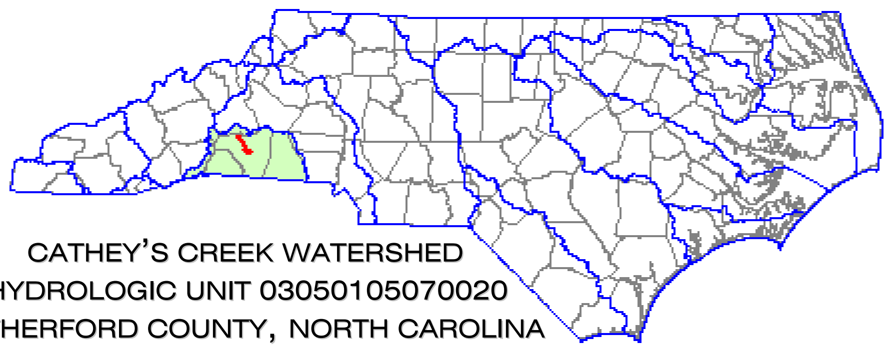
CATHEY'S CREEK TECHNICAL WATERSHED ASSESSMENT

INITIAL WATERSHED CHARACTERIZATION AND SAMPLING PLAN



CATHEY'S CREEK WATERSHED
HYDROLOGIC UNIT 03050105070020
RUTHERFORD COUNTY, NORTH CAROLINA

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FEBRUARY 2004

EXECUTIVE SUMMARY

The Ecosystem Enhancement Program (EEP) has selected the Cathey's Creek Watershed (CCW) (Hydrologic Unit 03050105070020), within the Broad River Basin of North Carolina, for a detailed technical watershed assessment. The purpose of this Cathey's Creek Technical Watershed Assessment includes characterizing the watershed, identifying any general problem areas related to ecological functions, determining how to address these problems, and developing a plan that includes specific solutions to the problems. The overall approach includes new methods of watershed assessment that focus on ecological functions of the watershed.

This report covers the initial hydrologic unit characterization and preliminary findings. A plan for detailed field data collection and water quality monitoring is also included. The characterization is a compilation of existing published GIS data and other databases regarding land use, water quality, ecosystem functions, current management measures, and existing restoration and protection needs. The current conditions and functional status of the watershed were evaluated and stressors were identified. The watershed evaluation includes interviews with local stakeholders and resource agencies, visual observation of the watershed, and analysis of existing data. Sub-watersheds (SWs) were identified and classified for future field studies and monitoring. Watershed management goals and potential functional improvement projects were also identified. Extensive field studies were not included in this phase of reporting.

Addressing ecological impacts in terms of functional losses and replacements on a watershed level is a new approach to mitigation planning and implementation in North Carolina. The approach used in this report is based on preliminary guidance provided to EEP by technical committees charged with developing the functional analysis methodology. This report addresses three main watershed functions and to the extent possible with the available data, a number of sub-functions. The three main functions are Water Quality, Hydrology, and Habitat. The actual analysis was limited to data currently available in GIS or other databases. The analysis relied on a simple ranking system rather than calculated models indexed to a reference watershed.

The analysis involved examining the watershed functions and sub-functions in terms of indicators developed for each of the functions and sub-functions. Some of the indicators are simple values that are obtained from attribute tables in the GIS, whereas others are derived from overlays and calculations using the data in the GIS. Percentages are based on total surface water length in a SW or total SW area.

The SWs were then ranked for each indicator with a value of 1 to 14, with lower values indicating higher functional status. Once the SW rankings for each of the indicators were determined, an average rank for each major function was calculated.

Water quality functions were assessed by evaluating relative amounts of forested area and cleared or impervious area, length of stream protected by a forested buffer, and length of stream classified as impaired. It was assumed that the highest level of water quality function would be achieved with 100% forested cover, 100% buffer protection, less than 12% impervious cover, and no streams classified as Impaired. These assumptions do not take into account the range of variation within which full function may be achieved, nor do they account for the possibility that sustainability may be achieved at lower levels of function.

Hydrology functions were assessed by evaluating relative areas of forested area and cleared or impervious area, length of stream protected by a forested buffer, area of ponds, and area of wetlands. The assumptions for forested and impervious area and buffered stream length are the same as noted above.

Habitat functions were assessed by evaluating relative areas of forested and cleared land, area of wetlands, buffered stream length, size of forest interior patches, and presence of suitable corridors between the large patches. The presence of forest patches with greater than 74 acres of interior area with at least one connection to another large patch implies the ability of the watershed to support a variety of species, including habitat specialists and wide-ranging species.

Stream reaches and hydric soils in cleared areas were targeted as degraded areas of interest for further analysis and potential watershed improvements. These degraded areas were identified using GIS procedures.

The functional analysis calculations resulted in an average rank for each of the 14 SWs for each of the three main ecological functions. These three average ranks were summed to obtain an overall functional score for each of the SWs. The functional scores clustered into four groups distinguished by shared characteristics. Group A sub-watersheds have the greatest ability to carry out their natural watershed functions whereas Group D is the most impaired. The differences in land use and land cover are the most apparent reason for impairment. Functional ability declines as both forested cover decreases and impervious area increases.

Based upon the findings of this study, the CCW appears to be in a transitional state. Urban runoff and sediment are suspected to be the leading causes of water quality impairment within the watershed. The urban runoff volumes, peak flows, and pollutant loads will continue to increase as development continues in the three municipalities. Water quality monitoring results in the urban areas of the CCW have been consistently indicative of stressed stream biota. Other areas of concern include the effects on water quality of the Spindale Wastewater Treatment Plant discharge and potential mercury contamination from old mining operations.

The altering of the streams as a result of mining and farming practices along with the changes to the floodplain and upland areas (increased impervious surface, loss of forest cover, and changes in soil permeability) are believed to be the main causes of impairment in the hydrologic functions of the watershed. The watershed is not efficient at absorbing overbank flows through short- or long-term storage and the channels do not handle peak flows in a stable manner. The flood control ponds also have affected the hydrologic functions by changing the timing and sediment balance of the stream flows.

The same causes of impairments to water quality and hydrology most likely have also impaired the habitat functions. The increased velocity and volume of urban runoff and the resulting scour, increased sediment load, and sandy substrates create a hostile environment for aquatic species.

Straightened and entrenched streams lack the riffle-pool sequence that provides a variety of habitat types.

The major stressor on terrestrial habitat functions is the removal and fragmentation of native vegetation. The decline in timber and farming has resulted in reforestation in many areas, but from observations made during windshield surveys, the species richness appears to be low and exotic invasive species have become established. It is not known whether the presence of exotic species on the stream banks affects aquatic communities.

A detailed field assessment is planned to address the watershed functional deficiencies and concerns identified through the GIS analysis. We hope to achieve a more complete understanding of the functional status of the watershed and how the stressors and indicators are linked to the aquatic community ratings. The objectives of the detailed field assessment are as follows:

- Assess the sources, severity, and causes of sedimentation and erosion;
- Identify the most critical areas for stream stabilization and restoration;
- Assess urban runoff;
- Assess habitat degradation;
- Evaluate the Spindale WWTP discharge to determine its contribution to water quality degradation; and
- Assess the potential mercury contamination from old mining operations.

The data collected from this detailed assessment will be used to re-define the preliminary ranking based on the GIS analysis and to evaluate the links between the suspect indicators and water quality ratings. Critical areas will be identified where functional deficiencies are the greatest and where implementation of watershed improvements such as stream or wetland restoration and best management practices will have the greatest impact on water quality and watershed functions. These findings will be documented in a Critical Areas Analysis Report.

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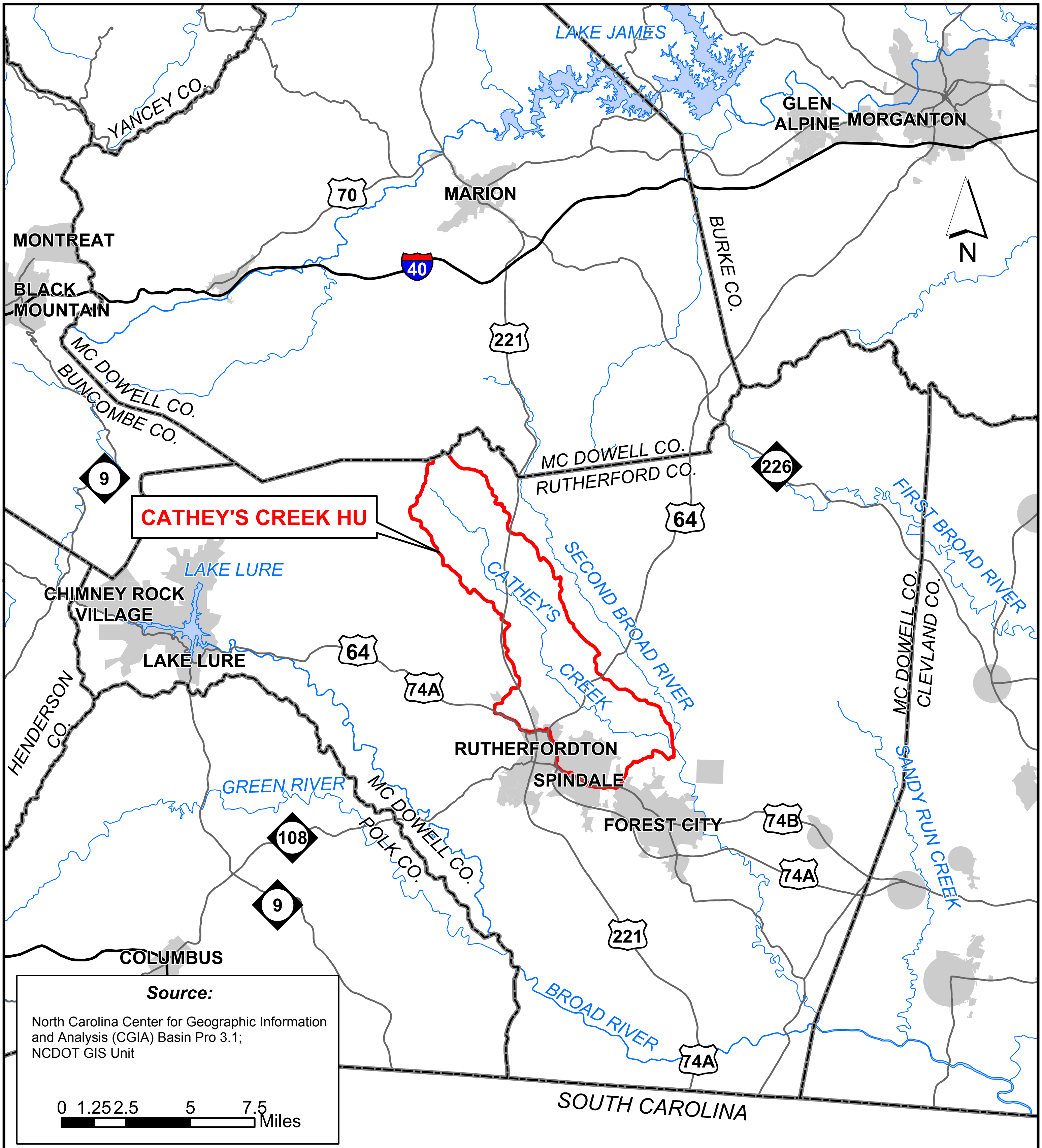
1.0 PURPOSE AND SCOPE

The Ecosystem Enhancement Program (EEP) has selected the Cathey's Creek Watershed (CCW) (Hydrologic Unit 03050105070020), within the Broad River Basin of North Carolina, for a detailed technical watershed assessment (**Figure 1**). The mission of the EEP is to restore, enhance, preserve, and protect the functions associated with wetlands, streams, and riparian areas including, but not limited to, those necessary for the restoration, maintenance and protection of water quality and riparian habitats throughout North Carolina. This mission is carried out through a comprehensive program that identifies ecosystem needs at the local watershed level and determines ways to preserve, restore, and enhance ecological functions within the target watersheds while addressing impacts from anticipated NCDOT transportation projects. The purpose of this Technical Watershed Assessment of the Cathey's Creek watershed is to characterize the watershed, identify any general problem areas related to ecological functions, determine how to address these problems, and develop a plan that includes specific solutions to the problems. The overall approach will include new methods of watershed assessment that focus on ecological functions of the watershed. These new methods will require flexibility in the overall approach of the watershed assessment as the project progresses, although the final product of a local watershed management plan will remain the same. The watershed management plan will be produced in a format that can be used by a variety of entities in the formation of their own solution implementation plans.

This report covers the initial hydrologic unit characterization and preliminary findings. A plan for detailed field data collection and water quality monitoring is also included. The characterization is a compilation of existing published data regarding land use, water quality, ecosystem functions, current management measures, and existing restoration and protection needs. Through interviews with local stakeholders and resource agencies, visual observation of the watershed, and analysis of the existing data, the current conditions and functional status of the watershed were defined and stressors were identified. Sub-watersheds were identified and classified for the future field studies and monitoring. Watershed management goals and potential functional improvement projects were also identified. Extensive field studies were not included in this phase of reporting.

The report is divided into six general sections. Section 2 provides the sources of data and analyses used in the watershed characterization. Section 3 describes the functional analysis approach to watershed assessment. Section 4 details existing conditions in the watershed and introduces the data from which functional indicators were derived. Section 5 provides information on existing watershed improvement programs. The functional analysis methods and results are presented in Section 6. Sections 7 and 8 summarize the findings of the GIS-based functional analysis and describe the approach for the detailed field assessment to further refine the functional analysis



Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
NCDOT GIS Unit

NCDENR
Ecosystem Enhancement Program

FIGURE 1
VICINITY MAP
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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2.0 RESOURCES AND METHODS

The characterization of the CCW involved gathering and reviewing existing watershed information from local governments, stakeholders, and state agencies to develop an understanding of what is known to date regarding existing watershed conditions. The conditions included land use, water quality, habitat, current management measures, and existing restoration and protection needs. The methods for gathering the data included phone calls, emails, onsite interviews, public meetings, and reviewing existing reports. A description of data collection techniques, location of the source of information, and methods used in the characterization of the watershed follow.

2.1 DATA SOURCES AND TYPES

The following agencies were consulted at their county, state, or regional office regarding the status of the watersheds' functions: N.C. Department of Transportation (NCDOT), N.C. Cooperative Extension Service (CES), Natural Resource Conservation Service (NRCS), N.C. Wildlife Resources Commission (WRC), Farm Services Administration (FSA, formerly ASCS), Federal Emergency Management Agency (FEMA), U.S. Forestry Service, U.S. Army Corps of Engineers, local and state land conservancies, federal and state park/refuge officials, and various divisions of the N.C. Department of the Environment and Natural Resources (DENR). The Parks and Recreation, Public Works, Engineering and Planning Departments of each municipality in the watershed were consulted to learn of any known areas of concern. These organizations helped in identifying watershed improvement projects that have already been implemented and in explaining current development trends.

The bulk of this technical watershed analysis is based on existing Geographic Information Systems (GIS) data. Detailed information on the data sources and how the data were used in this report is included in **Appendix A**. Data sources used to develop the GIS include:

- United States Geological Survey (USGS): Quadrangle maps (1965, 1982, 1985 and 1993) and Land use/land cover;
- North Carolina Center for Geographic Information and Analysis (NCCGIA): Soils (field work 1983-1998, published 1998), hydrography;
- BasinPro Version 3.1 (NCCGIA): Various relevant subsets of topography, hydrography, managed lands, pollution sources, natural resources, county and municipal boundaries (CD dated 2002, data was updated as necessary using the World Wide Web, as described below);
- North Carolina Department of Transportation (NCDOT) GIS Unit: Infrastructure data including roads and railroads;
- Rutherford County: Tax map parcels (2003) and FEMA floodplains (2003).

Other data, statistics, and descriptions found throughout this document were obtained mostly from publications posted on the World Wide Web by various federal, state, and local agencies. GIS databases were updated with the most recent Web information available where appropriate, (*e.g.,* discharge permits). These publications and all other data sources are listed in the bibliography in Section 9.0.

2.2 GIS PROCEDURES

2.2.1 Characterization and Watershed Analysis Procedures

Earth Tech compiled all existing data layers and data sets into a GIS using Environmental Systems Research Institute (ESRI) ARCGIS projected in North American Datum of 1983 in meters (NAD 83). ESRI ArcView 8.3 and in some instances Arc/INFO 8.3 were used to analyze all GIS data. First, the USGS quadrangles were geo-rectified to the road infrastructure acquired from the NCDOT GIS Unit. The Cathey's Creek Hydrologic Unit (HU) polygon was overlaid on the USGS quadrangles. The Cathey's Creek HU polygon was used to reduce file size and processing time for the majority of the GIS databases by clipping and retaining only the data that occurs within the watershed. After performing these procedures, the customized data set was used to generate the following information.

To evaluate stewardship of lands within the Cathey's Creek HU, the parcel database was manually searched by owner and secondary owner to distinguish between private, federal, state, regional, county, and municipal government ownership. Next, state protected easements were identified within the study area using the BasinPro databases.

The soil survey polygon coverage was updated by creating a new attribute field in the database called "hydric". Using information supplied by the Rutherford County NRCS, each map unit was classified as Non-hydric, Type A Hydric, or Type B Hydric. The definitions of these classes are given in Section 3.3.2. Quantities of these three categories were calculated for the hydrological unit, and the classifications were used in the potential projects analysis as described in Section 2.2.3.

The land use and land cover data were acquired from the USGS. The USGS raster data was converted to a polygon shapefile using ArcINFO. It was then analyzed on a watershed and sub-watershed basis to determine quantities of forested, cleared, wetlands, and impervious cover. All of these quantities were derived using a combination of different land use/land cover types as described in Section 2.2.2.

The streams database for the hydrologic unit was expanded to include new attributes. A "Status" attribute field was created in the database and each stream segment was classified as "Perennial" or "Intermittent" according to its depiction on USGS quadrangles (solid or dotted blue line, respectively). The attribute field "DWQ_CLASS" was expanded to apply a DWQ Best Usage classification to all stream segments, because the existing data was not complete for intermittent streams. By definition, unclassified streams carry the same classification as their receiving streams.

The contribution of road infrastructure to imperviousness of the watershed was determined by generating a 24-foot buffer around all road centerlines, assuming a 12-foot width per road lane. No roads wider than two lanes are present in the study area. This information was combined with impervious land use/land cover to arrive at an overall impervious quantity for the HU and each sub-watershed.

The watershed was further characterized by mapping the pollution sources within the basin. This was accomplished by creating a point file that identified NPDES permitted discharges based on parcel addresses and ownership. In addition, underground storage tanks, landfills, mines, water pumps, water tanks, sewage treatment plants, sewage pumps, sewage treatment plant discharges, and dams were all identified within the hydrological unit using BasinPro databases.

These processes were used to generate the mapping for general watershed characterization. Procedures for more detailed analyses are described in the latter part of this document and in **Appendix A**.

2.2.2 Sub-watershed Analysis Procedure

Analysis of the hydrology on the USGS quadrangles resulted in the delineation of 14 sub-watersheds ranging in size from 2.3 to 4.0 square miles. The Cathey's Creek sub-watershed polygon coverage was created as described in **Appendix A** and used to clip the sub-watershed areas for individual calculations. The sub-watershed analysis procedure included summarization of existing data (*e.g.,* total area of Woody Wetland polygons) as well as more detailed spatial analyses that describe the functional condition of the watershed on a sub-watershed scale.

Summary calculations included total areas of various combinations of land cover and land use categories for each sub-watershed. Impervious surface was defined as all polygons classified as Commercial/Industrial/Transportation, High Intensity Residential, or Low Intensity Residential, while recognizing that none of the categories are 100 percent impervious. Forested area was defined as all polygons classified as Deciduous Forest, Evergreen Forest, Mixed Forest, or Woody Wetlands. Wetland areas were defined as all polygons classified as either Woody Wetlands or Emergent Herbaceous Wetlands. Agricultural areas were defined as Pasture/Hay or Row Crops. These classifications are described in detail in Section 4.3.3. Other summary calculations included total stream length within a sub-watershed and total length of impaired stream.

