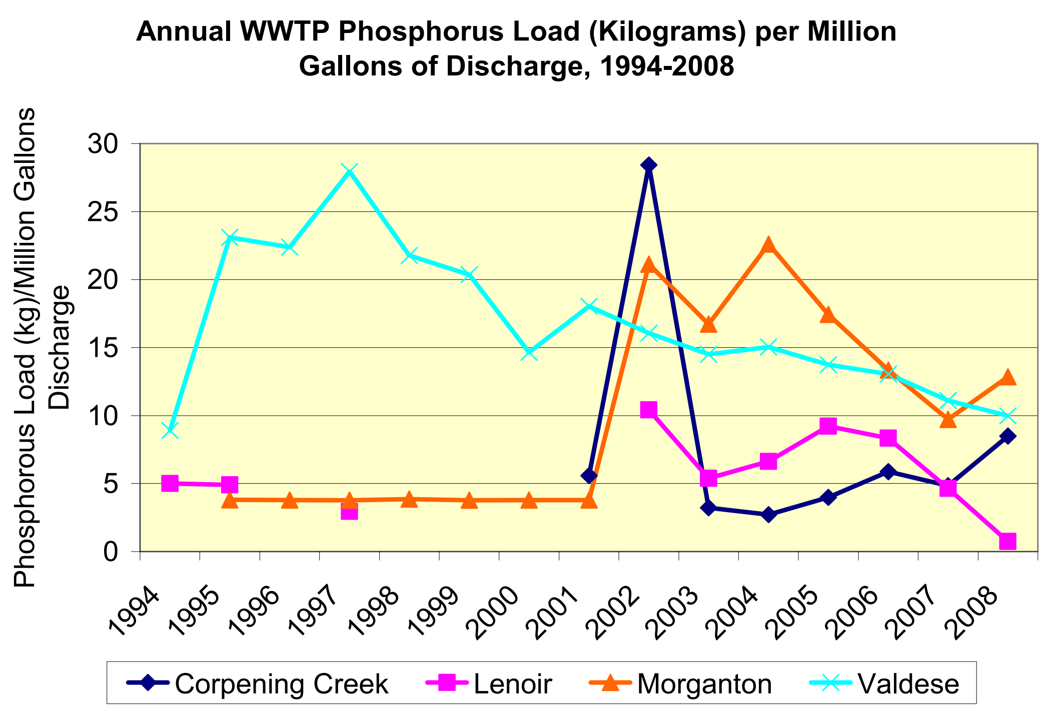
To better compare plants that treat different volumes of effluent and to get a relative understanding of efficiency, we divided the discharge rate by the nutrient load in the next several charts.

Figure F-3: Annual WWTP Nitrogen Load



Source: NC Division of Water Quality, Asheville Office.

Figure F-4: Annual WWTP Phosphrus Load

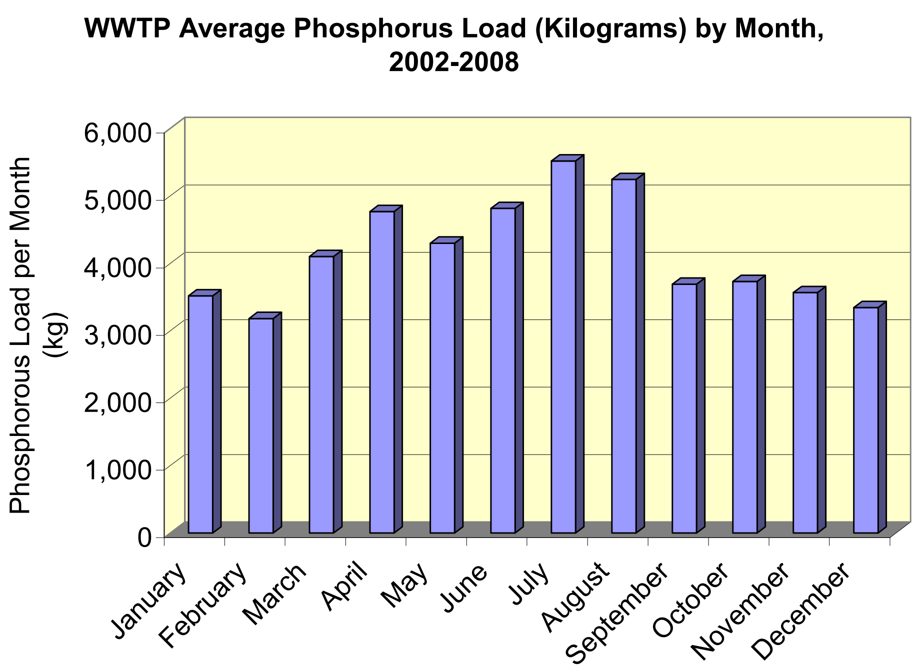


Source: NC Division of Water Quality, Asheville Office.

Table F-3: Monthly Nutrient Analysis from Wastewater Treatment Plants Discharging into the Rhodhiss Basin

Month / Year	Valdese		Morganton		Lenoir		Marion	
	TP (mg/l)	Total Nitrogen (mg/l)	TP (mg/l)	Total Nitrogen (mg/l)	TP (mg/l)	Total Nitrogen (mg/l)	TP (mg/l)	Total Nitrogen (mg/l)
Apr-07	2.85	9.65	2.14	11.30	0.99	22.80	1.26	5.20
May-07	3.35	6.57	2.62	17.80	2.96	8.50	0.40	1.70
Jun-07	3.15	6.65	3.00	10.70	3.20	3.31	2.62	4.80
Jul-07	3.53	8.57	3.55	13.40	4.50	2.99	4.61	5.20
Aug-07	3.67	3.43	3.31	15.68	0.20	5.99	0.56	0.64
Sep-07	3.13	8.09	1.97	7.52	0.75	4.06	0.32	1.70
Oct-07	2.53	7.69	2.86	9.20	0.60	3.61	1.30	5.50
Nov-07	4.20	2.64	3.37	13.00	0.78	5.17	0.78	9.35
Dec-07	2.48	5.32	3.60	19.20	0.52	3.56	1.00	16.20
Jan-08	2.15	6.32	3.30	24.10	0.90	7.37	3.30	13.30
Feb-08	1.90	13.60	2.32	57.40	0.35	7.72	1.90	6.90
Mar-08	1.73	5.22	4.64	60.20	0.80	5.31	1.30	9.50
Apr-08	3.10	1.25	1.51	26.70	0.37	5.76	1.70	9.50
Mean	2.90	6.54	2.94	22.02	1.30	6.63	1.62	6.88
Standard Deviation	0.72	3.21	0.83	17.26	1.35	5.17	1.24	4.59

Figure F-5: Average Phosphorus Load



Source: NC Division of Water Quality, Asheville Office.

The graphs show more phosphorus discharged during the summer for reasons yet to be determined. WWTP personnel speculated this may be related to O_2 levels and changes in incoming raw sewage strength.

Table F-4: WWTP Annual Discharge

WWTP Annual Discharge (Million Gallons), 1994-2008								
Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Lenoir	N/A	625	N/A	N/A	341	393	338	274
Morganton	828	654	N/A	891	1,048	897	767	732
Valdese	2,250	2,152	2,249	2,324	1,649	1,369	1,320	1,221
Corpening Creek	2,362	1,387	1,613	1,802	2,005	1,904	1,896	1,765
Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	
Lenoir	227	289	267	317	338	284	276	
Morganton	769	926	799	835	808	803	3,400	
Valdese	1,332	1,524	1,309	1,392	1,704	1,777	1,516	
Corpening Creek	1,625	1,677	1,544	1,458	1,097	974	836	

Table F-5: WWTP Annual Phosphorous Load

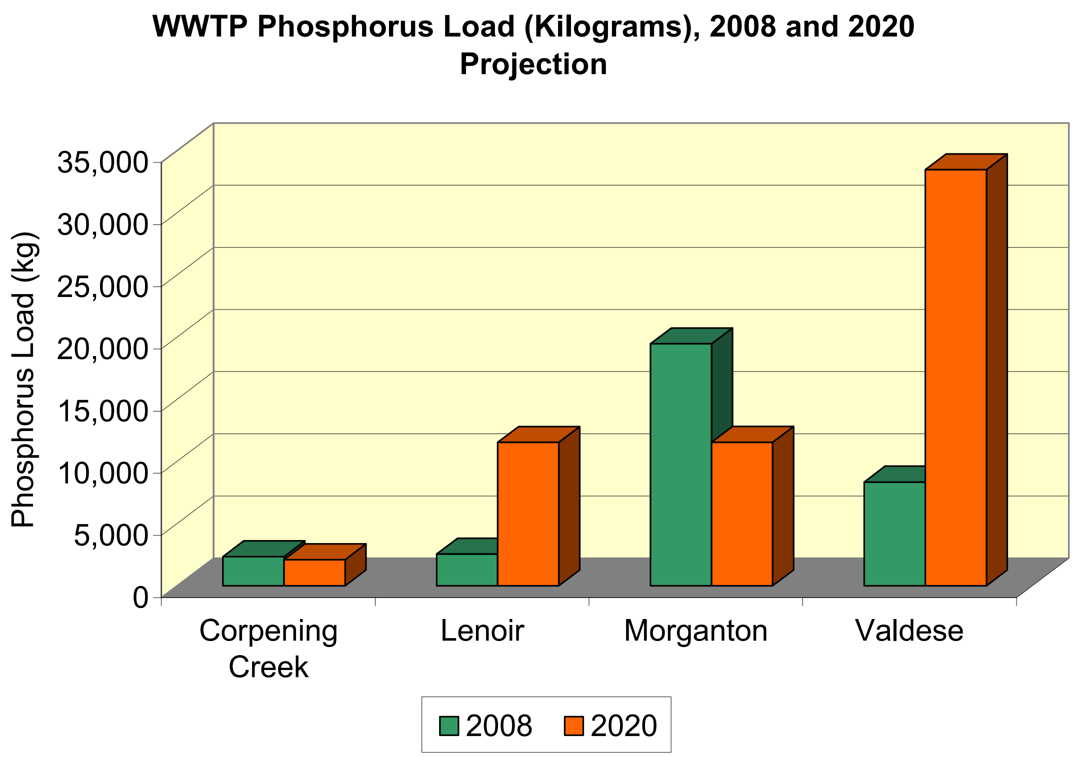
WWTP Annual Phosphorous Load (Kilograms), 1994-2008 and 2020 Projection								
Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Lenoir	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,532
Morganton	4,147	3,212	N/A	2,634	N/A	N/A	N/A	N/A
Valdese	N/A	8,188	8,516	8,784	6,358	5,178	5,008	4,624
Corpening Creek	21,034	32,050	36,126	50,340	43,646	38,762	27,788	31,843
Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2020**
Lenoir	6,441	933	726	1,264	1,983	1,373	2,340	2,108
Morganton	8,022	4,989	5,300	7,699	6,739	3,729	2,550	11,533
Valdese	28,156	25,480	29,601	24,286	22,741	17,270	19,472	11,548
Corpening Creek	26,094	24,332	23,224	20,047	14,316	10,825	8,346	33,468

Table F-6: WWTP Annual Nitrogen Load

WWTP Annual Nitrogen Load (Kilograms), 1994-2008 and 2020 Projection								
Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Lenoir	N/A	27,293	N/A	N/A	3,714	2,949	5,483	5,673
Morganton	50,484	40,548	N/A	31,075	81,425	80,359	33,711	26,008
Valdese	N/A	115,794	125,416	112,389	74,168	33,339	56,978	71,656
Corpening Creek	61,538	42,584	39,260	43,119	54,259	31,907	28,513	44,638
Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2020**
Lenoir	10,079	20,650	20,640	7,231	9,009	7,361	8,178	14,221
Morganton	28,565	28,986	19,532	20,371	19,837	29,856	120,413	41,496
Valdese	66,837	54,799	65,840	66,413	83,733	89,600	147,173	130,264
Corpening Creek	40,994	34,684	29,325	23,642	16,679	20,848	20,909	40,200

Phosphorus and nitrogen concentrations of the wastewater discharged from the WWTP facilities exhibited varying patterns. Valdese and Morganton WWTP's had similar total phosphate concentrations with equal variability. Lenoir and Marion had, on the average, half as much phosphorus as Valdese and Morganton, but twice the variability throughout the year. Nitrogen concentrations in the discharges were very similar between Valdese, Lenoir, and Marion, but Morganton had over three times as much nitrogen as the other three.

Figure F-6: WWTP Phosphorus Load



Source: NC Division of Water Quality, Asheville Office.

Predicting future discharge rate using the standard method used by DENR (2002-2008 median x 1.85 = 2020 Projection) may not give a true picture of future discharges of nutrients from the WWTP in Lake Rhodhiss. For example, in 1997 two textile plants closed in Morganton with a noticeable drop in loading from the WWTP in subsequent months. Textile plants are heavy water users and contribute phosphorus through the dyeing process. A two MGD loss in inflow to the Morganton WWTP resulted from just those two plant closings. Similar impacts are being felt in the other WWTP plants to varying degrees. Further industrial closings have plagued the area in the last decade.

Waste Water Treatment Plant Loading

The total annual nitrogen and phosphorus loading of the wastewater treatment plants were 191.59 metric tons and 36.04 metric tons, respectively (Table F_). However, the impact to Lake Rhodhiss from these facilities probably varies greatly. For example, the Marion and Lenoir WWTP discharged relatively low amounts of nutrients in the headwaters of Muddy Creek and Lower Creek, respectively. The nitrogen and phosphorus have a relatively long period of time to interact with inorganic and organic material that has washed into the creek. The extended travel time allows significant processing by physical, chemical, and biological activity until the nutrients reach Lake Rhodhiss. Phosphorus, to a large extent, is probably adsorbed on the clays from Muddy Creek and probably not to the same extent from Lower Creek. Morganton WWTP and, in particular, Valdese WWTP, discharge directly into Lake Rhodhiss. The nutrients, especially phosphorus, are readily available to the algae in the lake, whereas phosphorus washed in from the watersheds was usually associated with the suspended sediment and not quite as available to the lake algae.

Table F-7: Annual Point Source Loading from Waste Water Treatment Plants

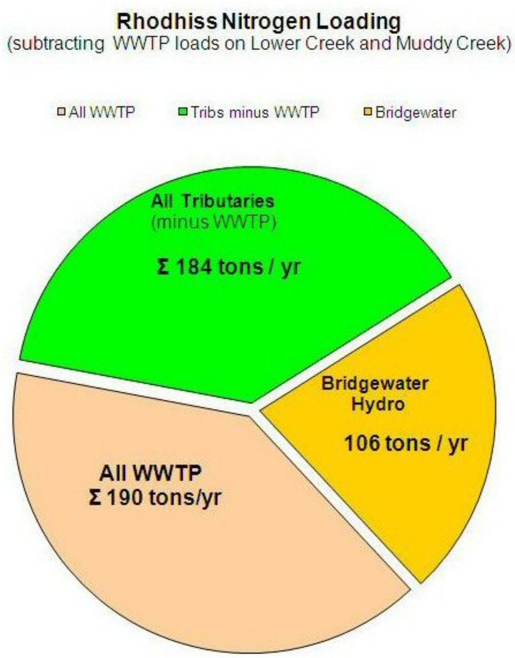
Facility	Total Nitrogen (metric tons/yr)	Total Phosphorus (metric tons/yr)
Morganton WWTP	142.21	20.03
Valdese WWTP	23.23	10.27
Lenoir WWTP	18.76	4.08
Marion WWTP	7.39	1.65
Total	191.59	36.04

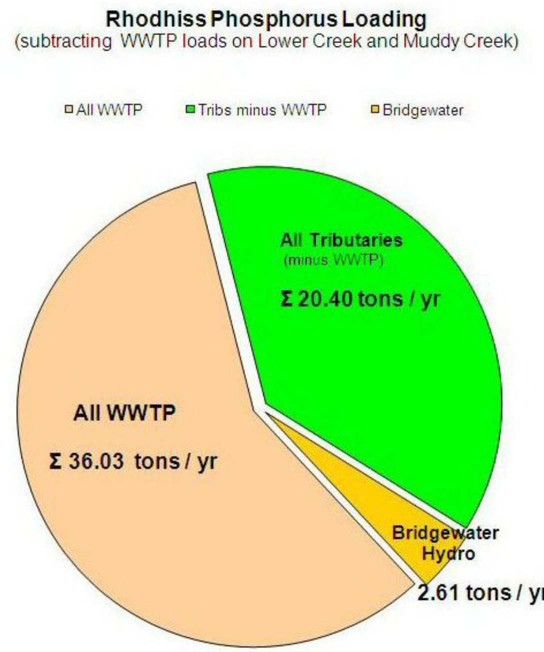
Point vs. Non-point Source Loading

According to calculations found in Devine Tarbel and Associates monitoring study (2009), the accounting for all of the nitrogen and phosphorus entering Lake Rhodhiss is summarized in Figure __ below. All of the tributaries (non-point sources) and all of the wastewater treatment plants (point sources) contributed equal amounts of nitrogen, mostly as nitrate. Bridgewater releases from Lake James contributed about 20% of the nitrogen entering Rhodhiss.

Phosphorus loading, however, was dominated by the point sources. During the year-long study, 61% of the phosphorus entered Rhodhiss from point source discharge. Of this amount, 85% entered directly (or almost directly) into Lake Rhodhiss.

Figure F-7: Relative Contributions of Nitrogen and Phosphorus from Point and Non-Point Sources





Point Source Recommendations

The following actions unfolded from information reviewed and discussed by the stakeholder and advisory groups working with WPCOG staff.

1. **Non-Structural Management Methods:** Continue to seek alternative methods for reducing the nutrient output from the wastewater treatment facilities.

2. **Plant Modifications:** Develop phased plans for design and construction of appropriate nutrient removal systems on priority WWTPs (Valdese and Morganton).

3. **Capital Improvements:** Work with the four existing wastewater treatment plants in the watershed to obtain funding for improvements to the plants that reduce nutrient loading to the lake. Facilitate talks with locals governments operating WWTPs and stakeholders

in the areas affected by the plants in order to gain support for capital improvement projects.

4. **Comprehensive Sewage Overflow:** Improve monitoring and detection of potential leaks in sewage distribution systems.

5. **Volunteer Water Monitoring Coalition:** Work with DENR to develop an alternative water quality monitoring program that provides more meaningful data to measure lake and watershed health in lieu of NPDES permit monitoring requirements.

Each of these recommendations can be found summarized in tabular form in Section G and will be expanded more in the remainder of this section.

In the future these actions will contribute to Lake Rhodhiss and downstream reservoirs supporting and maintaining their assigned set of surface water quality standards and allow for continued fishing, swimming and drinking water uses.

Non-Structural Management Methods

U.S. Environmental Protection Agency's On-Site Technical Assistance Program 104(g). The U.S. Environmental Protection Agency's On-Site Technical Assistance Program was implemented in 1982 to provide financial, technical, and operation and maintenance assistance to small, municipal wastewater treatment plants through direct on-site operator training. Assistance is provided to plants in danger of non-compliance or out of compliance with their discharge permits. Enhancing plant operations helps to improve water quality. Funding for the program is provided by the U.S. Environmental Protection Agency, state agencies. The On-Site Technical Assistance Program helps plant operating staff and the local elected officials work together on the problems at the treatment plant. As a result, local officials better understand wastewater treatment responsibilities and the needs of plant and staff.

After being contacted in regard to the findings of the monitoring study, staff at NC DENR worked with the Western Piedmont Council of Governments to gain input and support from the affected municipalities to begin implementation of technical assistance. Asheville Regional

Point Source Tactics

Office proposed a "Technical Assistance" project for all of the WWTP facilities with an emphasis on "optimization" with special emphasis on Primary Clarifier performance and review of all collection system lines that are in close proximity to tributaries of Lake Rhodhiss.

Additionally, NCG permittees will be inspected for additives to cooling towers, boilers and other equipment, which may contribute to total phosphorus.

Primary Clarifier optimization would involve reviewing the use of metal salts for phosphorus reduction/removal in addition to lowering the waste load (i.e. BOD, NH_3, and TSS), solids production, and optimizing the remaining components of the WWTP to work with improved operation for removal of total waste load. Energy usage and conservation would also be a component.

Plant Modifications

Treatment levels beyond secondary are called advanced treatment. Advanced treatment technologies can be extensions of conventional secondary biological treatment to further stabilize oxygen-demanding substances in the wastewater, or to remove nitrogen and phosphorus. Advanced treatment may also involve physical-chemical separation techniques such as absorption, flocculation/precipitation, membranes for advanced filtration, ion exchange, and reverse osmosis. In various combinations, these processes can achieve any degree of pollution control desired. As wastewater is purified to higher and higher degrees by such advanced treatment processes, the treated effluents can be reused for urban, landscape, and agricultural irrigation, industrial cooling and processing, recreational uses and water recharge, and even indirect augmentation of drinking water supplies.

Nitrogen Control

Nitrogen in one form or another is present in municipal wastewater and is usually not removed by secondary treatment. If discharged into lakes and streams or estuary waters, nitrogen in the form of ammonia can exert a direct demand on oxygen or stimulate the excessive growth of algae. Ammonia in wastewater effluent can be toxic to aquatic life in certain instances. By providing additional biological treatment beyond the secondary stage, nitrifying bacteria present in wastewater treatment can biologically convert ammonia to the non-toxic nitrate through a process known as nitrification. The nitrification process is normally sufficient to remove the toxicity associated with ammonia in the effluent. Since nitrate is also a nutrient, excess amounts can contribute to the uncontrolled growth of algae. In situations where nitrogen must be completely removed from effluent, an additional biological process can be added to the system to convert the nitrate to nitrogen gas. The conversion of nitrate to nitrogen gas is accomplished by bacteria in a process known as denitrification. Effluent with nitrogen in the form of nitrate is placed into a tank devoid of oxygen, where carbon-containing chemicals, such as methanol, are added or a small stream of raw wastewater is mixed in with the nitrified effluent. In this oxygen free environment, bacteria use the oxygen attached to the nitrogen in the nitrate form releasing nitrogen gas. Because nitrogen comprises almost 80 percent of the air in the earth's atmosphere, the release of nitrogen into the atmosphere does not cause any environmental harm.

Phosphorus Control

Phosphorus removal can be achieved through biological or chemical coagulation-sedimentation process.

Biological Phosphorus Removal

Phosphorus, like nitrogen, is also a necessary nutrient for the growth of algae. Phosphorus reduction is often needed to prevent excessive algal growth before discharging effluent into lakes, reservoirs and estuaries. Some biological treatment processes called biological nutrient removal (BNR) can also achieve nutrient reduction, removing both nitrogen and phosphorus. Most of the BNR processes involve modifications of suspended growth treatment systems so that the bacteria in these systems also convert nitrate nitrogen to inert nitrogen gas and trap phosphorus in the solids that are removed from the effluent.

Coagulation-Sedimentation Removal

A process known as chemical coagulation-sedimentation is used to increase the removal of solids from effluent after primary and secondary treatment. Solids heavier than water settle out of wastewater by gravity. With the addition of specific chemicals, solids can become heavier than water and will settle. Alum, lime, or iron salts are chemicals added to the wastewater to remove phosphorus. With these chemicals, the smaller particles 'floc' or clump together into large masses. The larger masses of particles will settle faster when the effluent reaches the next step--the sedimentation tank. This process can reduce the concentration of phosphate by more than 95 percent. (*Primer for Municipal*

Wastewater Treatment Systems, Office of Wastewater Management EPA 832-R-04-001, September 2004)

Capital Improvements

EPA and NCDENR should work with and provide guidance to staff at the four existing wastewater treatment plants in the watershed to obtain funding for improvements to the plants that reduce nutrient loading to the lake. Multiple entities should facilitate talks with the local governments operating the wastewater treatment plants and stakeholders in the areas affected by the plants in order to gain support for capital improvement projects.

Comprehensive Sewage Overflow

The review of affected collection lines would involve review of cleaning, inspections, and SSO records and reports. Sanitary sewers were designed and built to carry wastewater from domestic, industrial and commercial sources, but not to carry storm water. Nonetheless, some storm water enters sanitary sewers through cracks, particularly in older lines, and through roof and basement drains.

Volunteer Water Monitoring Coalition

Carrie Ruhlman, DENR Coalition Program Coordinator, has discussed benefits of the volunteer program at meeting of two instrumental organizations positioned to facilitate implementation of the Coalition Program: the Catawba-Wateree Water Management Group (WMG) and Catawba River Study (CRSC).

> The Catawba-Wateree WMG is a bi-state organization with 18 members. Membership in the group is limited to Duke Energy and public water suppliers with water withdrawal capacity of $\geq$100,000 gal/day from one of the Duke Energy Catawba-Wateree Hydroelectric Project reservoirs and/or regulated river reaches. There are a total of 19 facilities that fit this description. The one facility that is not currently a member of the group will be joining in January 2010. Member facilities are required to have one voting representative and an alternate. Current member organizations are as follows:
>
> - City of Morganton, NC
> - City of Belmont, NC
> - Town of Granite Falls, NC
> - City of Charlotte, NC
> - City of Statesville, NC
> - Town of Valdese, NC
> - Chester Metropolitan District
> - City of Rock Hill, SC
> - City of Gastonia, NC
> - City of Camden, SC
> - Town of Longview, NC
> - Duke Energy Carolinas, LLC (Licensee)

- City of Mt. Holly, NC
- City of Lenoir, NC
- Lincoln Co., NC
- City of Hickory, NC
- Lugoff-Elgin Water Authority
- Catawba River Water Treatment Plant (Lancaster Co., SC & Union Co., NC)

McKim & Creed is the WMG consultant. Joe Stowe, Senior Management Consultant for McKim & Creed, is the Project Manager

The Catawba River Study Committee (CRSC) is the key interface that the Western Piedmont Council of Governments uses to interact with local governments in the area of water resources. Formed in 1986, this Committee is staffed by the Western Piedmont Council of Governments (WPCOG), serves in an advisory role for 31 local governments within the Greater Hickory Metro on issues including water quality, water supply, water safety and recreation, and land use within the Upper Catawba River Basin. The Catawba River Study Committee consists of individuals representing local governments, nonprofit organizations, educational institutions and businesses from Alexander, Burke, Caldwell, Catawba and McDowell Counties in Western North Carolina.

Some concerns expressed by the two organizations were:

- How does this change the permitting process?
- Who chooses station locations?
- How can this work with facilities in SC if there are no in-stream monitoring requirements in their permits?
- Who decides who the members are?
- How is the money handled?
- Are the coalitions incorporated?
- Is DWQ going to make this mandatory?
- Does DWQ discontinue sample collection at ambient monitoring stations when a coalition is formed in a basin?
- Can the coalition use multiple labs?
- Would a coalition in the Catawba have less than 158 stations (number based on facilities w/ ups/dns sampling locations)?
- How many parameters have to be sampled at each station? What do the other Coalitions do?
- Is there grant money available to help with start-up?
- Should the Catawba Basin be split into 1, 2 or 3 Coalitions? All examples exist in the states other River Basins currently.

Initial efforts to develop a Catawba Coalition program occurred in 2007. Local governments at that time did not feel that it was worth the additional costs. The program model presented at the time required them to pay for more monitoring than their permit required. Local governments did not see any benefits for them. However, they like the increased flexibility of the program being presented in 2009 (i.e. not every parameter has to be sampled at every station), and were willing to be open-minded about re-evaluating the options.

Point Source Tactics

Both groups overwhelmingly saw increased efficiency as the reason for forming a coalition. They were interested in the costs but were comforted by the flexibility in station placement and parameters. They saw formation of a coalition as an opportunity to have a greater voice in some of the issues that are present in the other river basins and may become items of concern in the Catawba in the future.

At the WMG, everyone was very positive about the program and seemed interested in further evaluating the potential. The Catawba River Study Committee at the July 2009 asked staff to further purse the establishment of a monitoring coalition.

Estimated Load Reductions

Some reduction is expected from decreased industrial contributions to WWTPs due to changing economic conditions.

Non Structural Methods implemented this far are achieving some success.

Plant Modifications and Capital Improvements are linked together with the former allowing for the possibility of implementing major plant modification sin the future.

Comprehensive Sewage Overflow may not result in significant prevention in spill but since a crack or blockage in distributions lines which run immediately adjacent to stream channels could result in some load reductions

Volunteer Water Monitoring Coalition is essential in evaluating overall lake improvements over time, but in itself will not result in any reduction in loading form implementation.

Section G
Recommendations

This plan recommends twenty-two (22) strategies summarized below. The majority can be started immediately or in the next two years with ongoing implemented required over the next 20 year planning window.

Functional Focus Areas

The recommendations are separated into three functional focus areas: 1) Non-Agriculture, 2) Agriculture and, 3) Point Source, as organized in the narrative sections of this report.

Non-Agricultural Recommendations

1. **Subwatershed Plans:** Develop individual site specific restoration plans for each of the nineteen subwatersheds, beginning with priority sub-basins. Model plans after work developed for Muddy, Lower, and most recently Hunting Creek subwatersheds. Incorporate Nine Elements identified by EPA. Identify site specific BMPs to be implemented.

2. **Regional Coordination:** Establish a regional partnership to oversee all of the ongoing efforts in the Watershed to update plans and better coordinate existing efforts of implementing recommendations.

3. **Green Development Practices**: Develop a list of green policies to be presented to local governments that aid in watershed protection (reduced or impervious parking, LID, etc.). Garner local support for such initiatives and encourage their implementation.

4. **Education and Outreach:** Increase awareness and concern for water resource issues in the region through comprehensive education and outreach efforts.

5. **Best Management Practices:** Encourage the use of appropriate BMPs within the watershed that are the most beneficial in removing nutrients.