The percentage of total stream length protected on both sides by at least a 50-foot forested buffer was determined for each sub-watershed. A 50-foot buffer was created for each stream, resulting in polygons along each stream. This was then overlain with the forested layer. Both layers were visually inspected. The long polygons were cut perpendicularly to the stream, keeping the areas which were forested on both sides for at least 50-feet, and the in-between sections deleted. This buffer layer was then used to clip the stream layer, leaving only sections of the stream that were forested on both sides. The lengths were then totaled by sub-watershed.

An analysis of the presence of large, high-quality habitat patches and connecting corridors was performed using methods developed by the Division of Coastal Management (Stanfill *et al*. 1999). Briefly, a 300-foot buffer was generated around patches of forested area to account for edge effects. Polygons greater than or equal to 74 acres inside the buffer were designated "interior patches". Connecting corridors 600 feet wide or greater consisting of forest or agricultural area were identified. The number of patches, the total interior patch area, and the number of corridors to adjacent patches were determined per sub-watershed. Details of these procedures are given in **Appendix A**.

These sub-watershed values were summarized in a matrix that was used to rank functional status. This ranking procedure is described in detail in Section 6.0.

2.2.3 Potential Project Analysis Procedure

In addition to performing a functional analysis for the watershed, conventional GIS methods were also used to locate potential stream and wetland restoration areas. Streams mapped on the USGS quadrangles were intersected with land use categories that indicated cleared areas, on the assumption that cleared areas or the lack of a forested buffer would suggest alterations resulting in some degree of degradation. Land use categories included were Low Intensity Residential, High Intensity Residential, Commercial/Industrial/Transportation, Bare Rock/Sand/Clay, Pasture/Hay, Row Crops, and Urban/Recreational Grasses. A reselection was performed then to identify sites with more than 1,000 linear feet of channel within these cover types. Valley slope and stream sinuosity were not considered in this analysis because of the data quality. Intersecting cleared areas with Type A hydric soils identified potential wetland restoration sites. A reselection was then performed to identify sites larger than 5 acres. The number of landowners was not considered when identifying either stream or wetland sites at this stage of work for the watershed management plan.

2.3 FIELD SURVEYS

For the general watershed survey, a base map was created from BasinPro files showing state primary and secondary roads and all named streams in the CCW. Using this map, field ecologists visited various observation points and observed the streams from bridges and roadsides. Investigators made general observations of the stream conditions, riparian buffer quality, and surrounding landscape. Permission was not obtained to cross property boundaries for extensive observations at this phase of the project. These general observations, in combination with the GIS analysis, were used to make the sub-watershed delineations and to make general conclusions on the status of the waterways. Explanations of the observations are included in the sections where they are most relevant. A photolog is included in **Appendix B**.

2.4 INTERVIEWS

Interviews were a valuable source of information about the watershed. Discussions with local residents and resource agency employees provided information about past and current land use practices and clues to possible stream and wetland impairments. A list of contacts is provided in **Appendix C**. The information obtained from these interviews is included in the appropriate sections.

2.5 PUBLIC MEETINGS

Public meetings are being held throughout the planning process to facilitate involvement of all watershed stakeholders. The meetings insure that multiple objectives are pursued and partnering is used to improve the success of the watershed management plan.

The first public meeting was held on June 23, 2003 at the Rutherford County Extension Center in Spindale. The meeting was sponsored by the NCWRP and hosted by the Rutherford County Cooperative Extension Service, the Watershed Education for Communities and local Officials (WECO), and Earth Tech of North Carolina, Inc. WECO, a program of the North Carolina Cooperative Extension Service, facilitated the meeting with representatives from local agencies, community groups, and landowners. Local stakeholder perceptions of the importance of the watershed's ecological functions were revealed. Results of the public meeting can be found in the Summer 2003 newsletter included in **Appendix C**.

A Technical Advisory Committee was formed and met for the first time on September 29, 2003, also at the County Extension Center. Proceedings of this meeting and a list of committee members can be found in the Fall 2003 newsletter in **Appendix C**. A Group Charter for the technical committee was adopted and is also included in **Appendix C**. The committee is scheduled to meet again in March 2004.

2.6 LITERATURE REVIEW

To aid in the development of the characterization report and the watershed management plan existing literature was reviewed. The World Wide Web, books, and documents were reviewed for information on watershed functions, assessment techniques, best management practices, and current and past activities within the CCW. The information obtained is being used throughout this report and will be used in the development of the watershed management plan.

3.0 WATERSHED FUNCTIONS

Addressing ecological impacts in terms of functional losses and replacements on a watershed level is a new approach to mitigation planning and implementation in North Carolina. Watershed functional analysis specific to the ecology of North Carolina is still being developed and no definitive methodology for the approach has been adopted. The approach used in this report is based on preliminary guidance provided to EEP by technical committees charged with developing the functional analysis methodology.

This report addresses three main watershed functions and, to the extent possible with the available data, a number of sub-functions. The three main functions are as follows:

- **Water quality** - the relative levels of chemicals and substances in the water and the ability of the water to support life.
- **Hydrology** - the study of the occurrence, distribution, and movement of water. Hydrology is a function that can also affect other watershed functions including water quality and habitat.

The hydrologic functions of a watershed include both surface water and groundwater interactions.

- **Habitat** - all of the physical, biological, and chemical characteristics necessary to maintain an organism's viability. For purposes of this report, indicators are limited to a few spatial, structural, or qualitative characteristics of terrestrial and aquatic communities that directly or as surrogates describe some of the physical, biological, and chemical characteristics that influence the ability of the watershed to support typical Piedmont aquatic and terrestrial animal communities.

Following a well-established model for wetland functional assessment, watershed functions ideally would be evaluated relative to standards defined from a population of least-altered, self-maintaining watersheds in the same region. These standards would be derived from field indicators that can distinguish anthropogenic alterations. Thus, by differentiating natural variation from variation due to degradation, indices that reflect the relative degree of degradation could be developed to evaluate watershed condition or degree of function. To evaluate gains and losses of watershed function, simple logic models would be developed that represent the most common and fundamental functions (Smith *et al*. 1995, Rheinhardt *et al*. 1997).

As noted above, these logic models have not been developed yet for watershed analysis in North Carolina. In **Table 1** below, sub-functions and several suggested indicators of these functions are listed for each major watershed function, but the actual analysis in Section 6.0 was limited to data currently available in GIS or other databases. The analysis relied on a simple ranking system rather than calculated models indexed to a reference system. The watershed was partitioned into sub-watersheds that were ranked relative to each other, rather than to a standardized reference watershed.

Table 1. Watershed Functions and Indicators

Primary Function	Sub-Function	Indicator	Description
Water Quality	Elemental Cycling and Spiraling	Living biomass Detrital biomass Hydrologic alterations	Abiotic and biotic processes that convert elements from one form to another within the watershed. These processes include nutrient and elemental cycling, biogeochemical transformation, and export of dissolved organic constituents. Plants, water, and soil microbes drive these processes.
	Removal and Transport	Presence of stream buffers Presence of ponds Channel sinuosity Channel incision	Removal and transport of nutrients, contaminants, sediment, and other elements or compounds from surface waters. Plants, water, soil microbes, and stream morphology drive these processes.
	Retention	Soil surface texture Sub-soil texture Soil organic matter Stream buffers Wetland cover	The ability of the watershed to retain nutrients, contaminants, sediment, and other elements or compounds that are moving towards surface waters. Nutrients, contaminants, and other elements may be physically filtered from the system by binding to fine-textured clayey soils. Plants may also filter these substances as well as sediment.
	Thermal Regulation	Shading of channel Forested buffer	Absorption, storage, and dissipation of thermal energy. Temperature and thermal energy regulate the rate at which abiotic and biotic processes occur. Vertebrate and invertebrate aquatic community composition varies according to the water temperature and the amount of solar irradiation reaching the surface water body.
Hydrology	Sub-surface water storage	Presence of certain geologic formations Soil type Climate Abundance of perennial streams and springs	Availability of water storage beneath the surface. This ability is driven by geologic formations, soil type, and climate. This sub-function is difficult to predict without detailed geologic maps or extensive well data. Abundance of perennial streams and springs may be a surrogate measure.
	Moderation of groundwater flow or discharge	Slope Land cover type Stream buffers	Capacity of a watershed to control the rate of groundwater flow from upgradient sources. This presumably refers to headwater perennial streams and springs.
	Surface Water Flow or Discharge	Channel sinuosity Channel incision Land cover type Available floodplain	Capacity of a watershed to moderate surface water flow and energy from upgradient sources. This is related to the ability of higher-order streams to handle surface runoff and receive waters discharged by tributaries.
	Dynamic surface water storage	Soil permeability Floodplain width Floodplain land cover Presence of wetlands	Capacity of a watershed to detain and absorb moving water from overbank flow for a short duration when flow is out of channel. This may also include overland flow from overbank and upland surface water inputs.
	Long-term surface water storage	Microtopographic features Ponds or lakes Forest cover Soil organic matter Soil permeability	Capacity of a watershed to temporarily store (retain) surface water for long durations. It is associated with standing water not moving over the surface. Water sources may be overbank flow, overland flow, channelized flow from uplands, or direct precipitation. Water may be stored in microtopographic depressions and ponds, taken up by vegetation through evapotranspirative processes, or held in the soil.

Table 1 continued

Primary Function	Sub-Function	*Indicator*	Description
Habitat	Maintain Characteristic Plant Distribution and Abundance	Forested cover Presence of wetlands Presence of exotic invasive vegetation Number of natural community types	The sub-function of maintaining a characteristic plant distribution and abundance is difficult to define with no reference watershed. It is assumed that habitat function is enhanced by the presence of natural community cover and diverse, mature, and undisturbed plant communities.
	Maintain Characteristic Animal Distribution and Abundance	Trapping, point counts, or other surveys Forested cover Forested patch size Corridors between patches Number of terrestrial and aquatic community types Pools, rootwads, undercut banks, *etc*. for fish cover Rocks, leafpacks, *etc*. for benthos colonization Variety of pools Well-defined riffle-pool sequence Prevalence of nuisance predation Presence of habitat specialists Availability of water	Ability of the watershed to sustain viable, diverse terrestrial and aquatic wildlife communities characteristic of the region. Assumptions are that more diverse natural cover types will result in more diverse communities, large patches of natural cover with many connections to other patches and to water sources are preferable, patches large enough to overcome edge effects are preferable, stable, well-shaded streams are preferable; and structurally complex habitats (*e.g.,* self-sustaining, mixed-age forest stands and stable streams with a defined riffle-pool sequence and a variety of cover for aquatic species) are preferable.
	Physical Habitat Characteristics	Stand age Number of terrestrial and aquatic community types Contiguity of communities	Ability of the watershed to maintain interspersion, connectivity, temporal dynamics and spatial structure of the physical habitat. It suggests a stable, self-sustaining landscape with minimal disturbance. The assumptions and indicators for plant and animal functions listed above also apply to this function.

4.0 WATERSHED DESCRIPTION

This section provides an overview of the Cathey's Creek Watershed and the surrounding area. Subsections present the watershed's history, socioeconomic conditions and descriptions of the existing physical, biological, and water quality conditions. The topics chosen for inclusion all affect or explain, directly or indirectly, the functional status of the watershed. Following the description of each characteristic is a brief discussion as to how that characteristic relates to the general functions of the watershed.

4.1 GENERAL HISTORY

Of historical interest, Cathey's Creek was named for George Cathey, a revolutionary war soldier with the Over Mountain Men, who owned 300 acres along the creek. Holland's Creek was named after James Holland, a member of the Broad of Trustees for UNC at Chapel Hill in 1796. Holland's Creek was originally named Sheppard's Creek after William Sheppard, a mill owner along the creek (Interview with Nancy Ferguson, June 2003).

Established in 1768, Tryon County contained all the area that today is Rutherford County. Tryon was divided into Lincoln and Rutherford Counties in 1779. Rutherford County is located between the Blue Ridge Mountains, the Black Mountains, and the South Mountains of North Carolina, and as a result has a relatively mild climate. This isothermal effect has had a distinct effect on the history of the area.

The CCW may have the richest history among the county's watersheds according to local historians. There are remnants of Indian mounds along the streams, and the county was named for Brigadier General Griffith Rutherford, a revolutionary patriot. Perhaps the most interesting area within the watershed is Gilbert Town, located just northeast of Rutherfordton and under review for the national historical registry. The town is connected to three Revolutionary War battles: the Battle of Cane Creek; the Battle of King's Mountain; and the Battle of Cowpens. Gilbert Town is the oldest western county seat and was established by William Gilbert, who owned 2,000 acres of land, in 1779. The town was a crossroads with a courthouse, tavern, and a military hospital for revolutionary patriots. Patrick Ferguson's army camped at William Gilbert's home in September of 1780 before marching to King's Mountain. Major James Dunlap, first in command under Patrick Ferguson, was buried near the home on March 23, 1781. Colonel Daniel Morgan's injured troops from the Battle of Cowpens were treated in the hospital on January 17, 1781 (Interview with Nancy Ferguson, June 2003).

Two historic trails run through the CCW: Rutherford Trace and Over the Mountain Trail. Rutherford Trace, established in September of 1776, is the location of a marching trail once used by General Griffith Rutherford against the Cherokee Indians. General Rutherford was stationed at Fort McGaughey that was built in 1765. The march began at the fort, which was located behind the current Britain Church on US Highway 64. The Over Mountain Trail was used on October 5, 1780 by Patrick Ferguson's army on their way to the Battle of King's Mountain, which occurred on October 7. It was the first registered southeastern historical trail. This trail is unique in the fact that both the patriots and British camped along it. An existing Rails to Trails route marks the original location of the trail that starts at Gilbert Town and continues to US 64 (Interview with Nancy Ferguson, June 2003).

The area is also famous for gold mining. Gold was first discovered in the United States in 1828 in the community of Brindletown, which lies in Burke County between Rutherfordton and Morganton on US Highway 64 (www.blueridge.net, 2003). Remnants of goldmines can be found throughout the CCW and state historic placards mark the two sites of the famous Bechtler's Mint, one behind the Rutherford County Courthouse at W. Sixth Street and N. Washington, and another on US Highway 221. The first American gold dollar was minted there in 1830. Christopher Bechtler and his son, August, operated the mint in Rutherfordton from 1831 until 1849 (www.blueridge.net, 2003).

The community is proud of its heritage, and the landowners offer great insight into the historical use of the land throughout the CCW. The use of the land within the watershed reveals how functions may have been altered over time. For instance, the information about gold mining describes placer gold and vein gold. The placer gold is metal that has been deposited throughout the watershed's stream network. Sluices were built to help the landowners separate the gold from the sediment, and in many cases 'quicksilver' (mercury) was added to improve the separation process. Vein gold mining involved digging shafts in an effort to follow each vein of gold. The evidence of these practices was seen on David Hargett's land during a site visit in June of 2003. During the site visit, spoil piles from vein mining were observed. Also seen during the site visit, was a segment of stream with altered morphology caused by a large sluice run from placer mining. This activity alone would have disturbed the sediment balance that affects water quality functions. Habitat functions would have been impacted as well from this mining activity. The information obtained from the historical review of the watershed will aid in determining the cause of degradation.

According to information from Nancy Ferguson (Interview June 2003), early settlers to the area used oxen and plows to raise indigo, flax, corn, oats, and wheat. After the gold mine activity in the mid-1850's, timber and cotton became the main sources of income. By the 1950's, when the land became to poor to raise cotton, farmers began to raise cattle. Prior to the 1970's, it was not common to clear vegetation from the stream banks.

4.2 SOCIOECONOMIC CONDITIONS

4.2.1 Population

According to figures from the North Carolina Office of State Budget, Planning, and Management (2002), the certified county population estimate for Rutherford County in 2001 was 63,394. The municipal population was 18,063 or 28 percent of the total county population. The number of persons per square mile in 1995 was 106.84. The statewide figure was 150.61. Rutherfordton's population has increased approximately 14 percent over the past ten years and is expected to continue growing. The projected county population for 2009 is 67,858, an increase of 7 percent. An analysis of population growth from 2000 to 2001 classified Rutherford County as an area of low growth, with a net in-migration.

4.2.2 Economy

The CCW is mainly rural, but includes parts of Rutherfordton, Spindale, and Forest City. Although there are no economic figures for the watershed itself, it is assumed that the state figures according to the North Carolina Department of Commerce, Economic Policy, and Research Division (2003) for Rutherford County apply. The per capita income was $20,183 in 1998, about $5,000 below the state average. The unemployment rate in 1999 was 6.8 percent, which was double the state's average. The difference in unemployment rate is partly due to the number of manufacturing jobs that have been transferred out of the state and county forcing local mills to close. Although manufacturing has been declining, it still accounts for 39.5 percent of the workforce, while service, retail trade, and agriculture account for 16.4 percent, 15.3 percent, and 0.7 percent respectively. The overall economy in the area is steady with many local businesses typically found in a rural community. The economic statistics indicate that the area is in transition to a tourism and retirement community.

4.2.3 Industry

The two largest manufacturing industries in Rutherford County are high quality textiles and injection molding (Rutherford County Economic Development Commission (RCEDC) 2002). The oldest running textile plant, owned by Cone Mills Corporation and established in 1891, employs 1,120 people (RCEDC 2002). It is also the largest employer in the county. Other industries manufacture specialty valves, plumbing fixtures, and bearing assemblies (NC Dept. of Commerce, Economic Policy and Research Division 2003). Discussions with landowners in the community reveal that the textile mills have severely declined over the years. The Broyhill Furniture Plant, located in the CCW, is reducing its workforce this year. The mills have begun to outsource their work to countries where labor prices and taxes are lower. The landowners explain that the workforce dynamics have changed dramatically since they were children.

Gold mining is another major industry that once thrived in the watershed but now has become a recreational activity. In the general history, it was mentioned that gold was first discovered in the area in 1828. Many people rushed to the area to stake their claim, but poor records were kept about their activities. Mr. Lloyd Nanney, who owns the Thermal City Gold Mine, says that the alluvial material in many streams has been thoroughly disturbed by historical mining practices (Interview with Lloyd Nanney, August 2003). The task of locating the areas where gold extracting operations were set up is nearly impossible because of a lack of records.

The 1896 geologic survey by Henry Nitze and George Hanna gives the best descriptions of some of the gold deposits in the area (1896). The descriptions are vague and give no exact positions. There were three mines described that fall within the watershed. The locations are stated below and have not been paraphrased to eliminate further confusion.

> "The Alta (Monarch or Idler) Mine is situated about 5 miles north of Rutherfordton, on the divide between Cathey's creek [sic] and the second Broad river [sic]. The Ellwood Mine is situated 3 miles N. 20 E. from Rutherfordton and 1.5 miles southwest from the Alta mine, on the waters of Cathey creek. The Leeds

> Mine is situated on a quartz vein parallel to and 100 feet north of the Ellwood veins."

Although gold prospecting gained enormous attention in the 1800's, the amount of gold mined never provided long-term wealth. The amount of gold found in the veins and the methods used to retrieve the gold do not provide a profitable endeavor today. However, the effects of this past industry linger on in the form of streams deepened and scoured by sluice runs, mercury in the soils, and spoil piles.

4.2.4 Agricultural Activities

In the early part of the twentieth century most of the open land in the county was used to produce row crops. As the fields lost their productivity due to erosion, many were converted to pasture. Streams and woodlands were included in the fenced pastures to provide water and shade for the livestock (Rutherford County Source Water Protection Plan, 2002). Cropland is not prevalent, but pasture is scattered throughout. The statistics reveal that cropland accounts for less than 4 percent of the county's 361,101 acres. Little of the cropland is found on the uplands. The floodplains are planted in a mix of cotton, corn, soybeans, peaches, and truck crops (produce). Nursery crops are beginning to move into the area according to Albert Moore of the NRCS (2003).

The amount of pasture would suggest that the county has large livestock operations, but the statistics show otherwise. Rutherford County ranks only 65 in livestock revenue ($8.8 million) and 95 in crop revenue ($3.5 million) in the state according to the 1997 Census of Agriculture. There are only a few dairy farms in the county with none located in the CCW. Statistics from January 1, 2002 show that there were a total of 13,500 cattle in the county, of which 7,600 were beef cattle and only 300 were milk cows. The statistics also revealed that the county produces 1,800,000 chickens. According to the NRCS office there are no more than 10 active chicken farms. There are no hog or turkey farms within the county (Interview with Moore, June 2003).

While performing the windshield survey it was also evident that many areas in the watershed are being actively timbered. The areas timbered are being reforested in pines and kept on a 40 to 50-year rotation. Albert Moore explained that more replanting is done in Rutherford County than in all the surrounding counties combined (2003). The majority of the problems that arise from timbering are related to the logging roads and loading deck. Some of the wood is transported to pulp mills, but the all of the low value material is taken to chip mills. There is an active chip mill located in Union Mills, just over the northeastern ridgeline of the watershed. Timbering was extensive in the watershed but timber companies, like Champion and Bowater, are selling their large tracts of land as a result of escalating taxes. Mr. Albert Moore explained that Bowater sold most of their land to John Hancock Insurance, who in turn sold it off in smaller tracts (2003).

4.2.5 Zoning and Planning Jurisdictions

The county is trying to plan for an increase in development throughout the county. The County's Board of Commissioners has proposed a zoning plan and has scheduled 15 public meetings for September of 2003, in which they will receive public comments. The plan will then be revised by January of 2004 and resubmitted (Interview with Jim Lancaster, August 2003). The zoning will help improve sections of the community that are not well maintained and insure that proper infrastructure can be installed for the growing areas.

4.2.6 Land Stewardship

The primary landowners in the watershed are non-governmental entities. Approximately 3 percent of the watershed is owned by government entities, with the remainder being held by individuals, corporations, non-profit agencies, or other private entities. See **Table 2** below and **Figure 2**. The majority of the government holdings are infrastructure installations, with a minimum of designated public open-space uses or protected areas such as parks. Included in the private holdings are lands under conservation easements such as the Farmland Preservation program. They are shown on **Figure 2** as Private (Managed).

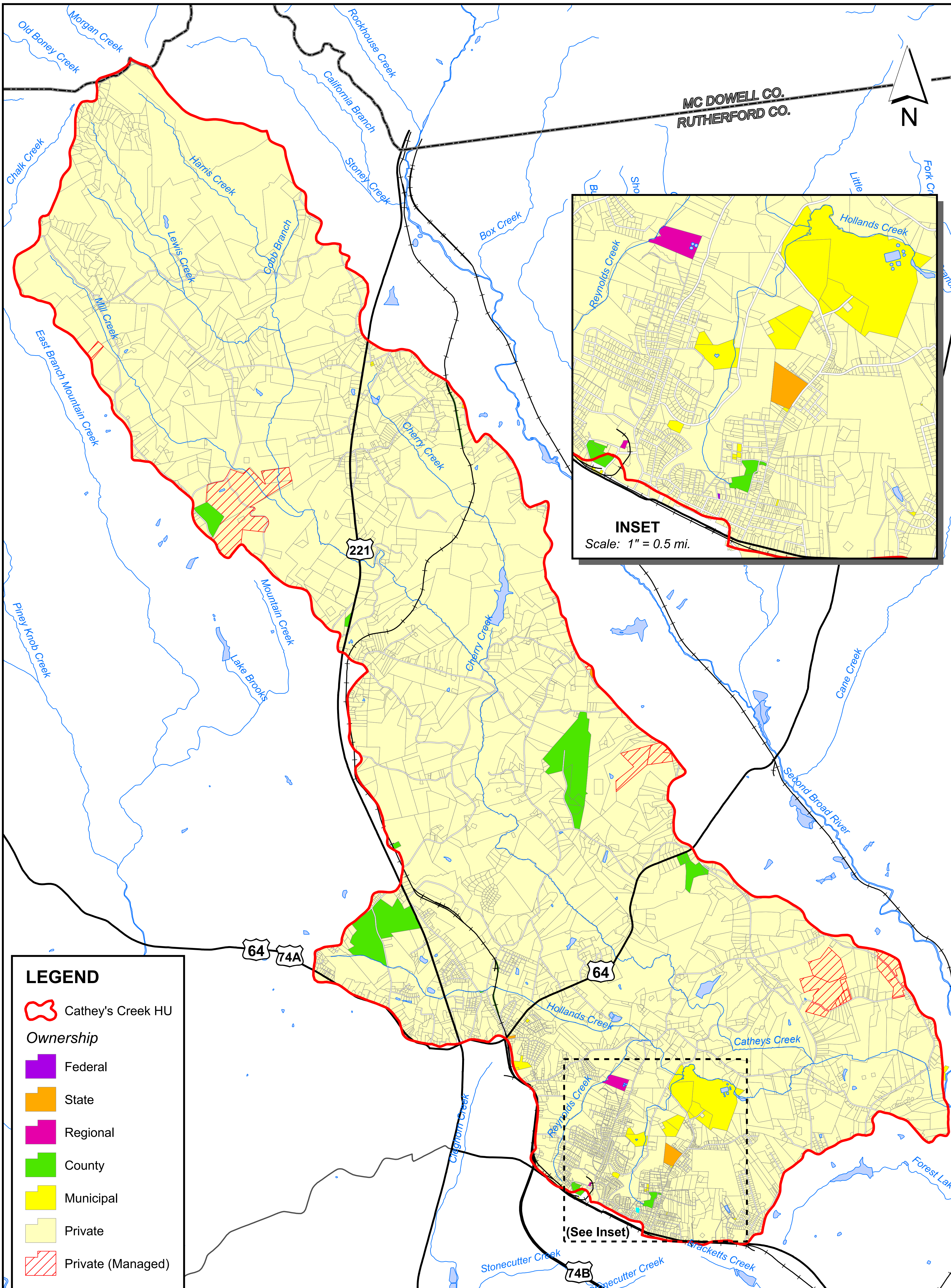
Table 2. Land Stewardship in Cathey's Creek Watershed

Stewardship Type	Number of Parcels	Total Acres	Percent
Municipal	30	287	1.00
County	31	501	1.75
State	4	23	0.08
Regional	2	19	0.07
Federal	1	0.2	0.00
Private	5102	27,823	97.1

4.3 PHYSICAL CHARACTERISTICS

Rutherford County is located 45 miles from Asheville, 70 miles from Charlotte, and 30 miles from Spartanburg, South Carolina. Nestled in the steep foothills of the Blue Ridge Mountains, the Black Mountains, and the South Mountains of North Carolina, Rutherfordton is known for is relatively mild climate. The summers are long and mild with an average temperature of 71 degrees in July, and the winters are short with an average temperature of 33 degrees in January. The county area is 565 square miles with an average elevation above sea level of 1,096 feet. The average rainfall for the area is 47 inches.

The CCW runs from northwest to southeast through north-central Rutherford County, with the northernmost tip forming a portion of the Rutherford-McDowell County boundary. See **Figure 1**. It is located between the Broad and Second Broad Rivers. The total watershed area is 44.77 square miles and the main channel length of Cathey's Creek is 19.2 miles long.



NCDENR
Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
North Carolina Corporate Geographic Database;
NCDOT GIS Unit; Rutherford County GIS

0 0.25 0.5 1 1.5 Miles

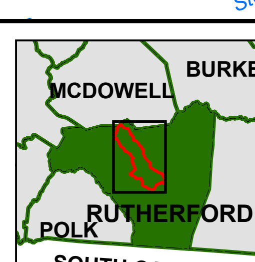


FIGURE 2
STEWARDSHIP
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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4.3.1 Geology and Topography

The headwaters of Cathey's Creek originate at the northwest end of the watershed on low mountains that fall within the Blue Ridge physiographic province. The remainder of the CCW lies within the Piedmont physiographic province. Metamorphosed granitic rocks underlie the Blue Ridge portion (NCGS 1991). Elevations in this area range from 2,508 feet on the summit of Rich Mountain to about 1,200 feet at the foothills of these mountains as shown in **Figure 3**. Metamorphic rocks such as gneiss, schist, and amphibolite underlie the Piedmont portion (NCGS 1991). Elevations range from 1,200 feet in the foothills to 806 feet where Cathey's Creek joins the Second Broad River. The average channel slope is 44.8 feet/mile. The hilly terrain is very finely dissected by numerous drainages that coalesce to form six major tributaries to Cathey's Creek. The major municipalities are located in the flatter terrain at the lower end of the basin.

4.3.2 Soils

A published soil survey is not available for Rutherford County. The soil coverage in BasinPro was used for analysis in this report. An official list of hydric soils for Rutherford County was obtained from the local NRCS agent. Detailed descriptions of map units were obtained from the *NRCS Official Soil Series Descriptions* website. The majority of soils in the CCW are steeply sloping and eroded or stony. Textures range from silt loam to sandy clay loam. See **Figure 4** for a complete list of soil map units in the watershed.

Approximately 11 percent of the watershed area is occupied by hydric soils. See **Table 3** below. Group A soils are map units that are all hydric or have hydric soils as a major component. In the CCW, these include the following soils, which are found in small patches in floodplains:

- **Helena-Worsham complex, 1 to 6 percent slopes;**
- **Udifluvents-Fluvaquents complex, mounded, occasionally flooded; and**
- **Wehadkee silt loam, 0 to 2 percent slopes, frequently flooded.**

Group B soils are map units with inclusions of hydric soils or with wet spots. These include the following soils:

- **Chewacla loam, 0 to 2 percent slopes, occasionally flooded** (hydric inclusion in Wehadkee); and
- **Dogue loam, 1 to 6 percent slopes, rarely flooded** (hydric inclusion in poorly drained soils).

The Chewacla unit is mapped extensively along the major perennial stream floodplains in the county. The Dogue unit occurs in a few depressional areas in these floodplains.

Hydric soils are one indicator of the potential presence (current or historic) of wetlands. Important functions of wetlands in watersheds include filtration of sediment, retention of nutrients and other pollutants, and storage of floodwaters. It is likely that the small area mapped as hydric is not a well-vegetated, highly functioning wetland. Areas mapped with Type B soils are often found not to qualify as wetlands at all.

Table 3. Hydric Soils in Cathey's Creek Watershed

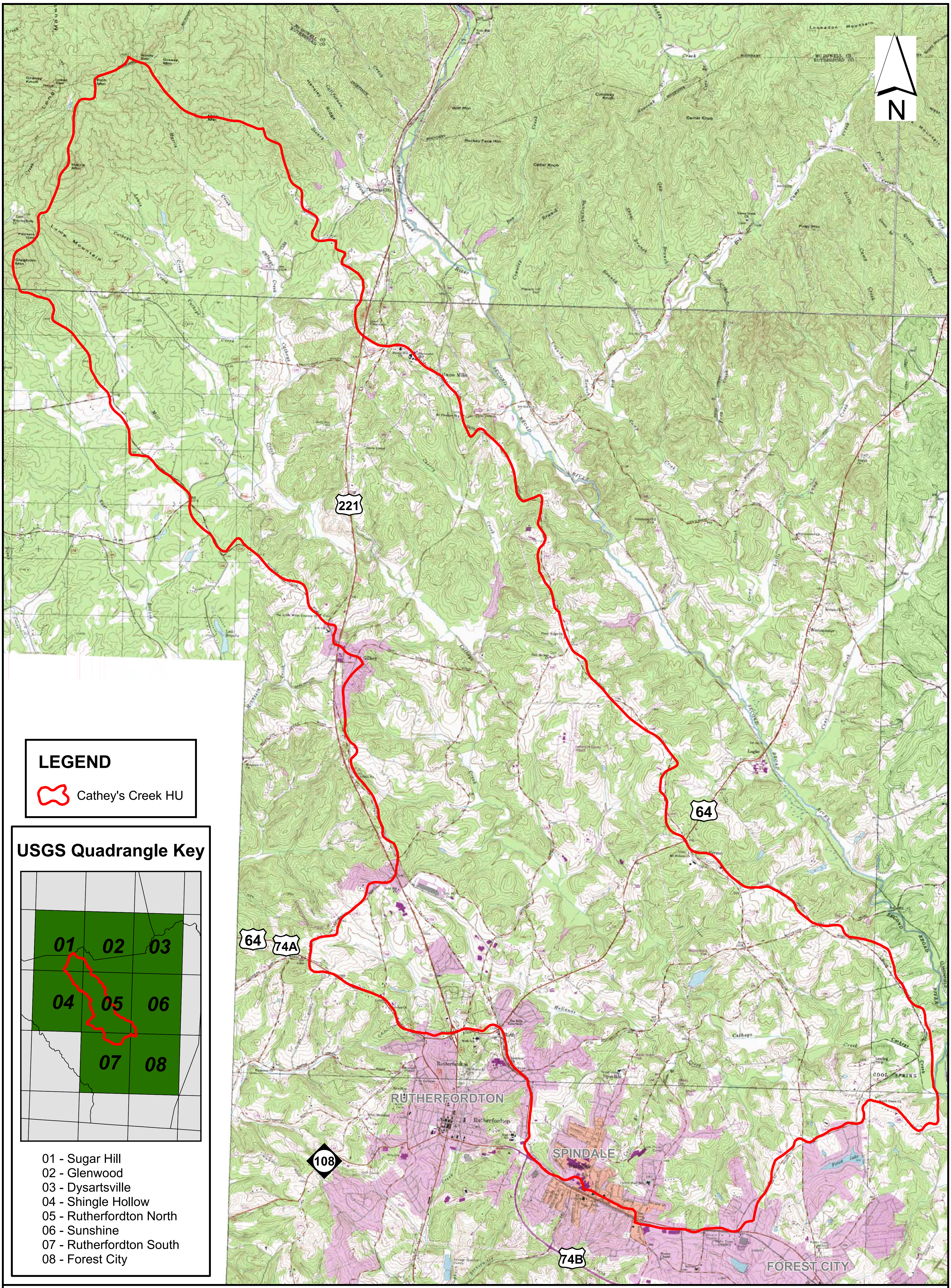
Soil Type	Area (acres)	Percentage of Watershed Area
Non-Hydric	25,442	88.8
Hydric Group A	420	1.5
Hydric Group B	2,777	9.7

4.3.3 Land Cover

Land cover and land use in the CCW are shown on **Figure 5**. The percentage of each cover type in the watershed is summarized in **Table 4** below. The majority of the watershed is rural to semi-rural in character. The northern half of the basin is covered by large tracts of deciduous and mixed evergreen-deciduous forest interspersed with pasture and row crops. The southern half also has a considerable amount of forest cover, but it is more dissected by roads and larger areas of pasture and row crops. The municipalities of Rutherfordton and Spindale also occupy a small portion of the downstream end of the watershed with low- and high-intensity residential and commercial development.

Land cover is integral to watershed function. It can be used as an indicator of several major functions, including water quality (filtration and retention of compounds and particulates, biogeochemical cycling), hydrology (storage, evapotranspiration, attenuation of flow velocities) and habitat (patch size, corridors, biodiversity). Impervious surface (categories marked with * below) occupies 5.8 percent of the watershed. Some watershed studies suggest that 10-12 percent impervious cover is the threshold beyond which water quality declines significantly.

The plant community component of land cover is described further in Section 3.4. Associated wildlife communities are also discussed.



NCDENR
Ecosystem Enhancement Program

Source:
USGS Quadrangles:
Rutherfordton South, NC 1993;
Rutherfordton North, NC 1993;
Sunshine, NC 1965; Forest City, NC 1993;
Glenwood, NC 1993; Shingle Hollow, NC 1982
Sugar Hill, NC 1985; Dysartsville, NC 1993

0 0.25 0.5 1 1.5 Miles

FIGURE 3
TOPOGRAPHY
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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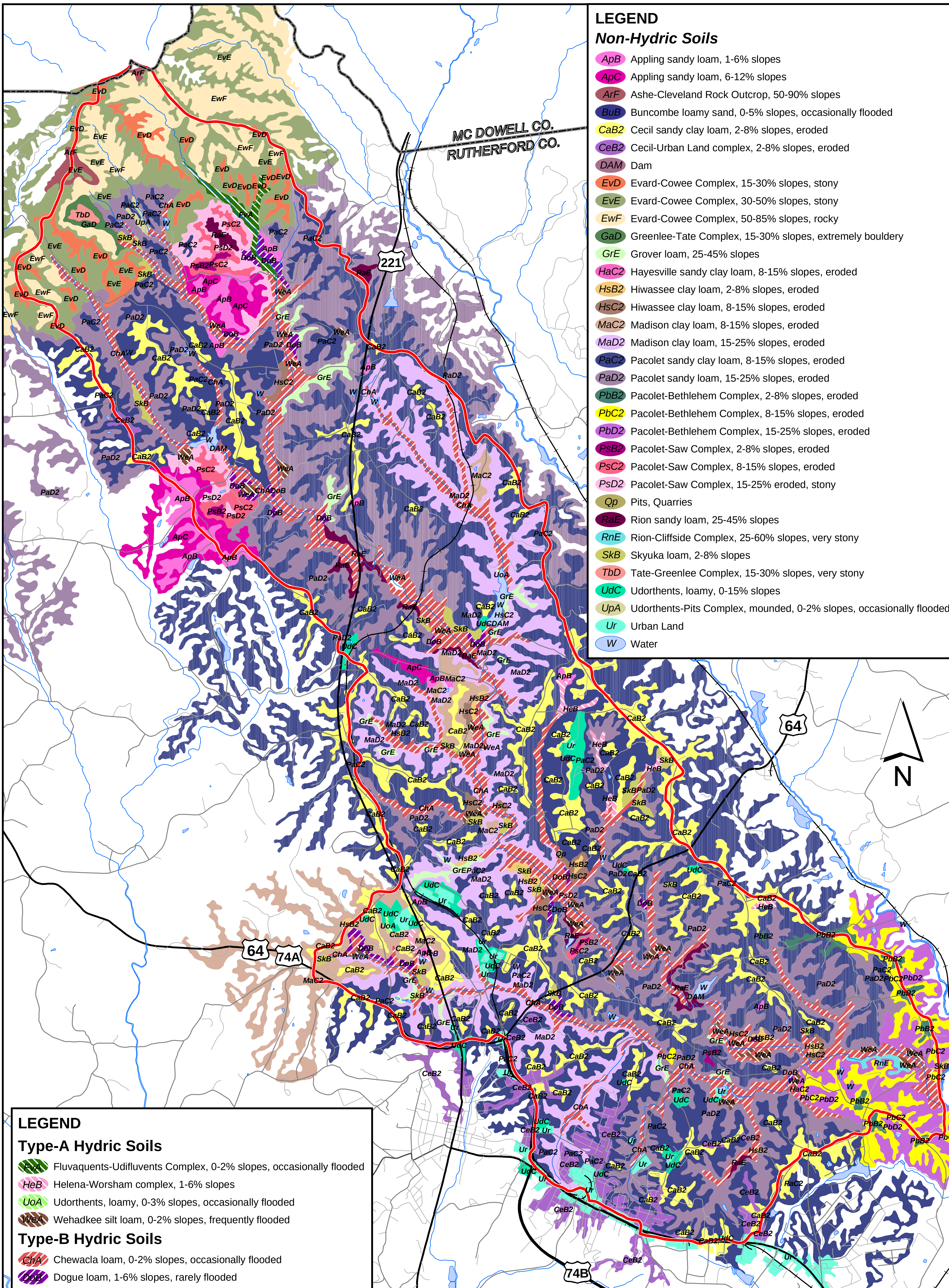