6. **Stormwater Management:** Fully implement and enforce stormwater BMP practices throughout the region in conjunction with current Phase II Programs.

7. **Sedimentation and Erosion Control:** Review current policies related to sedimentation and erosion control regulatory and oversight processes and implement corrective action for deficiencies.

8. **Secure Adequate Funding:** Seek opportunities to continue and enhance funding for acquisition of buffers, stream restoration, wetland enhancement, education and outreach efforts, monitoring, BMP retrofits and overall watershed improvements in vital areas

9. **Onsite Residential Sewage Treatment Systems:** Continue to operate and adequately fund the Unifour Septic Tank Repair Program. Work with local and state environmental health professionals to identify and correct failing systems.

10. **Geographic Information System (GIS):** Access to best available GIS information to aid in watershed planning and assessment. Continue updating and analyzing GIS layers related to land use/land cover characteristics and changes in the sub-basin.

11. **Instream Substrate Disturbances:** Restrict the use of suction dredges for recreational gold mining in tributaries to Lake Rhodhiss.

12. **Riparian Buffers:** Develop and promote incentives for non-agricultural, smaller property owners who voluntarily establish and maintain buffers along streams within the watershed.

13. **Long Range Land-Use Plans:** Review current comprehensive land-use plans relative to potential impact on nutrient loading and encourage updates to consider water quality impacts.

14. **Greenways Adjacent to Streams:** Encourage development of greenways along riparian corridors.

15. **Water Quality Monitoring:** Continue water quality monitoring to identify problem areas and document improvements. Incorporate a volunteer monitoring component.

Proposed Agricultural Recommendations

16. **Green Nurseryman Coalition**: Cooperative Extension, Soil and Water Conservation District and NRCS should continue to work with the ornamental nursery industry to promote use of BMP's (drip irrigation, cover crops, soil testing, No till techniques). Identify ornamental nursery owners interested in projects that involve installation of BMP's for data and monitoring.

17. **Increase Riparian Buffers**: Educate property owners on tax incentives and their rights as landowners for establishing conservation easements on their property. Develop and promote incentives for property owners who establish and maintain buffers along streams with intensive agriculture activity. Purchase conservation easement or fee-simple acquisition along waterways within the watershed focusing on priority subwatersheds.

Point Source Recommendations

18. **Non-Structural Management Methods:** Continue to seek alternative methods for reducing the nutrient output from the wastewater treatment facilities.

19. **Plant Modifications**: Develop phased plans for design and construction of appropriate nutrient removal systems on priority WWTPs (Valdese and Morganton).

20. **Capital Improvements**: Work with the four existing wastewater treatment plants in the Watershed to obtain funding for improvements to the plants that reduce nutrient loading to the lake. Facilitate talks with locals governments operating WWTPs and stakeholders in the areas affected by the plants in order to gain support for capital improvement projects.

21. **Comprehensive Sewage Overflow Investigation**: Improve monitoring and detection of potential leaks in sewage distribution systems.

22. **Volunteer Water Monitoring Coalition**: Work with DENR to develop an alternative water quality monitoring program that provides more meaningful data to measure lake and watershed health in lieu of NPDES permit monitoring requirements.

Watershed Plan Recommendations

The recommendations are discussed in narrative form in Sections D - F of the plan. The following pages summarize the recommendations in tabular form. The recommendation tables are meant as a reference for the strategies that should be implemented in the Lake Rhodhiss Watershed.

Note: The information in the recommendation tables contains additional information that may not appear in narrative sections of the plan, such as: costs estimates, potential partners and roles, performance indicators and estimated load reductions.

Strategy Classifications

The recommendations can be classified into four (4) general types: Planning and Policy; Restoration and Retrofits; Outreach and Education; Monitoring and Research.

Watershed Planning Tool Category

When appropriate we also noted in following recommendation tables which of the Eight Tools for Watershed Protection developed by the Center for Watershed Protection, applied for a given recommendation

Tools for Watershed Protection
Tool 1. Land Use Planning
Tool 2. Land Conservation
Tool 3. Aquatic Buffers
Tool 4. Better Site Design
Tool 5. Erosion and Sediment Control
Tool 6. Stormwater Best Management Practices
Tool 7. Non-Stormwater Discharges
Tool 8. Watershed Stewardship Programs

Potential Partners

No one individual or organization is solely responsible for improving, protecting or maintaining water quality in surface waters in general or Lake Rhodhiss in particular. Very few projects are implemented in a vacuum. There can added benefits when projects are approached in partnerships. The following table is not exhaustive but is meant to capture some key players working towards a restored Lake Rhodhiss and surrounding watershed.

PARTNERS	Abbreviation

American Rivers	AMR
Catawba River Keepers Foundation	CRK
DENR Division of Forestry	DF
DENR Division Water Quality	DWQ
DENR Ecosystem Enhancement Program	EEP
Foothills Landscape Association	FLA
Land and Lakes RC&D	RCD
Land Conservancies; Foothills, Catawba	CON
Local Governments	GOVT
Natural Resource Conservation Districts, Burke and Caldwell County	NRCS
NC Green Industry Council	GIC
NC Nurseryman's Association	NA
NC Science House	SH
NC State Cooperative Extension Service	EXT
Reese Institute for the Conservation of Natural Resources	RES
Soil and Water Conservation Service, Burke and Caldwell County	SWC
Trout Unlimited	TU
Wildlife Resources Commission	WRC
Western Piedmont Council of Governments	COG

Project Partner Involvement Detail

Type of Contributions by Partners	
Project Coordination	C
Conceptual Design	D
Technical Assistance	T
Funding	F
Maintenance	M

Partner organizations have different capacities, resources and expertise. For a given project an organizations contribution may vary. The table is an effort to capture the potential contribution of a given partner. In many cases an individual organization may have multiple roles. Generally, only the primary contributions to a given project are noted due to space constraints.

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 1

Practice Title:	Subwatershed Restoration Plans

Focus Area	Non-Agriculture	X	Agriculture	X	Point Source	

Strategy	Planning and Policy
Objective:	Identification and prioritizing of specific watershed problems and solution
Practice Narrative:	Develop individual site specific restoration plans for each of the nineteen subwatersheds, beginning with priority sub-basins. Model plans after work developed for Muddy, Lower, and most recently Hunting Creek subwatersheds. Incorporate Nine Elements identified by EPA. Identify site specific BMPs to be implemented.

Key Actions:	Project Initiator(s):
Seek funding (apply for grants when available) Find project facilitator, consultants as needed Solicit Citizen involvement (Identify watershed champions) Plan development; future implemention of recommendations	DENR

Watershed Planning Tool Category:	N/A

Potential Partners:		Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ RCD COG EXT SWCS	T/F C/T C/T T T/C	Project facilitator Technical Advisory Committee Citizens Advisory Committee Data (GIS)	Citizen involvement and increased awareness. Detection of problems

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Stakeholder Advisory groups and meetings	Varies based on extent and how it is undertaken. Estimates \$50-\$60 K per subwatershed	CWMTF, 205j, 319h, local government contribution	Priority watershed plans in 5 years; all plans in 10 years

Measureable Performance Indicators:	Ongoing development of watershed plans until all are complete. Implementation of plan recommendations
Estimated Load Reduction:	N/A, will promote reductions
Status:	Plans complete in North and South Muddy Creek, Lower Creek and Zack's Fork. Plan in development for Hunting Creek, Seeking funding for Central Morganton, Source Watershed Protection plan is a potential model for John's River watershed

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 2

Practice Title:	Regional Watershed Coordination

Focus Area	Non-Agriculture	X	Agriculture	X	Point Source	X

Strategy	Planning and Policy
Objective:	Better coordinate projects and resources in the Rhodhiss watershed
Practice Narrative:	Establish a regional partnership to oversee all of the ongoing efforts in the Watershed to update plans and better coordinate existing efforts of implementing recommendations. Share technical resources and expertise. Jointly seek funding.

Key Actions:	Project Initiator(s):
Identify watershed stakeholders Jointly meet to discuss and refine goals and objectives Develop an organizational structure that works best to achieve collaboration and allows coalition members to remain independent organizations. Determine meeting schedule	DENR

Watershed Planning Tool Category:	N/A

Potential Partners:		Resources/Technical Assistance Needed:	Additional Benefits
All	C/T	Group facilitation (i.e. WECO) Meeting location Secretary: minutes, correspondence	Efficient use of resources and time. Avoidance of undue competition for resources

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Representative of general public involved /appointed by local governments	Minimal in-kind, local resources	N/A	Established by end 2009

Measureable Performance Indicators:	Group established. Membership list. Meeting schedule
Estimated Load Reduction:	N/A, will promote reductions through implementation of plan recommendations and BMP's
Status:	Technical oversight group organized as part of Rhodhiss Project has discussed the need and possible structure of such a group, concerns over purpose and function of such as group.

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 3

Practice Title:	Green Development Practices				
Focus Area	Non-Agriculture	X	Agriculture		Point Source
Strategy	Planning and Policy				
Objective:	Encourage local governments to adopt green policies				
Practice Narrative:	Develop a list of green policies to be presented to local governments that aid in watershed protection (reduced or impervious parking, LID, etc.). Garner local support for such initiatives and encourage their implementation.				

Key Actions:	Project Initiator(s):
Develop a comprehensive list of green policies. Review local government land-use ordinances and town policies. Review Ordinances with local government Staff to determine need and possibilities. Present to local government board and recommend for adoption.	Local Governments COG

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ COG EXT	Staff to review, update and present recommended changes to land-use ordinances.	Local Government Awareness.

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Participation	$5,000-$15,000		2 – 4 Years

Measureable Performance Indicators:	Number of green policies adopted by local governments
Estimated Load Reduction:	Will promote reductions
Status:	Performed Upper Catawba Valley Conservation Forum in 2007.

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 4

Practice Title:	Education and Outreach

Focus Area	Non-Agriculture	X	Agriculture	X	Point Source	X

Strategy	Education and Outreach
Objective:	Increase awareness, concern and action
Practice Narrative:	Increase awareness and concern for water resource issues in the region through comprehensive education and outreach efforts. Encourage adoption of BMP's. Utilize Environmental Education practices and principles

Key Actions:	Project Initiator(s):
Collect and develop resource materials Work with and in schools Collaborate with existing programs	COG

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ CRC COG EXT SH SWCS	Staff- Program Coordinator Advisory Team to help set program priorities	Citizen involvement. Multi-Jurisdictional cooperation

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Volunteers	Varies based on extent of program	CWMTF, 205j, 319h, local government contribution	Ongoing

Measureable Performance Indicators:	Local Watershed Website, Number and type of written resources available; # of students/school reached
Estimated Load Reduction:	N/A, will promote reductions through awareness and improved environmental stewardship
Status:	Catawba Riverfest is a successful public festival held each September on the River

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 5

Practice Title:	Best Management Practices

Focus Area	Non-Agriculture	X	Agriculture	X	Point Source	

Strategy	Planning and Policy/Education and Outreach/Restoration and Retrofit
Objective:	Broadly adopt BMPs where appropriate
Practice Narrative:	Encourage the use of appropriate Non-Point Source BMPs within the watershed that are the most beneficial in removing nutrients.

Key Actions:	Project Initiator(s):
Utilize and refine existing subwatershed plans and continues to develop others. Assure active oversight groups (i.e. Lower Creek Advisory Team) Agricultural Community and Support Agencies continue to support and promote adoption of BMPs through technical and financial assistance programs	ALL

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
ALL	Technical Advisory Committee Citizens Advisory Committee	Takes awareness to action

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Recruit and work with early adopters	See Appendix ___	CWMTF, 205j, 319h, local government contribution	Ongoing

Measureable Performance Indicators:	Types and #'s of BMPs installed and/or implemented
Estimated Load Reduction:	N/A, will promote reductions
Status:	Subbasin Plans have more specific recommendations and oversight to encourage implementation in place. Phase II Stormwater Programs are beginning to address

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 6

Practice Title:	Stormwater Management

Focus Area	Non-Agriculture	X	Agriculture		Point Source	

Strategy	Planning and Policy/Restoration and Retrofits/Education and Outreach
Objective:	Better coordinate projects and resources in the Rhodhiss watershed
Practice Narrative:	Fully implement stormwater permits and management plans throughout the region in conjunction with current Phase II Programs.

Key Actions:	Project Initiator(s):
Identify watershed stakeholders Jointly meet to discuss and refine goals and objectives Develop an organizational structure that works best to achieve collaboration and allows coalition members to remain independent organizations. Determine meeting schedule	Local Stormwater Administrators

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ COG EXT	Stormwater Working Group (SWWG) Ongoing training for Stormwater Staff and Public Service personnel Adequate funding and staffing	Consistent application across jurisdictions. Sharing of resources and expertise

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Representatives of general public appointed to Stormwater Advisory Boards	$2 million annually to operate programs in the Burks Caldwell Counties (estimated by SWWG 7/9/09)	General fund local governments, grants Stormwater Utility Fees	Compliant with current permits and plans by 2010. New permits issues in 2011

Measureable Performance Indicators:	Annual Reports will include relevant program implementation information
Estimated Load Reduction:	N/A, will promote reductions
Status:	SWWG has been voluntarily assisting Phase II Stormwater communities in the region for nearly a decade. Programs not all fully funded and staffed

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 7

Practice Title:	Sedimentation and Erosion Control

Focus Area	Non-Agriculture	X	Agriculture		Point Source	

Strategy	Planning and Policy
Objective:	Sedimentation and Erosion Control Rules Enforced Adequately
Practice Narrative:	Review current policies related to sedimentation and erosion control regulatory and oversight processes and implement corrective action for deficiencies.

Key Actions:	Project Initiator(s):
Gather current policies, interview appropriate personnel Form advisory group Compare current findings with exemplary programs Identify deficiencies and recommend corrective actions Educate Grading Contractors and Heavy Equipment Operators on regulations	Local Governments COG

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ RES COG EXT DF	State and Federal Regulations Examples of Exemplary Programs	May encourage adequate staffing and funding levels

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Participation in advisory role	Varies depending on size of grant and technical expertise to write and administer $10-50K	Local governments Grants	Begin by 2015 or as funding becomes available

Measureable Performance Indicators:	Number of inspections of land disturbing activity. NOVs issues, corrective actions taken.
Estimated Load Reduction:	Compliance with regulations will promote reductions
Status:	Caldwell County administer the state program from 2006-2009 but found it too burdensome. Slow response time from regional offices.

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 8

Practice Title:	Secure Adequate Funding

Focus Areas:	Non-Agriculture	X	Agriculture	X	Point Source	X

Strategy:	Planning and Policy
Objective:	Adequate funding to implement recommendations of plan
Practice Narrative:	Seek opportunities to continue and enhance funding for watershed coordinators; acquisition of buffers, stream restoration, wetland enhancement, education and outreach efforts, monitoring, BMP retrofits and overall watershed improvements in vital areas

Key Actions:	Project Initiator(s):
Identify funding sources most appropriate fro each recommendation in the plan Identify project partners Develop pre-proposals for grant application Obtain letters of support from partners as needed	Local Partners

Watershed Planning Tool Category:	N/A

Potential Partners:		Resources/Technical Assistance Needed:	Additional Benefits
All	C D T F	Regional Oversight Group to: • provide coordination of grant application • staff to write grant applications • staff to administer grants • increase awareness of potential grants availability	Better projects. Maintain continuity of projects. Allow for adequate staffing levels

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Participation on concept development and promotion	Varies depending on size of grant and technical expertise to write and administer	Can sometimes incorporated into some grants as part of project management. Time to develop grant is not recoverable	Ongoing

Measureable Performance Indicators:	Annually, number of grants applied for and received; amount of grant funding applied for and received
Estimated Load Reduction:	Dependent of project funded, will promote reductions
Status:	Partnering organizations in the watershed have seldom not applied for available grants

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 9

Practice Title:	Onsite Residential Sewage Treatment					
Focus Area	Non-Agriculture	X	Agriculture		Point Source	
Strategy	Planning and Policy/Restoration and Retrofit/ Education and Outreach					
Objective:	Continue to operate and adequately fund the Unifour Septic Tank Repair Program					
Practice Narrative:	Work with local and state environmental health professionals to identify and correct failing systems.					

Key Actions:	Project Initiator(s):
Restructure existing Unifour Septic System Repair Program to more efficiently distribute funding and administer program. Coordinate with Environmental Health Specialists in County and State Collaborate with WaDE program	COG

Watershed Planning Tool Category:	Non-stormwater discharges

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ EXT Environmental Health	Funding for USSRP Assistance from County Environmental Health Specialists DENR assistance from WaDE Program	Remove health hazards

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Reporting failing systems. Participating with WaDE neighborhood surveys	\$500,000 to \$750,000 Average residential septic system repair \$5,000	Can sometimes incorporated into some grants as part of project management. Time to develop grant is not recoverable	Ongoing

Measureable Performance Indicators:	Annually, number of residential loan applied for and received; amount of grant funding applied for and received
Estimated Load Reduction:	Dependent of project funded, will promote reductions
Status:	No new loans or grants since November 2007. Managing outstanding loans

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 10

Practice Title:	Geographic Information System (GIS)

Focus Area	Non-Agriculture	X	Agriculture	X	Point Source	X

Strategy	Planning and Policy
Objective:	Access to best available GIS information to aid in watershed planning and assessment
Practice Narrative:	Continue updating and analyzing GIS layers related to land use/land cover characteristics and changes in the sub-basin.

Key Actions:	Project Initiator(s):
Adequately fund and Train local GIS professionals Secure necessary datasets, hardware and software Analysis raw data Develop Layers Run Analysis	COG

Watershed Planning Tool Category:	N/A

Potential Partners:		Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ COG GOVT	T/F C/T/F T/F	Training local GIS professionals Datasets, hardware and software Raw data Storage and Server capacity	Information utilized by multiple programs and jurisdictions

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Accessing web based GIS information	Equip \$30,000/year Data \$10,000/project Staff \$75,000 ¾ person /year	CWMTF, 205j, 319h, local government contribution Stormwater Phase II program	Ongoing

Measureable Performance Indicators:	Current and high resolution GIS layers available for use with watershed planning projects
Estimated Load Reduction:	N/A, will promote reductions through increased understanding and linkage with monitoring data
Status:	WPCOG has 6 full-time and 4 part-time GIS staff. 4 analyst level. Other local governments have GIS staff and most departs are growing.

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 11

Practice Title:	Instream Substrate Disturbances

Focus Area	Non-Agriculture	X	Agriculture	X	Point Source	X

Strategy	Planning and Policy
Objective:	Identification and prioritizing of specific watershed problems and solution
Practice Narrative:	Restrict the use of suction dredges for recreational gold mining in tributaries to Lake Rhodhiss.

Key Actions:	Project Initiator(s):
Review applicable law Assess current extent of gold dredging activity Determine potential extent of future dredging activity Determine effects of activity introducing nutrients, determine loading Evaluate activities impact on aquatic biological communities Analyze alternatives, make recommendations for action	DENR

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ RCD COG EXT	Technical Advisory Committee Legal assistance	Improve fish habitat and water clarity

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Recommending acceptable alternative practice	$45,000 for study	CWMTF, 205j, 319h, local government contribution	Initial investigation of law and extent of activity could occur within a year.

Measureable Performance Indicators:	Determination of extent of practice in watershed. Development of a Map. Report of relevant law.
Estimated Load Reduction:	Depends on current loading from activity
Status:	Unknown other than activity observed

Lake Rhodhiss Watershed Restoration

PRIORITY RECOMMENDATIONS WORKSHEET 12

Practice Title:	Riparian Buffers

Focus Area	Non-Agriculture	X	Agriculture		Point Source	

Strategy	Planning and Policy/Restoration and Retrofits/Education and Outreach
Objective:	Increase amount of stream side woody vegetation that is functions as a filter and stream stabilizer
Practice Narrative:	Encourage more streamside areas left undeveloped or restored with functioning buffers. Develop and promote incentives for non-agricultural, smaller property owners who voluntarily establish and maintain buffers along streams within the watershed.

Key Actions:	Project Initiator(s):
Increase width of riparian forested area Increase woody component of riparian area Keep new development out of riparian zone and flood plain Education landowners of environmental and tax benefits	DENR

Watershed Planning Tool Category:	Better Site Design/ Land Conservation

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ RCD COG EXT	Project facilitator (Watershed Coordinator) Funding for incentives	Improved wildlife habit and corridors

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Adopting practice of maintaining or establishing buffers.	Varies based on extent of project	CWMTF, 205j, 319h, local government contribution	Ongoing

Measureable Performance Indicators:	Stream frontage with functional buffers increasing in watershed
Estimated Load Reduction:	N/A, will promote reductions through bank stabilization and filtering
Status:	Agricultural Programs in place to assist willing landowners. Activity in Muddy and Lower Creek watershed groups to promote practice. CCAP program allow for outreach SWCD/NRCS to reach non agricultural groups

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 13

Practice Title:	Long Range Land-Use Plans					
Focus Area	Non-Agriculture	X	Agriculture		Point Source	
Strategy	Planning and Policy					
Objective:	Update local government land-use policies to include recommendations.					
Practice Narrative:	Review current comprehensive land-use plans relative to potential impact on nutrient loading and encourage updates to consider water quality impacts.					

Key Actions:	Project Initiator(s):
Review of local government comprehensive and land-use plans. Note needed changes. Review Changes with local government Staff. Present to local government board for adoption.	Local Governments COG

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ COG	Staff to review, update and present needed changes to comprehensive and land-use plans.	Local Government Awareness.

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Participation in Advisory Capacity and Public meetings	\$5,000-\$15,000/ Plan developed	Local Governments	2 – 4 Years

Measureable Performance Indicators:	Number of changes adopted by local governments.
Estimated Load Reduction:	Will promote reductions
Status:	Long Range plans are developed periodically at local governments request

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 14

Practice Title:	Greenways Adjacent to Streams

Focus Area	Non-Agriculture	X	Agriculture		Point Source	

Strategy	Planning and Policy
Objective:	
Practice Narrative:	Encourage development of greenways along riparian corridors.

Key Actions:	Project Initiator(s):
Can be done in conjunction with recommendation 3. Map out undeveloped riparian corridors appropriate for potential greenway locations. Educate the public and local government officials on the benefits.	

Watershed Planning Tool Category:	Better Site Design

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ RCD COG EXT SWCS	Staff to meet with local governments. GIS Staff.	Increase recreation al and Tourism opportunities

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Participation on concept development and promotion	Varies depending on size of project	PARTF CWMTF	2 – 4 Years

Measureable Performance Indicators:	Annually, number of blueway/greenway trail projects applied for and received; amount of grant funding applied for and received, trail miles
Estimated Load Reduction:	Dependent of project funded, will promote reductions
Status:	Caldwell Pathways and other groups have been promoting greenways and blueways

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 15

Practice Title:	Water Quality Monitoring				
Focus Area	Non-Agriculture	X	Agriculture	X	Point Source
Strategy	Monitoring (and Research)				
Objective:	Identify problem areas in watershed and access the effectiveness of projects				
Practice Narrative:	Continue water quality monitoring to identify problem areas and document improvements. Incorporate a volunteer monitoring component.				

Key Actions:	Project Initiator(s):
Utilize previous monitoring locations Add new monitoring sites as needs occur Periodic collection of water quality data Pre and Post monitoring at restoration and BMP sites	DENR

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ RCD COG EXT RES	Varies based on extent of study. Field Monitoring equipment, lab analysis Training, Coordination and Quality Control of volunteers needed	Citizen and student involvement possible. Early detection of problem

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Voluntary Citizen/Student Monitoring (MacroInvertbrates)	Varies based on extent of study	CWMTF, 205j, 319h, local governmment contribution	Ongoing

Measureable Performance Indicators:	Current Loading information from tributaries of most concern. Number of sites sampled on yearly basis
Estimated Load Reduction:	N/A, will promote reductions
Status:	12 months of key tributary completed spring 2008. Reese Institute has some student macroinvertebrate sites. Monitoring Coalition is being reconsidered in fall 2010.

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 16 (A-1)

Practice Title:	Increase Riparian Buffers

Focus Area	Non-Agriculture		Agriculture	X	Point Source	

Strategy	Planning and Policy
Objective:	
Practice Narrative:	Educate property owners on tax incentives and their rights as landowners for establishing conservation easements on their property. Develop and promote incentives for property owners who establish and maintain buffers along streams with intensive agriculture activity. Purchase conservation easement or fee-simple acquisition along waterways within the watershed focusing on priority subwatersheds.

Key Actions:	Project Initiator(s):
Identify funding sources most appropriate for each recommendation in the plan Identify project partners	Local Partners

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ RCD COG EXT SWCS		

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Participation	Varies depending on size of		Ongoing

Measureable Performance Indicators:	Annually, number of grants applied for and received; amount of grant funding applied for and received
Estimated Load Reduction:	Dependent of project funded, will promote reductions
Status:	

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 17 (A-2)

Practice Title:	Green Nurseryman's Coalition

Focus Area	Non-Agriculture		Agriculture	X	Point Source	

Strategy	Outreach and Education
Objective:	Expeditious Implement Agricultural BMP's
Practice Narrative:	Establish a partnership to promote green industry practices in the watershed.. and market products as green. Continue to work with ornamental nursery industry to promote use of BMP's (drip irrigation, cover crops, soil testing, No till techniques

Key Actions:	Project Initiator(s):
Identify funding sources most appropriate for each recommendation in the plan Identify project partners Develop pre-proposals for grant application Obtain letters of support from partner as needed	Cooperative Extension

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefits
DENR/DWQ RCD COG EXT SWCS	Oversight Cooperative Extension Service Identify property owners interested in projects that involve installation of BMP's	Better projects. Maintain continuity of projects.

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Private sector participation in projects and promotion	Varies depending on type and size of project		

Measureable Performance Indicators:	Annually, number of projects
Estimated Load Reduction:	Dependent of project implemented
Status:	

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 18 (PS-1)

Practice Title:	Non-Structural Management Methods				
Focus Area	Non-Agriculture		Agriculture		Point Source X
Strategy	Planning and Policy				
Objective:	Minimize nutrients in WWTP effluent				
Practice Narrative:	Continue to seek alternative methods for reducing the nutrient output from the wastewater treatment facilities.				

Key Actions:	Project Initiator(s):
	Local Plant Operators

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ EPA	Project facilitator	Potential Cost Savings Plant Operation

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
	Varies based on extent of study	CWMTF, 205j, 319h, local government contribution	Ongoing

Measureable Performance Indicators:	Ongoing development of watershed plans until all are complete. Implementation of plan recommendations
Estimated Load Reduction:	N/A, will promote reductions
Status:	

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 19 (PS-2)

Practice Title:	Plant Modifications

Focus Area	Non-Agriculture		Agriculture		Point Source	X

Strategy	Restoration and Retrofits
Objective:	Minimize nutrients in WWTP effluent
Practice Narrative:	Develop phased plans for design and construction of appropriate nutrient removal systems on priority WWTPs (Valdese and Morganton).

Key Actions:	Project Initiator(s):
	DENR

Watershed Planning Tool Category:	Better Site Design

Potential Partners:		Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ EPA			Better coordination with State and EPA

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
	Varies based on extent of modification required	local government contribution Low Interest Long Term Loans	

Measureable Performance Indicators:	Development of new treatment protocols. Reduction in nutrients in effluent and holding tanks
Estimated Load Reduction:	N/A, will promote reductions
Status:	Preliminary study done in conjunction with DENR/EPA 104 technical assistance program for WWTP in region even downstream of Lake Rhodhiss watershed

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 20 (PS-3)

Practice Title:	Capital Improvements in WWTP

Focus Area	Non-Agriculture		Agriculture		Point Source	X

Strategy	Restoration and Retrofits
Objective:	Identification and prioritizing of specific watershed problems and solution
Practice Narrative:	Work with the four existing wastewater treatment plants in the Watershed to obtain funding for improvements to the plants that reduce nutrient loading to the lake. Facilitate talks with locals governments operating WWTPs and stakeholders in the areas affected by the plants in order to gain support for capital improvement projects.

Key Actions:	Project Initiator(s):
Seek funding Promote Political/Citizen awareness of need for capital improvement project	Local Governments

Watershed Planning Tool Category:	N/A

Potential Partners:		Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ EPA		Construction and Design Site Plans Feasibility Selection of treatment method	More efficient plants

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Though local government board oversight	Varies based on extent of study	Loans, local government contribution	Ground need to begin soon, construction within 10 years

Measureable Performance Indicators:	Design Phase with construction plans developed Project identified in Local Governments long range plans
Estimated Load Reduction:	N/A, will promote reductions
Status:	Some recognition of eventual need for plant updates

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 21 (PS-4)

Practice Title:	Comprehensive Sewage Overflow				
Focus Area	Non-Agriculture		Agriculture		Point Source X
Strategy	Restoration and Retrofits				
Objective:	Locate and correct problems in sewage distribution system				
Practice Narrative:	Improve monitoring and detection of potential leaks in sewage distribution systems.				

Key Actions:	Project Initiator(s):
Appropriate map system Walk system lines GPS system Develop regular system check	WWTP operators

Watershed Planning Tool Category:	Non Stormwater Discharges

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ	Staff time Mapping GPS equipment	Savings in potential clean-up cost. Permit compliance

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Reporting overflows through hotline	Varies based on extent of effort	local government contribution	Ongoing

Measureable Performance Indicators:	Inspection plan developed. Inspection reports
Estimated Load Reduction:	Raw sewage leaks prevented
Status:	Sporadic inspection of system currently, complaint driven rather than prevention driven

Lake Rhodhiss Watershed Restoration

RECOMMENDATIONS WORKSHEET 22 (PS-5)

Practice Title:	Water Quality Monitoring Coalition

Focus Area	Non-Agriculture	X	Agriculture		Point Source	X

Strategy	Monitoring (and Research)
Objective:	Monitor water quality in the lake and key tributary streams
Practice Narrative:	Work with DENR to develop an alternative water quality monitoring program that provides more meaningful data to measure lake and watershed health in lieu of NPDES permit monitoring requirements.

Key Actions:	Project Initiator(s):
Utilize previous monitoring locations Add new monitoring sites as needs occur Minimum quarterly collection of water quality data	DENR WWTP Operators

Watershed Planning Tool Category:	N/A

Potential Partners:	Resources/Technical Assistance Needed:	Additional Benefit
DENR/DWQ COG EXT RES	Varies based on extent of study. Hand held monitors, lab analysis Training, Coordination and Quality Control Potential need for small boat if sampling lake	Clearer Picture water quality changes over time.

Public Involvement:	Cost Estimate:	Potential Funding:	Timeframe:
Depends on structure of coalition	Varies based on extent of study. More than current monitoring requirements	local NPDES permit holders (WWTP government contribution)	Establish group during new permit cycle 2010

Measureable Performance Indicators:	Number of sites sampled on yearly basis.
Estimated Load Reduction:	N/A, will promote reductions through having better information on conditions
Status:	Discussions about establishing coalition in the Catawba have occurred periodically since 2006. Monitoring Coalition is best established during 5 year permit cycle (next opportunity 2010)

	Strategy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Non-Agricultural Strategies										Implementation Year										
1	Subwatershed Plans																				
2	Regional Coordination																				
3	Green Development Practices																				
4	Education and Outreach																				
5	Best Management Practices																				
6	Stormwater Management																				
7	Sedimentation and Erosion Control																				
8	Secure Funding																				
9	Onsite Residential Sewage Systems																				
10	GIS Information																				
11	Instream Substrate Disturbances																				
12	Riparian Buffers																				
13	Long Range Land-Use Plans																				
14	Greenways Adjacent to Streams																				
15	Water Quality Monitoring																				
	Agricultural Strategies																				
16	Green Nurseryman's Coalition																				
17	Increase Riparian Buffers																				
	Point Source Strategies																				
18	Non-Structural Control Strategies Implemented																				
19	Appropriate WWTP Modifications																				
20	Capital Improvements in WWTP																				
21	Comprehensive Sewage Overflow Investigation																				
22	Volunteer Water Monitoring Coalition																				

Section H
Conclusion

One of the goals of the Lake Rhodhiss Project was to prepare a comprehensive watershed restoration plan that can be used by local governments and agencies as a roadmap for improving water quality conditions within the watershed.

The watershed restoration plan recommendations found in this document are necessarily general in nature due to the geographic scope of the Lake Rhodhiss watershed. However, implementing the recommendations will help reduce sediment and nutrient loading, improve water quality in the Lake and its tributary streams and protect our main local drinking water resource, Lake Rhodhiss and downstream reservoirs.

Municipalities in Counties of Burke, Caldwell and McDowell should consider formal adoption of this locally initiated Lake Rhodhiss Watershed Restoration Plan as a supplement to their respective Comprehensive Plans. Expeditious implementation of these recommendations will avoid state and federal mandates regarding how local governments manage our water resources.

Efforts undertaken now to improve existing water quality concerns could help reverse impaired lake conditions. We are all part of the problem and can be part of the solution!

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Appendix A
Lake Rhodhiss Visioning Project

This project was one of several precursors to the current plan. A summary of this project and its' recommendations is found on the proceeding pages of this Appendix. In the past seven years since this project was completed several of the recommendations form this project have been achieved but many are yet to be fulfilled.

Purpose

The Lake Rhodhiss Stakeholders Project sought to develop a set of land use recommendations for local governments sharing land-use jurisdiction along the Lake Rhodhiss by utilizing a committee comprised of local stakeholders. Because ten local governments have land-use jurisdiction within a 0.5 mile of Lake Rhodhiss, current policies regulating development near the Lake are variable, confusing and occasionally contradictory. A single, uniform set of standards will provide local governments, property owners and the development community with more predictable land use regulations and more consistency in their administration.

Twenty-two entities were represented on the committee including local governments, local and state resource agencies, and business interests. Staff with the Western Piedmont Council of Governments (WPCOG) facilitated all meetings.

Process

A stakeholders committee was established to develop recommendations for local governments, local and state resource agencies, nonprofits and businesses with interests in Lake Rhodhiss. Beginning in May 2000 monthly stakeholder meetings were held in the office of the Western Piedmont Council of Governments in Hickory. Generally, one or more speakers presented information on a specific topic, such as water quality, at each meeting. Based on discussion and comments made by Committee members following each presentation, WPCOG staff developed draft goals and strategies for that particular subject area. Goals and strategies were reviewed and modified based on feedback received from Committee members at the onset of the following meeting.

All committee decisions were made by consensus. For this project, consensus meant that all Committee members could accept the decision being made. Approximate timetables were established for each goal. Short-range goals are objectives that can be implemented in six months or less, moderate-range goals are objectives that can be implemented in six months to two years, and long-range goals are objectives that will require two years or more to implement. Besides these timetables, key implementers, who represent local governments and agencies responsible for enacting a particular goal, are also identified in this report.

WATER QUALITY RECOMMENDATIONS

1. Since sediment is the principal nonpoint source pollutant in Lake Rhodhiss, efforts should be increased to reduce the amount of sediment entering the Lake

A. Identify those streams entering Lake Rhodhiss that contribute the most seriously to sediment problems (among these streams are the Johns River, Lower Creek, Silver Creek and Muddy Creek) (*MEDIUM TERM*).

Key Implementers:

- Western Piedmont Council of Governments
- Duke Power Company
- Burke and Caldwell Counties

B. After problem streams have been identified under Strategy A, determine the major source(s) of sediment entering each stream and develop plans for reducing sediment inputs to each stream (*LONG TERM*).

Key Implementers:

- Natural Resource Conservation Service
- Western Piedmont Council of Governments
- Local governments

C. Recommend that Burke and Caldwell Counties consider establishing and administering sediment/erosion control programs to more effectively control erosion from land disturbing activities occurring locally (*SHORT TERM*).

Key Implementers:

- Burke and Caldwell Counties

2. Improve the water quality in "impaired streams" in the Lake Rhodhiss watershed

A. Improve the water quality in "impaired streams" by:

i. Encouraging the use of Best Management Practices in the watershed (*ONGOING*).

Key Implementers:

- Natural Resources Conservation Service
- Local Governments

ii. Seeking funding opportunities for stream improvements (*ONGOING*).

Key Implementers:

- Local governments
- Western Piedmont Council of Governments

iii. Increasing volunteer involvement and educational efforts, including local media and public forums or other methods to inform the public of the importance of improving water quality in local streams (*SHORT TERM*).

Key Implementers:

- Local governments

iv. Encouraging more comprehensive protection of riparian areas (*ONGOING*).

Key Implementers:

- Natural Resource Conservation Service
- NC Cooperative Extension – Burke and Caldwell Counties
- Local governments
- Duke Power Company
- Crescent Resources
- Foothills Conservancy

v. Developing passive recreation options along streams (*LONG TERM*).

Key Implementers:

- Local governments

vi. Promoting more aggressively the Unifour Septic Tank Repair Program (*SHORT TERM*).

Key Implementers:

- Western Piedmont Council of Governments
- Burke and Caldwell Counties

PUBLIC ACCESS AND RECREATION RECOMMENDATIONS

Public access to Lake Rhodhiss is provided primarily by Duke Power Company at four lake access sites. A commercial facility, Castle Bridge Marina, is located near the mid point of the Lake in Caldwell County, where access is fee-based. Duke Power Company recently retired Tator Hole Access Area following the completion of the Rhodhiss Access Area. The Town of Granite Falls is currently exploring purchase options with Duke Power Company for Tator Hole, which if purchased, would continue to serve as a public access area. (*park was established in 2007)*

Duke Power Company through an Access Area Initiative *was* offering long-term leases to public and private entities desiring to add or enhance existing recreation facilities at the utilities access areas along the Catawba River. The Town of Sawmills has entered into a lease agreement with Duke Power to provide additional recreational amenities at the Conley Spring Access Area.

3. Local governments should acknowledge the public's desire for more recreation and open space as the region becomes increasingly urbanized

A. To help preserve the quality of the surface water in the Upper Catawba River and provide additional hiking and biking opportunities, local governments and other interested parties should cooperate on ways to develop a Catawba River greenway east from Lake James to the existing City of Morganton Greenway (*LONG TERM*).

Key Implementers:

- Burke County
- Foothills Conservancy
- City of Morganton
- Town of Glen Alpine

B. Encourage local governments downstream of Morganton within the Lake Rhodhiss watershed to development greenways along the Catawba River and its tributaries *(LONG TERM)*.

Key Implementers:

- Local governments

C. Duke Power should be strongly encouraged to extend the lease options on existing public access areas to at least 50 years to encourage local governments to develop necessary infrastructure at those sites (SHORT TERM).

Key Implementers:

- Local governments
- Catawba-Wateree Relicensing Coalition

D. Lands along the Catawba River above Huffman's Bridge and along the lower Johns River should be opened for public recreational access, including opportunities for hunting (*LONG TERM*).

Key Implementers:

- Caldwell County
- Foothills Conservancy

CRITICAL LANDS RECOMENDATIONS

For the purpose of this project, critical lands are public and privately held lands that have been identified by resource agencies or conservation groups for special management because of their biological or ecological importance. This definition also includes lands identified by resource agencies that require restoration to improve biological function or productivity.

Two state agencies, NC DENR and the NC Wildlife Resources Commission, along with input from Duke Power Company, developed the Catawba River Basin Natural Resources Plan. This document outlines conservation goals that these agencies and the utility will work towards accomplishing over the next 10 to 20 years.

This plan places conservation goals for specific areas within one of three categories ranging from high to low in importance: Priority I Areas, Priority II Areas and Priority III Areas. The following recommendations pertain to lands found within the Lake Rhodhiss watershed.

Priority I Areas include the following:

- Establishing a riparian greenway to protect the upper Catawba River below Lake James;
- Establishing undeveloped buffers along the shoreline of Lake Rhodhiss; and,
- Establishing a conservation zone along the lower Johns River.

Priority II Areas include the following:

- Protecting riparian corridors of Upper Creek and Warrior Fork, and
- Establishing conservation zones along Gingercake, Steels and Wilson Creeks.

Priority III Areas include the following:

- Acquiring wetland areas along Bristol Creek;
- Establishing conservation zones along Silver, Clear, Mulberry, and Anthony Creeks, as well as the upper Johns River; and,
- Continuing implementation of the Muddy Creek Watershed Restoration Project.

The Foothills Conservancy of North Carolina was established in 1995 and is dedicated to working cooperatively with landowners to preserve and protect important natural areas and open spaces of the Foothills region of North Carolina, which includes Alexander, Burke, Caldwell, Catawba, Cleveland, Lincoln, McDowell and Rutherford Counties. This organization recently completed riparian corridor plans for both the upper Catawba and upper Johns Rivers. These efforts evaluated the condition of riparian buffers along both rivers on a parcel-by-parcel basis. The Conservancy will use these plans to prioritize parcels for acquiring easements and for fee simple purchase in the future as funds become available.

The Lower Creek subbasin is another area that has been identified as a high priority area by the North Carolina Wetlands Restoration Program and DWQ for restoration activities.

4. Within the Lake Rhodhiss watershed, lands identified as important for the recreational, cultural/historical and water quality interests of the region should be protected

A. Lands along the Catawba River west of Huffman Bridge and along the lower Johns River should be designated as prime candidates for additional protection or acquisition as "critical lands" (*LONG TERM*).

Key Implementers:

- Burke and Caldwell Counties
- Foothills Conservancy

B. Wetlands within the Bristol Creek subbasin should be protected from future development (*LONG TERM*).

Key Implementers:

- Burke and Caldwell Counties
- NC Wetlands Restoration Program

C. Existing conservation/preservation efforts among public and private entities need coordinated planning to maximize scarce resources for protection and acquisition efforts (*ONGOING*).

Key Implementers:

- Local governments
- Local and state resource agencies
- Duke Power
- Crescent Resources

SHORELINE STABILIZATION RECOMENDATIONS

The use of shoreline stabilization techniques is important for reducing erosion and bank slumping along the margins of lakes. Lakefront homeowners often employ shoreline stabilization to protect and maintain the physical integrity of their property. The use of riprap and hard structures, such as seawalls or bulkheads, has been used the most commonly in the past for reducing shoreline erosion. More recently, natural techniques, such as the use of vegetative plantings have increased in popularity, particularly with resource agencies involved in restoration activities, and to a lesser degree, homeowners.
Traditionally, shoreline stabilization activities have been regulated by Duke Power Company on Lake Rhodhiss. An applicant must obtain written permission from Duke Power Lake Management before any shoreline stabilization activity within the FERC project boundary may begin. For any stabilization project that exceeds 500 linear feet of shoreline, an applicant must also receive a permit from the US Army Corps of Engineers.

Duke Power Company's shoreline classification scheme largely dictates where and what method of shoreline stabilization will be allowed. No stabilization activities are allowed in areas classified as "Environmental Areas" which on Lake Rhodhiss include much of the shoreline located west of Huffman Bridge.

5. Since sediment is the principal pollutant of concern in Lake Rhodhiss, local governments with regulatory control over the lake's shoreline should implement the following strategies:

A. Require that woody vegetation may not be removed to improve access for shoreline stabilization activities (*SHORT TERM*).

Key Implementers:

- Local governments

B. Require property owners to obtain a shoreline stabilization permit from the appropriate local government before work can proceed (*SHORT TERM*).

Key Implementers:

- Local governments

C. Encourage property owners to use vegetative plantings, followed by riprap, in that order, for shoreline stabilization projects. The use of hard structures, such as retaining walls should be discouraged (*SHORT TERM*).

Key Implementers:
- Duke Power
- Natural Resource Conservation Service
- Local governments

i. If retaining walls are selected, rip-rap will be required with a minimum depth of one (1) foot and a slope of 2 to 1 to be placed along the base of the wall (consistent with Duke Power requirements) (*ONGOING*).

Key Implementers:
- Duke Power
- Natural Resource Conservation Service
- Local governments

ii. Require a professional engineer to develop and sign plans for any project involving retaining walls exceeding six (6) feet in height (*SHORT TERM*).

Key Implementers:
- Local governments

BUFFERS RECOMENDATIONS

Lake Shoreline - A riparian buffer is a forested or vegetated strip of land that borders a stream, river or lake. These buffers serve to filter sediment and other pollutants from rainwater that flows over land into streams and lakes, thus protecting these waters from nearby land uses. In addition to treating runoff, riparian buffers provide a variety of other important benefits including reducing bank erosion, contributing organic matter to streams, storing flood waters, providing habitat for aquatic and terrestrial animals, and providing opportunities for recreation, such as greenways.

Burke and Caldwell Counties have different buffer requirements for the shoreline of Lake Rhodhiss. Burke County's buffer ordinance requires 65-foot forested buffers for new development activities along the Lake. Woody vegetation is protected within the first 100 feet of the lake and erosion control plans are required for land disturbing activities within 250 feet of the lake.

In May 2001 the North Carolina Environmental Management Commission adopted rules to protect riparian buffers along the Catawba River beginning below Lake James. These rules require 50-foot buffers with a two-tier design. The first tier, representing the area closest to the lake, requires an undisturbed 30-foot forested buffer. The second tier, immediately upslope from the first tier, consists of a 20-foot managed zone. Vegetation within this tier can be grass, although forest vegetation is recommended. These state rules became effective for new development activities occurring in Caldwell County as well as for most local governments with land use jurisdiction along the lake effective June 30, 2001. Local governments within the Catawba River basin, such as Burke County, that had local ordinances in place that met or exceeded the new state rules, were allowed to continue administering their buffer ordinances.

Stream Side - Streams occupying lands within water supply watershed areas have mandatory buffer requirements. For the Lake Rhodhiss watershed these buffer requirements are applicable for projects that require the filing of a sediment erosion control plan with the state. One hundred foot vegetative buffers are required for new development activities that exceed the low-density option under each local government's watershed protection ordinance. For low-density development, 30-foot vegetated buffers are required along all perennial waters.

On May 23, 2000 Crescent Resources, Incorporated announced the establishment of permanent conservation easements on all company property fronting perennial stream channels that flow into the Catawba River. These conservation buffers will range from no less than 50 feet to more than 300 feet. Because Crescent Resources owns several thousands of acres of land that drain into Lake Rhodhiss, this buffer protection program will offer considerable water quality protection to affected streams and the Catawba River as well.

6. Since sediment is the principal pollutant of concern in Lake Rhodhiss, local governments with regulatory control over land within the lake's watershed should implement the following strategies:

A. Develop and promote incentives for property owners who voluntarily establish and maintain buffers along streams within the watershed (*LONG TERM*).

Key Implementers:
- Local governments
- Natural Resources Conservation Service

B. Encourage riparian property owners to leave natural undergrowth within the buffer area undisturbed (*ONGOING*).

Key Implementers:
- Local governments
- Natural Resources Conservation Service
- Crescent Resources
- Duke Power

DENSITY CONTROL RECOMENDATIONS

For areas in which development densities are low enough to preclude the need for engineered stormwater best management practices, the most reliable way to assure long-term protection of water quality is to manage future development through land-use controls. These land-use controls include density restrictions, cluster development, limits on impervious surfaces, and prohibitions on certain types land uses. Zoning ordinances and subdivision regulations are the two most commonly used tools for implementing these land-use controls. The Town of Rhodhiss is the only local government with land-use jurisdiction within 0.5 miles of the Lake that has not adopted either zoning or subdivision regulations, although the Town does administer several land-use ordinances including a water supply watershed protection ordinance.

Most local governments located within the Lake Rhodhiss watershed have adopted water supply watershed protection ordinances. Three municipalities, Cedar Rock and Lenoir, located in Caldwell County, and Marion, located in McDowell County have not adopted watershed protection ordinances. These local governments were not required to do so since they are located outside the protected area of the Lake Rhodhiss watershed.

The watershed protection ordinances place limits on the density of new residential and commercial development that can occur within these watersheds, as well as prohibit certain activities from occurring in the future. As discussed earlier within this report, these rules also require vegetated buffers along perennial waters for new development requiring an erosion control permit from the state. Provisions of the water supply watershed protection rules for the Lake Rhodhiss area are summarized in Table 5.

One common technique for managing new development is to allow higher density development in areas served by existing infrastructure. Within the Lake Rhodhiss watershed, Burke County is the only local government that regulates the density of residential development based on the availability of public water and sewer. For land within 250 feet of full pool of the lake, Burke County allows 0.5-acre lots if public water and sewer are available, 1.5-acre lots if either public water or sewer is available, and 2.0-acre lots if neither public water nor sewer is available.

Subdivision regulations and design can be modified to provide enhanced water quality benefits. One effective technique commonly referred to as Conservation or Open Space Subdivisions generally requires mandatory open space dedication in new subdivisions. The amount of land required to be set aside as permanent open space generally ranges from 10 to 50% of the total area of the subdivision. To offset land set aside for open space protection, many local governments allow a cluster option. Clustering is a technique that allows houses to be concentrated in a compact portion of the development at a density greater than that typically allowed under a local government's conventional land use codes. This is accomplished by trading a greater density of homes on one portion of a site in exchange for reduced density elsewhere. Often these areas of reduced density are dedicated or reserved as community open space to provide active and passive recreation for residents living within the community.

Few local governments within the Lake Rhodhiss watershed have adopted conservation subdivision principles into their land use codes. The Town of Granite Falls requires 15% open space dedication in new subdivisions in situations where the developer chooses to employ a Traditional Neighborhood Design (TND). Caldwell County is examining incorporating open space requirements for new subdivisions in the County. The Burke County Commissioners in February 2002 adopted land use rules requiring 25% of the buildable land area of new subdivisions in the Lake James area be dedicated as permanent open space. These new rules, however, do not apply to other areas of the County.

7. Development standards to minimize stormwater runoff and to maintain the rural character of the area

A. Undisturbed 30-foot buffers along permanent streams should be required within new residential subdivisions and commercial and industrial developments located within the critical and protected watershed areas of Lake Rhodhiss (*SHORT TERM*).

Key Implementers:

- Local governments

8. Local governments should amend their land use codes to allow cluster subdivisions and offer incentives for developers who choose to adopt this design option

A. Lot sizes and setback standards should be reduced for developers implementing cluster subdivisions (*SHORT TERM*).

Key Implementers:

- Local governments

B. Open space dedication of 15% of the total area should be required in new subdivisions located within the critical and protected areas of the watershed. Land within mandatory buffers may total up to 50% of this required open space (SHORT TERM).

Key Implementers:

- Local governments

Appendix B
Watershed Model

The Generalized Watershed Loading Functions Model (GWLF) (Haith and Shoemaker, 1987) was selected for this effort. GWLF allows the user to estimate runoff, and sediment and nutrient loadings from watersheds with varied land-use characteristics. Contributions from point-source dischargers can also be accounted for as well as septic systems and manure applications to agricultural lands.

Methodology

The model selected for this project was the Generalized Watershed Loading Functions (GWLF) Model, originally developed by Doug Haith at Cornell University. This model is based on simple runoff, sediment and groundwater relationships combined with empirical chemical parameters. Monthly nutrient fluxes in streams can be simulated without calibration. The model appears to possess a high degree of predictive accuracy based on the results of a validation study conducted on a largely agricultural watershed in New York (Haith and Shoemaker, 1987).

GWLF includes dissolved and solid-phase nitrogen and phosphorus in streamflow from multiple sources including ground water, point sources, septic tanks, and rural and urban runoff. Nutrient loads from rural areas are carried in runoff and eroded soil from various land-use categories, each of which is considered uniform with respect to soil and cover. Dissolved nutrient loads are generated by multiplying runoff by dissolved concentrations. The Soil Conservation Service Curve Number Equation is used for calculating runoff. To generate solid-phase rural nutrient loads, monthly sediment yields are multiplied by average sediment nutrient concentrations. The Universal Soil Loss Equation is used to calculate erosion, and sediment yield is estimated by multiplying erosion by the sediment delivery ratio. Urban nutrient loads are modeled by exponential accumulation and washoff functions. Additional details about the description and function of this model can be found in Haith, Mandel and Wu (1992).

Modeled Scenarios

The GWLF Model was applied to estimate sediment and nutrient loads entering the Rhodhiss Lake from 19 distinct subbasins for the year 2000. In addition, based on growth projected to occur within the watershed during the next two decades, model simulations were also performed for the year 2020. Model inputs and assumptions made concerning various land- use practices and anticipated growth are outlined below. Unless otherwise stated, similar techniques and assumptions were made for both the 2000 and 2020 model simulations.

Ten-year model simulations were performed for both the baseline (2000) and the 2020 scenarios. Average annual sediment and nutrient loading figures were generated and reported to account for year-to-year variability in weather conditions.

Model Inputs

GWLF requires site-specific data to estimate sediment and nutrient loads from discrete subbasins. Four broad categories of information must be assembled for GWLF model runs. These categories are:

- **Land-use data** includes information on the aerial coverage of particular land use practices as well as the management of these areas.
- **Weather data** required for models runs include daily temperature and precipitation for the simulation period.
- **Transport parameters** include the necessary hydrologic, erosion and sediment constants.
- **Nutrient parameters** are the various nitrogen and phosphorus data required for generating nutrient loading estimates.

Each of these four categories, including sources of data, and general assumptions employed during this project.

Two model simulations were performed; a baseline simulation representing conditions present for the year 2000, and a second model run for the year 2020 based on anticipated growth within the watershed. Ten-year model simulations were performed for both the baseline (2000) and the 2020 scenarios. Average annual sediment and nutrient loading estimates were generated and reported to minimize year-to-year variability in weather conditions.

Average annual sediment loading values for the baseline scenario ranged from 140,000 kg/yr for Center Morganton, a small, urban subwatershed, to 2,300,000 kg/yr for Wilson Creek, a large, predominantly forested watershed. High sediment loading values were generally associated with large (>100 km2) subwatersheds. Under the 2020 scenario, the model predicted that sediment loading will remain constant or decline for each of the watershed's 19 subwatersheds. For the entire watershed, annual sediment loading was predicted to decline by 3.4% (from 19,850,000 kg/yr to 19,170,000 kg/yr) by 2020 and this decline was attributed to the decrease in open and forested lands with a concomitant increase in paved surfaces associated with new development. Export coefficients were calculated to allow sediment loss among subwatersheds to be compared on an equal aerial basis. Subwatersheds exhibiting the highest sediment export coefficients were mixed-use catchments with proportionately more agricultural and urban, and less forested lands than other subwatersheds.

Subwatersheds exhibiting high nitrogen and phosphorus loadings for 2000 were catchments with sizeable wastewater treatment plants. About 21% of the total nitrogen and 48% of the total phosphorus entering Rhodhiss Lake in 2000 originated from four point-source dischargers. The contribution of these dischargers to total nitrogen and phosphorus loadings by 2020 is expected to increase to 31% and 62%, respectively.

Total nitrogen and phosphorus export coefficients were examined to identify subwatersheds with disproportionately high nutrient loadings attributed to nonpoint sources. This examination revealed that several urban subwatersheds in the Morganton and Lenoir areas were generally contributing the highest nutrient loads to the lake during 2000. Subwatersheds showing the greatest percent increase in nutrient export coefficients by 2020, however, were catchments where residential growth is anticipated to be particularly strong over the next 20 years.

Point Source Dischargers

Information on dischargers with active NPDES permits was collected from the NC Department of Environment and Natural Resources Regional Office in Asheville. Monthly reports were generated for 25 dischargers for the period beginning April 2001 and ending March 2002 for estimating the volume of effluent discharged by each facility (Map 4 and Appendix Table A-8). A preliminary analysis of this data showed that only five of these facilities had average discharges exceeding 0.2 MGD. One of these five facilities, SGL Carbon Corporation, did not report nutrient concentrations for their discharge. Effluent released from this plant consists largely of noncontact cooling water, thus nutrient loadings from this plant are negligible (Jim Reid, NC DWQ, personal communication, June 20, 2003). For this reason, nitrogen and phosphorus loads from this plant were assumed to be zero. Nutrient data, however, were generally available for the other four dischargers, which were municipal wastewater treatment plants.

To better account for variability in generating loading estimates, a longer time period was selected for analyzing information available for these remaining four municipal dischargers. Monthly DEM reports were examined for the period beginning January 1994 and ending March 2002 -- a nine-year period. Total nitrogen and phosphorus concentrations, discharge and loading estimates are presented in Appendix Tables A-9 through A-15. Monthly phosphorus and nitrogen loading estimates were generated for each of these four facilities. One facility, the City of Morganton's wastewater treatment plant, did not report phosphorus concentrations in their monthly reports to the state. Monthly phosphorus concentrations at the other three plants ranged from under 1 to over 11 ppm, with total phosphorus concentrations in the 1-2 ppm range being the most common. For the Morganton plant, therefore, a phosphorus concentration of 1 ppm was assigned so monthly phosphorus loadings could be estimated.

For the nine-year period both mean and median loading estimates for total nitrogen and total phosphorus were generated. For subbasin modeling, the median loading figures were used because of the variable nature of the mean loading estimates among years.

For the 2020 model simulations, a 3.5% annual increase in discharge from wastewater treatment plants was assumed. For planning purposes, staff at two of the four plants indicated that they generally assume discharge will increase from 2 to 5% annually. This increase is expected to capture future wastewater demand primarily from residential customers. The same nitrogen and phosphorus concentrations used for the 2000 model simulations were used for the 2020 model runs. Monthly mean and median nitrogen and phosphorus loads for the 1994-2002 period along with projected nutrient loads for 2020 are displayed in Appendix Tables A-16 to A-23.

Considerable uncertainty exists in predicting future discharges from wastewater treatment plants, particularly those located in municipalities that are currently losing large water dependant industries because of restructuring that is occurring in today's economy. In the western Piedmont of North Carolina the manufacturing sector has incurred large job losses as textile and apparel companies have closed plants to consolidate or move operations out of the region. Annual discharge at the Corpening Creek (City of Marion) and the 2002 period. Morganton wastewater treatment plants has actually declined during the 1993-2004.

Water quality models are important tools for professionals charged with managing lakes. While individual models vary in their degree of data requirements and user sophistication, these tools are commonly employed to predict biological (i.e., algal abundance), chemical (i.e., nutrient concentrations and loadings) and physical (i.e., discharge) parameters of interest. Based on a given set of assumptions, anticipated changes in land use and point source contributors can be examined under a variety of scenarios for providing insight into changes in water quality conditions.

Modeling Results and Discussion

Population estimates and projections for the 19 subwatersheds occupying the watershed are displayed in Table 3. 2000 population estimates for individual subwatersheds were quite variable and ranged from 273 for Wilson Creek to 16,227 for South Rhodhiss. Most of the sparsely populated subwatersheds are located in the northern portion of the watershed and contain large amounts of federal land holdings.

Over the next 20 years the North Muddy Creek, Silver Creek, South Rhodhiss and Hunting Creek subwatersheds are projected to add over 2,000 people per catchment. The Upper Creek subwatershed is the only catchment projected to exhibit a population loss although the Wilson Creek and Upper Johns River subwatersheds are expected to grow slowly, adding less than 100 new residents apiece.

On a percentage basis, three subwatersheds are expected to exhibit over a 40% growth in population over the next 20 years: Irish Creek, North Muddy Creek and South Muddy Creek. Overall the population of the entire watershed is projected to increase by 21.0% over the next 20 years increasing from 128,444 in 2000 to 155,474 by 2020.