NCDENR

Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1; NCDOT GIS Unit; Rutherford Co. NRCS

0 0.25 0.5 1 1.5 Miles

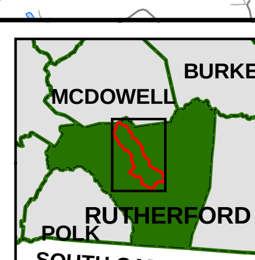

FIGURE 4
SOILS
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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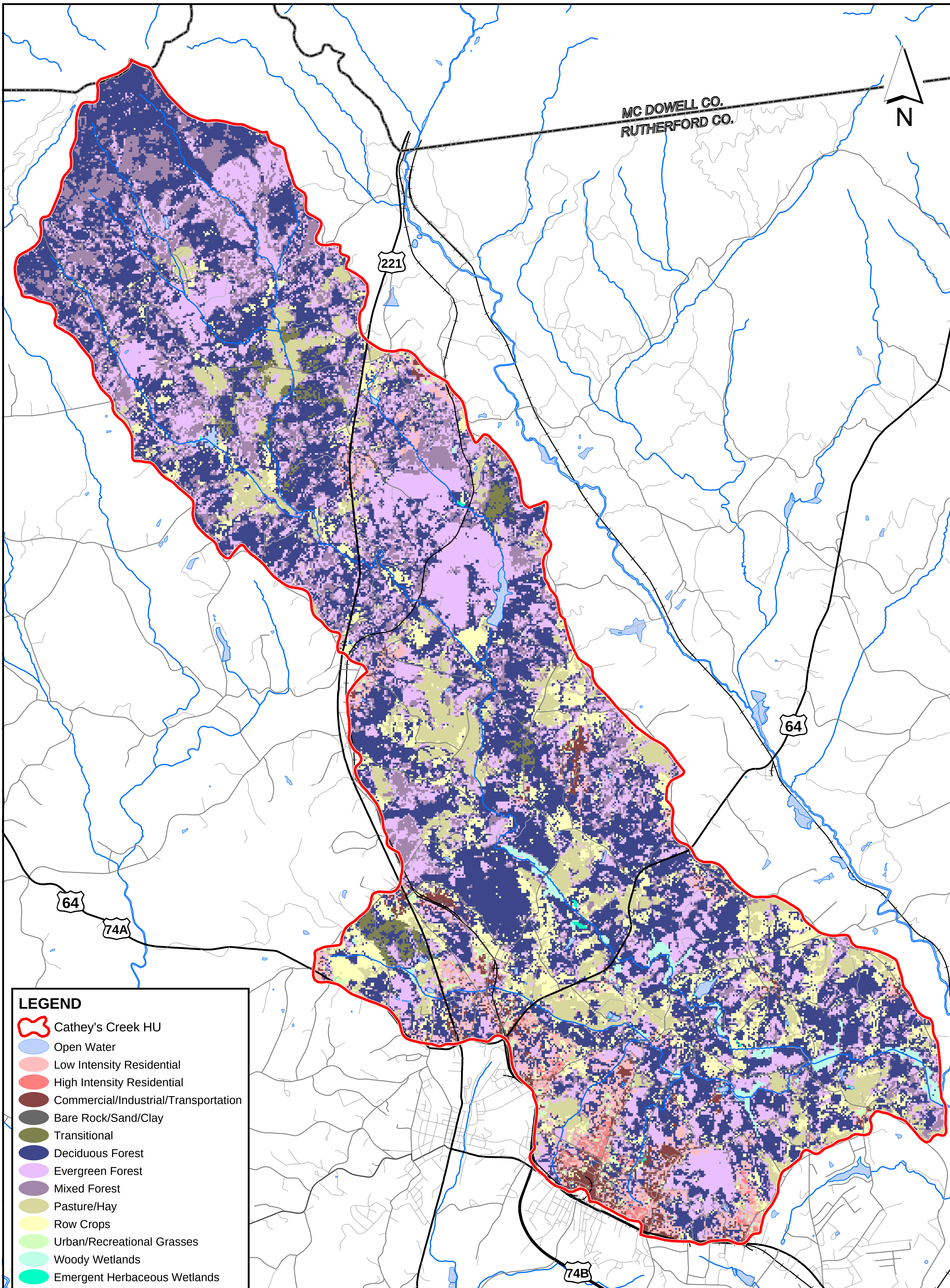

NCDENR
Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
NCDOT GIS Unit; USGS

0 0.25 0.5 1 1.5 Miles

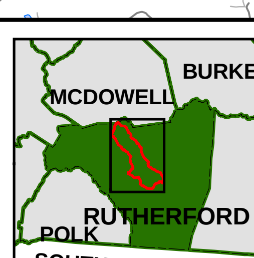

FIGURE 5
LAND USE / LAND COVER
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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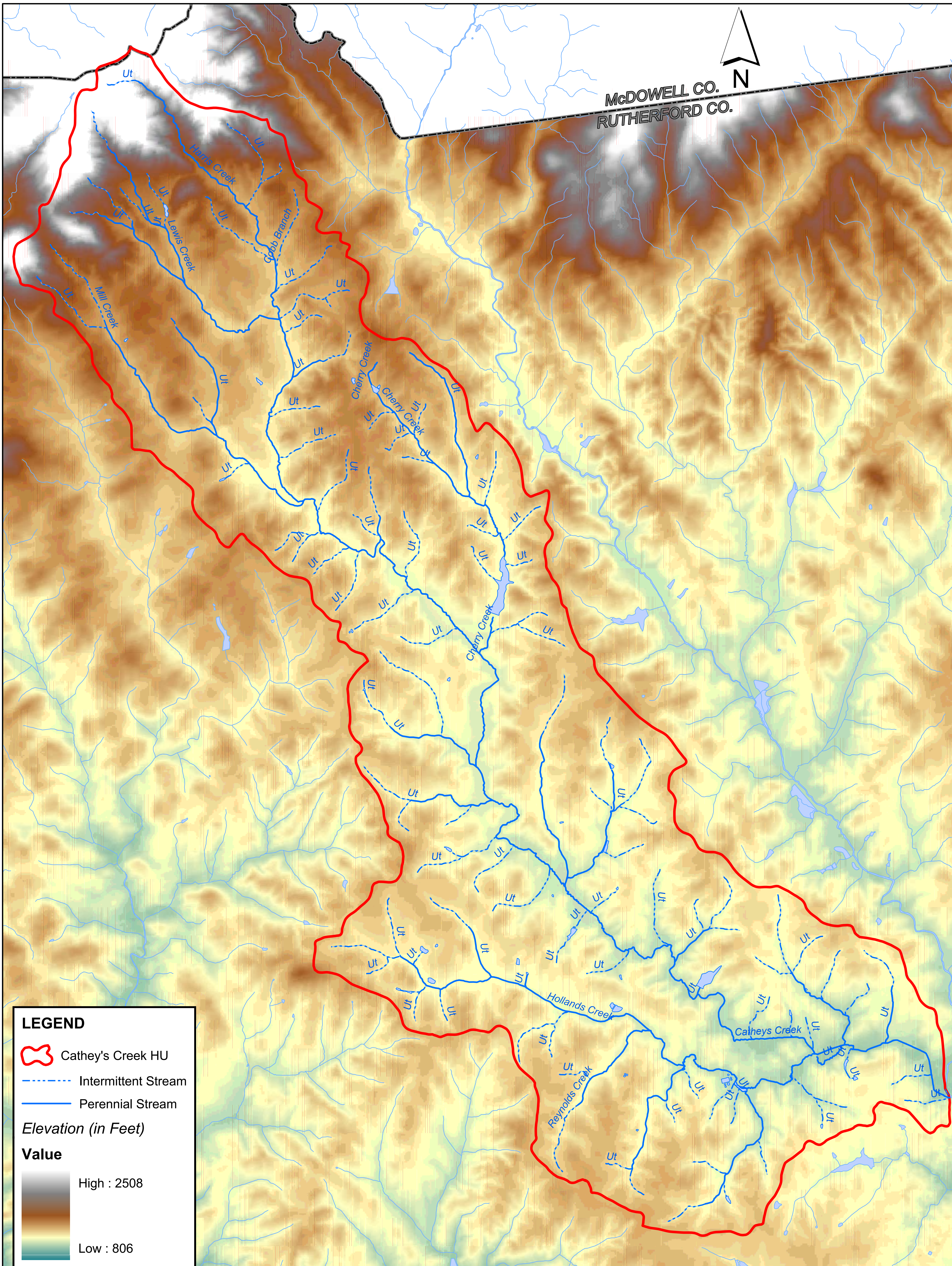
Table 4. Land Use and Land Cover

Type	Acres	Percentage of Watershed Area
Natural		**74.2**
Deciduous Forest	9729	37.2
Evergreen Forest	6116	21.4
Mixed Forest	4158	14.5
Woody Wetlands	295	1.0
Emergent Herbaceous Wetlands	15	0.1
Cultural		**7.3**
Commercial/Industrial/Transportation*	534	1.9
High Intensity Residential*	109	0.4
Low Intensity Residential*	999	3.5
Transitional	298	1.0
Urban/Recreational Grasses	139	0.5
Agricultural		**18.2**
Pasture/Hay	2438	8.5
Row Crops	2769	9.7
Other		**0.4**
Bare Rock/Sand/Clay	45	0.2
Open Water	64	0.2

4.3.4 Surface Waters

Seven named perennial streams with numerous tributaries drain to Cathey's Creek (**Figure 6**). **Table 5** summarizes the total mapped stream length and area of ponds and lakes in the watershed. No fieldwork has been done to identify unmapped streams or to verify actual intermittent and perennial lengths. From limited field observations, the streams appear to be both unstable and stable Rosgen Stream Types B, C, and E. The unstable stream channels of Rosgen Stream Types C and E have low sinuosity, eroding banks, and/or incision but are building new floodplain benches at lower elevations within the old channel banks. The streams appear to have dense riparian vegetation, although often consisting of exotic invasive species. Bare banks caused by animal impacts were witnessed at some locations. The streams had evidence of past bank erosion from incision, probably associated with farming practices. The geomorphology and stability characteristics of the streams cannot be determined without a more thorough field investigation. No continuous stream flow records are known to exist for Cathey's Creek or its tributaries.

In the 1970's, the Second Broad River Flood Control Program, funded by PL566 of the Small Watershed Act, built three impoundments in the CCW. Dams were constructed along an upper reach of Cathey's Creek (15 acres), Cherry Creek (40 acres), and an unnamed tributary to Cathey's Creek (24 acres). Farm ponds dot the landscape as well.



Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
USGS Quadrangles

0 0.25 0.5 1 1.5 Miles

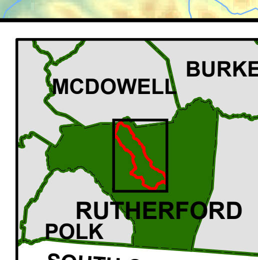


FIGURE 6
SURFACE WATERS
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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Table 5. Surface Waters

Streams	
Intermittent	390,658 feet (23 miles)
Perennial	245,816 feet (14 miles)
Total	636,474 feet (37 miles)
Ponds/Lakes	96 acres (0.15 sq miles)

4.3.5 Transportation Infrastructure

The transportation infrastructure is shown on **Figure 7**. The roads follow the ridgelines in the CCW with the watershed bounded by the roads except in headwater areas. The main highway in the watershed is US 221. Cathey's Creek has a total of 11 road crossings and one railroad crossing before converging with the Second Broad River. There are 170 miles of primary and secondary roads that contribute to 490 acres of impervious surface.

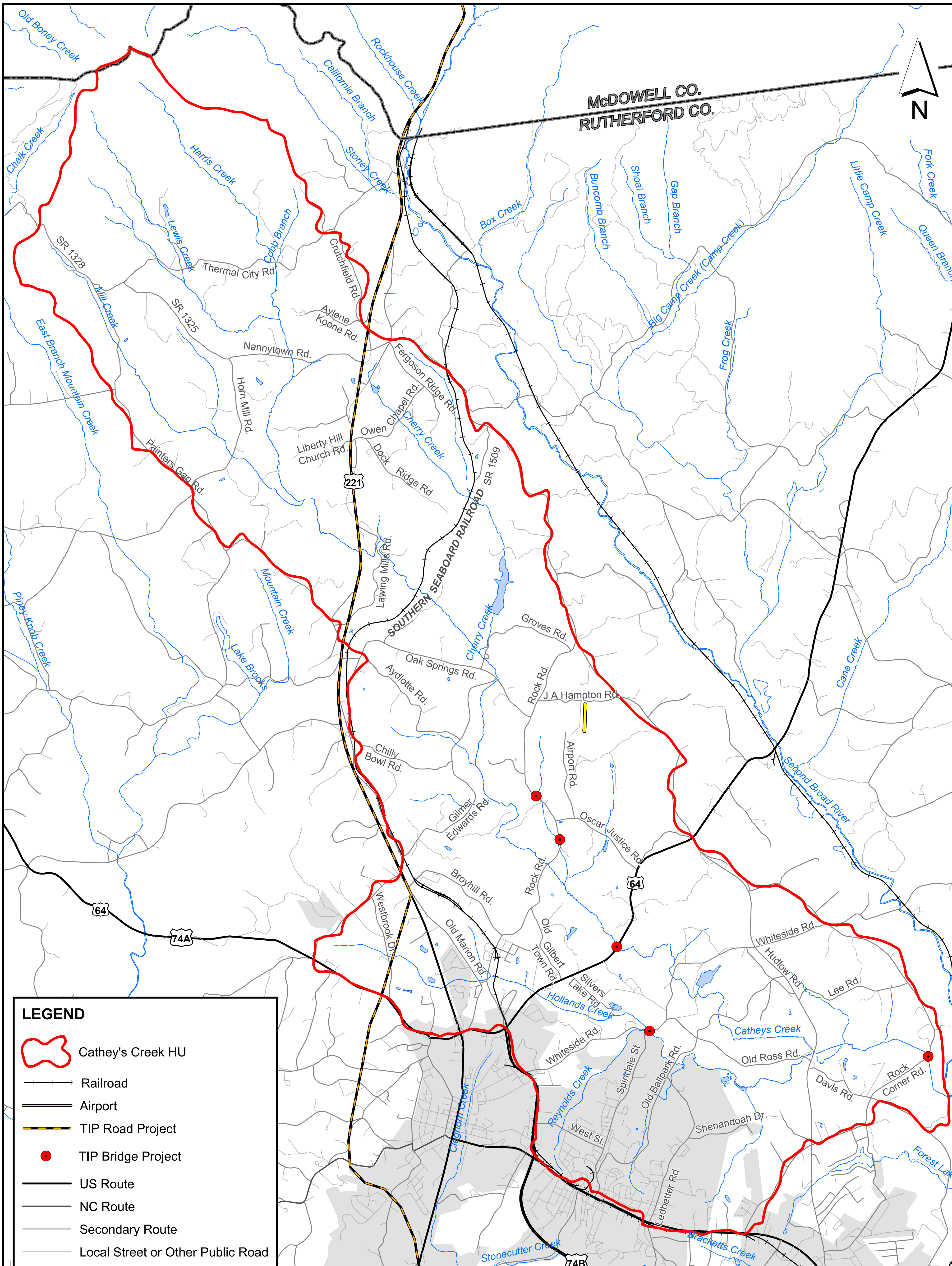
A Thoroughfare Plan was developed for the Rutherford County Urban Area to assess future transportation needs, while at the same time seeking to minimize adverse environmental effects (Statewide Planning Branch 1999). Rutherford County, Forest City, Ruth, Rutherfordton, and Spindale adopted the plan in September of 1999. The plan states that adequate transportation infrastructure is needed to support local and regional economies and without it industry and investors will turn to other areas. The improvements proposed by the plan are aimed at relieving congestion and improving safety by eliminating capacity deficiencies. There are 11 improvements proposed, but only two will affect the CCW. They are the widening of US 221 to four lanes throughout its length in the watershed and the addition of the Rutherfordton Bypass (US 221 Bypass), which will also be a four-lane facility. In addition to the roadway projects many of the bridges in the CCW are in need of repair or replacement.

4.4 BIOTIC CHARACTERISTICS

4.4.1 Plant Communities

For purposes of this report, all plant community descriptions were taken from published mapping and reports by various agencies. Nomenclature follows Radford et al. (1968). No fieldwork has been conducted to verify map units, which mostly describe mature or undisturbed conditions. Variations in stand age, level of disturbance, understory composition, or other factors are undetectable at the scale of available mapping.

Nearly three-fourths of the CCW is covered with natural vegetation in the form of evergreen, deciduous, and mixed forests and woody and emergent wetlands (**Table 6** and **Figure 5**). During the windshield survey of the basin, it was noted that many of the forest stands are relatively young, which is probably a reflection of the area's logging history.



NCDENR
Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
USGS Quadrangles

0 0.25 0.5 1 1.5 Miles

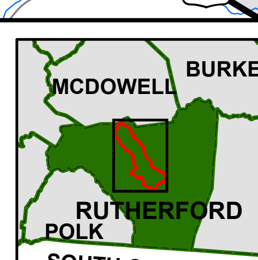


FIGURE 7
TRANSPORTATION INFRASTRUCTURE
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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Exotic invasive species including Japanese honeysuckle (*Lonicera japonica*), mimosa (*Albizia julibrissin*), Japanese grass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), Chinese privet (*Ligustrum sinense*), and kudzu (*Pueraria lobata*) are prominent throughout the watershed. Many fields are completely overgrown with kudzu. Albert Moore indicated that these fields probably had major erosion problems, and kudzu had been introduced by the Soil Conservation Service to reduce sediment loss (2003). Large stands of Chinese privet also are present along some streams. One knowledgeable landowner believes that those areas were formerly wetlands forested with typical bottomland hardwood species. Placer mining in the streams caused the streams to incise, thereby lowering the water table and reducing the frequency of overbank flooding. This alteration in hydrology gave the Chinese privet a competitive advantage over the native species (Interview with David Hargett, June 2003).

The map units used on the USGS land cover map (from which **Figure 5** is derived) are from the 21-category National Land Cover Data (NLCD) project (Vogelmann *et al*., 2001). The table below lists the categories of natural cover mapped in the CCW and used for description and analysis in this report. The NLCD categories are generic so that they can be applied throughout the country. Therefore, the descriptions used below were taken from draft information provided by the North Carolina Gap Analysis Project (NCGAP), which gives descriptions specific to land cover in North Carolina (McKerrow *et al.*, in preparation). NCGAP is producing a highly detailed land cover map of North Carolina that currently is being assessed for accuracy to the extent practicable through ground-truthing and expert review. The more-detailed NCGAP map units were cross-referenced to the NLCD map units, as well as to the National Vegetation Classification (NVC) (Natureserve, 2003) and to the familiar North Carolina Natural Heritage Program (NCNHP) community types. A table in **Appendix D** gives the complete cross-referencing for the map units present in the CCW. In addition, the corresponding narrative community descriptions from the NVC are provided following the table (based on Earth Tech's best professional judgment). These narratives describe the typical dominant species composition of the community, along with hydrology, landscape position, and soil type when possible. In lieu of field surveys, these community descriptions can be valuable for assessing habitat functions of the watershed and for predicting associated wildlife communities and potential habitat for threatened and endangered species.