Development Trends - A strong relationship exists between projected population increases and anticipated new development since most future development activities will be residential in nature. Two subwatersheds located in the southern portion of the watershed, Silver Creek and North Muddy Creek, are projected to add over 800 ha of new development during the next 20 years. New residential development is expected to dominate nonresidential development in all but three subwatersheds: Center Morganton, Upper Creek and Zacks Fork. Not surprisingly, subwatersheds containing portions of Lenoir and Morganton, such as Zacks Fork, Silver Creek, Lower Creek and Hunting Creek, are projected to experience the greatest amounts of nonresidential development.

Sediment

Sediment loading data and export coefficient values are presented in Table 4. Loading estimates differed by an order of magnitude between the lowest (Center Morganton) and highest (Wilson Creek) subwatershed values. The Wilson Creek subwatershed exhibited the highest sediment loading value of 2,300,000 kg/yr resulting of this catchment's large size and steep topography. Not surprisingly, large subwatersheds (catchments over 100 km^2) tended to exhibit the highest sediment loading values.

By 2020 the GWLF Model predicts that sediment loading will remain constant or decline for each of the 19 subwatersheds in the Rhodhiss Lake watershed. Collectively, sediment loading is predicted to decrease from 19,850,000 kg/yr in 2000 to 19,170,000 kg/yr by 2020. This represents a decline in loading of 3.4%. The conversion of open and forested lands to developed uses with paved surfaces likely accounts for the decline in loading over this period.

Perhaps a better method for comparing sediment yield among subwatersheds is to examine export coefficients because this variable expresses sediment loss on an aerial basis. When this analysis was performed, a different picture emerged concerning subwatersheds and sediment loss. Three subwatersheds, Warrior Fork, Zacks Fork and North Rhodhiss exhibited the highest export coefficients with values exceeding 20,000 kg/ha/yr. Previously when only sediment loading data were considered, the contribution of North Rhodhiss and Warrior Fork appeared minimal because of the relatively small size of each of these two catchments. Conversely, the Wilson Creek subwatershed that exhibited the highest sediment loading value for the watershed had only the seventh highest sediment export coefficient value.

Sediment export coefficients are expected to decline or remain unchanged for all 19 subwatersheds. Declines over 10% in the sediment export coefficients are expected for two subwatersheds, South Rhodhiss (-12.87%) and North Rhodhiss (-11.11%). Both subwatersheds are expected to experience strong increases in residential development.

Sediment export coefficients may serve as an important screening tool for identifying subwatersheds for best management practice (BMP) consideration. By targeting catchments with high sediment export rates, rather than simply high sediment loading; BMPs can be concentrated in areas where the greatest gains per unit area in sediment control can be realized. It should be emphasized, however, that this report is not a planning document and that a more detailed analysis of land use as well as specific agricultural and urban management practices should be performed for subwatersheds with high sediment export coefficients at a more refined spatial scale before developing a plan involving site-specific BMPs.

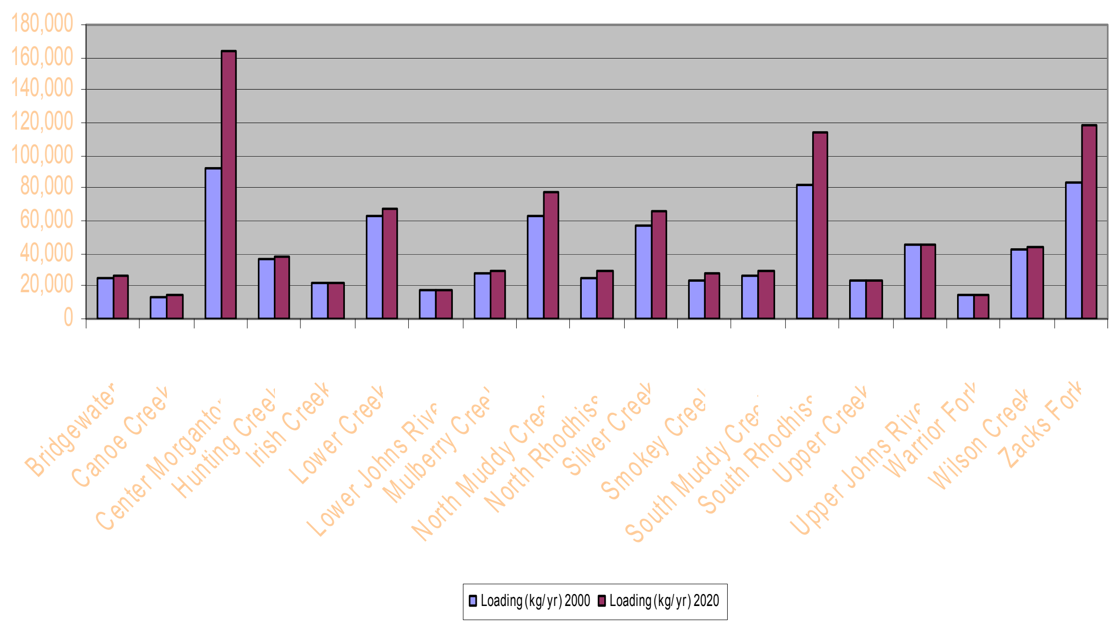
Nitrogen

Total nitrogen loading values are presented in _____. Annual loading values for 2000 range from 13,130 kg/yr for Canoe Creek, a small forested subwatershed, to 91,910 kg/yr for Center Morganton, a small urban catchment. This subwatershed also contains a municipal wastewater treatment plant that strongly affects nitrogen loadings. Four of the five subwatersheds with the highest total nitrogen loading values contain municipal wastewater treatment plants.
Unlike sediment, total nitrogen loading within the watershed is expected to increase substantially over the next 20 years, increasing by 23% from 779,850 kg/yr to 960,930 kg/yr. Subwatersheds predicted to experience the largest increases in nitrogen loading are those four with large point-source contributors, as well as North Rhodhiss. The majority of subwatersheds (12 of 19) in the watershed are expected to exhibit rather modest increases in nitrogen loading of under 10% by 2020.

Nitrogen loadings attributed to nonpoint contributors along with export coefficients for each subwatershed are presented in Table 6. Nitrogen loadings ranged from 8,780 kg/yr for Center Morganton to 63,230/yr for Lower Creek. In general, subwatersheds with the highest nitrogen loading values tended to be large-sized catchments with considerable agricultural activity. Several of these subwatersheds, particularly Lower Creek, North Rhodhiss and North Muddy

Creek have hay, pasture and crop land where manure is applied regularly for nine months of the year.

Total Nitrogen Loading for Rhodhiss Lake Subbasins, 2000 and 2020.

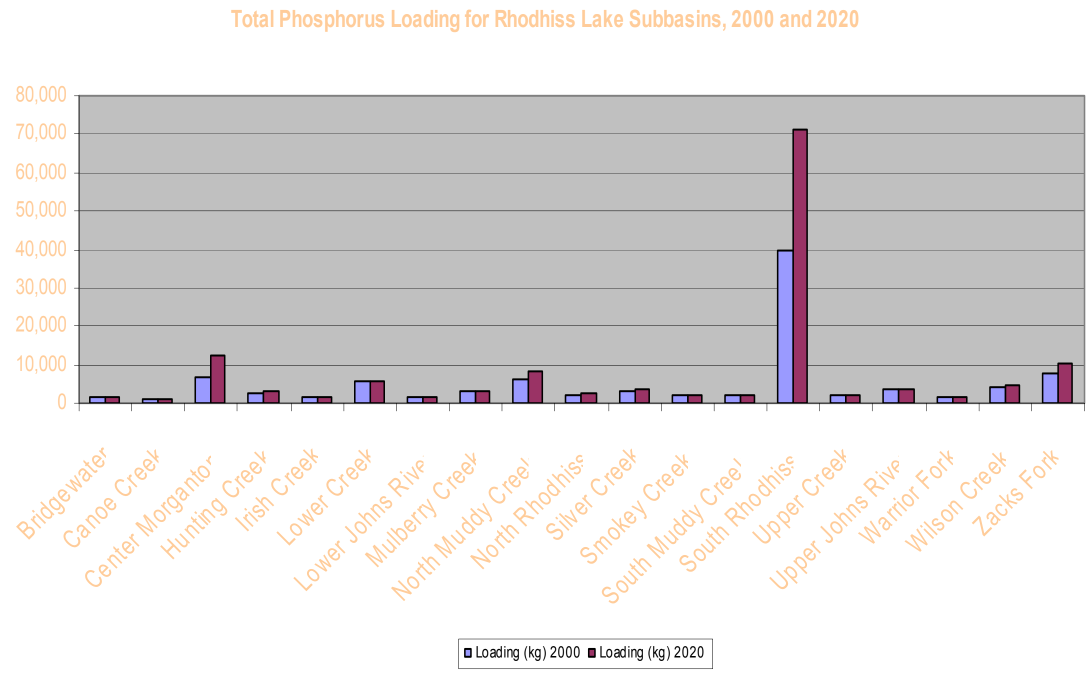


Model results indicate that nitrogen loadings are expected to increase for all subwatersheds except Upper Creek. Subwatersheds predicted to exhibit the largest increases in nitrogen loadings over the next 20 years are North Muddy Creek, Silver Creek and North Rhodhiss. These three areas have considerable agricultural lands and are also experiencing more suburban growth than most other subwatershed.

Export coefficients for nitrogen ranged from 233 kg/ha/yr for the Upper Johns River to 668 kg/ha/yr for North Rhodhiss. Two subwatersheds, Center Morganton and Hunting Creek, followed North Rhodhiss with the second and third largest export coefficient values, respectively. Both these subwatersheds contain sections of the City of Morganton and indicate that on an aerial basis, nitrogen loadings originating from urban areas in the watershed can be important.

Phosphorus

As with nitrogen, subwatersheds exhibiting the highest phosphorus loadings were dominated by catchments with large point-source contributors. The Valdese wastewater treatment plant is located in the South Rhodhiss subwatershed, and this catchment had phosphorus loadings over five times greater than the next largest subwatershed (Zacks Fork). Total phosphorus loading values



ranged from 920 kg/yr to 39,810 kg/yr with the majority of subwatersheds (13 of 19) exhibiting values less than 5,000 kg/yr.

Projected increases between 30 and 80% in phosphorus loadings by 2020 are expected for the four subwatersheds containing municipal wastewater treatment plants. Two other subwatersheds, North Rhodhiss and Silver Creek are expected to experience significant, but more modest increases of phosphorus loadings exceeding 10%. Eight of the subwatersheds are expected to exhibit increases in phosphorus loadings of less than 3% by 2020.

Phosphorus loadings attributed strictly to nonpoint sources and export coefficients for each subwatershed are shown in _________. Loadings ranged from 720 kg/yr for Center Morganton to 5,510 for Lower Creek. Three of the four subwatersheds with loading values exceeding 4,000 kg/yr were relatively large catchments with significant agricultural activity, although the Zacks Fork subwatershed also contains most of the City of Lenoir. The relatively high phosphorus loadings displayed by the Wilson Creek subwatershed can be attributed solely to the large size of this catchment.

Low to moderate increases in export coefficients for most subwatersheds are predicted for 2020. Export coefficients for four subwatersheds, however, are predicted to increase by at least 10% by 2020. These four subwatersheds, Center Morganton, North Muddy Creek, North Rhodhiss and Silver Creek, are mixed-use catchments, and all but Center Morganton are expected to experience significant residential development over the next 20 years.

Point Source vs. Nonpoint Source Contributions

Table 8 shows the majority of nitrogen and phosphorus loading for 2000 contributed by the 19 Rhodhiss Lake subbasins originates from nonpoint sources. About 79% and 52% of the total nitrogen and phosphorus, respectively, originate from nonpoint sources.

By 2020 the collective contribution from the four point sources modeled in the study is predicted to become more pronounced. For example, the contribution of the four point sources to total nitrogen loading is projected to increase from 21% in 2000 to 31% by 2020. An even greater increase is anticipated for phosphorus with the percentage of total phosphorus loading attributed to point sources increasing from 48% in 2000 to 62% by 2020.

Figure 3 contains current and projected loading estimates from four municipal wastewater treatment plants. Current and projected loads of nitrogen greatly exceed that of phosphorus at three of the four plants. The exception is the Valdese wastewater treatment plant where nitrogen and phosphorus loads are numerically similar. Nitrogen loads from the Morganton plant and phosphorus loads from the Valdese plant are considerably higher than nitrogen and phosphorus loads from the other three plants.

Comparison of Modeled Results to Previous Studies

Comparing water quality data from different studies is problematic because project goals, sampling sites, methodologies and data analysis typically differ. Table 9 presents loading estimates for several subbasins in the Rhodhiss Lake watershed from three independent studies. One important distinction in examining these data is that results reported by the US EPA and USGS are based on monitoring data while estimates generated for this study are based on modeling and have not been verified with field collected samples. Because the US EPA sampling sites for the Johns River and Lower Creek occurred near these streams' confluence with Rhodhiss Lake, loading data generated for Zacks Fork from this study was combined with loads generated from Lower Creek to yield a single loading estimate for this larger catchment for comparison purposes. Likewise modeled loads from the Upper Johns were combined with loads generated from the Lower Johns to yield loading estimates for the Johns River.

Historical sediment loading data for the Rhodhiss Lake is scant despite the importance sediment can have on adversely affecting water quality and aquatic life. Annual sediment loading estimates reported by the USGS (1997) for Lower Creek were about three higher than similar loading estimates predicted by the GWLF Model. The estimates generated by these two studies, however, do not lend themselves to comparison because of the differences in methodologies employed. The USGS loading estimate was based on in-stream monitoring data. Thus contributors to sediment loading accounted for in the USGS study would include sheet erosion, in-channel or stream bank erosion, and perhaps the movement of some bed (i.e., stream bottom) materials. In contrast, GWLF accounts only for sediment loading attributable to sheet erosion. One would therefore expect sediment loading estimates based on monitored data to be higher than loading estimates generated by the GWLF model. A second important variable is weather. The USGS value is based on field samples collected over a 12-month period and weather conditions during this study, particularly rainfall, may not have been representative of an "average" year.

Nitrogen and phosphorus loading data was available for several streams in the watershed based on results reported by US EPA (1975). Loading estimates generated in this study generally compared favorably to results reported earlier by US EPA. Nutrient loading estimates were within an order of magnitude of one another except for phosphorus loading from Hunting Creek where the value reported by US EPA exceeded that predicted by the GWLF Model by a factor of 23. Despite the discrepancy in sediment loading, values reported by the USGS for nitrogen and phosphorus loading in Lower Creek were very similar to those predicted by GWLF.

Conclusions

The Rhodhiss Lake watershed encompasses a vast land area of 1,839 km2. Topography and soils vary considerably within the watershed. The northern portion of this watershed is very rural, undeveloped and contains substantial federal land holdings. Development activities are concentrated along the I-40, US 70 and NC 18 corridors. Major point-source dischargers (facilities with discharges exceeding 1 MGD) are few in number, but are located in close proximity to Rhodhiss Lake and contribute significant amounts of nitrogen and phosphorus loads to this reservoir. Because of the size and diversity of activities occurring within this watershed, developing strategies for managing sediment and nutrients entering Rhodhiss Lake will be a challenging task.

Uncertainty exists concerning a variety of factors influencing loadings to Rhodhiss Lake, such as the bioavailability, transformation and assimilation of nutrients in route from each subbasin to Rhodhiss Lake. In addition, lake response to future nutrient inputs under different conditions requires better understanding. Nevertheless, this report provides useful loading estimates, previously unavailable for the entire watershed, which can serve as an important first step for assisting local and state agencies for targeting specific subbasins contributing disproportionate loads of sediment and nutrients to Rhodhiss Lake, with appropriate best management practices.

Subbasin	Subbasin size (ha)	Subbasin size (km^2)	Loading-2000 (kg)	Export Coef-2000 (Kg/km^2/yr)	Loading-2020 (kg)	Export Coef-2020 (kg/km^2/yr)
Bridgewater	7,027	70.27	390,000	5,550	370,000	5,265
Canoe Creek	3,978	39.78	350,000	8,798	320,000	8,044
Center Morganton	1,411	14.11	140,000	9,922	130,000	9,213
Hunting Creek	6,605	66.05	680,000	10,295	640,000	9,690
Irish Creek	8,907	89.07	420,000	4,715	420,000	4,715
Lower Creek	14,932	149.32	2,120,000	14,198	2,100,000	14,064
Lower Johns River	6,903	69.03	740,000	10,720	730,000	10,575
Mulberry Creek	10,761	107.61	1,510,000	14,032	1,500,000	13,939
North Muddy Creek	15,153	151.53	1,490,000	9,833	1,380,000	9,107
North Rhodhiss	3,651	36.51	900,000	24,651	800,000	21,912
Silver Creek	15,770	157.7	420,000	2,663	400,000	2,536
Smokey Creek	5,211	52.11	810,000	15,544	750,000	14,393
South Muddy Creek	10,322	103.22	710,000	6,879	680,000	6,588
South Rhodhiss	9,380	93.8	1,010,000	10,768	880,000	9,382
Upper Creek	9,597	95.97	1,060,000	11,045	1,060,000	11,045
Upper Johns River	19,191	191.91	1,740,000	9,067	1,720,000	8,963
Warrior Fork	4,046	40.46	890,000	21,997	890,000	21,997
Wilson Creek	17,897	178.97	2,300,000	12,851	2,300,000	12,851
Zacks Fork	10,508	105.08	2,170,000	20,651	2,100,000	19,985
TOTAL	**181,250**	**1812.5**	**19,850,000**	**10,952**	**19,170,000**	**10,577**

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Appendix C
Additional Background Information

The US Geological Survey Lake Modeling Study - conducted a water quality study of Lake Rhodhiss during 1993 and 1994 in cooperation with the Western Piedmont Council of Governments. The objectives of these efforts were to describe ambient hydrologic and water quality conditions, estimate nutrient and sediment loadings from selected tributaries and point sources, and simulate circulation and water quality characteristics of the lake using a hydrodynamic computer model. Estimates of total suspended solids, nitrogen and phosphorus loadings indicated that nearly all of the suspended solids and the majority of nitrogen and phosphorus entering the headwaters of the lake originated from nonpoint sources. While less than 1% of the suspended solids load to the reservoir was from point sources, up to 27% and 22% of the total nitrogen and total phosphorus loads, respectively, were from point sources (Giorgino and Bales, 1997).

DWQ Intensive Survey Unit - monitored Lake Rhodhiss from May through September, 2007. Secchi depths at the upstream sampling site were consistently less than a meter while measurements taken in the middle of the reservoir and near the dam were usually close to or slightly greater than a meter. Turbidity values followed a similar pattern with greater turbidity observed upstream and decreasing downstream. This pattern of increasing water clarity from upstream to downstream is typical of many run-of-the-river reservoirs. An exception occurred in May when the greatest turbidity values were observed near the dam and improved further upstream.

Dissolved oxygen, pH and percent dissolved oxygen saturation values were elevated in Lake Rhodhiss in 2007. Conditions consistent with increased algal productivity. Chlorophyll a values (an additional indicator of increased algal growth) were generally low to moderate with the exception of a value observed in the upper portion of the lake on September 26th (70 µg/L). This chlorophyll a value was greater than the state water quality standard of 40 µg/L. Total phosphorus concentrations were elevated in 2007 and total Kjeldahl nitrogen and total nitrogen ranged from moderate to elevated. An Algal Growth Potential Test run on a water sample collected from Lake

Rhodhiss on July 11th. Results indicated that the reservoir was co-limited for nitrogen and phosphorus, indicating that neither nutrient was limiting to the growth of algae

Based on the calculated NCTSI scores, Lake Rhodhiss was determined to exhibit moderate biological productivity in May (mesotrophic) and elevated biological productivity from June through September (eutrophic). The trophic state scores in 2007 were higher than those observed the last time Lake Rhodhiss was monitored by DWQ in 2002. The increased intensity and duration of the drought in 2007 as compared with the previous drought of 2002 may have contributed to the increase in the numeric NCTSI trophic state scores.

Sedimentation- The accumulation of sediment by lakes and reservoirs is a natural process, although the rate of sedimentation can be greatly accelerated by the number, intensity and duration of land-disturbing activities within the watershed. Sediment is often considered the state's most problematic water quality pollutant. Sediment originates primarily from land-disturbing activities occurring throughout the watershed, with the majority of sediment entering lakes during storm events from streams flowing into the reservoir. The effects of sediment on aquatic systems are well documented and include the filling in of water bodies, transporting pollutants such as metals, pesticides and phosphorus, degrading and destroying fish and wildlife habitat, increasing water treatment costs to utilities, diminishing recreation activities and overall lake aesthetics (see review by Waters, 1995).

Bathymetric data collected by the USGS in the mid 1990s (USGS, 1997) suggested that nearly 34% of the original storage volume of Rhodhiss Lake has been lost based on the original published volume for the lake (US EPA, 1975). A recent study commissioned by Caldwell County showed that two coves studied on the north side of Lake Rhodhiss had lost over half their original storage capacity. However, the study also showed the cost prohibitive nature of removing sediments from the system. Efforts to minimizing erosion is therefore of paramount importance.

Nutrients - Nutrient concentrations are generally elevated in the upper portion of the reservoir (NC Department of Environment, Health and Natural Resources, 1992, 1994 and 1995; US Geological Survey, 1997) and generally decline with distance downstream, where the lowest nutrient concentrations are found near the dam forebay. This gradient in nutrient concentrations is a typical pattern exhibited in many reservoirs (Thornton, Kimmel and Payne, 1990). Two factors are largely responsible for the high concentrations of nutrients typically found in the lake. One variable is the large size of the lake's watershed with respect to lake area. Of the seven lakes located along the Catawba River in North Carolina, Rhodhiss Lake has a watershed to surface area ratio that is nearly twice as large as the next greatest lake system on the Catawba chain (Table 1). This would tend to indicates that nutrient and sediment loadings from non-point

Table 1. Characteristics of the Catawba Chain of Lakes in North Carolina.

Lake	Surface Area (Acres)	Mean Depth (Feet)	Shore Length (Miles)	Watershed Area (Sq. Mi.)	W.A./S.A. Ratio	Retention Time (Days)
James	6,510	46	145	380	37	208
Rhodhiss	3,515	20	90	710	129	21
Hickory	4,100	33	105	220	34	33
Lookout Shoals	1,270	30	39	139	70	7
Norman	32,510	33	520	341	7	239
Mountain Island	3,234	16	61	69	14	12
Wylie	12,450	23	327	1,161	60	39

Source: North Carolina Division of Water Quality, 1999

sources may be more significant for Rhodhiss Lake than similarly sized Piedmont lakes because of the relatively large size of the drainage area. In addition to nutrient inputs from non-point sources, three major point source dischargers release effluent into the Lake thus collectively contributing to nitrogen and phosphorus inputs to the reservoir.

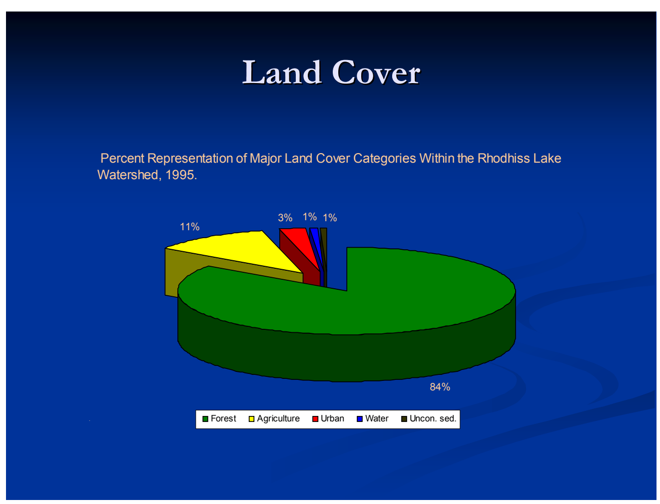
Work done by Duke Power as part of the utility's relicensing effort suggests that reducing nutrients loads to Lake Rhodhiss may also have a beneficial effect on water quality conditions in Lake Hickory, located immediately down river and currently consider unclassifiable by DWQ 2002 Basin Plan.

Algae - Algal concentrations in Rhodhiss Lake are typically less than what would be expected given the reservoir's abundant level of nutrients. Limited light conditions caused by abiotic turbidity, along with a short retention time, generally keep algal numbers somewhat suppressed.

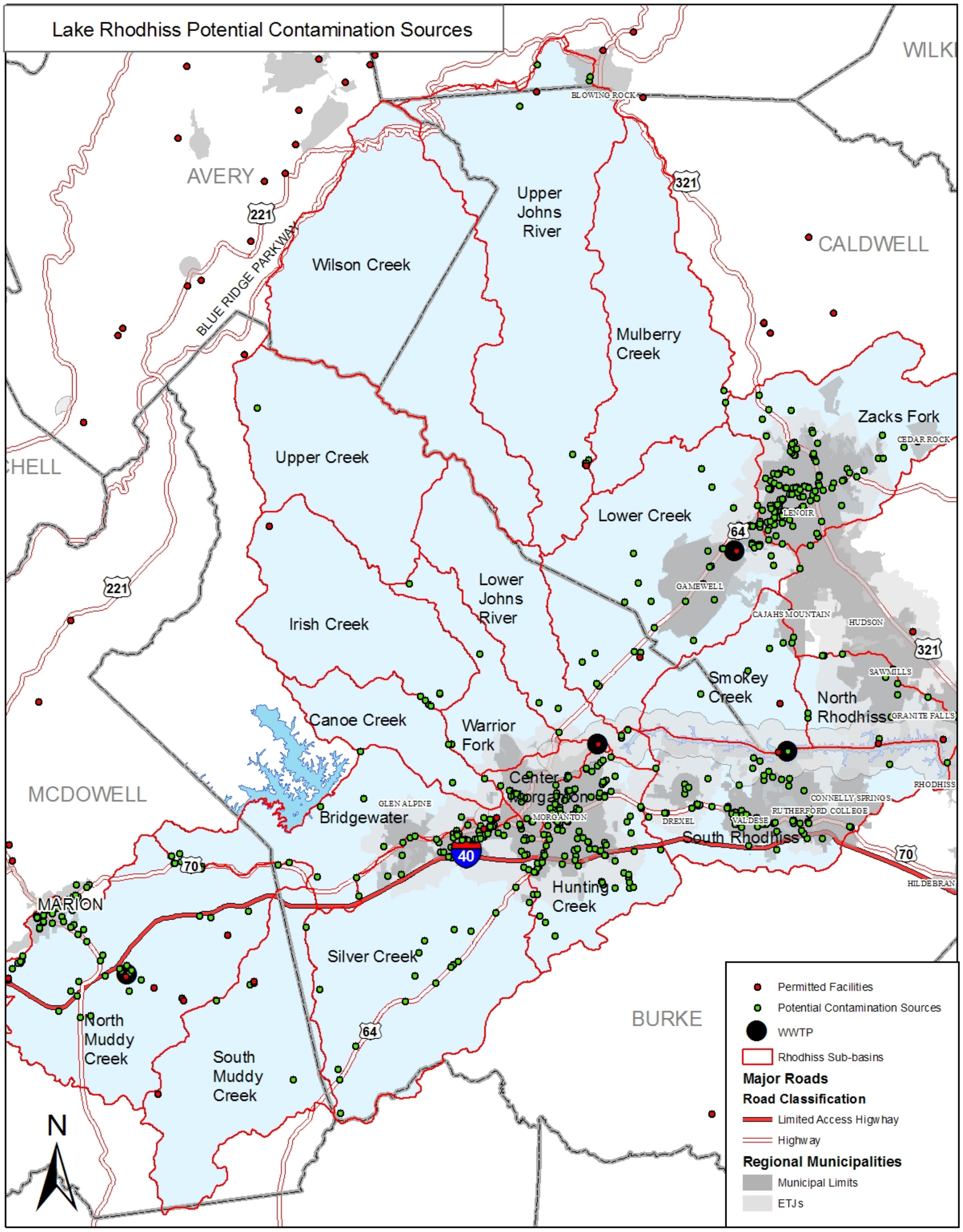
As a result, algal concentrations tend to be relatively low and contribute to moderate chlorophyll-a values and a trophic designation oscillating between mesotrophic and eutrophic. Although algal concentrations and biomass may be suppressed when lake turbidity values are high, blue-green taxa are able to maintain populations under high sediment loading conditions (Burkholder et al., 1998) and thus serve to inoculate reservoirs later when conditions for algal growth become more favorable.

During the late spring of both 2000 and 2001, severe taste and odor problems were experienced in drinking water originating from Rhodhiss Lake. A special study conducted by DWQ in 2001 (Vander Borgh, 2001) indicated that moderate algal blooms within the Lake were dominated by two blue-green algae, *Anabaena* and *Aphanizomemon*, both of which have been implicated with taste and odor problems. A combination of factors, including elevated nutrient concentrations, abundant light, warm water temperatures and reduced flow through the reservoir appeared to contribute to the formation and persistence of these taste and odor producing genera. As a result of these two episodic events, municipalities with intakes on the lake (Granite Falls, Lenoir and Valdese) have either altered water treatment processes in their respective plants or are in the process of purchasing new equipment to better treat these algae. During the height of the blue-green algae bloom, the Town of Valdese estimated that treating with additional activated carbon at the Town's water treatment plant cost about $800 per week. In addition to these short-term costs, Granite Falls and Lenoir are investing over $1 million dollars collectively in improvements to their water treatment plants to help prevent future taste and odor problems.