Table 6. General Natural Cover Descriptions

NLCD Code	Unit Description
41 Deciduous Forest	Regenerating deciduous trees with a shrub stature. Commonly dominated by sweetgum, tulip poplars and maples.
	Generally post and blackjack oak dominated woodlands. White ash and pignut hickory can be found in combination with Eastern red cedar on glades.
	Primarily oak dominated forests, white oak is often dominant. Also represented by sweetgum and tulip poplar dominated forests.
	American beech-red oak-white oak Forests.
42 Evergreen Forest	Managed pine plantations, densely planted. Most planted stands are loblolly, but slash and longleaf occur as well.
	Dry to xeric pine forests dominated by Virginia pine, shortleaf pine or eastern red cedar.
	Loblolly dominated forests resulting from succession following clearing. This type occurs on all moisture regimes following disturbance with the exception of the extremely xeric sites.
43 Mixed Forest	Mixed forest dominated by yellow pines with drier oaks including southern red, post, and chestnut oaks.
	Mixed forests of the coastal plain and piedmont. Includes loblolly pine with white, southern red and/or post oak and loblolly with water oak. On basic sites of the Piedmont, eastern red cedar may co-occur with post, black, and blackjack oaks.
91 Woody Wetland	Riverside shrubs with temporarily flooded hydrologies. Found in the both the Mountains and Piedmont. Containing dominants such as smooth alder and Carolina or black willows.
	Saturated shrublands of the Piedmont, includes buttonbush, swamp-loosestrife, and alders.
	Includes temporarily to seasonally flooded forests dominated by hardwood species. Hardwoods include sweetgum, red maple, sycamore which co-occur in a mosaic of bottomland and levee positions. Includes alluvial hardwood forests in the mountains.
	The swamp chestnut oak, cherrybark oak, shumard oak and sweetgum alliance is one representative. Other alliances are dominated by water oak, willow oak, and overcup oak. Swamp forests can be dominated by sweetgum, red maple, and black gum being dominant.

Agricultural fields cover approximately 18 percent of the CCW. The map units and descriptions are listed in **Table 7** below. There are no NHP or NVC equivalents for these community types. As noted in Section 4.2.4, the row crops commonly planted in Rutherford County are cotton, corn, soybeans, and truck crops. Beef cattle graze pastures mainly planted in fescue.

Table 7. Agricultural Cover Descriptions

NLCD Code	Unit Description
81Agriculture-Hay, Pasture	Farm fields used for pasture grass or hay production, as well as old fields dominated by native and exotic grasses.
82 Agriculture-Row Crops	Farm fields used for row crops.

4.4.2 Terrestrial Wildlife Communities

Species that prefer open habitat for feeding and nesting can be found in any of the cover types listed in **Table 4** as Cultural or Agricultural. The faunal species present in these disturbed habitats are opportunistic and capable of surviving on a variety of resources, ranging from vegetation to both living and dead faunal components. The European starling (*Sturnus vulgaris*) and American robin (*Turdus migratorius*) are common birds that use Cultural or Agricultural habitats to find insects, seeds, or worms. The five-lined skink (*Eumeces inexpectatus*) may bask on sunny tree trunks or fence posts near Cultural or Agricultural areas, while the Eastern bluebird (*Sialis sialia*) may utilize fences as well, for perching and preening. The American crow (*Corvus brachyrhynchos*) and the Virginia opossum (*Didelphis virginiana*) are true opportunists. They will often visit Cultural and Agricultural habitats and forage on virtually any edible items including vegetation, fruits, seeds, insects, and carrion.

Many species are highly adaptive and may use the edges of forests and clearings or prefer a mixture of habitat types. The Eastern cottontail (*Sylvilagus floridanus*) prefers a mix of herbaceous and woody vegetation and may be found in the dense shrub vegetation or out in open roadsides, and residential areas noted in **Table 4** as Natural, Cultural and Agricultural. White-tailed deer (*Odocoileus virginianus*) also use the forested areas as well as the adjacent open areas. The black rat snake (*Elaphe obsoleta*) will come out of any variety of Natural habitats to forage on rodents in open Agricultural and Cultural areas. They attain the greatest densities where forests and farmlands are intermixed. Indigo bunting (*Passerina cyanea*) and common yellowthroat (*Geothlypis trichas*) are Neotropical migrants that inhabit dense, shrubby vegetation along transitional areas. Any number of Natural habitats at the appropriate density that are in close proximity to Agricultural or Urban grasses for foraging would qualify. The blue jay (*Cyanocitta cristata*), song sparrow (*Melospiza melodia*), eastern towhee (*Pipilo erythropthalmus*) and Eastern bluebird can be seen traveling from their preferred Natural deciduous or mixed deciduous forest habitat to Agricultural and Cultural edge habitat for foraging all year round.

The various forest types classified as Natural cover types in **Table 4** (detailed in **Appendix D)** are important habitat for many wildlife species, providing crucial foraging, nesting, and/or denning areas. Neotropical migratory birds, in particular, are dependent on these areas when they are of sufficient size and quality. Species such as the Acadian flycatcher (*Empidonax virescens*) and the Louisiana waterthrush (*Seiurus motacilla*) thrive in forested riparian areas composed of deciduous species, whereas the black-and-white warbler (*Mniotilta varia*), black-throated green warbler (*Dendroica dominica*), and the red-eyed vireo (*Vireo olivaceous*) prefer the upland deciduous and mixed forest types. Species such as the downy woodpecker (*Picoides pubescens*), Carolina chickadee (*Parus carolinensis*), and the tufted titmouse (*Parus bicolor*) are found in deciduous or mixed forest areas throughout the year. All three species also commonly occur in wooded Cultural cover types. Species such as the fence lizard (*Sceloporus undulates*) and the pine warbler (*Dendroica pinus*) prefer evergreen forest for both shelter and foraging. Pine warblers typically forage in the crowns of pine trees for insects and small seeds, but occasionally can be found on the ground searching for insects and seeds.

In the leaf litter of the deciduous forested habitats, the Northern short-tailed shrew (*Blarina brevicauda*) and the white-footed mouse (*Peromyscus leucopus*) may be found. The gray squirrel (*Sciurus carolinensis*) is often observed foraging in wooded areas consisting of deciduous and mixed deciduous forest types, both on the ground and in trees. The spring peeper (*Hyla crucifer*) and the five-lined skink (*Eumeces fasciatus*) can be found under forest litter and in brushy undergrowth in deciduous forests often near small streams or standing water. The Eastern box turtle (*Terrapene carolina*) is a highly adaptable terrestrial turtle. It is found in deciduous, evergreen, and mixed forests and is often found near streams in hot, dry weather. The deciduous and mixed forest wetland habitats are especially appealing to mud salamanders (*Pseudotriton montanus*) and southern cricket frogs (*Acris gryllus*). Nomenclature and habitat characteristics follow American Ornithologists' Union (2002), Conant and Collins (1998), Martof *et al.* (1980), and Webster *et al.* (1985).

4.4.3 Aquatic Communities

The uppermost reaches of the CCW are comprised of high-gradient, first-order streams dominated by step-pool sequences. These streams typically have bedrock substrates and cascading reaches, with frequently spaced, deep pools. Substrates characteristic of this stream type are cobble with small amounts of sand and other fine particulate matter. First-order streams of this type in the Piedmont typically support viable populations of yellowfin shiner (*Notropis lutipinnis*), and fantail darter (*Etheostoma flabellare*). The riparian community consists mostly of deciduous trees and mixed evergreen-deciduous shrubs, as described in Section 4.3.3.

In the CCW, second-order streams are characterized by a moderate gradient with a well-defined riffle-pool sequence. Substrates characteristic of this stream type are dominated by gravel and pebbles, with deposits of fine particulates in pools and point bars. Second-order streams of this type in the Piedmont typically support viable populations of bluehead chub (*Nocomis leptocephalus*), creek chub (*Semotilus atromaculatus*), and white sucker (*Catostomus commersoni*). The riparian community is mostly pasture grasses and mixed evergreen-deciduous shrubs, as described in Section 4.3.3.

Cathey's Creek becomes a third-order stream at its confluence with Holland's Creek. At this point Cathey's Creek has a well-defined channel and moderate to low gradient, with bed material consisting mostly of sand. The riffle-pool sequence throughout this section is not well defined. According to a communication from Win Taylor, District 8 Biologist for the WRC, Cathey's Creek supports a viable population of redbreast sunfish (*Lepomis auritus*) and smallmouth bass (*Micropterus dolomieu*). The riparian community is mostly urban in nature with deciduous trees and mixed evergreen-deciduous shrubs, and is described in Section 4.3.3. Nomenclature and habitat conditions follow Menhinick (1991) and Rohde *et al*. (1994).

Detailed information on benthic macroinvertebrate communities can be found in the DWQ monitoring report in **Appendix F.**

Historic flood control measures and farm activities have resulted in the creation of a number of variably sized ponds throughout the Cathy's Creek watershed on streams of all order classes. While these ponds have created a unique deepwater habitat in their respective stream complex, they have also added several notable obstacles. The dams restrict upstream migration for a variety of species, separating fishes from potential breeding habitat. The siltation that is associated with the slowing of water within a pond will change the aquatic vegetation complex in that specific area. This also creates a cache of sediment that could be delivered downstream during a flood event or in the event of a dam failure. These are some of the most notable of the potential problems associated with the ponds in the CCW. However, other problems are often created when a stream is dammed to create an impoundment.

4.4.4 Endangered Species

Plants and animals with a federal classification of Endangered (E), Threatened (T), Proposed Endangered (PE), and Proposed Threatened (PT) are protected under provisions of Section 7 and Section 9 of the Endangered Species Act of 1973, as amended.

The USFWS lists 5 species under federal protection for Rutherford County as of February 25, 2003 (USFWS 2003). These species are listed in **Table 8**. Complete species accounts are given in **Appendix E**. No occurrences of these species are on record at NHP as occurring within the CCW. However, potential habitat for the dwarf-flowered heartleaf is likely present in the basin. Two of the specific soil types it requires, Madison and Pacolet, are present in the basin. Habitat for the small whorled pogonia may also be present in the forested areas with an open understory.

Table 8. Species Under Federal Protection in Rutherford County

Common Name	Scientific Name	Status
Vertebrates		
Indiana bat	*Myotis sodalis*	Endangered
Vascular Plants		
Dwarf-flowered heartleaf	*Hexastylis naniflora*	Threatened
Small whorled pogonia	*Isotria medeoloides*	Threatened
White irisette	*Sisyrinchium dichotomum*	Endangered
Nonvascular Plants		
Rock gnome lichen	*Gymnoderma lineare*	Endangered

Federal Species of Concern (FSC) are not legally protected under the Endangered Species Act and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. **Table 9** shows FSC species listed for Rutherford County and whether habitat is present in the CCW. No FSC species are currently recorded as occurring in the CCW according to NHP records. However, the NVC indicates that sweet pinesap (*Monotropsis odorata*) is associated with a deciduous forest type [I.B.2.N.a.36 *Quercus prinus*-(*Quercus coccinea, Quercus velutina*) Forest Alliance] that occurs in the CCW.

Table 9. Federal Species of Concern

Common Name	Scientific Name	Habitat Present
Vertebrates		
Cerulean warbler	*Dendroica cerulea*	No
Eastern small-footed myotis	*Myotis leibii*	Yes
Green salamander	*Aneides aeneus*	No
Northern pine snake	*Pituophis melanoleucus melanoleucus*	No
Southern Appalachian woodrat	*Neotoma floridana haematoreia*	No
Invertebrates		
Diana fritillary butterfly	*Speyeria diana*	No
Vascular Plants		
Butternut	*Juglans cinerea*	Yes
Carolina saxifrage	*Saxifraga caroliniana*	No
Divided-leaf ragwort	*Senecio millefolium*	No
Granite dome goldenrod	*Solidago simulans*	No
Mountain catchfly	*Silene ovata*	No
Sweet pinesap	*Monotropsis odorata*	Yes

Organisms that are listed as Endangered (E), Threatened (T), or Special Concern (SC) on the North Carolina Natural Heritage Program listsof rare plant and animal species (Amoroso 2002 LeGrand *et al.* 2001) are afforded state protection under the State Endangered Species Act and the North Carolina Plant Protection and Conservation Act of 1979. Fifty-two species occur on the State list for Rutherford County. This list is included in **Appendix E**. According to NHP records, the Santee chub (a small fish) (SR) is known to occur in Cathey's Creek in the vicinity of Oak Springs Road.

4.5 WATER QUALITY

4.5.1 Best Usage Classifications

Surface waters in North Carolina are assigned a classification by the Division of Water Quality (DWQ) that is designed to maintain, protect, and enhance water quality within the state (NCDENR 2003a). The streams in the CCW are all classified as either *WS-V* or *Class C* as shown in **Table 10** below and on **Figure 8**. *Class C* waters are protected for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. There are no restrictions on watershed development activities. *WS-V* waters are waters that are protected as water supplies which are generally upstream and draining to Class WS-IV waters or waters previously used for drinking water supply purposes or waters used by industry to supply their employees, but not municipalities or counties, with a raw drinking water supply source, although this type of use is not restricted to WS-V classification. Class WS-V waters are suitable for all Class C uses. Waters of this class are protected water supplies; and following treatment are considered safe for drinking, culinary, or food-processing purposes

Table 10. Best Usage Classifications

Waterbody	Description	Class	Index No.
Cathey's Creek	From source to dam at old Duke Power Co.'s Raw Water Supply Intake	WS-V	9-41-13-(0.5)
Cathey's Creek	From dam at old Duke Power Co. Raw Water Supply Reservoir to Second. Broad River	C	9-41-13-(6)
Lewis Creek	From source to Cathey's Creek	WS-V	9-41-13-1
Harris Creek	From source to Cathey's Creek	WS-V	9-41-13-2
Cobb Branch	From source to Harris Creek	WS-V	9-41-13-2-1
Mill Creek	From source to Cathey's Creek	WS-V	9-41-13-3
Cherry Creek	From source to Cathey's Creek	WS-V	9-41-13-5
Holland's Creek	From source to Duke Power Co. old Auxiliary Raw Water Supply Intake	WS-V	9-41-13-7-(1)
Reynolds Creek	From source to Holland's Creek	C	9-41-13-7-2

The total length of WS-V streams is 483,946 feet (91.7 miles). The total length of Class C streams is 152,528 feet (28.9 miles).

4.5.2 NPDES Sites

Point source discharges in North Carolina are regulated through the National Pollutant Discharge Elimination System (NPDES) program administered by the DWQ. A NPDES permit must be obtained to discharge pollutants from a point source directly into waters of the United States. Point sources may include direct industrial discharge and municipal wastewater containing pollutants such as human wastes, toxic chemicals and metals, fecal coliform, oil and grease, pesticides, and food wastes.

Three individual wastewater discharge permits have been issued in the CCW (NCDENR 2002b). These permits are listed in **Table 11** below and their locations are mapped on **Figure 8**.

Four facilities in the CCW experienced problems complying with NPDES permit limits over the most recent two-year review period. The facilities were the Spindale WWTP, Central School, White Oak Manor, and United World Mission. Problems were addressed by operational changes at each facility and all are currently in full compliance with their permits.

According to the Broad River Basinwide Assessment Report (NCDENR 2001a), the Spindale Wastewater Treatment Plant had problems with toxic effluent for over 10 years before upgrading its process and moving its discharge from Holland's Creek to Cathey's Creek in 1998. In 1999, the facility still failed two out of four toxicity tests, but this was a lower failure rate than before the upgrade. Holland's Creek has shown signs of recovery since the removal of the discharge, with its EPT rating increasing from a low Poor in 1988 to a high Fair in 2000. However, sampling at Cathey's Creek below the discharge in 2000 revealed an elevated conductivity reading and clear but plum-colored water. The fish community was rated Poor and the benthic macroinvertebrate rating was Fair. Details of these studies can be found in the Basinwide Assessment Report in **Appendix F**.

Table 11. NPDES Individual Wastewater Discharge Permits

Permit	Owner	Facility	Type	Class	Flow (gal/day)	Receiving Stream	Status
NC0030139	White Oak Manor	White Oak Manor-Rutherfordton	100% Domestic < 1MGD	Minor	15000	Catheys Creek	Active
NC0020664	Town of Spindale	Spindale WWTP	Municipal, Large	Major	4500000	Catheys Creek	In review
NC0032174	United World Mission	United World Mission	100% Domestic < 1MGD	Minor	20000	Cherry Creek	In review

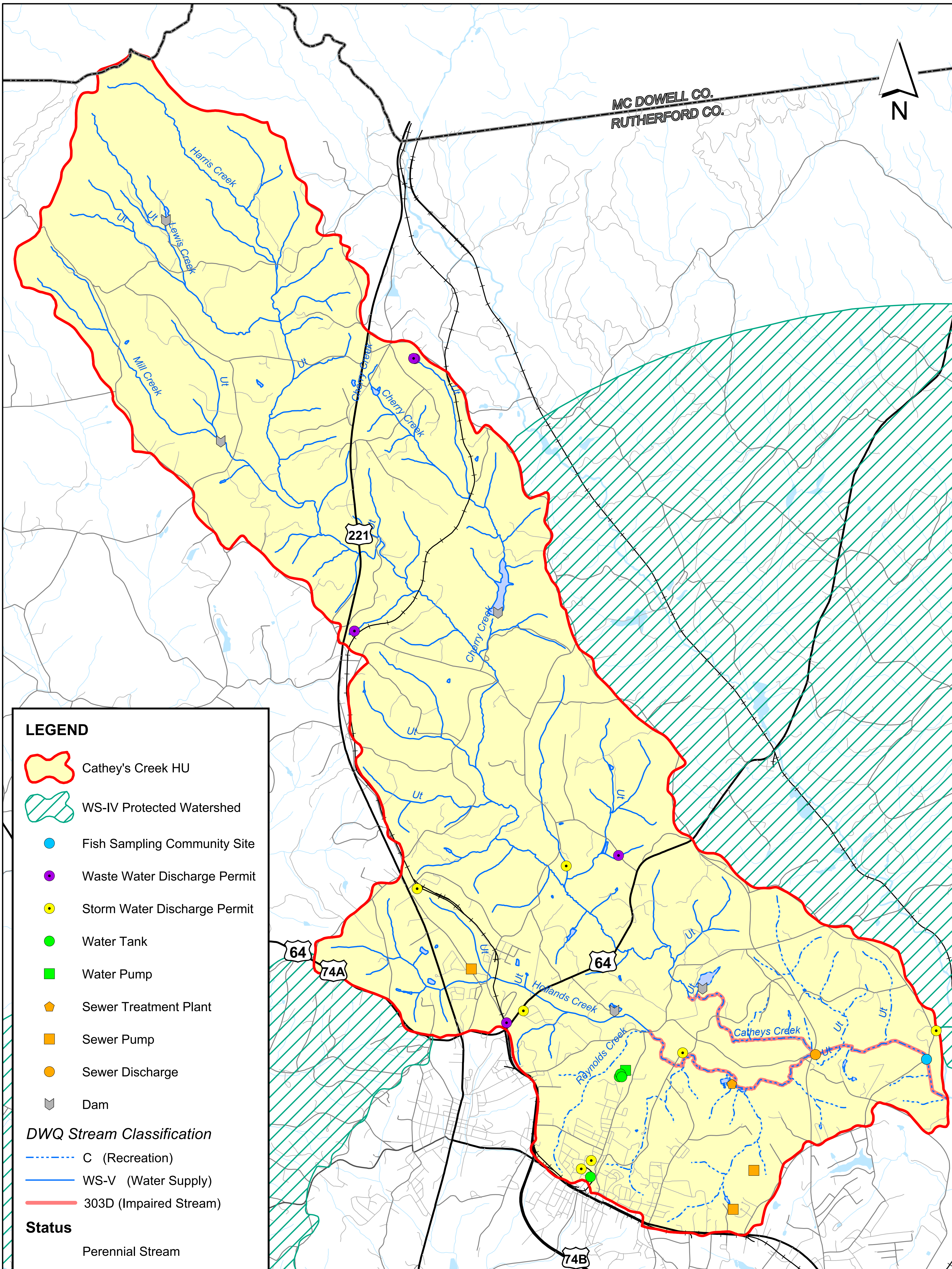
NPDES Wastewater Discharge General Permits are issued for one of five given state-wide activities such as the discharge of wastewaters associated with sand dredging or discharge of wastewaters associated with petroleum-based groundwater remediation. One general wastewater discharge permit has been issued in the CCW (NCDENR 2001b). This permit is listed in **Table 12** below and is mapped on **Figure 8.**

Table 12. NPDES Wastewater Discharge General Permits

COC* Number	Facility	Address
NCG500278	Gilkey Lumber Company Incorporated	2250 U.S. 221 North
Permit Type	Non-contact cooling water, boiler blowdown, cooling tower blowdown, condensate, cooling water associated with hydroelectric dams	

*Certificate of Coverage

The NPDES stormwater management program regulates point source discharges of stormwater from specific activities that have been identified as having significant pollution potential. Eight general stormwater permits have been issued in the CCW (NCDENR 2002d). These permits are listed below in **Table 13** and their locations are mapped on **Figure 8.** The Gilkey Lumber Company stormwater permit is in the same location as its wastewater permit, so only one symbol is visible on the map.