Lakeshore Development - Although two counties (Burke and Caldwell) and eight municipalities (Connelly Springs, Drexel, Granite Falls, Morganton, Rhodhiss, Rutherford College, Sawmills and Valdese) have land-use jurisdiction within one mile of the lake, lake-front development has historically been extremely limited. Crescent Resources, Incorporated, a land-holding subsidiary of Duke Energy, owns over 95% of the shoreline and has traditionally managed



its lands for timber production. Over the past decade, however, Crescent Resources, responding to market forces, has begun to sell property around Lake Rhodhiss to private developers, capitalizing on the growing demand for lake front and lake view properties. _________ subdivisions are currently under development along the Lake's shoreline


Lake Rhodhiss Potential Contamination Sources
AVERY
CALDWELL
MCDOWELL
BURKE
BLUE RIDGE PARKWAY
Wilson Creek
Upper Johns River
Mulberry Creek
Zacks Fork
Upper Creek
Lower Creek
Irish Creek
Lower Johns River
Smokey Creek
North Rhodhiss
Canoe Creek
Warrior Fork
Center Morganton
Bridgewater
South Rhodhiss
Hunting Creek
Silver Creek
North Muddy Creek
South Muddy Creek
MARION
BLOWING ROCK
LENOIR
CEDAR ROCK
GAMEWELL
CAJAHS MOUNTAIN
HUDSON
SAWMILLS
GRANITE FALLS
RHODHISS
CONNELLY SPRINGS
RUTHERFORD COLLEGE
VALDESE
DREXEL
MORGANTON
GLEN ALPINE
HILDEBRAN
N
Permitted Facilities
Potential Contamination Sources
WWTP
Rhodhiss Sub-basins
Major Roads
Road Classification
Limited Access Higwhay
Highway
Regional Municipalities
Municipal Limits
ETJs

Appendix D
Ongoing Watershed Protection Efforts

This appendix attempts to reference the ongoing projects in the watershed that relate to watershed management. Most of these projects and programs are ongoing in nature. Although an attempt has been made to be inclusive, this section may fail to reference a project of program unintentionally. The difficultly in capturing all ongoing efforts by various groups working in the watershed highlights the need to implement recommendation #2 in the short-term, *Regional Coordination: Establish a regional partnership to oversee all of the ongoing efforts in the Watershed to update plans and better coordinate existing efforts of implementing recommendations.*

Muddy Creek Watershed Restoration Initiative

The Muddy Creek Watershed Restoration Patnership has been ongoing since 1998. Members of the partnership include the McDowell Soil and Water Conservation District, McDowell County, Burke County, City of Marion, NC Cooperative Extension Service, Natural Resources Conservation Service, NC Wildlife Resources Commission, Duke Energy Corporation, Trout Unlimited, Foothills Conservancy of North Carolina, Carolina Land and Lakes RC&D, and Equinox Environmental.

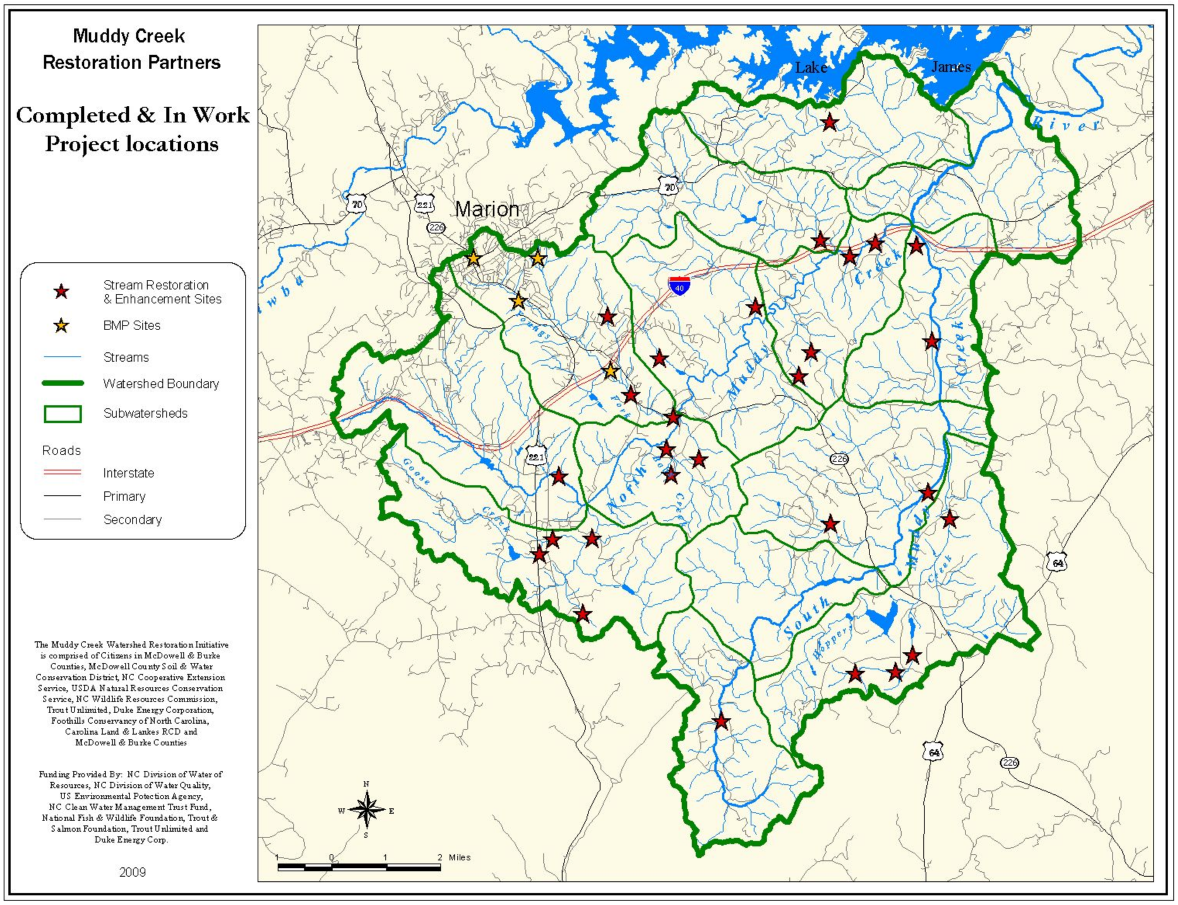
Activities accomplished by the initiative include natural channel design restoration, riparian reforestation, and livestock exclusion on 51,200 feet of stream in the Muddy Creek watershed. There is a total of 23 miles (120,000 Feet) of stream restoration or enhancement completed or in the process of being completed, one farmland preservation easement protecting 115 acres of farmland and one mile of stream, and five stormwater BMP's completed, or in the process of being completed.

In 2003, the Muddy Creek Restoration Partners completed its Feasibility Report and Restoration Plan for the Muddy Creek Watershed. This planning document focused restoration efforts and was instrumental in leveraging funding, generating approximately $4.5 million in cash and in-kind services since 1998 to pay for improvements to the Muddy Creek watershed. Conservation and water quality improvements have an estimated value of $16.5 million. The program includes an educational and outreach component that serves both broad educational purposes and targeted marketing of conservation solutions to key property owners.

Funding sources for the program include the NC Clean Water Management Trust Fund, NC Ecosystem Enhancement Program, NC Wildlife Resources Commission, NC Division of Water Quality, NC Division of Water Resources, NC Department of Agriculture, USDA Natural Resources Conservation Service, US Environmental Protection Agency, Duke Energy Corporation, Duke Foundation, Trout Unlimited (various chapters statewide), Trout and Salmon Foundation, Vulcan Materials, and the National Fish and Wildlife Foundation.

The Muddy Creek Restoration Partnership works on a voluntary basis with landowners and organizations that are located in the priority areas and inform them of conservation opportunities available, appropriate agencies or funding sources. Local businesses are encouraged to capitalize upon and profit from investments being made in conservation and water quality improvements.

Goals and objectives for the partnership include writing an updated watershed plan, monitoring to evaluate improvements to watershed conditions, gaining new partners, making greenway connections, utilizing better stormwater management techniques, encouraging farmland preservation and more stream conservation.



Lower Creek Watershed Restoration Implementation Plan

The Lower Creek watershed is a 100 square mile area that drains parts of Caldwell and Burke Counties and is a main tributary to Lake Rhodhiss. Lower Creek and several of its feeder streams are on North Carolina's list of impaired waters. Water quality in the Lower Creek watershed has been of concern for decades. There are several streams that are on North Carolina's 2006 list of impaired waters (known as the 303(d) list)—Lower Creek, Zacks Fork, Spainhour Creek, Greasy Creek, and Bristol Creek. These streams suffer from excess sedimentation, degraded habitat for aquatic organisms, fecal coliform bacteria contamination, excessive stormwater flows, and pollutants such as nutrients, metals, and other toxicants from various non-point pollution sources. In addition, Lake Rhodhiss, into which Lower Creek flows, is on the 303(d) list due to factors related to excess nutrients.

The LCAT membership consists of folks from many of the same groups represented on the original Lower Creek TAC, including Local Governments: many department staff (Planning/Community Development, Public Works, Stormwater and School Districts) from –

Burke and Caldwell County, the City of Lenoir, the Town of Gamewell; Soil & Water Conservation Districts; State Agencies: NC State Cooperative Extension Service, NCSU Science House, NC Division of Water Quality, Ecosystem Enhancement Program; Federal Agencies: Natural Resource Conservation Service; Non-Governmental Organizations: Caldwell County Pathways, Reese Institute, Carolina Land and Lakes RC&D, Western Piedmont Council of Governments. Others groups individuals not mentioned are periodically represented and membership is open to all who are interested.

The Lower Creek Advisory Team (LCAT) was formed in August of 2006 at the end of the EEP local watershed planning (LWP) initiative. The LCAT was established as a subgroup of Caldwell County Pathways and represents a continuation of the Lower Creek Technical Advisory Committee (TAC) that supported earlier phases of the LWP effort. The LCAT mission, as determined at its first official meeting in September 2006, is:
"To restore and protect Lower Creek and its tributaries, while increasing public awareness of local water quality issues".

In 1998, the Western Piedmont Council of Governments published the Lower Creek Watershed Project, which documented water quality problems and named watershed protection recommendations and urban stormwater recommendations. This effort included a study of fecal coliform bacteria levels, stormwater outfall mapping, and benthic macroinvertebrate monitoring. Stakeholders were involved in early stages of identifying problems areas and potential management strategies.

In 2003, the North Carolina Ecosystem Enhancement Program (EEP) started follow-up planning in the Lower Creek watershed. The plan expanded on the efforts of the previous work, developing more information on the health of streams in the watershed and identifying causes of degradation. Its goals were to: (1) to assess stream quality in the watershed, identifying key sources of degradation and pollution, and (2) to develop a comprehensive strategy to address watershed needs. The plan is the result of three years of effort involving in-stream data collection on water quality, habitat, and channel stability, Geographic Information System (GIS) data analysis, and development of ecologically and locally relevant management strategies to restore and preserve stream health. A Technical Advisory Committee (TAC) aided the planning team in reviewing data, identifying plan recommendations, and developing implementation priorities. The TAC, comprised of natural resource and planning staff from Lenoir, Caldwell and Burke Counties, nonprofit organizations, and regional and state government entities, was essential to the development of a watershed plan that incorporates priorities of the local community.

After the Lower Creek Watershed Management Plan was completed, a subset of the TAC formed the Lower Creek Advisory Team. This team meets regularly to coordinate efforts to implement the watershed plan.

1) To advise EEP in the implementation of stream and wetland restoration projects.

(2) To increase public awareness of local watershed issues and solutions, especially of stormwater best management practices (BMPs).

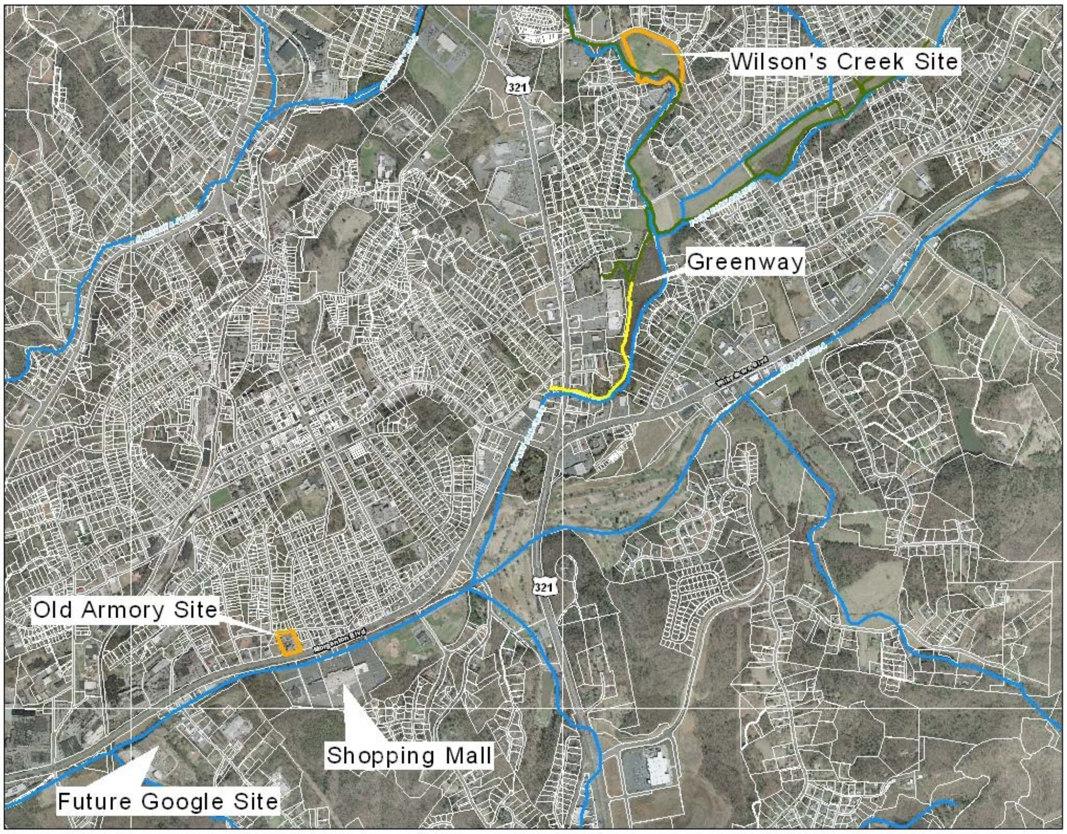
(3) To link local greenway efforts to Lower Creek watershed education objectives.

(4) To educate local government decision-makers on stream health issues.

(5) To encourage the adoption of Lower Creek Watershed Management Plan recommendations.

(6) To explore the possibility of partnerships with locally based businesses and institutions.

(7) To identify priority grant-fundable projects and apply for funding. Project types include stormwater BMPs and floodplain parcel acquisition for greenways and buffer establishment.



Hunting Creek Restoration Project

Equinox is working with the CLLRC&D and the Hunting Creek Partners to develop a local watershed plan for the 25.5 sq mi Hunting Creek Watershed. It is a 2 year project funded by the 319 program and CWMTF with the intention of improving the impaired section of Hunting Creek, ultimately removing it from the state impaired list in the long term. Over the next two years they will be collecting fish and chemical data in addition to walking the entire impaired section of Hunting Creek looking at potential impacts. They also will be identifying potential stormwater BMP opportunities to implement throughout the watershed. An additional component of the project is developing a land cover classification dataset for the 25.5 sq mi watershed by digitizing land uses as seen in 2005 aerial orthophotos.

City of Morganton Greenways

In the early 1990's, the City of Morganton acquired large amounts of property along the Catawba River, which meanders nearly 8 miles through the corporate limits of the city. The City was able to acquire 6 miles of river front through an aggressive grant writing campaign in the early 1990s. With this river frontage, Morganton was able to develop an extensive regional bikeway and pedestrian greenway system along its river front to provide recreation to its citizens and users from areas well outside the City of Morganton. It has been highlighted numerous times in regional and national conferences.

The two main sections of the City of Morganton greenway include the Catawba River Greenway and the Freedom Trail Greenway. The Catawba River Greenway Park offers at total of 3.8 miles of paved, fully accessible walking trail. The Catawba River Greenway runs along the Catawba River from the Rocky Ford Access area off Lenoir Road/NC 18 N. to the Greenlee Ford Access adjacent to the Catawba River Soccer Complex Loop located off Greenlee Ford Road.
The Freedom Trail Greenway connects Freedom Park and Freedom High School to the Catawba River Greenway. Freedom Trail extends .6 miles from the Freedom Trail Access Point adjacent to Freedom Park and is highlighted by a 226-foot, 90-ton pedestrian bridge that crosses

City of Lenoir Greenways

The Lenoir Greenway includes a 7.3 mile system of paved trails that allow for walking, biking, jogging, skating, and more on 25 beautiful acres. A major section of the trail is the Town Creek Greenway which consisted of two phases. The first phase was a ½ mile walking and bike trail located on Broadway (Highway 11) that connects to Rock Spring Park.

Phase II of the Town Creek Greenway system was completed in 2006. The additional trail will began at the Rock Springs Park area, ran along the creek through the Wampler Keith Park and commenced at the Lenoir City Middle School property. It ends adjacent to the new Lenoir City Swimming Pool Complex. Phase II added approximately 1.25 miles of trail to the greenway which made the total length 1.75 miles one way.

Unifour Septic Tank Repair Program

Water quality in western North Carolina is threatened by the discharge of untreated wastewater into streams, either through leaking septic tank systems or straight piping. Often, the homes identified as having wastewater disposal problems are located in low-income areas of the state and citizens cannot afford to make the necessary repairs. The Western Piedmont COG organized a program that targets straight piping situations or faulty septic tanks and provides a grant or a loan to repair the home so that it meets compliance with NC environmental standards. The money lent out to fix septic tanks was supplied by a grant from the NC Clean Water Management Trust Fund. The low-interest loans are repaid over five years, perpetuating the repair program and helping NC citizen make repairs to their home they would have been unable to afford otherwise.

CWMTF Grant Awarded to Granite Falls and Lenoir for Shoreline Protection

The Foothills Conservancy received $1,673,200 from the Clean Water Management Trust Fund (CWMTF) that requires a 53% match in an effort to establish 158 acres of riparian buffer on 21,200 linear feet along one side of the Catawba River (WS IV) and unnamed tributaries.

Designation of Wilson Creek as a Federal Wild and Scenic River

The Western Piedmont Council of Governments, Foothills Conservancy and Caldwell County have worked cooperatively with the U.S. Forest Service over the past year to secure Wild and Scenic River status for Wilson Creek located in Avery and Caldwell Counties. In May 1999 Congressman Cass Ballenger from Hickory introduced legislation that would designate Wilson Creek as a federal Wild and Scenic River. If approved by Congress, a 23.3-mile stream corridor encompassing nearly 7,500 acres would receive special protection and management.

Designation of Bridgewater Section of the Catawba River as a Trout Water

Development of a Small Area Plans (ex. Bridgewater Section of the Catawba River in Burke County)

FERC Relicensing Agreements

The relicensing of Duke Energy's hydropower dams is another factor that will affect land and water resources within the upper basin. Originally scheduled for renewal by the Federal Energy Regulatory Commission (FERC) in 2008, the utility is currently operating on a license extension. Duke Energy formally began the application process in 2003. As a condition to relicensing, Duke Energy will be required to provide mitigation for impacts attributed to their operation of their dams. While state regulatory agencies have been granted the authority to conduct negotiations with utilities concerning mitigation planning, FERC recognized the importance of the public in identifying key issues to be addressed by utilities during this process. Public involvement in this process has been significant and has been critical to ensure that broad-based community goals and values are adequately addressed by Duke Energy over the next several decades.

Agricultural BMP Technical Assistance and Support

Land Use Planning and Local Ordinances Enacted - Land use refers to how a tract of land is utilized, whether it is designated residential, business, or for undeveloped uses like agriculture or open space. In the Rhodhiss Watershed Plan, land uses are mainly categorized as impervious or developed, or open space or forested. Local governments tend to categorize their developed uses in the zoning ordinance, with open space being up to the owners of the property. However, a local government can require open space be set aside, as long as a property owner has use of their property.

Much of the time, these restrictions can be outlined in a comprehensive plan and then set forth in a subdivision or zoning ordinance. A local government may require a new subdivision to have open space set aside, or may allow more clustered development for open space in return. Municipality, county, state and federal government all play a role in implementation of Ordinances, especially with respect to environmental concerns.

Land Use Planning - All of the municipalities and counties that are in the Rhodhiss watershed have adopted zoning and subdivision policies. Of these, most of them have adopted measures for requiring open space, or allowing clustered development in exchange for the open space.

Water Supply Watershed Rules

Water Supply Watershed Ordinances are intended to protect those waters used as sources of water supply for drinking, culinary, or food processing purposes. The Ordinace establishes tighter restrictions in the Critical area which extends ½ mile from a drinking water point of intake, and less is less restrictive in the Protected Area which extends 5 miles from the drinking water point of intake. The watersheds are classified into four different categories based on levels of development and the level of protection desired.

> **Water Supply I Watersheds** are for those users desiring maximum protection for their water supplies. WS-I waters are those within essentially natural and undeveloped watersheds with no permitted point source (wastewater) discharges. Development is not allowed in these areas. WS-I watersheds are entirely composed of publicly owned land

and comprise just 0.2% of the total state land area..

Water Supply II Watersheds are for those users desiring maximum protection for their water supplies where a WS-I classification is not feasible. WS-II waters are generally located within predominantly undeveloped watersheds. Restrictions for development in the critical areas are separated into two categories: A low density option and a high density option. The low density option allows for one dwelling unit per acre or 6% built-upon area. The high density option allows for 6 -24% built-upon area. Landfills are not allowed in these areas, and agricultural BMPs are required.

Restrictions for development in the protected areas are also separated into a low density option and a high density option. The low density option allows for one dwelling unit per acre or 12% built-upon area. The high density option allows for 12 -30% built-upon area. Landfills cannot have any new discharging in these areas.

Water Supply III Watersheds are for those users where a more protective WS-I or WS-II classification is not feasible. WS-III waters are generally located within low to moderately developed watersheds. Restrictions for development in the critical areas are separated into two categories: A low density option and a high density option. The low density option allows for one dwelling unit per acre or 12% built-upon area. The high density option allows for 12 -30% built-upon area. Landfills are not allowed in these areas, and agricultural BMPs are required. Restrictions for development in the protected areas are also separated into a low density option and a high density option. The low density option allows for two dwelling unit per acre or 24% built-upon area. The high density option allows for 24 -50% built-upon area. Landfills cannot have any new discharging in these areas.

Water Supply IV Watersheds are for those users where a WS-I, WS-II, or WS-III classification is not feasible. WS-IV waters are generally located within moderately to highly developed watersheds. Restrictions for development in the critical areas are separated into two categories: A low density option and a high density option. The low density option allows for two dwelling units per acre or 24% built-upon area. The high density option allows for 24 -50% built-upon area. Landfills are not allowed in these areas, and agricultural BMPs are required. Restrictions for development in the protected areas are also separated into a low density option and a high density option. The low density option allows for two dwelling unit per acre or 24% built-upon area. The high density option allows for 24 -70% built-upon area.

Phase II Stormwater Programs

EPA's Stormwater Phase II Ordinance is intended to improve water quality by reducing the number of pollutants that are picked up by stormwater, carried into municipal separate storm sewer systems (MS4s), and ultimately discharged into local rivers streams without being treated. These pollutants can include oil and grease from roadways, pesticides from lawns, sediment from construction sites, and carelessly discarded trash, such as cigarette butts, paper wrappers, and plastic bottles. These pollutants can impair the waterways when deposited through MS4 discharges and discourage recreational use of the resource, contaminate drinking water supplies, and interfere with the habitat for fish, other aquatic organisms, and wildlife.

The term "Phase II" applies to MS4s that are small, or under 100,000 in population. EPA's Stormwater Phase I dealt with those MS4s over 100,000.

The following are the Six Minimum Measures of a Stormwater Phase II Ordinance as outlined by EPA:

(1) Public Education and Outreach Distributing educational materials and performing outreach to inform citizens about the impacts polluted storm water runoff discharges can have on water quality.

(2) Public participation/Involvement Providing opportunities for citizens to participate in program development and implementation, including effectively publicizing public hearings and/or encouraging citizen representatives on a storm water management panel.

(3) Illicit Discharge Detection and Elimination Developing and implementing a plan to detect and eliminate illicit discharges to the storm sewer system (includes developing a system map and informing the community about hazards associated with illegal discharges and improper disposal of waste).

(4) Construction Site Runoff Control Developing, implementing, and enforcing an erosion and sediment control program for construction activities that disturb one or more acres of land (controls could include silt fences and temporary storm water detention ponds).

(5) Post-Construction Runoff Control Developing, implementing, and enforcing a program to address discharges of post-construction storm water runoff from new development and redevelopment areas. Applicable controls could include preventative actions such as protecting sensitive areas (e.g., wetlands) or the use of structural BMPs such as grassed swales or porous pavement.

(6) Pollution Prevention/Good Housekeeping Developing and implementing a program with the goal of preventing or reducing pollutant runoff from municipal operations. The program must include municipal staff training on pollution prevention measures and techniques (e.g., regular street sweeping, reduction in the use of pesticides or street salt, or frequent catch-basin cleaning).

Flood Damage Prevention Ordinance

FEMA has required that all local governments adopt a Flood Damage Prevention Ordinance (FDPO) if they want to be eligible for the National Flood Insurance Program. The purpose of the FDPO is to promote public health, safety, and general welfare and to minimize public and private losses due to flood conditions within flood prone areas.

The FDPO is designed to:

(1) restrict or prohibit uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion, flood heights or velocities;
(2) require that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction;
(3) control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of floodwaters;

(4) control filling, grading, dredging, and all other development that may increase erosion or flood damage; and

(5) prevent or regulate the construction of flood barriers that will unnaturally divert flood waters or which may increase flood hazards to other lands.

Sediment and Erosion Control

Both Counties taken over monitoring and permitting for Sedimentation and Erosion from the State.

Catawba Buffer Rules

Buffer Requirement Ordinance that requires a minimum 60 foot buffer along riparian waterways. Burke and Caldwell County, as well as the Town Governments within their boundaries, have adopted land use ordinances that affect water quality. Both Counties taken over monitoring and permitting for Sedimentation and Erosion from the State, as well as adopting a Buffer Requirement Ordinance that requires a minimum 60 foot buffer along riparian waterways. Other ordinances adopted by the local governments include Water Supply Watershed Ordinances (WS-I, WS-II, WS-III, and WS-IV), a Stormwater Phase II Ordinance, and the Flood Damage Prevention Ordinance (FDPO).

Local Government	WS-I	WS-II	WS-III	WS-IV	Phase II	FDPO
Burke County	X		X	X		X
Connelly Springs					X	X
Drexel					X	
Glen Alpine					X	
Hildebran				X	X	
Morganton			X	X	X	X
Rutherford College				X	X	X
Valdese				X	X	X
Caldwell County				X	X*	X
Cajah's Mountain				X	X	
Cedar Rock					X	
Gamewell				X	X	
Granite Falls				X	X	X
Hudson				X	X	
Lenoir					X	
Rhodhiss				X	X	X
Sawmills				X	X	

Lake Rhodhiss Visioning Project

In December 1999 the North Carolina Department of Environment, Health and Natural Resources awarded the Western Piedmont Council of Governments (WPCOG) a water quality planning grant. The purpose of this “Visioning Project” was to work with a local stakeholder committee composed of individuals representing local governments, local and state resource agencies and private interests in developing a single set of land use recommendations for local governments sharing land-use jurisdiction along the lake. The committee’s recommendations are contained within Appendix A of this plan and serve as one of the building blocks in the current project.

Appendix E
Education and Outreach Plan

This section discusses public education and outreach activities proposed to support and enhance the nutrient and sediment reduction activities outlined in this Plan.

Participation

All of the proposed load reduction activities discussed in this plan are voluntary on the part of private landowners. A key component of success in reducing the various pollutant loads identified will be securing the voluntary participation of private landowners. To secure participation, education and outreach is needed to influence knowledge, motivation, and behavior of the targeted participants. The goal of education and outreach activities is to achieve the necessary motivation that will result in participation in the load reduction practices identified.

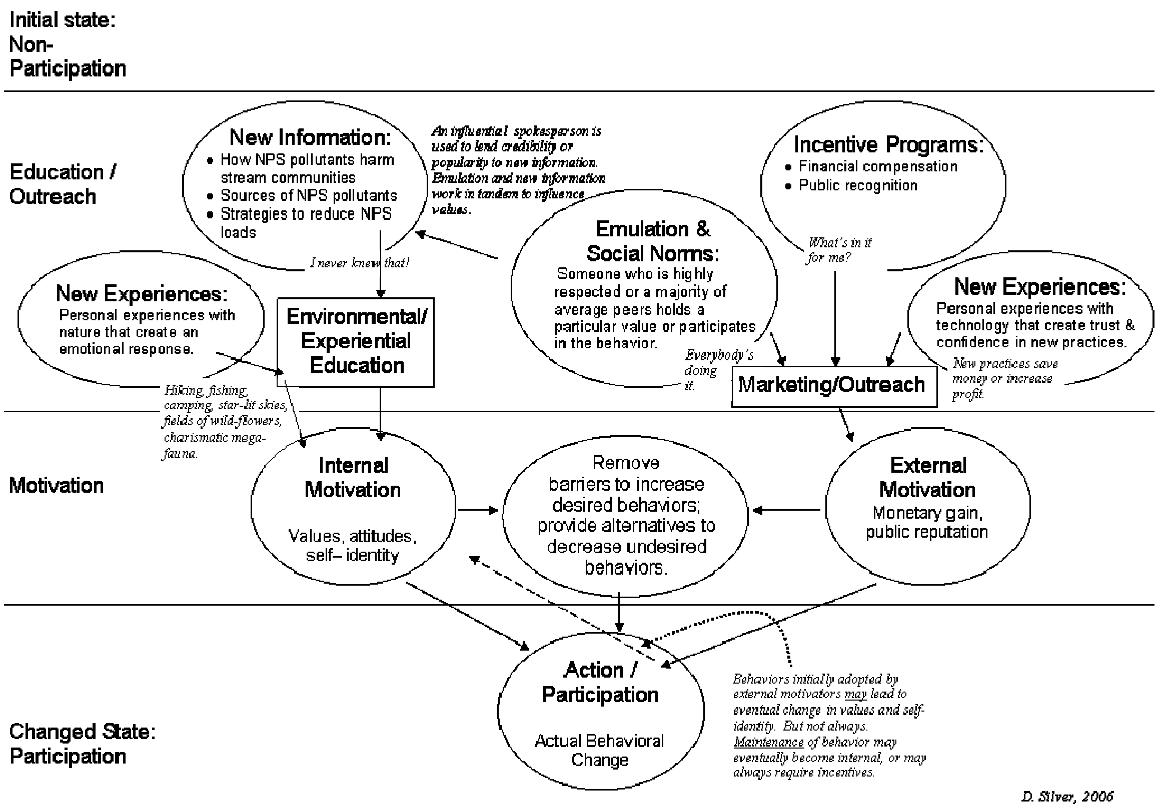
Conservation Behavior Model

Knowledge ⇨ Motivation ⇨ Action

To achieve actual behavior change among the targeted audience a behavior change model is instructive (see figure G-1):

Behavior may be influenced by a number of internal or external motivating factors: Internal motivators include personal values, attitudes, and self-identity. These are a core element of most conservation behavior. Individuals who consider themselves conservationists or environmentalists, who value a healthy and extensive natural environment for its own worth or for personal enjoyment, are the most likely individuals to engage in behavior that protects natural resources. Improved actions toward the environment may be influenced by providing new information if some basic level of value for natural resources pre-exists. New information applies general moral beliefs to specific environmental contexts. For example, a widespread lack of knowledge about where stormwater run-off goes may result in careless dumping of pollutants in storm drains and on the landscape. An education campaign designed to increase awareness that stormwater run-off, and its associated pollutants, goes directly to streams with no filtering or treatment, may result in improved practices. This example presumes a pre-existing value ("I care about water quality"), and a specific lack of information ("I didn't realize stormwater doesn't get treated.") In this case, providing new information activates an internal motivator and may result in behavior change.

Figure G-1: EDUCATION AND OUTREACH MODEL for INFLUENCING NEW PARTICIPATION in NPS LOAD REDUCTION PRACTICES



However, if the necessary values and attitudes toward the environment do not pre-exist, providing new information will not result in successful behavior change. For example, educating landowners about the value of stream buffers for filtering pollutants and reducing the volume and velocity of run-off has not been effective in motivating landowners to install stream buffers on their property. New information alone is not sufficient. The underlying reasons for non-participation are unknown; surveys and/or focus groups would be needed to determine them. A few possibilities include: landowners don't care that much about water quality once it leaves their property; landowners care about water quality, but not as much as other more pressing problems, such as financial security.

Developing/changing internal motivators (values, attitudes, self-identify as a conservationist) when they do not pre-exist is extremely difficult in adults. Attitudes can be influenced through a variety of factors. Repeated experiences with nature that result in a positive emotional reaction can develop environmental values. Outdoor recreation is a common mechanism. Those who enjoy forests, lakes and wildlife are most likely to protect them. However, this process is extremely slow, and usually works in tandem with other influences. Emulating someone who is highly respected and admired is another mechanism for changing values. The use of a popular figure as a spokesperson for a cause capitalizes on this strategy. The most effective mechanism for influencing values is to change behavior through an external motivator. Repeated engagement in the activity, and enjoyment of resulting consequences, may eventually develop an internal value that did not previously exist. For example, a landowner who engages in a variety of conservation practices, based on external motivators, and is hailed as a hero in his community, may eventually adopt additional practices through internal motivation, or may maintain practices once external motivators are removed. In other words, he begins behaving like a conservationist and eventually comes to see himself as one. Self-identify may be changed through behavior.

It is important to note that while influencing attitudes, values, and self-identify in adults is extremely difficult, there is great potential for developing environmental values in children and adolescents. Societal change in conservation behavior due to personal values is usually generational. That is, repeated exposure to environmental education and affective experiences over the course of childhood and adolescence may result in a new generation of adult decision makers who value nature, consider themselves conservationists, and incorporate a variety of conservation practices in their everyday lifestyles. Providing such environmental education experiences for children and adolescents is a worthwhile investment in improved practices in the long-run, but measurable results in the environment may not be evident for ten, 20, or 30 years.

Because changing internal motivators in adults is so difficult, efforts to achieve behavior change for conservation depends strongly on external motivators. External motivators include tangible benefits for participating or not participating, and intangible benefits such as reputation in the community.

Tangible benefits include financial assistance, rewards, or avoidance of fees. A variety of program strategies may be devised to offer tangible incentives for participation. These include cost-share programs for installing Best Management Practices; grant incentives (direct payment for participating or 100% cost of installations); and tax benefits for conservation easements. Financial benefits may also be derived directly from a new practice. This is considered a win-win situation – a practice that benefits the environment while also providing improved efficiency, yield, or profit, or reduction in operating costs for the practitioner. Demonstration projects that build trust and confidence in the value of a practice are often effective in achieving behavior change (adoption of the practice without additional incentives).

Intangible benefits include public recognition and awards programs. Whether behavior is internally or externally motivated, obstacles may prevent adoption of a practice. Desired behaviors may include one-time, “big” practices, such as a new installation (putting in a stream buffer, or a raingarden or a chemical mixing facility); or they may be “small” behaviors that must be sustained over time, such as recycling, or conserving water, or changing the way chemical mixing or tilling is done. For big, one-time practices such as installations, obstacles are usually financial, either in the cost of the installation itself, or in the opportunity cost of the land-use (e.g., loss of the productive use of land by installing a stream buffer). For small, lifestyle changes, convenience is a key factor. This includes how much time the new practice requires (e.g., taking recyclables to a central location vs. curb-side pick-up); how difficult or complicated the practice is (e.g., conducting soil tests and calculating fertilizer needs); and acquisition, maintenance, and storage of required equipment (e.g., storage space for multiple recycling bins vs. just one bin for all recyclables). Identifying and removing such obstacles is critical to achieve actual adoption of new practices.

Education vs. Outreach

To design an effective program, it is important to differentiate between education and outreach. Education involves conveying new information and/or experiences to the targeted audience. Education may be effective when positive values and attitudes pre-exist, so that new information may result in changed practices (e.g., awareness that storm water run-off does not get filtered or treated). Education may be effective over the long term (generational change) to develop desired values and attitudes. Education may also be effective to convey the technical or economic benefits of a new practice to create financial motivation (for example, educating growers on the cost of product wasted through spills, and the savings that may be achieved through use of a chemical mixing facility).

Outreach involves marketing a particular program – soliciting participation in a program for the external benefits that are offered, or marketing the removal of barriers so that internal motivators may be acted upon. For example, if it is determined that residents don't recycle because it is inconvenient, a new curbside service may remove that barrier. Marketing is then needed to inform the audience of the new convenience to motivate utilizing it. External rewards and modeling for emulation may be needed to get people started. These also require marketing.

For "small," lifestyle changes aimed at a large population, such as recycling, or water conservation, social marketing techniques are used. For "big," one-time practices, such as installations, one-on-one outreach, or outreach to very small groups, is needed. This is the door-to-door approach.

The distinction made here between education and outreach is that education is conceptual – it involves increasing understanding of how nature or technology works --- why sediment in streams is bad for aquatic communities; how hydrology is changed when land is cleared; the chain of events that results from excess nutrients in streams. Outreach involves selling a particular practice or program: new curbside pick-up makes recycling super-convenient; cost-share available for fencing cattle out of streams. Outreach programs usually are based on external motivators, while education stimulates internal motivators to alter behavior.

To truly change behavior, or to secure participants in conservation efforts, an analysis is required of the desired behavior, the targeted audience, the motivators at work, and the potential obstacles. Research of the target audience (surveys, focus groups, interviews) may be necessary to determine motivators and obstacles. From this analysis, program strategies may be identified, and specific outreach or education programs may then be designed.

Following is discussion of the targeted audience for the pollutant load reduction practices identified in this Plan, hypotheses and anecdotal data regarding motivators and obstacles, and initial education and outreach plans for securing participation in the targeted practices.

Target Audiences, Motivations, Barriers

Table G-1 lists the pollutant load reduction activities proposed in the Plan, and their related target audiences

Load reduction activity	Targeted Audience
Restoration of unstable and eroding streams to reduce sediment loading (________ linear feet);	All landowners, and leasers
Revegetation of riparian areas to reduce sediment and nutrient inputs from residential areas, crop land and pastures (_______ linear feet);	All landowners, and leasers
Conservation tillage to reduce sediment and nutrient inputs from land currently cultivated with minimal field residue (____ acres);	Crop growers - owners or leasers
Prescribed grazing to reduce sediment and nutrient inputs from pasture considered to be heavily overgrazed (___ acres);	Livestock growers
Livestock exclusion to reduce sediment inputs due to cattle access to streams (_____ linear feet);	Livestock growers
Use of soil sampling and analysis in ornamental nursery growing operations to reduce unnecessary fertilization (___ acres);	Ornamental Nursery owners or leasers
Use of ground cover in ornamental nursery growing operations to reduce erosion and uptake nutrients (___ acres);	Ornamental Nursery owners or leasers
Use of drip irrigation in ornamental nursery growing operations to reduce erosion (___ acres);	Ornamental Nursery owners or leasers
Use of in line fertilization with drip irrigation in ornamental nursery growing operations to reduce erosion and minimize nutrient application (___ acres);	Ornamental Nursery owners or leasers
Proper disposal animal wastes in poultry growing operations to reduce nutrient loading (___ acres);	Poultry Farmers owners or leasers

For all of the proposed pollutant load reduction activities, experience and anecdotal data suggests that behavior related to these practices is primarily externally motivated. While some landowners certainly value the natural and/or cultural resource values of their property, this internal motivator is not dependable throughout the targeted audience. Most landowners and growers are concerned first and foremost with financial security – the ability to make a living, succeed in their business, and plan for retirement. Conservation of land and protection of natural resources is valued primarily in terms of the economic value of the resource. It is important to note that this is a generalization based on limited experience of project managers and colleagues. Focus groups with representatives of each audience group would be needed to more accurately describe trends in motivations for each group.

Based on primarily external motivation, achieving participation in the above targeted practices will be dependent on financial incentive programs and providing new experiences with targeted practices.

Experience with New Technologies

External motivators can be activated through experience with new technologies that improve the potential participant's financial outcome. Trying out a new technology carries risk for the practitioner. Until the practice is well-proven, the risk of financial loss may make it unpalatable. Tendency to participate in practices that involve new technology will be greater among "early adopters" – individuals who have a naturally high tolerance for risk, or who derive some internal benefit from participation (such as the thrill of being a pioneer) that offsets the potential financial loss. "Late adopters" are individuals who will be resistant to adopting a new practice until its financial viability is well proven.

Increasing participation in new technologies can be achieved two ways:

1) Marketing the financial benefits inherent in the practice to early adopters.

2) Providing additional financial incentives to reduce the financial risk for late adopters.

Programs that remove the financial risk of adopting new practices and enable participants to experience the benefits first-hand can be effective in accelerating participation rates. Proving the value of the practice to the participant's bottom line may eventually lead to continued participation in the practice, even without additional financial incentives.

To achieve the implementation levels targeted in this plan, it is likely that the natural rate of adoption of these practices will need to be accelerated. Thus, additional financial incentives must be used to entice late adopters to participate sooner.

The primary program established to perform this function is the Environmental Quality Incentives Program (EQIP), administered through the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). This program offers incentive payments for on-going conservation practices and cost sharing up to 75% for conservation installations, according to a site-specific conservation plan. Incentive payments help reduce the financial risk of trying new technologies. However, the program is limited in duration. Incentives for any given practice on particular acreage is limited to an initial contract period (generally 3-5 years). Once this time period is complete, the same acreage may not be re-enrolled for the same practice. This is in keeping with the Education/Outreach model: personal experience with the new technology is intended to create trust and confidence in its inherent value. The pest scouting and mating disruption practices are so new that there is insufficient information to determine whether the practices are sufficiently cost-effective on their own for participants to continue them at their own cost once their incentive contract expires. If the savings in production costs is significantly greater than the cost of hiring the scout, then the practice is likely to be continued, and incentive program will be successful. Increasing participation in these practices will simply be a matter of marketing of the incentive program. However, if the cost savings is only marginally greater than the cost of the scout, or if the cost-savings balance is null (a break-even situation), then the incentive must be continued for the practice to be maintained. In other words, if the practice is not truly cost-effective, then the true barrier to participation is not lack of confidence in the practice, but rather, cost. In that case, continued financial incentives may be needed.

Financial incentive programs

Because the practices targeted in this plan are expensive to implement, cost of installation or acquisition of equipment has been shown anecdotally to be a barrier to participation1. For this reason, financial incentive programs must be a key component of any program aimed at increasing participation in all of these practices. Some financial incentive programs currently exist through various agencies:

- The Agricultural Cost-Share (ACS) Program, administered through the Soil and Water Conservation Districts, provides 75% cost-share funding for certain practices. Of the practices targeted in this plan, cost-share is available through this program for: restoration of unstable and eroding streams (related to agricultural activities only); revegetation of riparian areas (for cropland and pastures only); conservation tillage; livestock exclusion.

- CCAP

[1] Anecdotal observations from District Conservationist, US Department of Agriculture, Natural Resources Conservation Service, 2004, and Mud Creek Watershed Coordinator, 2004.

- The Environmental Quality Incentives Program (EQIP), administered through the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), offers incentive payments for on-going conservation practices and cost sharing up to 75% for conservation installations, according to a site-specific conservation plan. Applications are competitive and are funded based on priority ranking; specific dollar amounts are not earmarked for specific practices. Of the practices targeted in this watershed plan, those qualifying for assistance through this program are: Restoration of unstable and eroding streams to reduce sediment loading; conservation tillage to reduce sediment and nutrient inputs from land currently cultivated with minimal field residue; prescribed grazing to reduce sediment and nutrient inputs from pasture considered to be heavily overgrazed; livestock exclusion to reduce sediment inputs due to cattle access to streams.

- The Wetlands Reserve Program (WRP), administered through the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), provides 75% cost-share for restoration of qualifying wetland areas, or will pay landowners for putting wetland property into 30-year or permanent conservation easements. (Payments vary based on duration of the easement). Of the practices targeted in this plan, assistance or payment is potentially available through this program for: Revegetation of riparian areas to reduce sediment and nutrient inputs from residential areas, crop land and pastures.

- The Conservation Reserve Program (CRP), administered through the US Department of Agriculture (USDA) Farm Services Agency (FSA), offers annual rental payments, incentive payments, and cost-share assistance for establishing approved cover on eligible cropland. Of the practices targeted in this plan, financial assistance is available through this program for: Revegetation of riparian areas to reduce sediment and nutrient inputs (crop land and pastures only); and conservation tillage to reduce sediment and nutrient inputs from land currently cultivated with minimal field residue.

- The Ecosystem Enhancement Program (EEP), an agency within the North Carolina Department of Environment and Natural Resources (NC DENR), carries out stream and wetland restoration projects at 100% cost, for qualifying sites where landowners agree to various land-use restrictions. Of the practices targeted in this plan, financial assistance is available through this program for: Restoration of unstable and eroding streams to reduce sediment loading.

Education/Outreach Strategies

The time frame for this Plan is ten years, with targeted milestones throughout that period. This is considered short term for achieving behavior change. In this time frame, education aimed at increasing audience knowledge about the environmental benefits of the targeted practices will only result in the level of behavior change desired if internal motivators are already present. That is, motivating participants to adopt the desired practices simply because "it's the right thing to do," is unlikely in this time frame for audiences who are not already predisposed to conservation behavior. Efforts in the last three years to obtain project participants for the targeted practices have not been successful. This indicates that sufficient internal motivation is not present.

Behavior change in the time frame desired requires the use external motivators. For all of the practices targeted in this plan, education and outreach activities will not be effective until programs address true landowner interests and needs (overcome barriers to participation) and sufficient funding is available to provide financial incentives at the participation level desired. Once these conditions are met, outreach activities can be used to market the program opportunities to the targeted audience.

Social Marketing of Conservation Programs

A dual strategy is planned for marketing the programs offered to the target audience:

1) Targeted publicity:

- Media – articles and/or advertisements (public service announcements) published in local newspapers, as well as community and commodity newsletters, and newsletters of program partners, such as Extension Agents' or NRCS agents' newsletters to their clientele. Articles should describe the program goals, and especially the benefits to participants, as well as give contact information, background information, etc. Radio spots and guest appearances on local media may also be helpful. A marketing campaign

- Literature - simple hard-copy literature should be created that describes the program(s) offered. Landowners need time to consider the opportunity, discuss it, research various options, etc. Having program literature to take home is an important marketing tool.

- Direct mailing – A letter from the program coordinator, with program literature enclosed, direct mailed to targeted eligible landowners.

2) One-on-One Outreach (door-to-door sales).

The most successful means of securing project participants is likely to be individual discussions with landowners. For stream restoration and stream bank stabilization, this involves project staff researching a targeted area to identify potential project sites where work is needed. For the remaining practices (conservation tillage; cattle exclusion; prescribed grazing) research should be coordinated with partner agencies such as Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS) to identify landowners and agricultural operators within the targeted area who are not currently participating in these practices, and whose operations are the biggest contributors of pollutant loading. These targeted "recruits" should then be approached individually to solicit their participation in the program.

Note: if these strategies are not successful in securing the desired level of participation to achieve the targeted implementation levels in this plan, then audience research needs to be conducted to further identify barriers to participation. Several components of this outreach plan are based on limited experience and anecdotal data regarding the needs and preferences of the target audience. This analysis is discussed above. If these assumptions are inaccurate, then participation may not be achieved, in spite of high quality outreach efforts. If this occurs, then time and resources must be devoted to stepping back and conducting more thorough audience research and redesigning programs based on results.

Long-Term Education

In addition to marketing and outreach of program opportunities to solicit participation in targeted practices, true education over the long-term is recommended as an investment in future conservation behavior.

Education programs that address internal motivators (i.e., provide general knowledge and awareness, and work to influence attitudes and values) are unlikely to translate directly into immediate changes in behavior or measurable improvement in stream quality over the first ten years. However, such programs can result in meaningful change over a longer term. First, programs that provide general knowledge and awareness can be successful with a subset of the targeted audience who are already predisposed to conservation behavior (i.e., attitudes and values already exists). Second, repeated exposure to information combined with adoption of practices in the community (modeling) can lead to slow change in attitudes and values and eventual change in behavior. Accordingly, continued public education related to stream quality is recommended. General education includes media presence (newspaper articles, radio spots, and local TV messages on a regular basis), distribution of literature and/or take-home items (magnets, key chains, etc.), availability of resource professionals to speak at schools, civic and community groups and other venues, and availability of resource professionals to respond to constituent inquiries related to stream problems. In addition, general public education includes publicizing successful practices achieved through the programs described above.

Finally, and most importantly, environmental education programs for youth can provide lasting impacts in both knowledge and attitudes. Such programs can help develop the next generation of decision makers to be one that more readily adopts the practices targeted in this plan as well as other conservation practices. It is strongly recommended to offering, Adopt-A-Stream Program, the Kids-in-the-Creek Program, or other similar programs that partner with schools to provide school children meaningful experiences with stream environments as well as ecological knowledge and skills related to stream quality.

Education and Planning efforts related to additional problems with unidentified practices

While unpaved roads and residential areas are generally a major sources of sediment, current information on these areas is not sufficient to identify which specific source control practices are most needed. This plan recommends that additional assessment activities be conducted to identify sediment source control practices for low density residential areas and unpaved roads, and recommends that those measures be implemented within a ten year planning period. Nutrient source control practices are also recommended for developed areas. These practices are not reflected in the implementation targets, cost estimates and anticipated pollutant reduction estimates presented in this Plan.

Once the sources of sediment and nutrient loading from developed areas and related control practices are identified, a process similar to that outlined above can be implemented to conduct education or outreach for these practices:

- Identify the target audience for each pollutant load reduction practice.
- Identify motivations and barriers to participation for the targeted audience(s) – conduct audience research through focus groups, surveys, and interviews.
- Design programs that will activate motivations within the desired time frame and address barriers.
- Market the programs to the target audience using media, targeted mailings, literature, and door-to-door sales.

Anticipated education programs for these sediment sources include promotion of on-site stormwater management practices for homes, businesses, and industries: The use of bioretention areas to capture, store, and slowly discharge stormwater run-off is likely to be an important practice. Similarly, use of other storage or interception strategies, such as cisterns, green roofs and porous paving are likely, though as yet undocumented, target practices. Similarly, reducing illicit discharges to stormwater systems or discharges to impervious surfaces, such as leaking dumpsters, leaking vehicles, dumping on parking lots, etc., may be targeted practices for reducing nutrient and sediment sources from developed areas. For many of these practices, education (raising knowledge and awareness), may be sufficient to achieve behavior change through internal motivators, if conservation values and attitudes are present in a majority of the targeted audience. For many, these behaviors may truly be the result of simply not knowing better. However, some external motivators may be needed to overcome obstacles such as habits, time, inconvenience, or expense before practices are widely adopted.

In some local areas of the watershed, for some targeted pollutants, Federal, state, or local laws and ordinances may support some of the proposed load-reduction activities. For example, sediment and nutrient loads from developed areas may be due to run-off from construction sites, run-off from unpaved roads and eroding roadbeds, and/or run-off from hard surfaces such as roads, parking lots, and rooftops. State law already exists prohibiting sediment run-off from construction sites. Similarly, other practices, such as on-site management of stormwater from impervious sites, may be required by local ordinances in the near future. In such cases, adequate monitoring and enforcement of the laws is needed in combination with an education campaign. An education campaign for these practices would have a dual approach:

- raising audience awareness of the law, including the penalties it carries, and
- training the targeted audience in the technical implementation of the desired practices (e.g. IDDE and Good Housekeeping Program for government employees, Clearwater Contractor training to improve skills of contractors in *effectively* maintaining sediment on construction sites).

Details on education or outreach plans for targeted practices related to these pollutant loads will be developed once actual pollutant sources have been identified and load reduction targets are developed.

Techniques such as use of prompts and other strategies for promoting repetitive conservation behaviors, such as recycling regularly, or water or energy conservation practices, are not addressed here as the current and anticipated targeted practices in this plan are one-time installations, rather than repetitive lifestyle practices.

Grass roots volunteers

Catawba River Keeper Foundation's Muddy Water Watch and Cove Keepers training is a great opportunity to educate folks about erosion control and have them make a big difference by monitoring their neighborhood for sediment violations. Muddy Water Watch is a state-wide initiative to reduce stormwater runoff from construction sites by providing training workshops and materials to help volunteers understand erosion control violations, and monitor erosion problems to help prevent our number one polluter- sediment. The certification training will cover why erosion control is important, Best Management Practices to prevent erosion, regulations for sediment, how to recognize a violation, site visits to active construction sites, how to report violations. This program is being coordinated across the state and over 20 volunteers have became trained CoveKeepers in the greater Hickory Metro Area in Fall of 2008 and are now able to assist professional regulators to identify problems that need to be addresses.

Summary of Education and Outreach Plan

1. Identify target audience for each pollutant load reduction practice.

2. Identify motivations and barriers to participation for the targeted audience(s). We think we know the motivations of our target audience for some of the targeted practices, based on experience of NRCS, SWCD, and CES, experience of the watershed organizations, and anecdotal data from limited audience representatives.

3. Increase funding for popular programs:
    - Marketing outreach to inform interested participants of increased funding availability
    - Media, commodity newsletters, targeted mailings, door-to-door sales.
    - If participation does not increase, then assumed motivations are incorrect
    - Audience research to determine true reasons behind low participation
    - Recruitment and training of pest scouts to increase labor supply for this practice.

4. Funding for stream restoration and stabilization with more flexibility in design.

    a. Audience research to determine additional barriers that make CRP, WRP, and EEP unattractive.

    b. Door-to-door sales of stream restoration and stabilization options.

    c. Training local contractors in best practices for stream restoration and streambank stabilization (Stream Doctor program or similar technical training).

5. Audience research to determine reasons behind low participation in prescribed grazing, livestock exclusion, and conservation tillage.

    a. Focus groups, surveys, interviews

i. Based on results, design programs to provide incentives and address identified obstacles

1. Market programs – media, commodity newsletters, targeted mailings, door-to-door sales

6. General public education for long-term change

a. Media presence (newspaper articles/PSAs, radio spots, and local TV messages)

b. Distribution of literature and/or take-home items (magnets, key chains, etc.)

c. Availability of resource professionals to speak at schools, civic and community groups and other venues

d. Availability of resource professionals to respond to constituent inquiries related to stream problems

e. Publicity for success stories (Lower Creek Advisory Team Newsletter)

f. Stream-related Environmental Education for youth – Adopt-A Stream or similar programs

7. Develop plan for addressing sediment and nutrient loading from developed areas

a. Research pollutant load sources for these areas, develop target load reductions, and identify target practices for load reductions.

b. Identify the target audience for each pollutant load reduction practice.

c. Identify motivations and barriers to participation for the targeted audience(s) – conduct audience research through focus groups, surveys, and interviews.

d. Design programs that will activate motivations within the desired time frame and address barriers (Carolina Yards and Neighborhoods-CES)

e. Market the programs to the target audience using media, targeted mailings, literature, and door-to-door sales.

f. Grass roots volunteers in our watersheds that help improve our waterways.

* *This section borrows heavily from work by Diane Silver, NC State Cooperative Extension Agent and Chairperson of the NC Environmental Education Association*

Appendix F
Waste Water Treatment - Primer and DMRs

America's public water-based infrastructure – its water supply, wastewater, and stormwater facilities, and collection/distribution systems – are integral to our economic and environmental vitality.

However, much of this country's public wastewater system infrastructure has crossed the quarter-century mark, dating back to the CWA construction grant funding of the 1970s. Many of our collection systems date from the end of World War II and the population boom of the post war era. The oldest portions of the collection system pipe network exceed 100 years of service. Significant parts of this infrastructure are severely stressed from either: overuse and/or the persistent under-funding of repair, rehabilitation, and replacement. In an increasing number of communities, existing systems are deteriorating, yet the demand for new infrastructure to accommodate growth presses unabated. A revitalized approach to managing capital wastewater assets for cost effective performance is emerging across the country. This asset management approach focuses on the cost effective sustained performance of the wastewater collection and treatment system assets over their useful life.

System operators, designers, and regulatory agencies use tests to evaluate the strength of wastewater and the amount of treatment required, the quality of effluent at different stages of treatment, and the quality of receiving waters at the point of discharge. Tests also determine whether treatment is in compliance with state, local, and federal regulations. WWTP's in the Lake Rhodhiss watershed operating are all in compliance with their current permits. These permits which expire in 2010 do not have nutrient removal requirements at the present time.

Waste Water Treatment Plants serve the more urbanized areas of the region. During the early days of our nation's history, people living in both the cities and the countryside used cesspools and privies to dispose of domestic wastewater. Cities began to install wastewater collection systems in the late nineteenth century because of an increasing awareness of waterborne disease and the popularity of indoor plumbing and flush toilets. The use of sewage collection systems brought dramatic improvements to public health, further encouraging the growth of metropolitan areas.

The basic function of the wastewater treatment plant is to speed up the natural processes by which water purifies itself. In earlier years, the natural treatment process in streams and lakes was adequate to perform basic wastewater treatment. As our population and industry grew to their present size, increased levels of treatment prior to discharging domestic wastewater became necessary.

Clean Water Act Requirements for Wastewater Treatment –

The 1972 Amendments to the Federal Water Pollution Control Act (Public Law 92-500–, known as the Clean Water Act (CWA), established the foundation for wastewater discharge control in this country. The CWA's primary objective is to 'restore and maintain the chemical, physical and biological integrity of the nation's waters.' The CWA established a control program for ensuring that communities have clean water by regulating the release of contaminants into our country's waterways. Permits that limit the amount of pollutants discharged are required of all municipal and industrial wastewater dischargers under the National Pollutant Discharge Elimination System (NPDES) permit program. In addition, a construction grants program was set up to assist publicly owned wastewater treatment works (POTW) build the improvements required to meet these new limits. The 1987 Amendments to the CWA established State Revolving Funds (SRF) to replace grants as the current principal federal funding source for the construction of wastewater treatment and collection systems.

Over 75 percent of the nation's population is served by centralized wastewater collection and treatment systems. The remaining population uses septic or other onsite systems. Approximately 16,000 municipal wastewater treatment facilities are in operation nationwide. The CWA requires that municipal wastewater treatment plant discharges meet a minimum of 'secondary treatment'.

Wastewater is sewage, stormwater, and water that has been used for various purposes around the community. In sewage varies regionally and from home to home based on such factors as the number and type of water-using mixtures and appliances, the number of occupants, their ages, and even their habits, such as the types of foods they eat. However, when compared to the variety of wastewater flows generated by different nonresidential sources, household wastewater shares many similar characteristics overall.

Nonresidential wastewater in small communities is generated by such diverse sources as offices, businesses, department stores, restaurants, schools, hospitals, farms, manufacturers, and other commercial, industrial, and institutional entities.