NCDENR
Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1; USGS Quadrangles; NCDOT GIS Unit; NCDENR

0 0.25 0.5 1 1.5 Miles

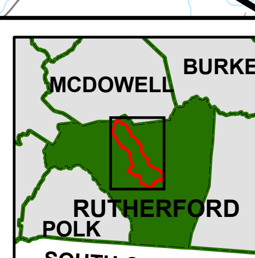


FIGURE 8
WATER QUALITY
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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Table 13. NPDES Stormwater Discharge General Permits

COC_number	Facility	Address
NCG180074	Broyhill Furniture Ind Incorporated	300 Broyhill Rd
NCG170114	Four Leaf Textiles LLC	Oxford St
NCG170113	Stonecutter Realty LLC	Yelton St
NCG210218	Gilkey Lumber Company Inc	2250 U.S. 221 North
NCG100108	Logan's Used Car Parts & Svc	990 Old Ballpark Rd
NCG210356	Parton Lumber Company Incorporated	251 Parton Rd
NCG100107	Mount Vernon Motors	3080 Upper Hudlow Rd
NCG100106	Bud's Junk Yard	700 Rock Corner Rd

Phase I of the NPDES Stormwater program was signed into law in 1990, which requires permits for large or medium municipalities with populations of 100,000 people or more (NCDENR 2003c). Phase II was signed into law in December 1999 with additional smaller communities added to the list requiring permits. Phase II requires small MS4s (municipal separate storm water sewer systems) to be permitted. To be included in the Phase II program a small MS4 is either automatically designated by the state, or by petition (NCDENR 2003c). As of this report, no cities or towns within CCW were listed on the EPA's Identified Phase II Counties and Municipalities in N.C. list (2003b).

4.5.3 Non-Point Source

Unlike pollution from industrial and sewage treatment, non-point source (NPS) pollution comes from many non-discrete sources. As runoff from rainfall or snowmelt moves over the earth's surface, natural and man-made pollutants are picked up, carried, and ultimately deposited into lakes, rivers, wetlands, and groundwater. NPS pollution includes fertilizers, herbicides, and insecticides from farms and residential areas; hydrocarbons and chemicals from urban runoff and industrial sites; sediments from construction sites, land clearing, and eroding stream banks; bacteria and nutrients from livestock, animal wastes, and faulty septic systems; and atmospheric deposition. The effects of NPS pollutants on water resources vary, and in many instances, may not be fully understood. These pollutants generally have harmful effects on drinking water supplies, recreation, wildlife, and fisheries (USEPA 1994).

During the field visits, visual observations of potential NPS pollution sources were documented. Atmospheric deposition from vehicles; overland erosion; erosion from stream banks; fertilizers, herbicides, and insecticides from residential and agricultural areas; and hydrocarbon and chemical runoff from industrial and residential driveways and parking lots were identified as potential sources of NPS pollution in the watershed.

4.5.4 Monitoring Stations

Benthic macroinvertebrates collected on Cathey's Creek at SR 1549 and Holland's Creek at SR 1548 in 1995 and 2000 received bio-classifications of Fair (NCDENR, 2002a). The Town of Spindale's wastewater treatment plant and non-point source runoff impact these two creeks. A Poor rating was assigned to fish communities in Cathey's Creek at SR 1549 during a survey in 2000 (NCDENR 2001a), another indicator of water quality problems in Cathey's Creek. No water chemistry samples were collected in the CCW. Cathey's and Holland's Creeks are impaired for aquatic life and secondary recreational uses. Further details about the monitoring history and results in the CCW can be found in the Broad River Basinwide Assessment Report (NCDENR 2001a) and in the DWQ monitoring report in **Appendix F.**

4.5.5 303 (d) Waters

North Carolina's §303(d) List (NCDENR 2002) is an accounting of all impaired waterbodies. An impaired waterbody is one that does not meet water quality standards. The source of impairment might be from point sources, non-point sources, and atmospheric deposition (NCDENR 2002).

Two streams in the CCW appear in Part 5 of the 2000 §303(d) List. Part 5 constitutes about half of the entire §303(d) list and covers biologically impaired waterbodies with no identified cause of impairment. Cathey's Creek, from the dam at the old Duke Power Company reservoir to the Second Broad River, is listed as impaired because of sediment, with agriculture and indirect discharges as potential sources. Holland's Creek, from the old Duke Power Company auxiliary raw water supply intake to Cathey's Creek, is listed as impaired because of unknown causes, with indirect discharges as a potential source. These impaired segments are shown on **Figure 8**.

4.5.6 Use Support Ratings

Cathey's Creek (1.9 miles from the confluence with Holland Creek to the Second Broad River) was rated impaired, partially supporting, based on three benthic macroinvertebrate samples collected between 1988 and 1995 (NCDENR 2002a). Habitat degradation is the listed impairment. The Spindale wastewater treatment plant (WWTP), non-point sources including agriculture and urban runoff, and habitat problems including sedimentation and lack of pools and riffles are the potential causes of impairment.

Holland's Creek (2.8 miles from 0.4 miles downstream of Rutherford County SR 1538 to confluence with Cathey's Creek) was rated impaired, non-supporting, based on data that are greater than five years old. At that time, it was the receiving stream for the Spindale WWTP. In 1999, the WWTP relocated its discharge from Holland's Creek to Cathey's Creek and made plant upgrades that improved the water quality of Holland's Creek and improved the quality of the effluent. The improvements have increased the water quality of Holland's Creek, but it still receives stormwater and other non-point sources of pollution. Habitat degradation including sedimentation, embedded riffles, and filled-in pools has been noted in the stream. For these reasons, it is still considered impaired.

4.5.7 Basin-Wide Report

The Environmental Management Commission approved the second Broad River Basin-Wide Water Quality Plan in February of 2003. The goals and objectives of the basinwide plan are described in **Appendix G**. The CCW is located in the Broad River Subbasin 03-08-02, which includes the middle portion of Broad River, Walnut Creek, Mountain Creek, lower Green River, and the Second Broad. Cathey's Creek empties in to the Second Broad near Cool Spring, north of Forest City. According to the report, the greatest water quality problems appear to be associated with the non-point sources of pollution from the urban areas of Rutherfordton, Spindale, and Forest City.

5.0 EXISTING WATERSHED IMPROVEMENT PROGRAMS

There are 15 existing watershed improvement programs within the Broad River Basin that can affect the CCW. The programs range from those originating from the federal Clean Water Act to ones that local landowners organized to monitor land use practices that affect water quality. A list of the programs can be found below in **Table 14**. The local NRCS office has been utilizing all of the USDA's programs throughout the watershed under the direction of the Rutherford County Conservation District (USDA-NRCS 2003). The focus within the county now is on stream bank stabilization and livestock exclusion through the Environmental Quality Improvement Program (EQIP). Many of the other programs focus on obtaining easements on land for its protection and preservation. The Rutherford County Drinking Water Protection Project is of particular interest. A technical committee has produced a document with recommendations that include engineered, planning, education, and regulatory measures. No watershed protection ordinances currently exist beyond the state regulations that apply to water supply watersheds. A complete summary of the programs can be found in **Appendix G**.

Table 14. Existing Watershed Improvement Programs

Federal
Clean Water Act - Section 319 Program
USDA - NRCS Environmental Quality Improvement Program
Rutherford County Drinking Water Protection Project
State
Broad River Basinwide Water Quality Plan
Clean Water Management Trust Fund
NC Agriculture Cost Share Program
Wildlife Resources Commission Fisheries Management Division
Regional/Local
Rutherford County Soil and Water Conservation District
Mountain Valleys RC&D
Conservation Trust for North Carolina
Carolina Mountain Land Conservancy
Foothills Conservancy
Volunteer Water Information Network
The Nature Conservancy
The Concerned Citizens of Rutherford County's Forest Watch Program

The watershed assessment process should focus on combining the goals of these various programs together to meet common objectives and share their valuable resources. Many of these group's leaders may participate in the watershed management plan advisory committee.

6.0 WATERSHED FUNCTIONAL ANALYSIS

6.1 PROCEDURES

The CCW was delineated into sub-watersheds (SWs) of approximately 2 to 4 square miles for the functional analysis. The delineation resulted in a total of 14 sub-watersheds within the CCW. **Figure 9** shows the delineated SWs labeled with their names and drainage areas.

Cathey's Creek is the main drainage in seven of the SWs. Holland's Creek is the main drainage of the three SWs that drain the northern portions of Rutherfordton, Spindale, and Forest City. The remaining SWs drain Mill Creek, Harris Creek, Cherry Creek, and the area surrounding the airport. The SWs are numbered from the western boundary to the eastern boundary in the downstream direction.

The next step in the analysis process involved examining the watershed functions and sub-functions developed by the Ecosystem Enhancement Program (EEP) committees. Indicators of the status of these functions were developed for each of the functions and sub-functions where available. With the type of data available in the GIS system, the analysis of the SWs is limited to the three main watershed functions. Some of the indicators are simple values that are obtained from attribute tables in the GIS, whereas others are derived from overlays and calculations using the data in the GIS. Percentages are based on total surface water length in a SW or total SW area.

A matrix of the SWs and chosen indicators was developed. The matrix was then populated with the appropriate values using the GIS data and calculations. These values included the following:

- Percent area of different cover types (forested, wetland, impervious, forest interior)
- Percentage of surface waters classified as Impaired
- Number of wildlife corridors (corridors (forested areas at least 600 feet wide connecting large patches of forest)
- Area and number of interior patches (forested patches that are at least 74 acres in size after buffering inward 300 feet to account for edge effects)

Figures 10 and **11** depict some of these indicators. The raw data are provided in **Appendix H.**

The SWs were then ranked for each indicator with a value of 1 to 14, with lower values indicating higher functional status. Once the SW rankings for each of the indicators were determined, an average rank for each major function was calculated. The indicator ranks summed and averaged for each major function were as follows:

Water Quality

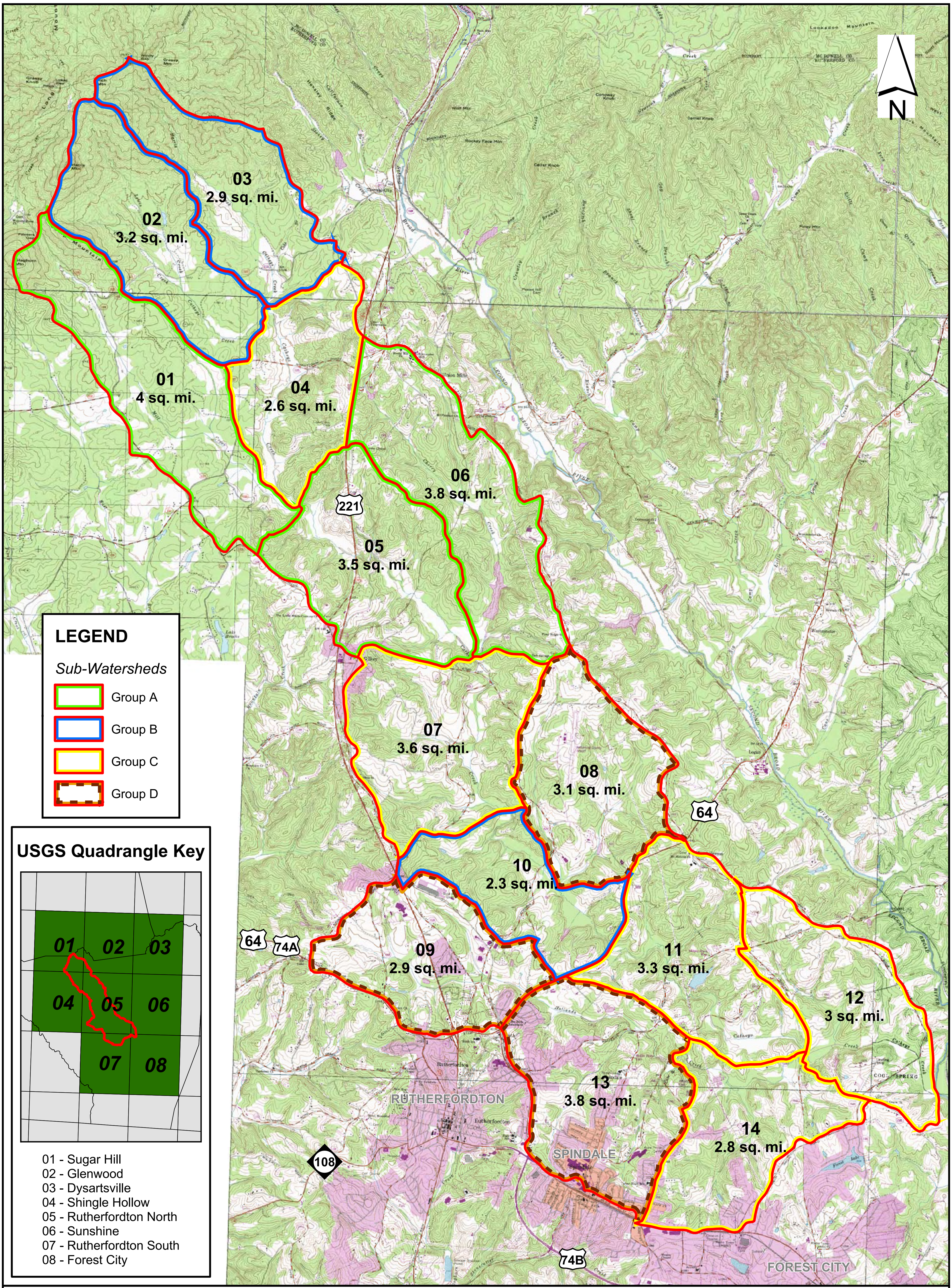
- percentage of forested area
- percentage of impervious area
- presence of impaired streams
- percentage of wetlands
- percentage of buffer-protected stream length

Hydrology

- percentage of forested cover
- percentage of impervious cover
- percentage of wetlands
- percentage of buffer-protected stream length

Habitat

- percentage of forested cover
- percentage of wetland area
- percentage of buffer-protected stream length
- percentage of interior area
- number of wildlife corridors
- number of patches classified as interior area



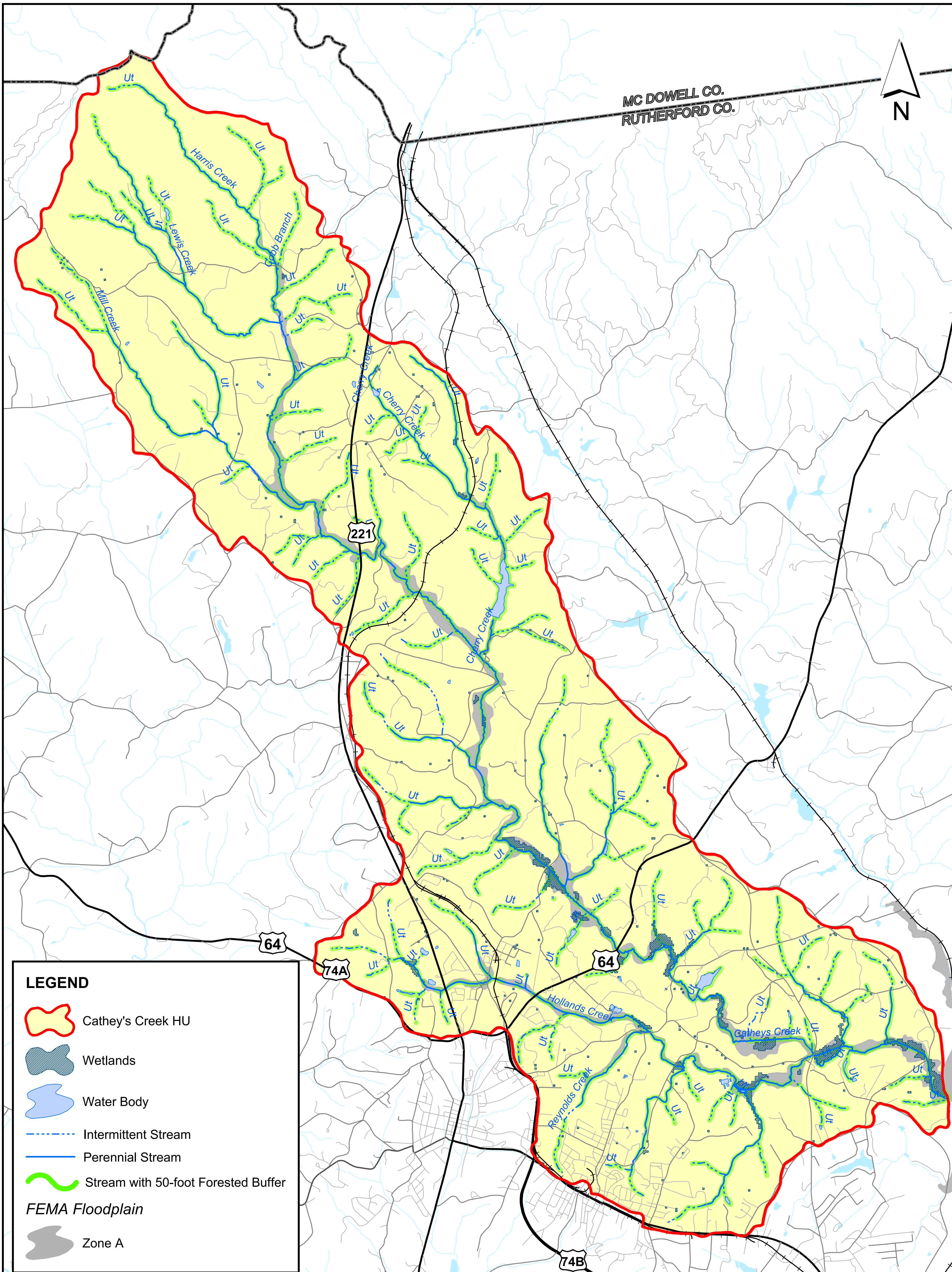
NCDENR
Ecosystem Enhancement Program

Source:
USGS Quadrangles:
Rutherfordton South, NC 1993;
Rutherfordton North, NC 1993;
Sunshine, NC 1965; Forest City, NC 1993;
Glenwood, NC 1993; Shingle Hollow, NC 1982
Sugar Hill, NC 1985; Dysartsville, NC 1993

0 0.25 0.5 1 1.5 Miles

FIGURE 9
SUB-WATERSHED DIVISIONS
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

K:\61794\GIS\FiguresRev1\f09_Sub-wshed.mxd 3/04



NCDENR
Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1; USGS; USGS Quadrangles; NCDOT GIS Unit; FEMA