Wastewater is mostly water by weight. Other materials make up only a small portion of wastewater, but can be present in large enough quantities to endanger public health and the environment. Because practically anything that can be flushed down a toilet, drain, or sewer can be found in wastewater, even household sewage contains many potential pollutants.

Nutrients

Wastewater often contains large amounts of the nutrients nitrogen and phosphorus in the form of nitrate and phosphate, which promote plant growth. Organisms only require small amounts of nutrients in biological treatment, so there normally is an excess available in treated wastewater. In severe cases, excessive nutrients in receiving waters cause algae and other plants to grow quickly depleting oxygen in the water. Deprived of oxygen fish and other aquatic life die often emitting foul odors.

How is treatment achieved?

The goal of wastewater treatment is to remove as much of the floating and biodegradable pollutants and disease-causing agents in wastewater as possible to minimize the risks to public health and impact on the environment. To do this Wastewater collection and treatment systems are in operation every day of the year, rain or shine.

Most systems achieve treatment through a series of stages. The primary stage often includes separating trash and large solid materials from the rest of the wastewater by screens and/or mechanically grinding them into finer materials. The remaining solids, oils, and greases are allowed to settle or separate from the rest of the stream in a septic tank, clarifier tank, or pond. The settled materials form a biologically active bottom layer of sludge. In all systems, the sludge accumulates and eventually needs to be removed, treated, and disposed of as well.

The secondary stage of treatment uses a combination of biological and physical processes to reduce the amount of organic wastes. This can be achieved by filtering the wastewater through biologically active media, such as trickling filters, sand filters, other specially designed filters, or soil (the most common method used with septic systems). Or, community systems commonly use an activated sludge process, in which wastewater is exposed to both oxygen and the biologically active sludge, either through wind action or mechanical means, such as mixing and aeration. Disinfection is often the final step after secondary or tertiary treatment and helps to kill most remaining viruses and bacteria.

A variety of advanced (or tertiary) treatment methods are sometimes required to reduce nutrients, toxic substances, or excessive amounts of dissolved materials in wastewater. These methods and there potential to provide significant reductions in nutrient input into Lake Rhodhiss will be discussed in following sections.

Appendix G
Impaired Surface Waters

This table includes some references to surface waters with the Western Piedmont Council of Governments Region some of which is outside the Lake Rhodhiss watershed most notable Alexander and Catawba County.

Impaired Surface Water in the Upper Catawba Valley

DWQ Subbasin	Watersheds	County	Use Support Category	Reason for Rating	Parameter of Interest	Listing Year
YOUNGS FORK (COPERNING CREEK) From source to Marion WWTP.	30501010401	McDowell	Aquatic Life	Biological Criteria Exceeded	Benthos	1998
YOUNGS FORK (COPERNING CREEK) From Marion WWTP to North Muddy Creek.	30501010401	McDowell	Aquatic Life	Biological Criteria Exceeded	FishCom, Benthos	1998
CLARK CREEK (SHOOKS LAKE) From Miller Branch to 0.9 mile upstream of Walker Creek.	03050102040, 030501020403	Catawba	Aquatic Life	Biological Criteria Exceeded	Benthos	1998
SPAINHOUR CREEK From source to Johns River.	30501010701	Caldwell	Aquatic Life	Biological Criteria Exceeded	Benthos	2000
GREASY CREEK From SR 1305 to Lower Creek.	3050101080020	Caldwell	Aquatic Life	Biological Criteria Exceeded	Benthos	2000
BRISTOL CREEK From source to Lower Creek.	30501010703	Caldwell	Aquatic Life	Biological Criteria Exceeded	Benthos	2000
HUNTING CREEK From a point1.0 mile upstream of Burke County SR 1940 to a point 0.4 mile downstream of Pee Dee Branch.	30501010504	Burke	Aquatic Life	Biological Criteria Exceeded	FishCom	2006

CATAWBA RIVER (Rhodhiss Lake below elevation 996) From Johns River to Rhodhiss Dam.	03050101080, 030501010802	Caldwell Burke	Aquatic Life	Standard Violation	High pH	2006
IRISH CREEK From Roses Creek to Warrior Fork.	30501010502	Burke	Aquatic Life	Biological Criteria Exceeded	FishCom	2006
MCGALLIARD CREEK From a point 0.6 mile upstream of mouth to Rhodhiss Lake, Catawba River.	30501010801	Burke	Aquatic Life	Biological Criteria Exceeded	FishCom, Benthos	2006
HORSEFORD CREEK From Frye Creek to a point 0.7 mile upstream of mouth	30501010804	Catawba	Aquatic Life	Biological Criteria Exceeded	Benthos	2006
MAIDEN CREEK From source to a point 0.7 mile upstream from backwaters of Maiden Reservoir.	30501020402	Catawba	Aquatic Life	Biological Criteria Exceeded	Benthos	2006
CATAWBA RIVER (including backwaters of Lake James below elevation 1200) From Dam at Old Fort Finishing Plant Water Supply Intake to North Fork Catawba River.	03050101010, 03050101010, 03050101030, 030501010105	McDowell	Aquatic Life	Standard Violation	Turbidity	2008
WILSON CREEK From Source to Johns River	03050101060, 03050101060, 030501010605	Caldwell Avery	Aquatic Life	Standard Violation	Low pH	2008
LOWER LITTLE RIVER From source to a point 0.5 mile upstream of Stirewalt Creek.	03050101100, 030501011003	Alexander	Aquatic Life	Standard Violation	Low pH	2008
SOUTH FORK CATAWBA RIVER From source to Catawba-Lincoln County Line.	03050102020, 03050102030, 030501020301	Catawba	Aquatic Life	Standard Violation	Low pH	2008
HENRY FORK From State Route 1124 to State Route 1143	03050102010, 030501020102	Catawba	Aquatic Life	Standard Violation	Low pH	2008
HENRY FORK From State Route 1143 to Jacob Fork.	30501020103	Catawba	Aquatic Life	Standard Violation	Turbidity	2008

CLARK CREEK From a point 0.9 mile upstream of Walker Creek to South Fork Catawba River.	30501020403	Catawba	Aquatic Life	Standard Violation	Turbidity	2008

NC DENR DWQ data, 2008 is draft list submitted to EPA for approval.

Surface Water Classifications and Use Support Ratings

All surface waters in the state are assigned a primary classification that is appropriate to the best uses of that water. Examples of primary classifications include Class C waters that are managed to support aquatic life and secondary recreation activities. In addition to primary classifications, surface waters may be assigned a supplemental classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Examples of supplemental classifications include High Quality Waters, Outstanding Water Resources and Trout Waters.

An important way of interpreting water quality data and assessing water quality conditions is determining how well a stream or lake supports its designated uses, referred to a water's use support rating. This rating aggregates a water's multiple use determinations into a single measure of water quality conditions.

Use Support Rating	**Water Quality Condition**	**Definition**
Fully Supporting (FS)	Good	Water quality meets designated use criteria.
Partially Supporting (PS)	Fair (Impaired)	Wate quality fails to meet designated use criteria at times.
Not Supporting (NS)	Poor (Impaired)	Water quality frequently fails to meet designated use criteria.

Surface waters are rated as fully supporting (FS), fully supporting but threatened (ST), partially supporting (PS) or not supporting (NS). These terms refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are fully supported, partially supported or not supported. For example, waters classified for fishing and water contact recreation (Class C for freshwaters) are rated as fully supporting if data used to determine use support (such as chemical/physical data collected at ambient sites and/or benthic macroinvertebrate bioclassifications) did not exceed specific criteria. If these criteria were exceeded, however, then the waters would be rated as ST, PS or NS, depending on the number of occasions water quality standards were not met.

A waterbody is fully supporting but threatened when water quality conditions support current designated uses but has some notable water quality problems suggesting designated uses may not be supported in the future unless corrective action is taken.

Waters rated as either partially supporting or not supporting are considered impaired. Waters that are considered partially supporting fail to meet designated use criteria at times, whereas waters considered not supporting frequently fail to meet designated use criteria. For both these use support ratings, there must be a specified degree of degradation before a stream is considered impaired.

The federal Clean Water Act requires states to develop a list every two years identifying waters not meeting water quality standards. This list, known as the 303(d) list, identifies of all the impaired lakes and streams found in the state. Waters are placed on this list regardless of whether the source of pollution is known and whether the pollution sources can be legally controlled or acted upon by the state. For waters on this list, states must develop Total Maximum Daily Loads (TMDLs) or management strategies for improving conditions in each listed water. A TMDL is a calculation of the maximum amount of a pollutant, such as phosphorus, that a lake or stream can receive and still meet state water quality standards.

Streams that have no data to determine their use support are listed as not rated (NR).

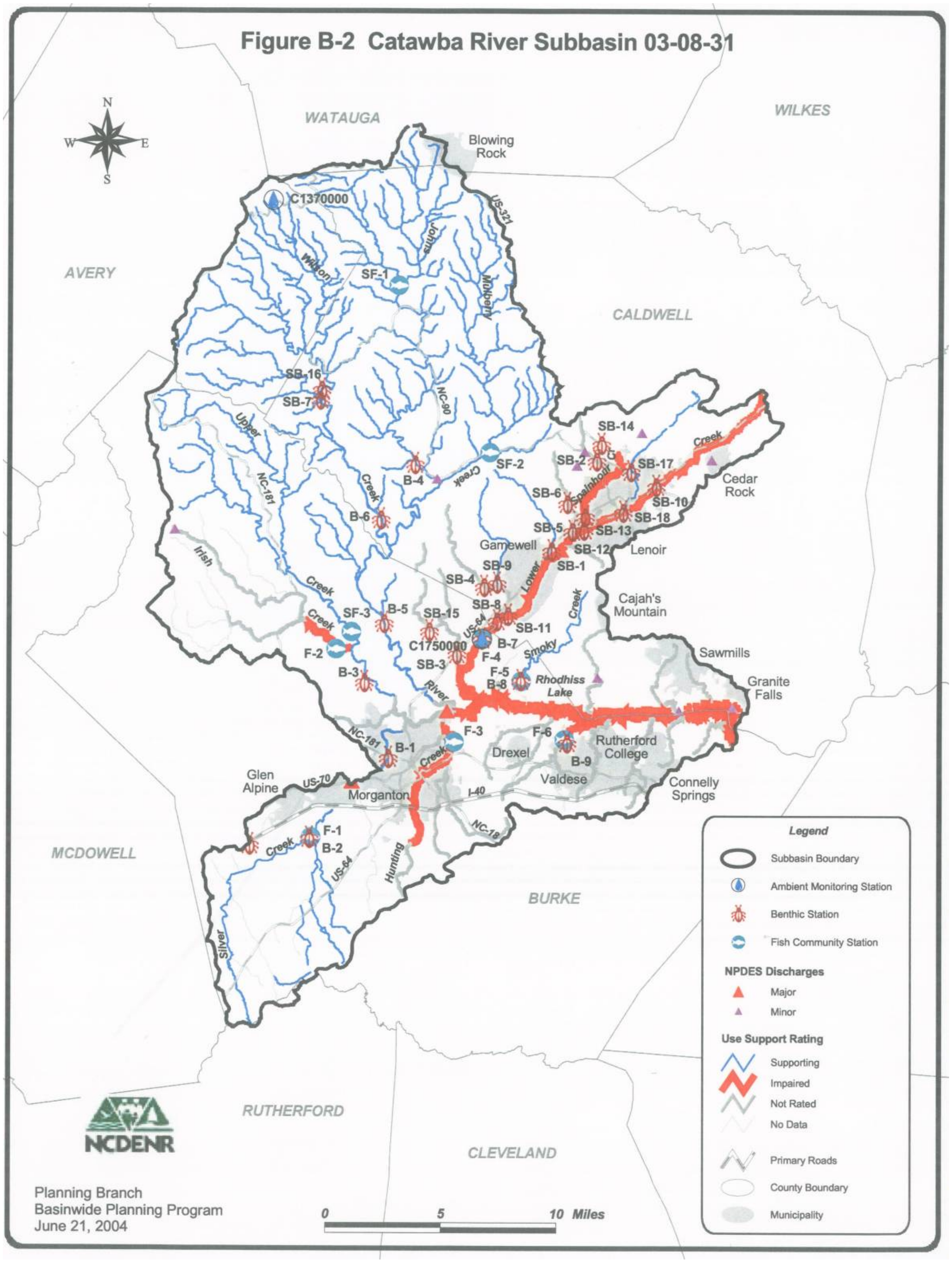


Figure B-2 Catawba River Subbasin 03-08-31
WATAUGA
WILKES
AVERY
CALDWELL
MCDOWELL
BURKE
RUTHERFORD
CLEVELAND
Blowing Rock
Cedar Rock
Lenoir
Gamewell
Cajah's Mountain
Sawmills
Granite Falls
Rhodhiss Lake
Rutherford College
Drexel
Valdese
Connelly Springs
Morganton
Glen Alpine
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
NCDENR
Planning Branch
Basinwide Planning Program
June 21, 2004
0
5
10 Miles

Appendix H
Water Quality Monitoring Plan

Long Term Monitoring

Monitoring should continue after baseline conditions are established. The data collected as part of the overall Rhodhiss Project during the drought of 2007-2009 could be considered this baseline. However, the impact of the drought caused record lows in the basin and elsewhere in the state during the period of sampling, makes this suspect as a baseline. The 6-month long-term stream flow averages hovered around 35% for much of the sampling period.

While certain watersheds will not be a major focus of implementation efforts for the near future, there may be a time lag in recovery of the stream. For this reason it would be valuable to continue monitoring in all sub-watersheds even after the implementation focus has shifted to other areas.

All sites should be sampled annually if possible for the duration of the 10 year planning period. As the implementation emphasis changes to other sub-watersheds, benthic macroinvertebrate sites should be added in those sub-watersheds.

If NCDWQ resources allow, it would be valuable to establish these site locations and initiate monitoring within the next few years, to allow for data collection prior to large-scale project implementation.

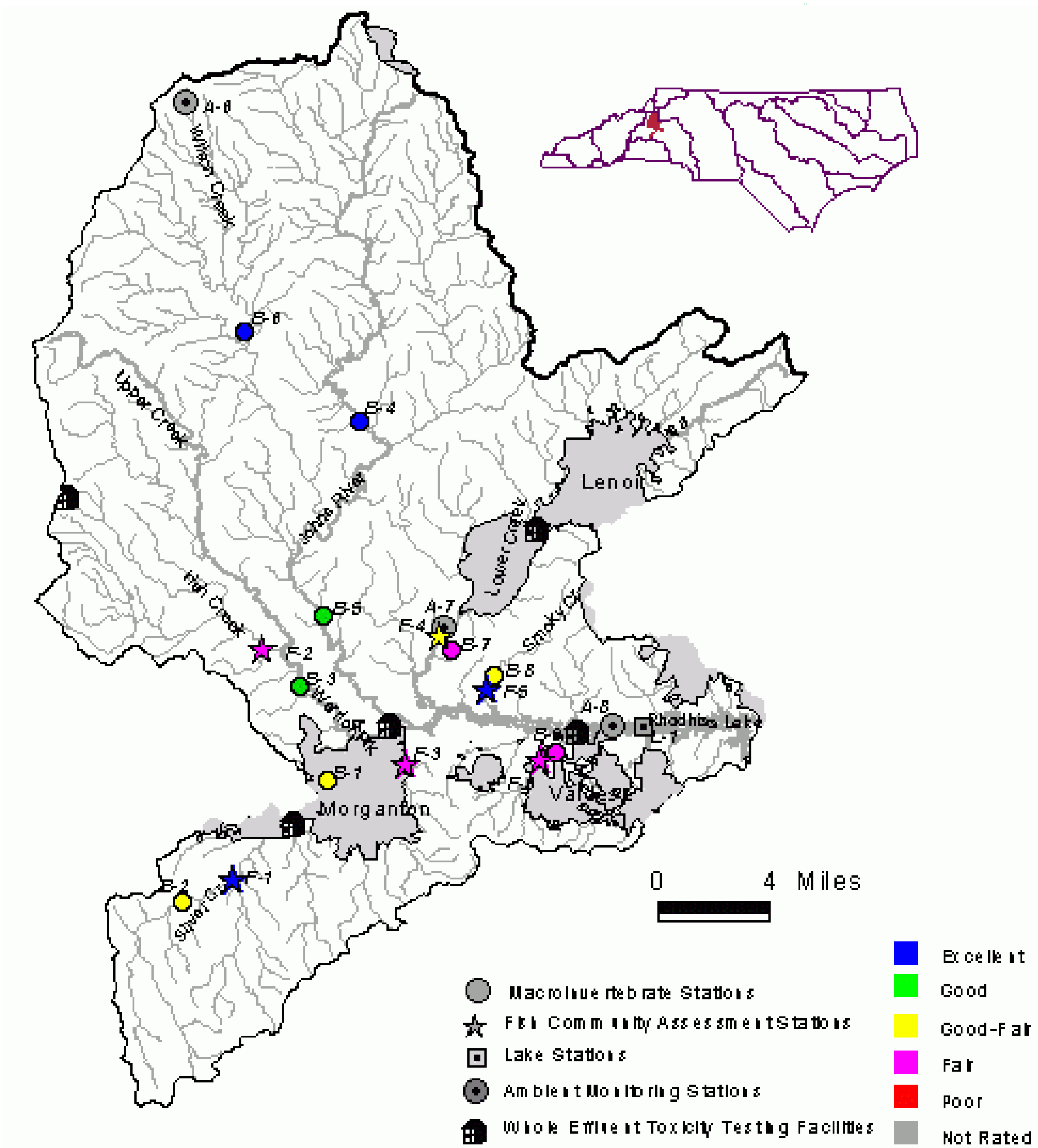
DENR Ambient sampling sites in Lake Rhodhiss Watershed

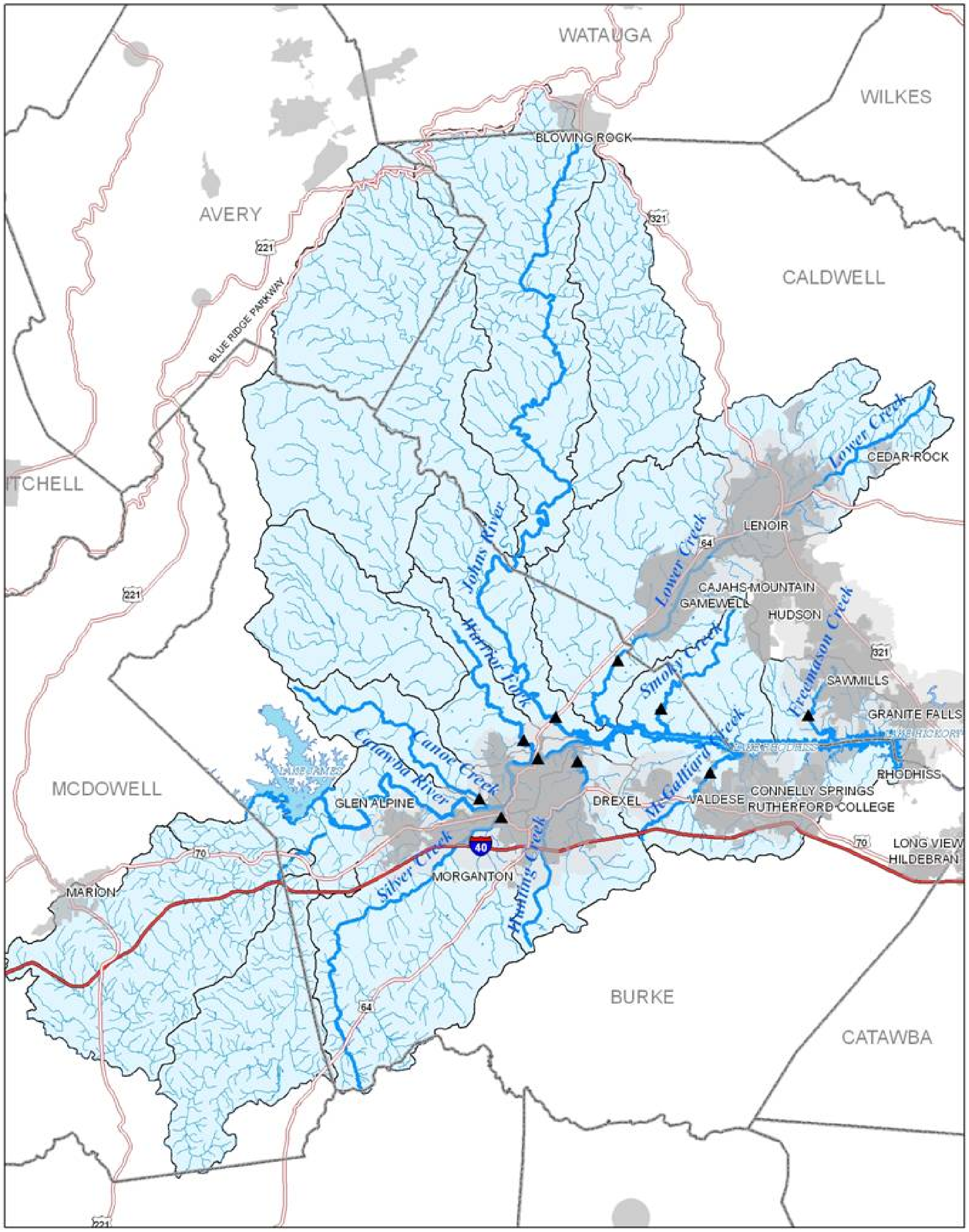
Waterbodies monitored in Subbasin 31 for Basinwide assessment, 1997 - 2002.

Map	#1	Waterbody	County	Location	1997	2002		
B-1	Catawba	R2	Burke	NC	181	Good-Fair	Good-Fair	
B-2	Silver	Cr	Burke	SR	1149/SR	1127	Good-Fair	Good-Fair
B-3	Warrior	Fk	Burke	SR	1440	Excellent	Good	
B-4	Johns	R	Caldwell	SR	1356	Excellent	Excellent	
B-5	Johns	R	Burke	SR	1438	---	Good	
B-6	Wilson	Cr	Caldwell	SR	1335/SR	1328	Excellent	Excellent
B-7	Lower	Cr	Burke	SR	1501	Fair	Fair	

B-8	Smoky	Cr	Burke	SR	1515	Good	Good-Fair	
B-9	McGalliard	Cr	Burke	SR	1538	Good-Fair	Fair	
F-1	Silver	Cr	Burke	SR	1149	---	Excellent	
F-2	Irish	Cr	Burke	SR	1439	---	Fair	
F-3	Hunting	Cr	Burke	SR	1512	---	Fair	
F-4	Lower	Cr2	Burke	SR	1501	Good-Fair	Good-Fair	
F-5	Smoky	Cr2	Burke	SR	1515	---	Excellent	
F-6	McGalliard	Cr2	Burke	SR	1538	Good	Fair	

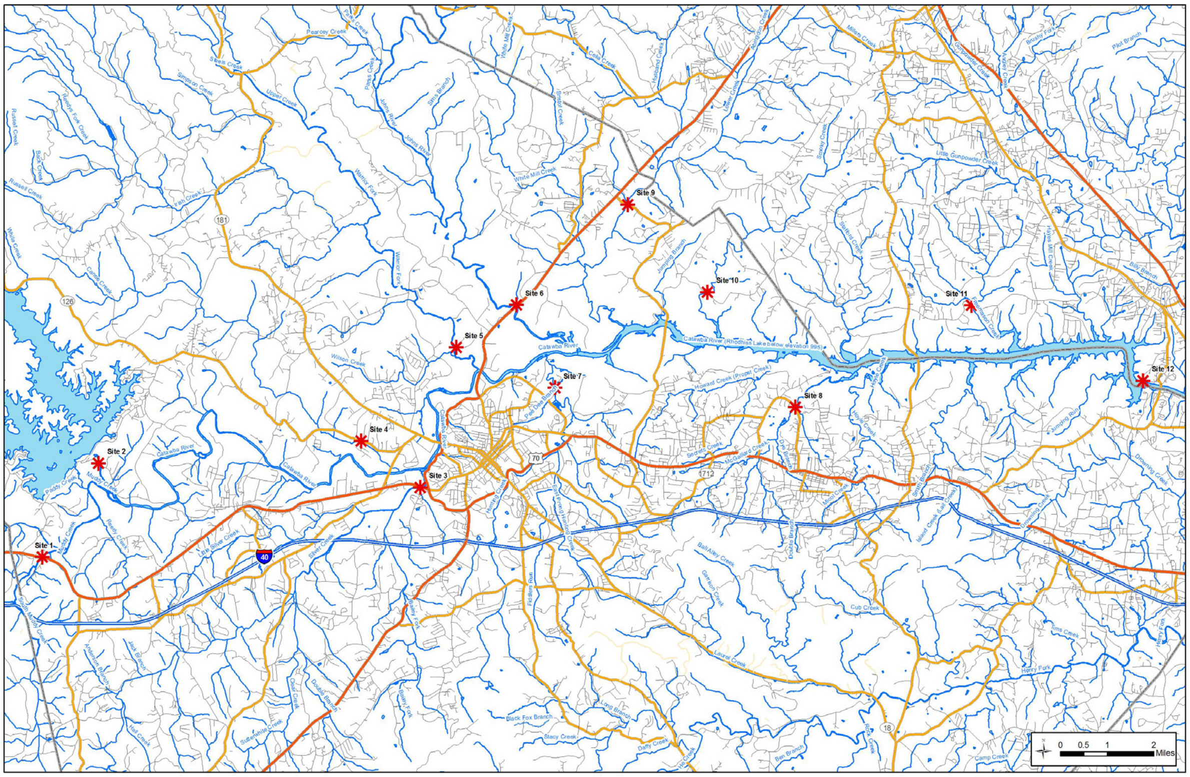
L-1 Lake Rhodhiss Burke, Caldwell
1B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites; L = lake assessment sites.

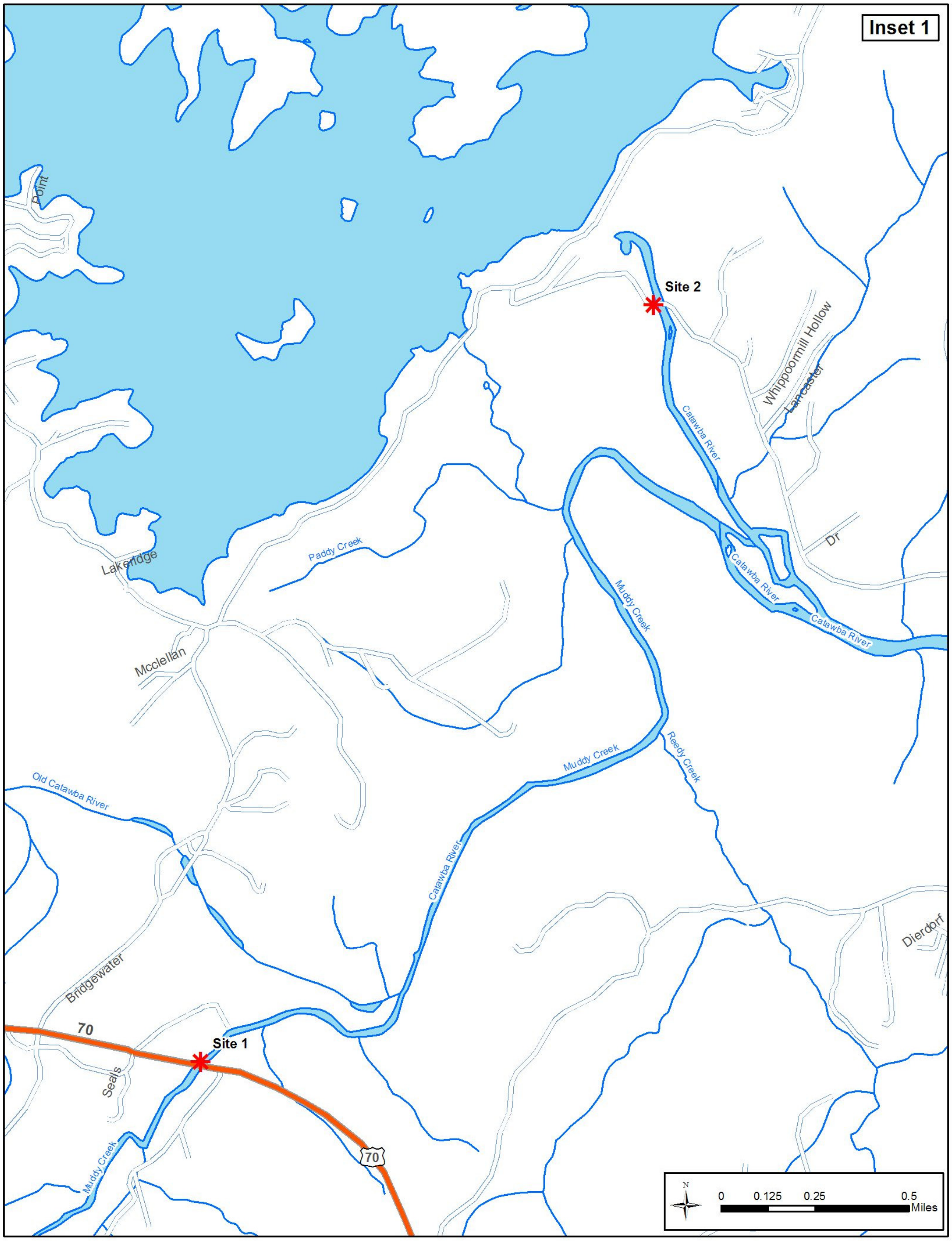




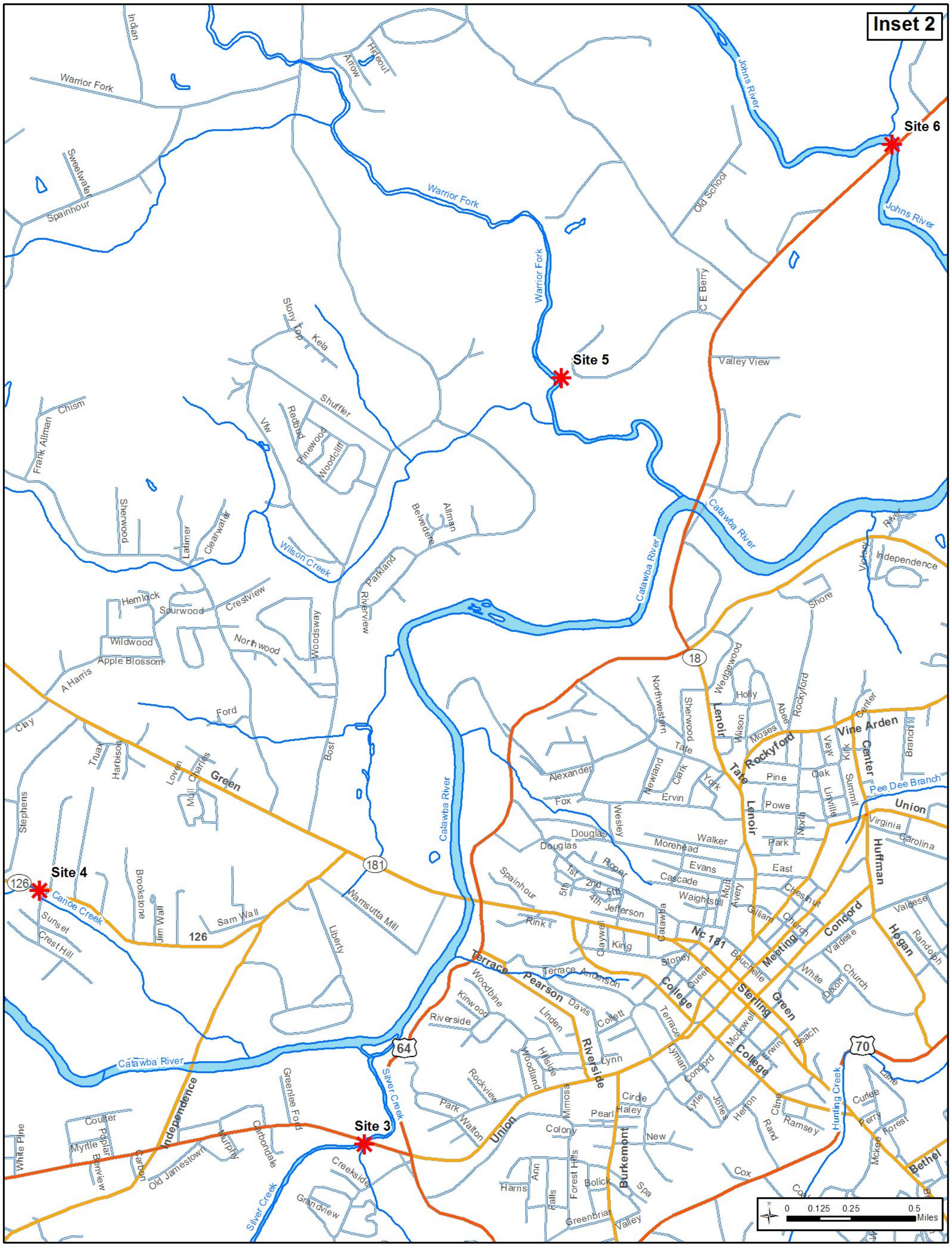
Basinwide Assessment Report - Catawba River Basin - June 2003

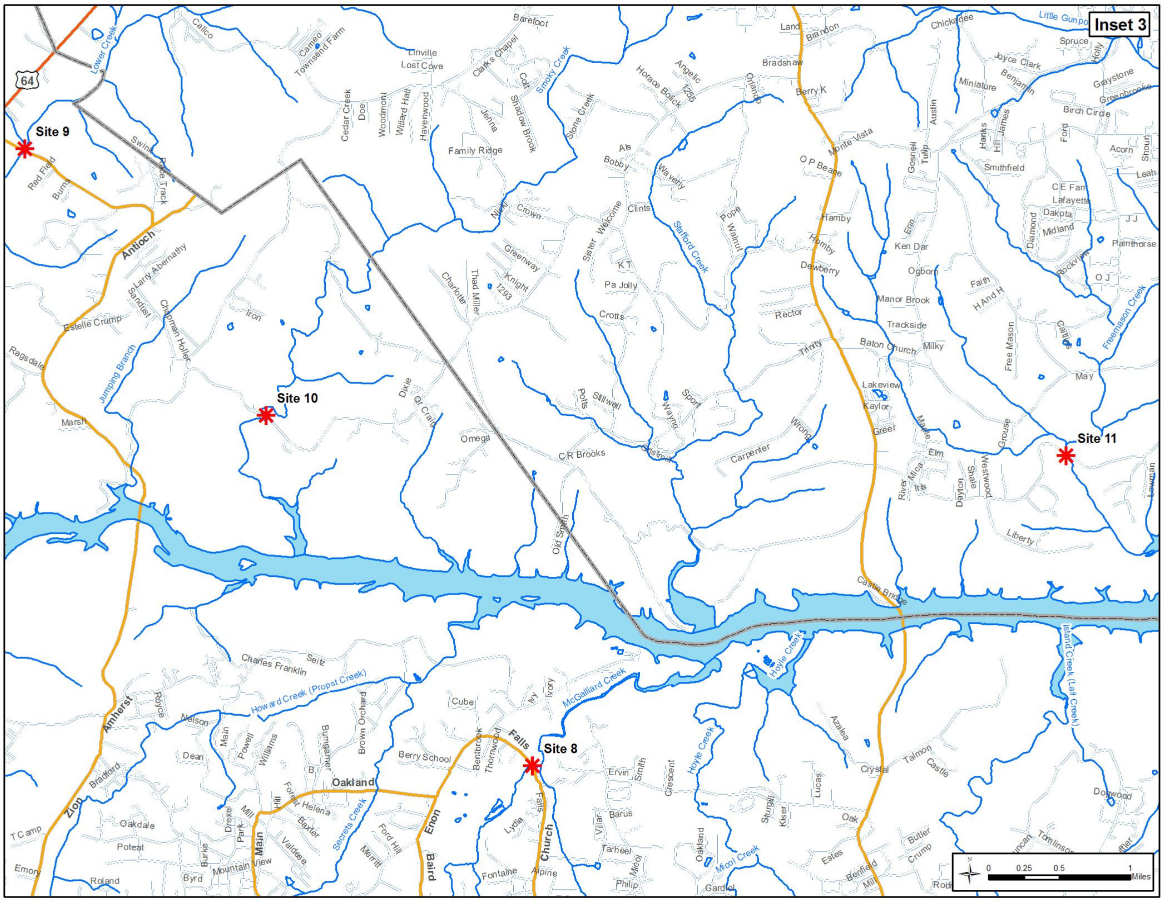
Established Monitoring locations




Inset 1
Site 2
Site 1
Point
Lakeridge
Mcclellan
Paddy Creek
Catawba River
Muddy Creek
Reedy Creek
Old Catawba River
Whippoormill Hollow
Lancaster
Dr
Dierdorf
Bridgewater
Seals
70
N
0 0.125 0.25 0.5
Miles

Appendix H
Monitoring Plan





Costs

Water Quality monitoring is costing other NC organizations from approximately $150 - $250 per station per month dependent on the monitoring requirements and the accessibility of the stations. I would expect the price in the Rhodhiss Watershed would be on the higher end due to the smaller number of stations and the limited number of commercial laboratories in the area

Voluntary Monitoring Coalition

Contact information of current NC Coalition members who could to share their 1st hand knowledge of Coalition start-up and maintenance.

John Mease, Duke Energy – Yadkin-Pee Dee River Basin Association
jrmease@duke-energy.com; 704-382-3946

Chad Ham, City of Fayetteville – Middle Cape Fear River Basin Association
chad.ham@faypwc.com; 910-223-4702

Ron Hargrove, Winston-Salem – Yadkin-Pee Dee River Basin Association
ronh@cityofws.org; 336-727-8418

Sydney Miller, Triangle J COG – Upper Cape Fear River Basin Association
smiller@tjcog.org; 919-558-5352

Carrie Ruhlman
Monitoring Coalition Coordinator
NC Division of Water Quality
1621 Mail Service Center
Raleigh, NC 27699-1621

Phone: (919)743-8411
carrie.ruhlman@ncdenr.gov

Appendix I
Practice Costs and Efficiencies

Please see the following Internet site for information on management measure efficiencies http://h2o.enr.state.nc.us/su/bmp_forms.htm (the BMP manual is the top link and there is another table with supplements)

Appendix J
Financial Assistance Resources
Grant, Loans and Cost Share

Agriculture Cost Share Program - Division of Soil and Water Conservation
Financial incentives are provided through North Carolina's Agriculture Cost Share Program. This program is administered by the Division of Soil and Water Conservation (Division) in the Department of Environment and Natural Resources. Due to the program's success, it has been extended to all 96 Soil and Water Conservation Districts (Districts) that includes all 100 counties. 10-25%. Farmers
http://www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html

Aquatic Weed Problems – Division of Water Resources
Staff assists local governments by providing free evaluation of aquatic weed problems affecting public waters and **cost sharing** when control efforts are needed.
http://www.dwr.ehnr.state.nc.us/wrps/weeds.htm

Aquatic Restoration Grants
Army Corps of Engineers - Section 206. Aquatic ecosystem restoration and protection projects. 35%. Non-federal public agencies
http://www.saw.usace.army.mil/ Floodplain/Section%20206.htm

Clean Water Management Trust Fund
CWMTF will fund projects that (1) enhance or restore degraded waters, (2) protect unpolluted waters, and/or (3) contribute toward a network of riparian buffers and greenways for environmental, educational, and recreational benefits.
http://www.cwmtf.net/

Clean Water Partners Infrastructure Program
Rural Center - Congress provides states with grant funds to establish revolving load pro grams to assist funding of wastewater treatment facilities and estuary and nonpoint programs. Local Government
http://www.ncruralcenter.org/grants/water.htm

Clean Water State Revolving Fund and the NC Clean Water Revolving Loan and Grant Program
Wastewater System Expansion and Improvements - Division of Water Quality – Construction Grants and Loans Section**.** The section administers two major programs that assist local governments, the federally funded These programs can provide both low interest loan and grant funds for wastewater treatment projects.
http://www.nccgl.net/fap/cwsrf/index.html

Community Development Block Grant Program
All North Carolina small cities in Lake Rhodhiss Watershed are eligible to apply for funds from the U.S. Department of Housing and Urban Development (HUD).
http://www.ncdca.org/cdbg/

Conservation Community Cost Share Program
NCDENR - Soil and Water Conservation Districts. Jointly funds water resources projects
Local Governments
http://www.enr.state.nc.us/DSWC/pages/ccap_program. html

Conservation Reserve Program
USDA – NRCS, Convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover. Cost Sharing. Farmers, Ranchers
http://www.nrcs.usda.gov/programs/crp

Conservation Reserve Enhancement
NCDENR – DSWC. Seeks to protect land along water sources that is in agricultural production. Up to 75% Cost Share. Farmers, Ranchers
http://www.enr.state.nc.us/DSWC/pages/crep.html

Cooperative Water Program
USGS – Projects associated with estuary and NonPoint Source Programs. Local Governments
http://water.usgs.gov/coop/

Ecosystem Enhancement Program (EEP)
NCDENR- Conduct watershed assessment, planning, and restoration implementation. EEP offers. Public and Private Entities
http://www.nceep.net/business/landowner/landowner.htm

Environmental Education Model Library Grants
The Project Tomorrow program provides financial and other support to develop and enhance model environmental education library collections and promote the integration of environmental education in the teaching of North Carolina's competency-based curriculum.
http://www.ee.enr.state.nc.us/pt/pttoc.htm

Erosion and Sediment Control Awards, Division of Land Resources, Land Quality Section
The North Carolina Sedimentation Control Commission (SCC) accepts and encourages proposals for research and/or educational projects related to erosion and sedimentation control. For more information, you may contact Caroline Medlin at (919) 733-4574 or at
caroline.medlin@ncmail.net
http://www.dlr.enr.state.nc.us/eroprop.html

Environmental Quality Incentives Program (EQIP)
Farmers, Ranchers, and Eligible Civic Groups involved in Resource Planning
A voluntary program whereby eligible candidates who own or control land on which crops or livestock are produced in an identified priority area or have a State identified priority natural resource concern develop a conservation plan to manage one's valuable natural resources.
http://www.nc.nrcs.usda.gov/Programs/eqip.htm

Farmland Preservation Trust Fund -Dept of Agriculture and Consumer Services (NCDA) –
NCDA contracted with The Conservation Trust for North Carolina (CTNC) to accept farmland easement applications, and to administer state-appropriated funds.
http://www.enr.state.nc.us/DSWC/files/ncfpp.htm

Farm Bill Programs
Funds agricultural management and grassland, wetlands and wildlife preserve programs. Varies. Farmers, Ranchers
http://offices.sc.egov.usda.gov / locator / app

Federal Program Multiple Assistance Types – Water, Wastewater
United States Dept. of Agriculture – Rural Business-Cooperative Service
Programs provide loans and grants for rural community water, sewage disposal, solid waste disposal, storm drain systems, telecommunications, computer networks and related technology. Eligible applicants include municipal and county governments, public service authorities, Indian tribal organizations and broadly based community nonprofit corporations.
http://www.rurdev.usda.gov/nc/rus.htm

Habitat Enhancement Program (HEP)
Duke Energy

Nonpoint Source Management Program Funding - 319 Grant Program
Division of Water Quality – Water Quality Section. The Clean Water Act - Section 319(h) allows EPA to provide funds to states (such as NC) who distribute the money to eligible candidates in a competitive process for innovative nonpoint source management strategies meant to be a demonstration for others.
http://h2o.enr.state.nc.us/nps/319.htm

Parks and Recreation Grant Programs-Division of Parks and Recreation
Grants to provided money to environmental organizations, and groups and state and local governments for park and recreation purposes, trail related needs and to acquire and protect important natural areas, preserve the state's ecological diversity and cultural heritage, and to inventory natural heritage resources of the state.
http://ils.unc.edu/parkproject/prkgrants.html

Parks and Recreation Trust Fund (PARTF)
PARTF is the primary source of funding to build and renovate facilities in the state parks as well as to buy land for new and existing parks. A local government can request a maximum of $500,000 with each grant application.
http://www.partf.net/apply.html

NC Rural and Economic Development Center Water and Sewer Grant Program
The program is intended to help NC units of governments by funding up to $10,000 per job created, for up to one half of water and sewer infrastructure costs, or a maximum of $500,000, in projects that result in the creation of private sector jobs. Jobs must be full time, and must pay at least minimum wage. A local match of 5% of the total cost of the infrastructure is required.
For grant requirements, deadlines, and further information on the program, visit
http://www.ncruralcenter.org/grants/water.htm
For information on other economic development grants, visit
http://www.ncruralcenter.org/research/grants.htm

NC Division of Pollution and Prevention

The Solid Waste Management Trust Fund is used to make grants in support of waste reduction efforts. Programs can fall into two areas if eligibility: recycling business or community waste reduction and recycling.
http://www.p2pays.org/localgov/assistance/financial.asp

North Carolina Trails Program
The NC Adopt-A-Trail Grant program awards funds totaling $135,000 annually to government agencies, non-profit organizations, and private trail groups for such projects as trail building, trail signage and facilities, trail maintenance, and trail information brochures and maps.
http://ils.unc.edu/parkproject/trails/grant.html

Recreational Trails Program (RTP)
A $1.1 million dollar grant program with the intent to meet the trail and trail-related recreational needs identified by the Statewide Comprehensive Outdoor Recreation Plan (SCORP). The grant applicants must be able contribute 20% of the project cost with cash or in-kind contributions.

Septic Systems – Repairing or Replacing – Grants and/or Loans
Grants and/or loans may be available to individuals and agencies for assistance in repairing or replacing inadequate wastewater treatment systems (both septic and 'straight-pipe systems).Funding Sources for individuals located in counties with an active WaDE program, the individual may apply to the county itself for financial assistance. Funding Sources for Individuals in counties without an active WaDE program:
http://www.deh.enr.state.nc.us/oww/Wade/funds.PDF
Funding Sources for Agencies:
http://www.deh.enr.state.nc.us/oww/Wade/USDA_offices.PDF

Urban and Community Forestry Grant Program
Division of Forest Resources. Grants are available to local or state government, educational institutions, non-profit 501(c)(3) organizations and other tax-exempt organizations. The program goal is to encourage citizen involvement in creating and supporting long-term and sustained urban and community forestry programs at the local level.
http://www.dfr.state.nc.us/managing/urban_grant.htm

Waste Reduction Grants
Division of Pollution Prevention - Grants are to reduce the flow of waste (i.e., organics, construction and demolition debris, electronics, paper, etc.) to North Carolina disposal facilities. Some grants are available only to government and nonprofit organizations, while others are available to the private sector as well.
http://www.p2pays.org/financial/index.htm

Water Quality Planning and Protection - Division of Water Quality – Water Quality Section – 205j Grant Program
The Clean Water Act - Section 205(j) allows EPA to provide funds to states (such as NC) that distribute the money to eligible candidates (regional planning organizations) in a competitive process for water quality management planning. The Division prefers potential projects that deal with long-term growth management, impaired waters restoration, and public education. For more information please contact Dianne Reid 919-807-6300, dianne.reid@ncdenr.gov

Water System Improvements – Division of Environmental Health – Public Water Supply Section
To provide guidance, technical and financial assistance to units of local government and certain non-profit water corporations, in order to provide safe drinking water in North Carolina.
http://www.deh.enr.state.nc.us/pws/srf/srf_branch.htm

Wetland Protection Development Grant
USEPA - Develop comprehensive monitoring and assessment programs; Improve compensatory mitigation effectiveness; Refurbish wetland, aquatic resources, protection. 25%. States, tribes, local governments interstate association, non governmental organizations, (NGOs), intertribal consortia, nonprofit's
http://www.epa.gov/owow/wetlands/grantguidelines/

Water Resources Grants – Division of Water Resources
This program is designed to provide cost-share grants and technical assistance to local governments throughout the State. Applications for grants are accepted for seven purposes: General Navigation, Recreational Navigation, Water Management, Stream Restoration, Beach Protection, Land Acquisition and Facility Development for Water-Based Recreation, and Aquatic Weed Control.
http://www.dwr.ehnr.state.nc.us/wrps/grant.htm

Voluntary Environmental Improvement Bonds
The Environmental Finance Advisory Board recently released a report on summarizing an alternative funding strategy for local governments to promote household environmental projects. In a few other states where localities have been given (or already had) the authority to implement such a program, counties and municipalities have started to lend money to households that volunteer to install environmental improvements (i.e. photovoltaic panels, energy efficiency). The local government is then paid back through a special assessment on property through property taxes. These types of assessments could potentially be used for a number of environmental improvements to a property (i.e. green roofs, stream buffers, replacement of old wood stoves, etc.).
http://www.epa.gov/efinpage/publications/VoluntaryEnviroImprovementBondsReports.pdf

FOUNDATION FUNDING

The Foundation Center
This website provides information on individual grants as well as grants for non-profits.
http://foundationcenter.org/

Z. Smith Reynolds Foundation
This is a strong resource for county and town government striving to create “active” reform ZSR Foundation Focus Areas: community and economic development; democracy and civic engagement; environment; pre-collegiate education; social justice and equity
http://www.zsr.org/

GRANT RESOURCE SITES

Environmental Finance Center at UNC Chapel Hill
In addition to its Environmental Funding Database for the Southeast, the EFC provides a compendium of NC water and sewer water funding resources. Federal funding sources for environmental protection, solid waste management, watershed protection, brownfields remediation, capacity building, and energy efficiency and conservation are also posted online at http://www.efc.unc.edu/funding.html

Grants.gov
Allows organizations to electronically find and apply for more than $400 billion in Federal grants. Grants.gov is THE single access point for over 1,000 grant programs offered by all federal grant making agencies.
http://www.grants.gov/

EPA Grants
The EPA has created a guide to assist local governments in the federal grant process. A list of all EPA grants, including regional grants, can be found at http://www.epa.gov/epahome/grants.htm
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ENVIRONMENTAL EDUCATION

American Honda Foundation Grants
The American Honda Foundation makes grants to K–12 schools, colleges, universities, trade schools, and others for programs that benefit youth and scientific education. The average grant range is $40,000 to $80,000. Grants are awarded on a quarterly schedule.

Annenberg Foundation
The Annenberg Foundation focuses its grantmaking on the following program areas: education and youth development; arts, culture, and humanities; civic and community; animal services and the environment; and health and human services. Letters of inquiry that address the Foundation's interests are accepted throughout the year. The Foundation only considers organizations that are tax exempt.

Ben & Jerry's Foundation
The Ben & Jerry's Foundation offers competitive grants to not-for-profit, grassroots organizations throughout the United States which facilitate progressive social change by addressing the underlying conditions of societal and environmental problems. The Foundation will only consider proposals from grassroots, constituent-led organizations. Full grants range from $1,001 - $15,000 and throughout the year, the Ben & Jerry's Foundation may fund a small number of material grants for $1,000 or less. The application process to the Ben & Jerry's Foundation begins with an initial Letter of Interest, and if invited, is followed by a full proposal. Letters of Interest may be submitted at any time and are reviewed on an ongoing basis.

Campus Ecology Fellowships
For more than a decade, NWF's Campus Ecology program has been helping transform the nation's college campuses into living models of an ecologically sustainable society, and training a new generation of environmental leaders. Campus Ecology Fellowships are be awarded to college

undergraduate and graduate students who desire to help reverse global warming on campus and beyond. The maximum grant request is $3,000

Captain Planet Foundation $250 - $2,500 Grants
The Captain Planet Foundation provides grants of up to $2,500 to school and community groups to support hands-on environmental projects. You can submit a proposal at any time during the year. However, proposals will only be reviewed the last day of March, June, September, and December.

DonorsChoose.org and Progress Energy Support Classroom Energy Projects
Progress Energy will fund $50,000 in creative energy education projects in the North Carolina communities it serves this school year.

Garden Club of America Scholarships and Fellowships
GCA offers several research fellowships and scholarships for undergrads, grads and people already in the field. Topics include: ecological restoration, urban forestry, environmental studies, wetland studies, botany, desert studies and more.

Georgia Pacific Foundation
The Georgia-Pacific Foundation supports a wide range of organizations that improve the quality of life in communities where Georgia-Pacific operates. The Foundation has identified the following key investment areas: educational efforts; community enrichment; environmental programs; and entrepreneurship initiatives. Applications may be submitted online from January 1 through October 31, annually.

Jenny Jones Announces Continuation of Community Grant Program
Jenny's Heroes community grant program will donate $1 million during 2009. The program provides grants of up to $25,000 each to fund projects that promise long-term community benefits. The program's focus is primarily on smaller communities where fundraising can be difficult.

Keepers in the Classroom
Programs for children offered at your location. These K-8 programs are designed to transport N.C. Zoo's education resources into the classroom. Educators will use hands-on learning techniques to unravel the mystery and marvel of the Earth’s wildlife.

Lowe’s Charitable & Educational Foundation Grants
Grants range from $5,000 to $50,000. Community improvement projects and K-12 Public School Initiatives are primary philanthropic focus areas.

Plum $500 Youth Grants
Plum TV and Do Something want to see you and your project reach the next level. Youth, age 25 or under (at time of application) are eligible to apply. $500 Plum grants are awarded weekly.

National Geographic Society Young Explorer Grants
The National Geographic Society's Young Explorers Grants offer opportunities to individuals between the ages of 18 and 25 to pursue research, exploration, and conservation-related projects consistent with National Geographic's existing grant programs, including the Committee for Research and Exploration, the Expeditions Council, and the Conservation Trust. The grant program accepts applications throughout the year.

Pay it Forward Foundation Minigrants
Pay it Forward Foundation offers minigrants (from $50 to $500) to fund service-oriented projects designed by youth to support their school, neighborhood, or greater community. Application deadlines are January 15, April 15 and October 15 of each year.

Toshiba America Grants for Enhancing Math and Science Ed.
Toshiba America grants up to $5,000 for 7th-12th grade teachers and up to $1,000 for K-6th grade teachers for enhancement in science and math education. K–6th grade program grants are due October 1. 7th - 12th grade program grants are due February 1 and August 1.

Urban and Community Forestry Challenge Cost-Share Grant Program
The National Urban and Community Forestry Advisory Council's 2009 Challenge Cost-Share Grant Program seeks to establish sustainable urban and community forests by encouraging communities to manage and protect their natural resources. Innovation Grants and Best Practices Grants of up to $50,000 support nonprofit organizations urban and community forestry efforts. All grants must be matched at least one-to-one with non-federal funds. Applications are due in February

Some local governments also subscribe to fee based grant information sites.

Information in this appendix has been gleaned from multiple resources, most notably:
Jessica Stevermer, Master of Public Affairs Student, Western Carolina University
North Carolina Office of Environmental Education
Paul Clark, NC DENR Division of Water Quality

Appendix K
Glossary of Terms and Acronyms

303(d) list	List of impaired streams identified by the state every two years and submitted to EPA as required under Section 303(d) of the Federal Clean Water Act.
Assimilative Capacity	The total amount of pollution that a waterbody can breakdown or assimilate and still maintain its designated uses.
Basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
Benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality.
Best management practices (BMPs)	Techniques that are determined to be currently effective, practical means o preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often BMPs are applied as system of practices and not just one at a time.
Buffers	Vegetated corridors along streams and lakes that help protect water quality by providing a transition between upland development and the receiving water body.
Ecoregion	An ecoregion (ecological region), sometimes called a bioregion, is an ecologically and geographically defined area. Ecoregions cover relatively large areas of land or water, and contain characteristic, geographically distinct assemblages of natural communities and species. The biodiversity of flora, fauna and ecosystems that characterize an ecoregion tends to be distinct from that of other ecoregions.
Eutrophic	From Greek for “well-nourished” describes waters that have high levels of nutrients and therefore are generally highly productive biologically.
Fecal coliform Bacteria	Bacteria typically associated with the intestinal tract of warm blooded animals and are widely used as an indicator of the potential presence of pathogenic, or disease-causing, bacteria and viruses.
FS	Fully Supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.

HUC	Hydrologic units form the building blocks of a watershed classification scheme sponsored by the Water Resources Council. This system partitions the country into 21 regions, 362 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit. Each eight-digit hydrologic unit covers an average of 975 square miles. The eight-digit hydrologic units have been further subdivided into smaller eleven and fourteen-digit units. The fourteen-digit hydrologic units range from about 4,000 to 50,000 acres in size and are small enough to be useful as a planning and reporting tool for many state and federal agencies and conservation organizations involved in restoration activities.
Impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.
Impervious	Any surface in a landscape that cannot effectively absorb or infiltrate rainfall, which may include roads, streets, parking lots, rooftops and sidewalks. Often determined as what is not green at the development site.
Load	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr).
Major Discharger	A point source discharger, such as a wastewater treatment plant or industry, that releases at least one million gallons of effluent per day into a waterbody.
MGD	Millions of gallons per day.
NPS	Nonpoint source pollution. Pollution originating from diffuse sources on the landscape, from runoff or groundwater.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
Nutrient Enrichment	Increasing levels of nutrients entering a water body over time. If the process is accelerated by human influences, it is often termed cultural eutrophication.
Nutrients	A food substance (such as phosphorus) usable in metabolism as a source of energy or of building material.
Oxygen consuming wastes	Substances such as decomposing organic matter or chemicals which remove dissolved oxygen from the water column.

Point Source Dischargers	Industries and wastewater treatment plants that are permitted to release treated wastewater directly into lakes and streams.
PS	Partially Supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.
Primary classification	All surface waters are assigned a primary classification by DWQ. All waters must at least meet the standards for Class C (fishable/swimmable) waters. Other primary classifications provide additional levels of protection for primary water contact recreation (Class B) and drinking water (Water Supply Classes I-V).
Sedimentation	The sinking and deposition of waterborne particles, such as sediment, algae and dead organisms.
Subbasin	A subbasin is a designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of large streams or lakes within a river basin. Every river basin in North Carolina is divided into subbasins. For example, the Catawba River basin has consists of nine subbasins. There are 133 subbasins statewide. The subbasins established by the Division of Water Quality across the state are used primarily for planning purposes by the Division.
Subwatershed	A designated subunit or subwatershed area of a major river basin. Subwatershed typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subwatersheds. These subwatersheds are part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council.
Supplemental Classification	Classifications that may be granted by the state to provide special protection to sensitive or highly valued water resources.
TMDL	Total maximum daily load. The maximum quantity of a pollutant that can enter a waterbody from point and nonpoint sources without affecting the beneficial uses of the waterbody.
Toxicity	Any substance or combination of substance released into a waterbody which has the potential to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions or physical deformities in aquatic life or their offspring. Toxic substances frequently encountered in water quality management include chlorine, ammonia, organics, and heavy metals.
Turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.

Use Support Ratings	An assessment of how well a waterbody supports its designated uses.
Watershed	The watershed of a major river system is referred to as a basin or river basin. A watershed is the area of land that captures rain and snow and drains to a common lake, river or stream. A watershed may vary in size from several acres for a small creek or pond to thousands of square miles for a major river system, such as the Catawba River. The watershed of a major river system is usually referred to as a basin or river basin.