0 0.25 0.5 1 1.5 Miles

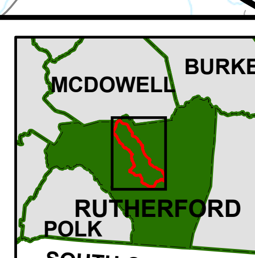


FIGURE 10 - HYDROLOGY AND WATER QUALITY FUNCTION INDICATORS

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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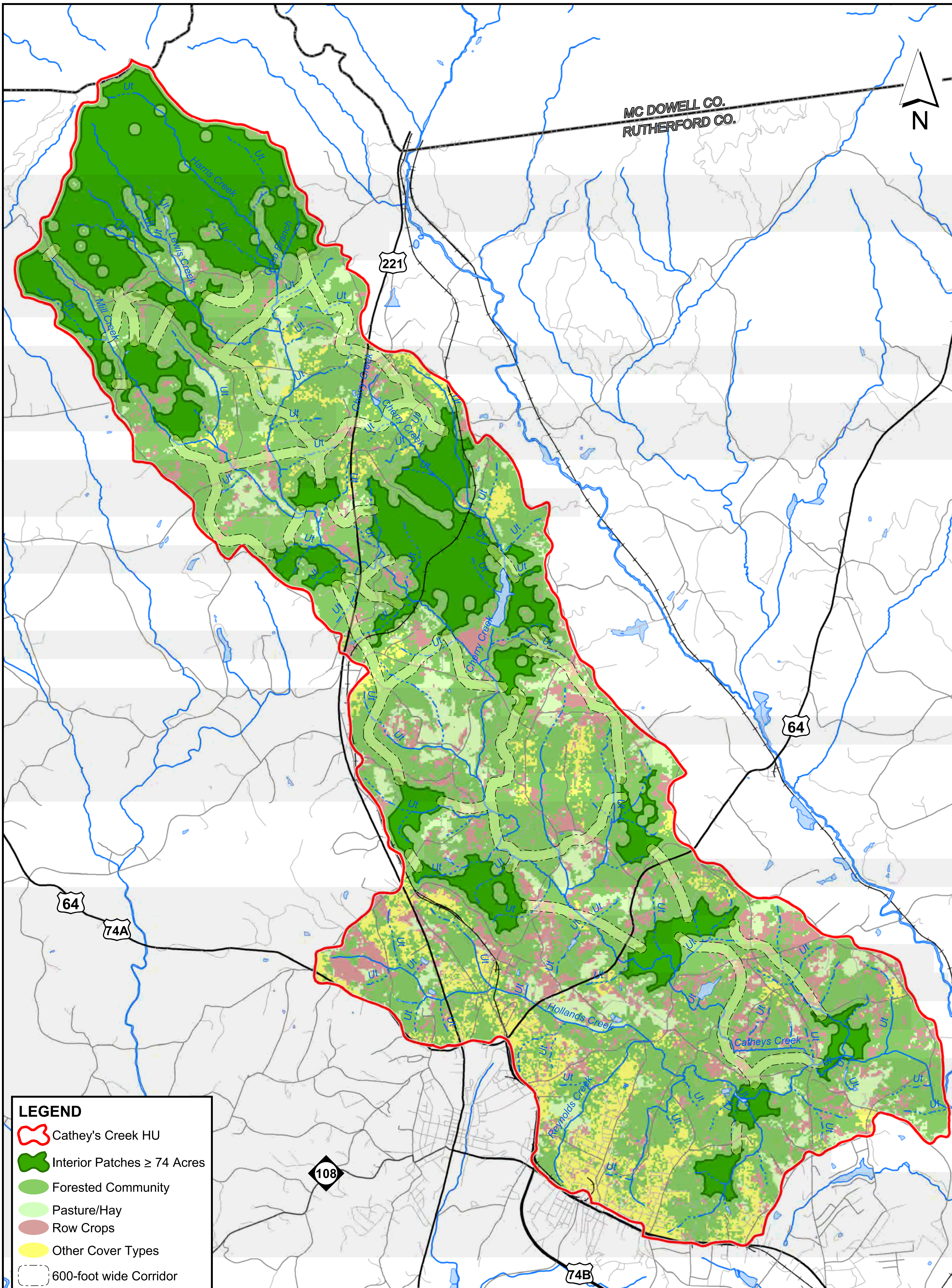
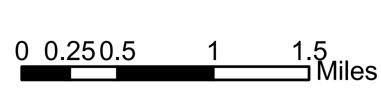


NCDENR
Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
NCDOT GIS Unit



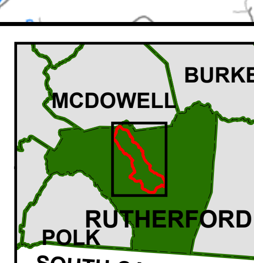


FIGURE 11
HABITAT FUNCTION INDICATORS
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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Water quality functions were assessed by evaluating relative amounts of forested area and cleared or impervious area, length of stream protected by a forested buffer, and length of stream classified as impaired. It was assumed that the highest level of water quality function would be achieved with 100% forested cover, 100% buffer protection, less than 12% impervious cover, and no streams classified as Impaired. These assumptions do not take into account the range of variation within which full function may be achieved, nor do they account for the possibility that sustainability may be achieved at lower levels of function.

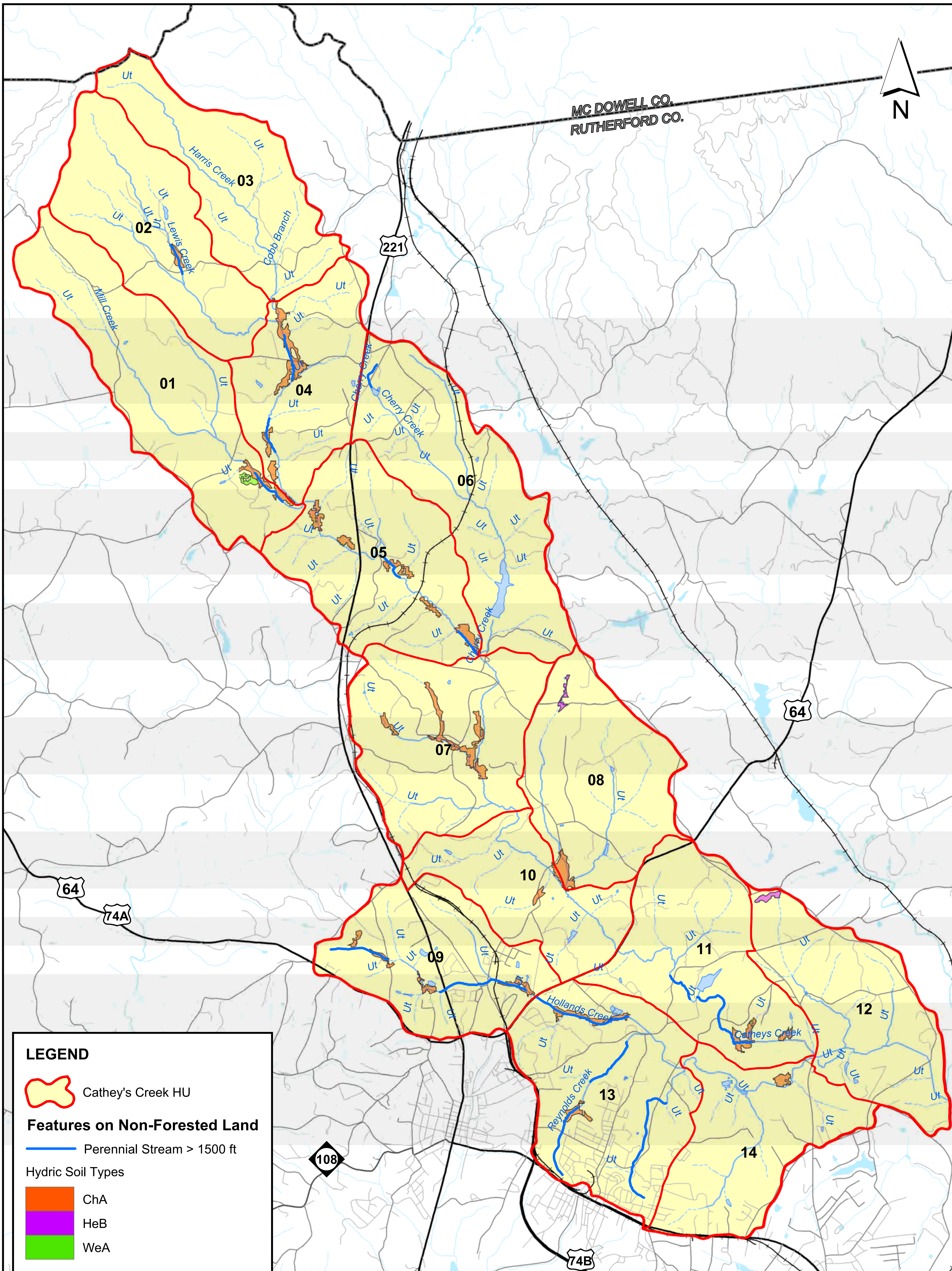
Hydrology functions were assessed by evaluating relative areas of forested area and cleared or impervious area, length of stream protected by a forested buffer, area of ponds, and area of wetlands. The assumptions for forested and impervious area and buffered stream length are the same as noted above. Ponds and wetlands are present throughout the watershed and presumably are performing storage and flow moderation functions. However, without a reference watershed, it is difficult to judge with the available data what level of function the area of ponds and wetlands provide for the watershed as a whole. Gage data or accounts of flood damage would provide more insight into this function, but were not available.

Habitat functions were assessed by evaluating relative areas of forest and cleared land, area of wetlands, buffered stream length, size of forest interior patches, and presence of suitable corridors between the large patches. The presence of forest patches with greater than 74 acres of interior area with at least one connection to another large patch implies the ability of the watershed to support a variety of species, including habitat specialists and wide-ranging species. However, without reference standards or a census of the wildlife population, it is difficult to assess the level of this function in the CCW. An anecdotal indicator that wildlife habitat may be insufficient is the presence of nuisance predation in the watershed. Landowners have complained of coyote incursions into farmlands and predation of domesticated livestock.

Stream reaches and hydric soils in cleared areas were targeted as degraded areas of interest for further analysis and potential watershed improvements. These degraded areas were identified using the GIS procedures described in Section 2.2.3 and are discussed in the following sections. **Figure 12** shows the locations of these degraded areas within the CCW. **Figures 13 A-N** show aerial photography of the individual SWs and the locations of the potential watershed improvements.

6.2 RESULTS

The functional analysis calculations resulted in an average rank for each of the 14 SWs for each of the three main ecological functions. These three average ranks were summed to obtain an overall functional score for each of the SWs. **Table 15** below shows the ranks for each indicator, the average ranking for each main watershed function, and the overall functional score for each SW. The functional scores clustered into four groups distinguished by shared characteristics, which are described below.



NCDENR
Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1; USGS Quadrangles; NCDOT GIS Unit; NCDENR

0 0.25 0.5 1 1.5 Miles

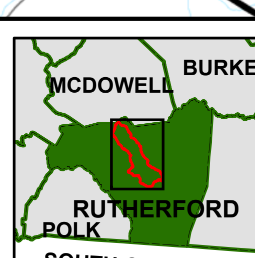
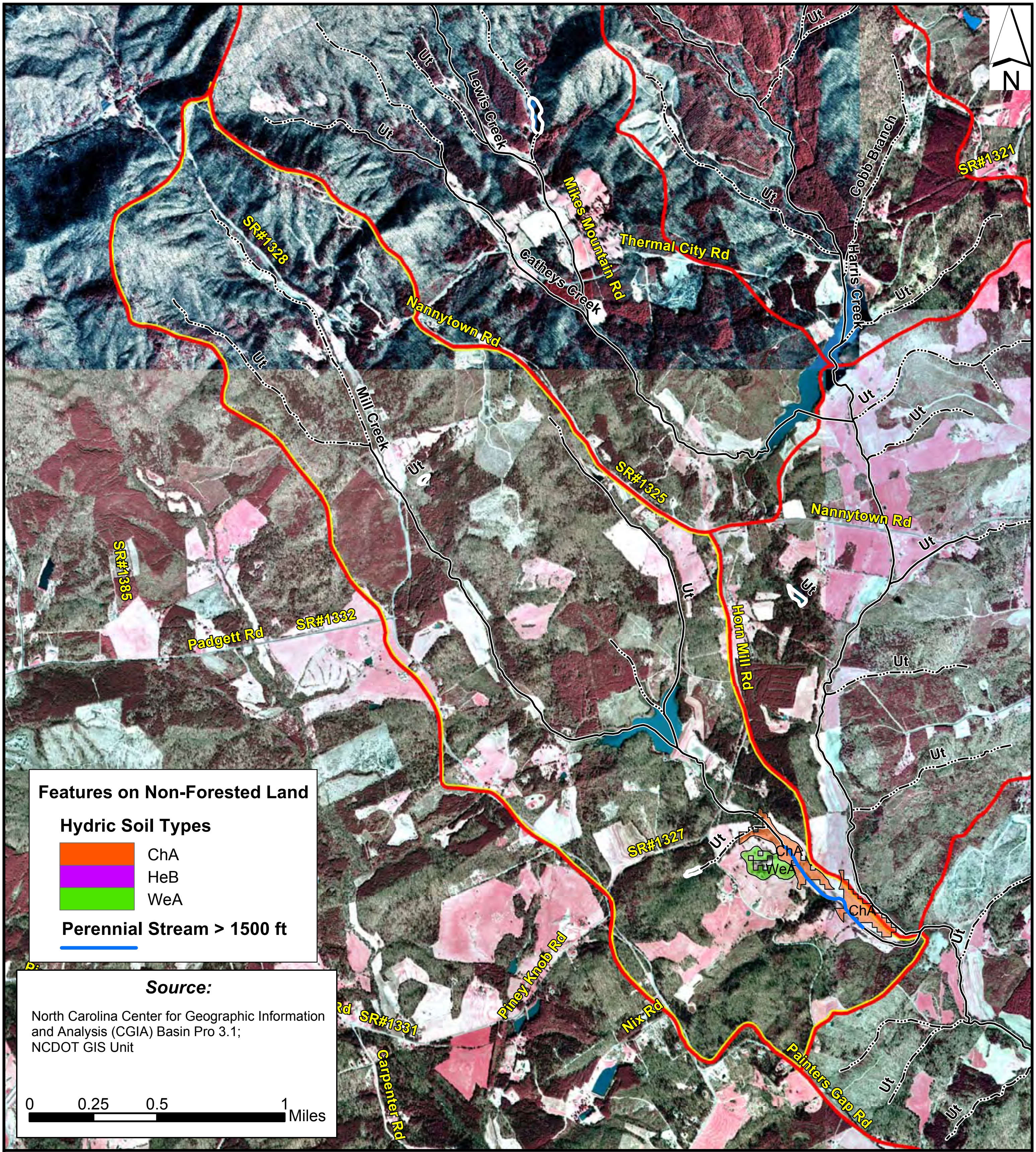


FIGURE 12
POTENTIAL PROJECTS
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

K:\61794\GIS\FiguresRev1\F12_strmsoilsites.mxd 3/04



NCDENR
Ecosystem Enhancement Program

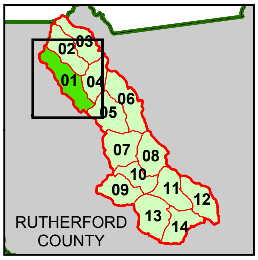


FIGURE 13-01
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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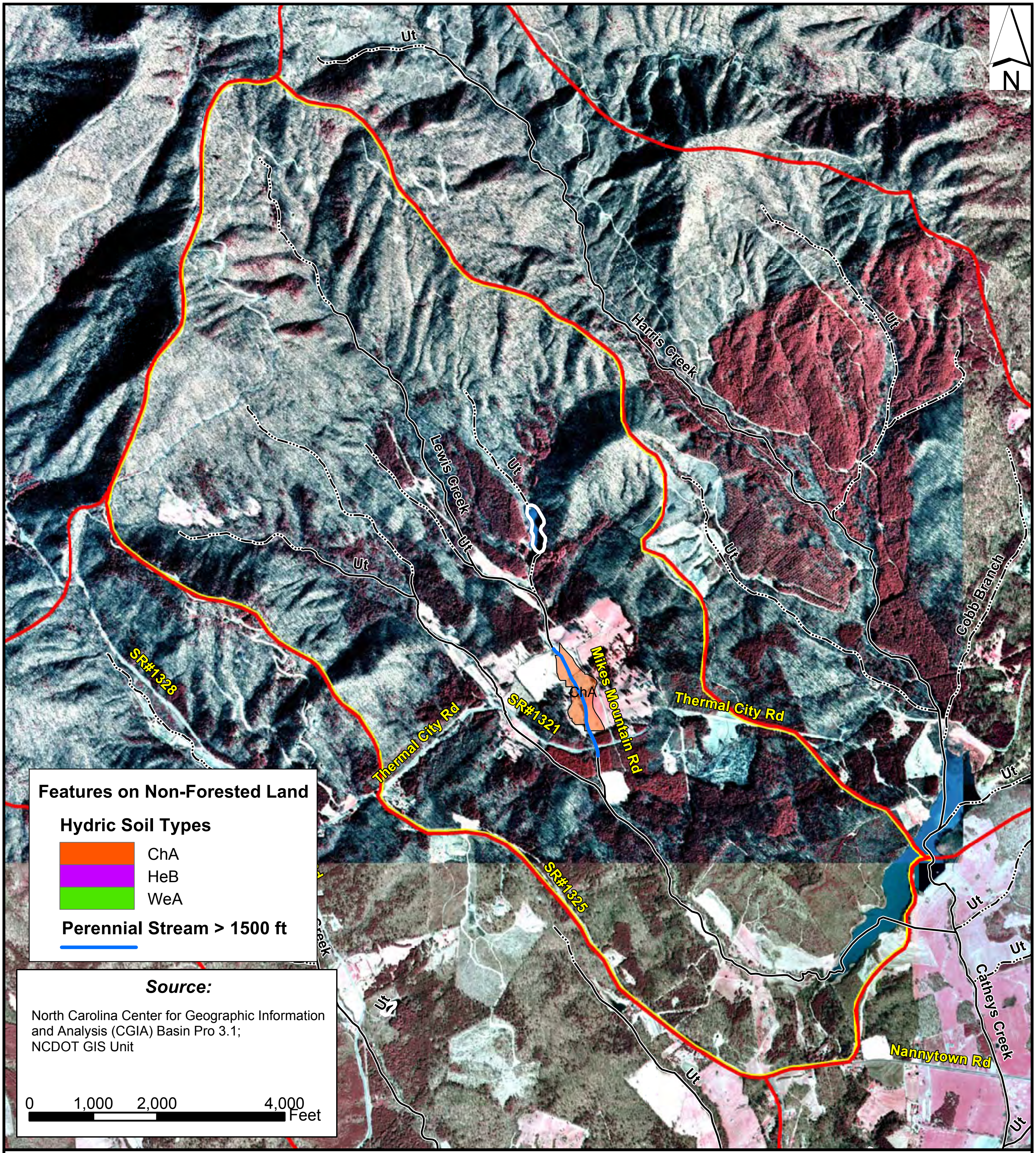


NCDENR
Ecosystem Enhancement Program

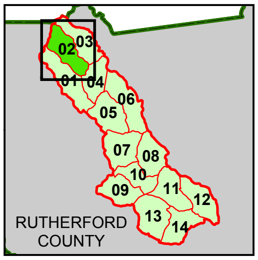
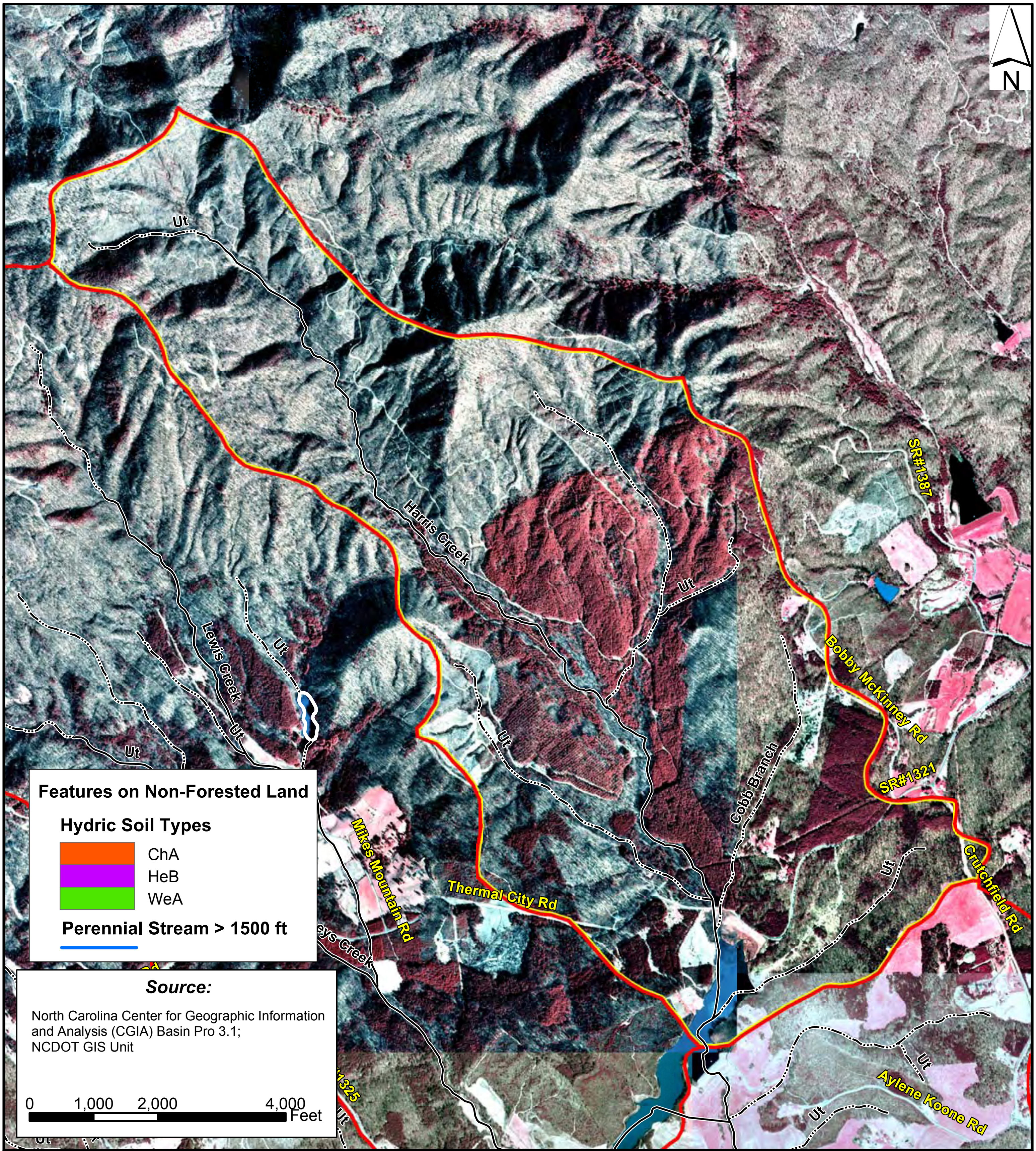


FIGURE 13-02
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

K:\61794\GIS\FiguresRev1\F13-02_SubWShed.mxd 3/04



NCDENR
Ecosystem Enhancement Program

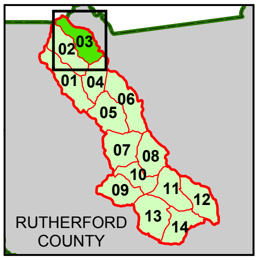
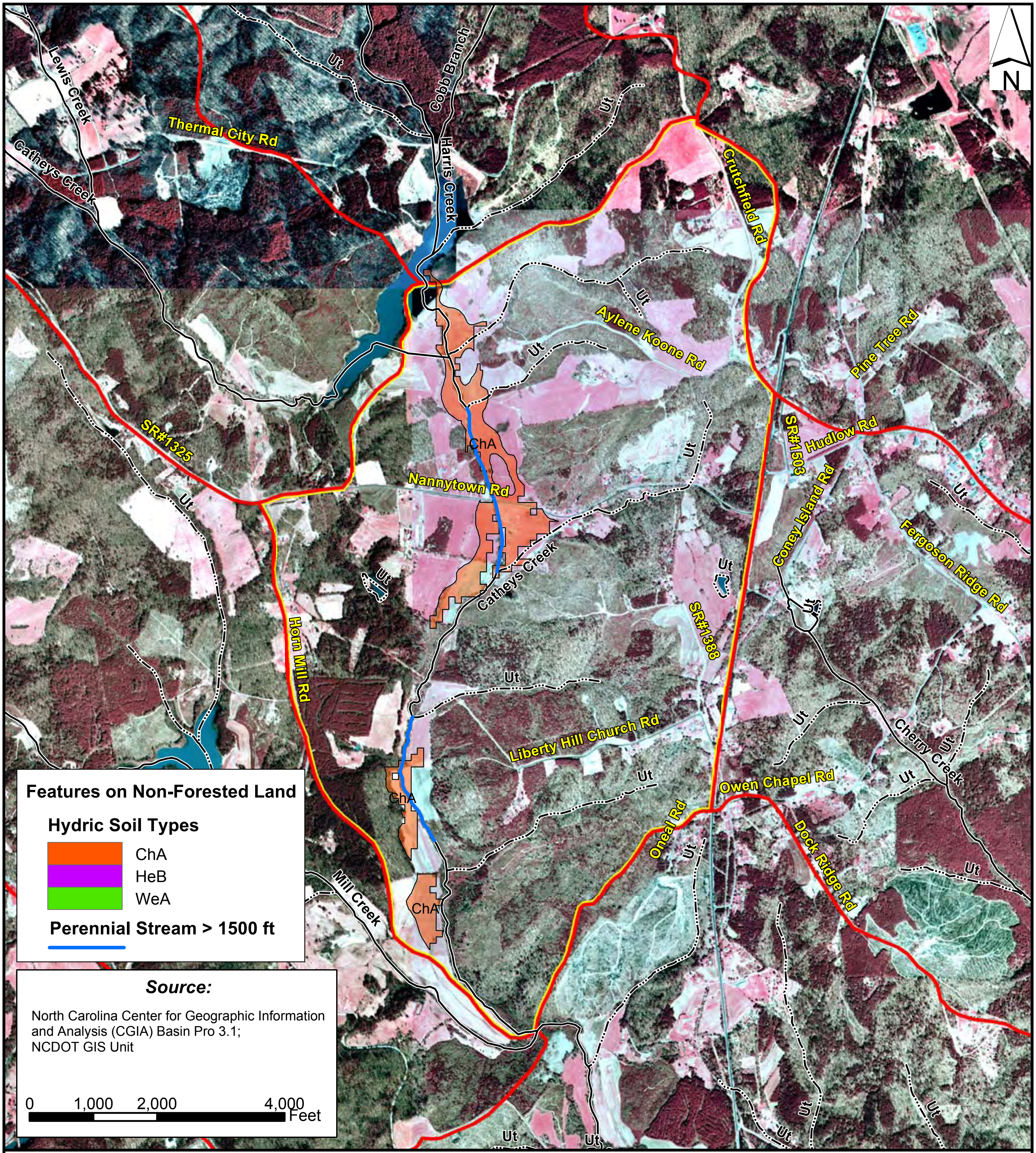


FIGURE 13-03
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina



NCDENR
Ecosystem Enhancement Program

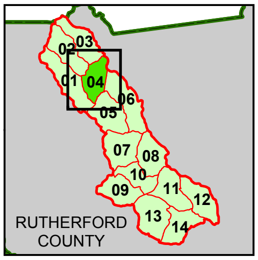
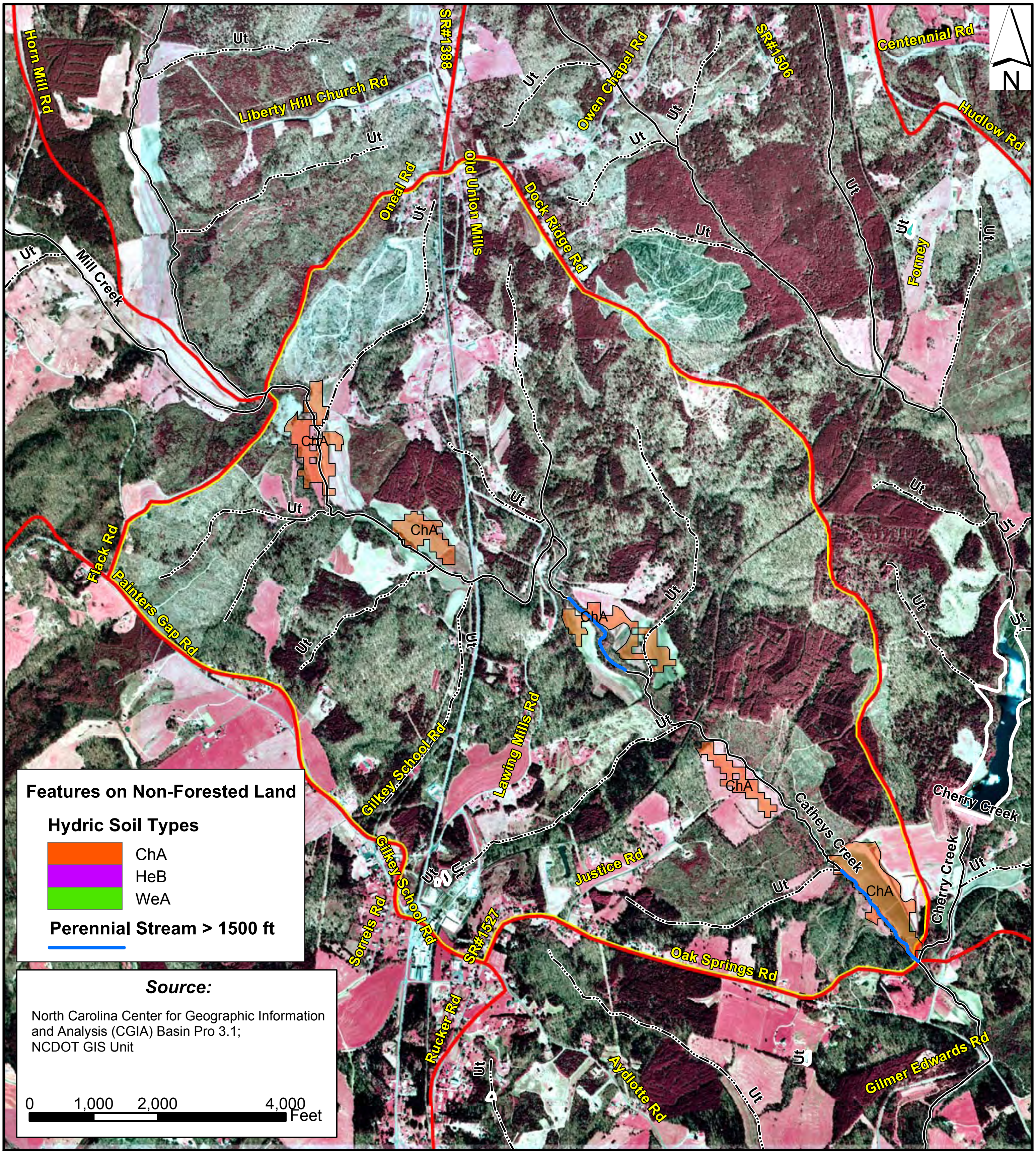


FIGURE 13-04
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

K:\61794\GIS\FiguresRev1\F13-04_SubWShed.mxd 3/04



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Ecosystem Enhancement Program

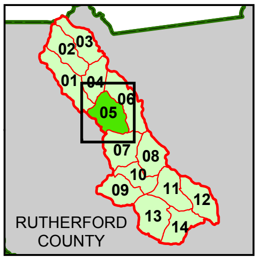

FIGURE 13-05
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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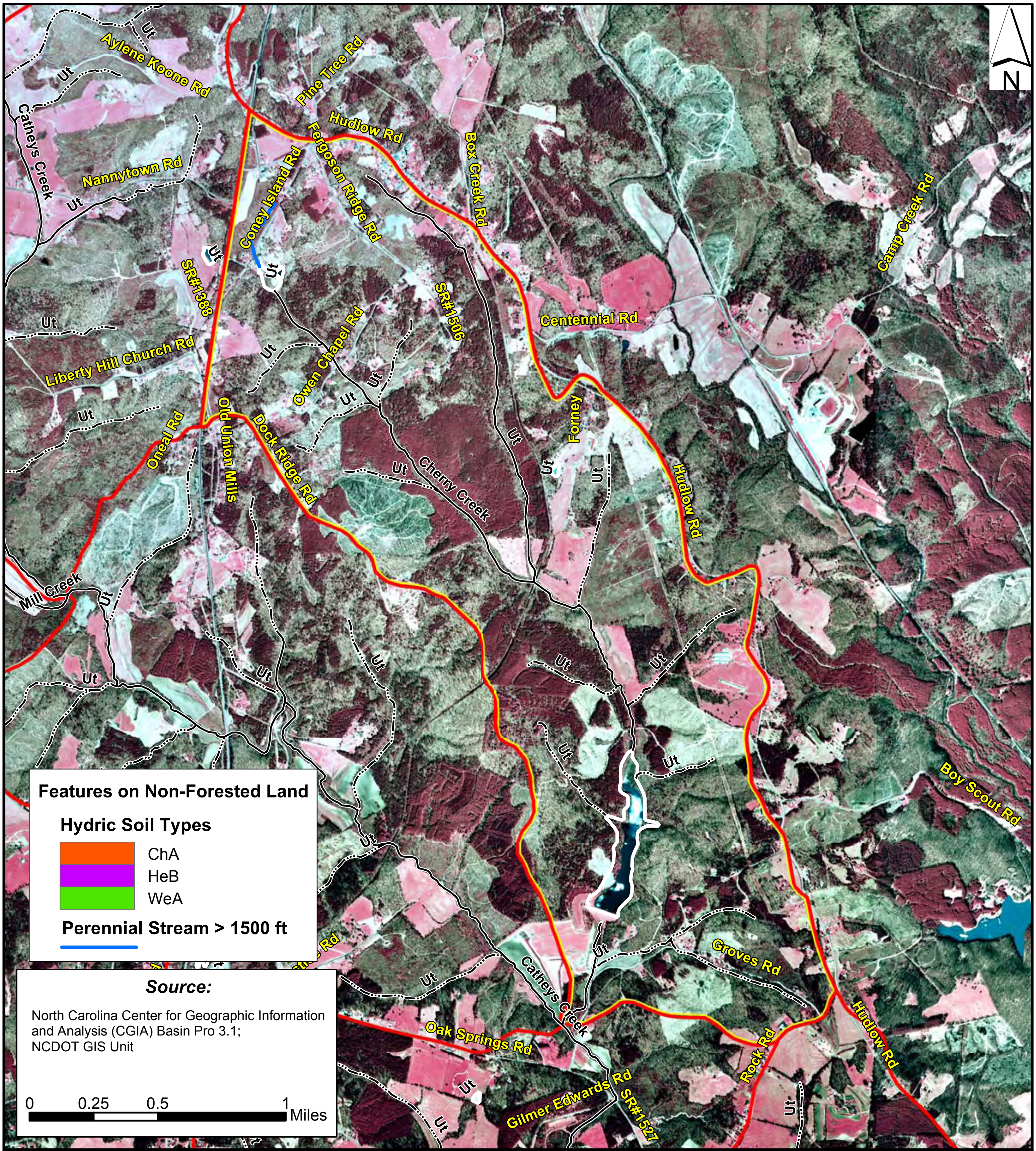

NCDENR
Ecosystem Enhancement Program

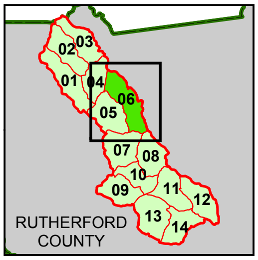

FIGURE 13-06
SUB-WATERSHED MAP
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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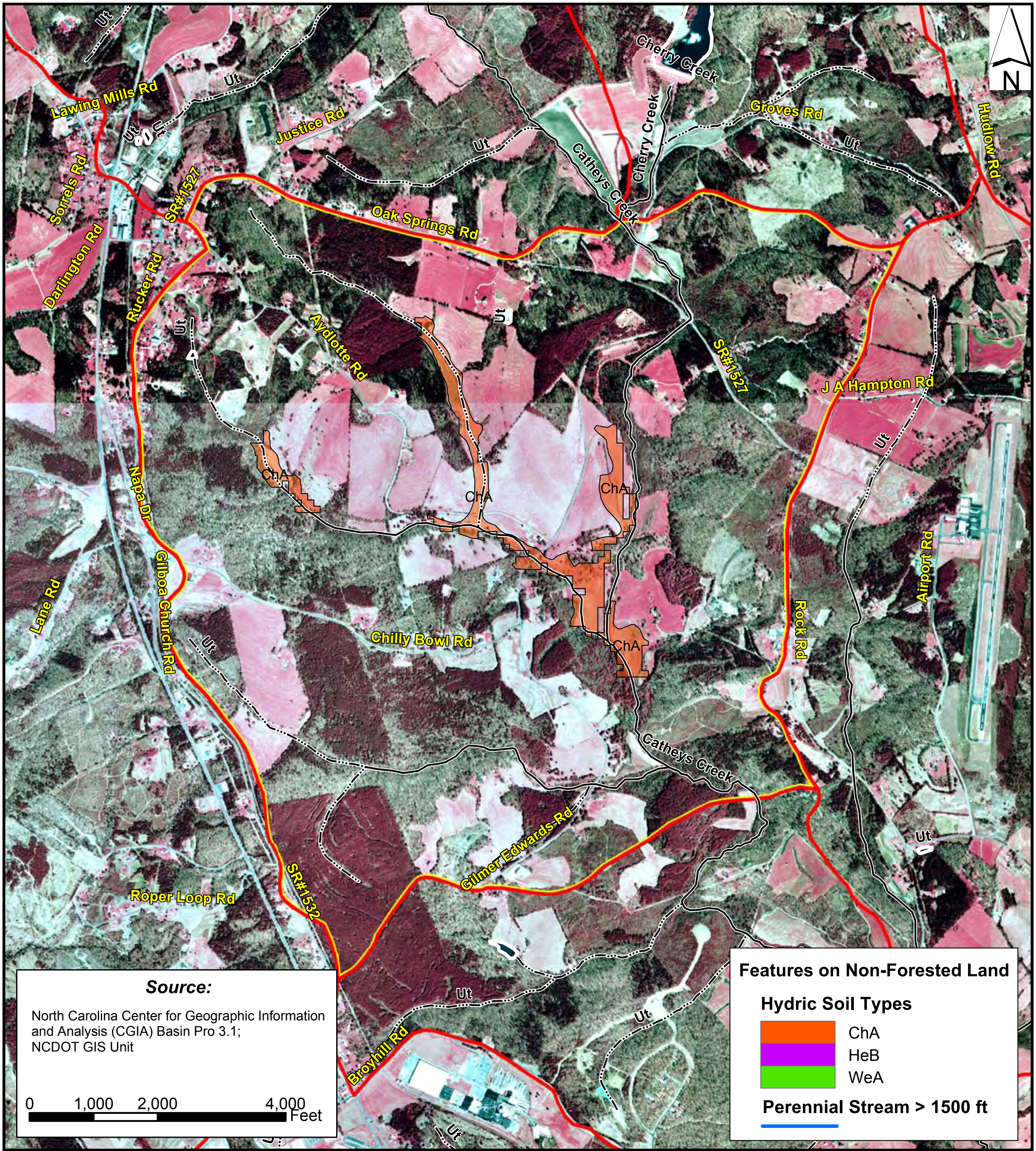

NCDENR
Ecosystem Enhancement Program

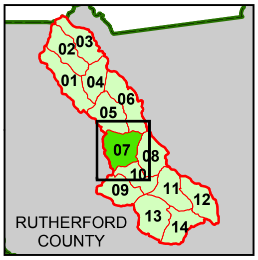

FIGURE 13-07
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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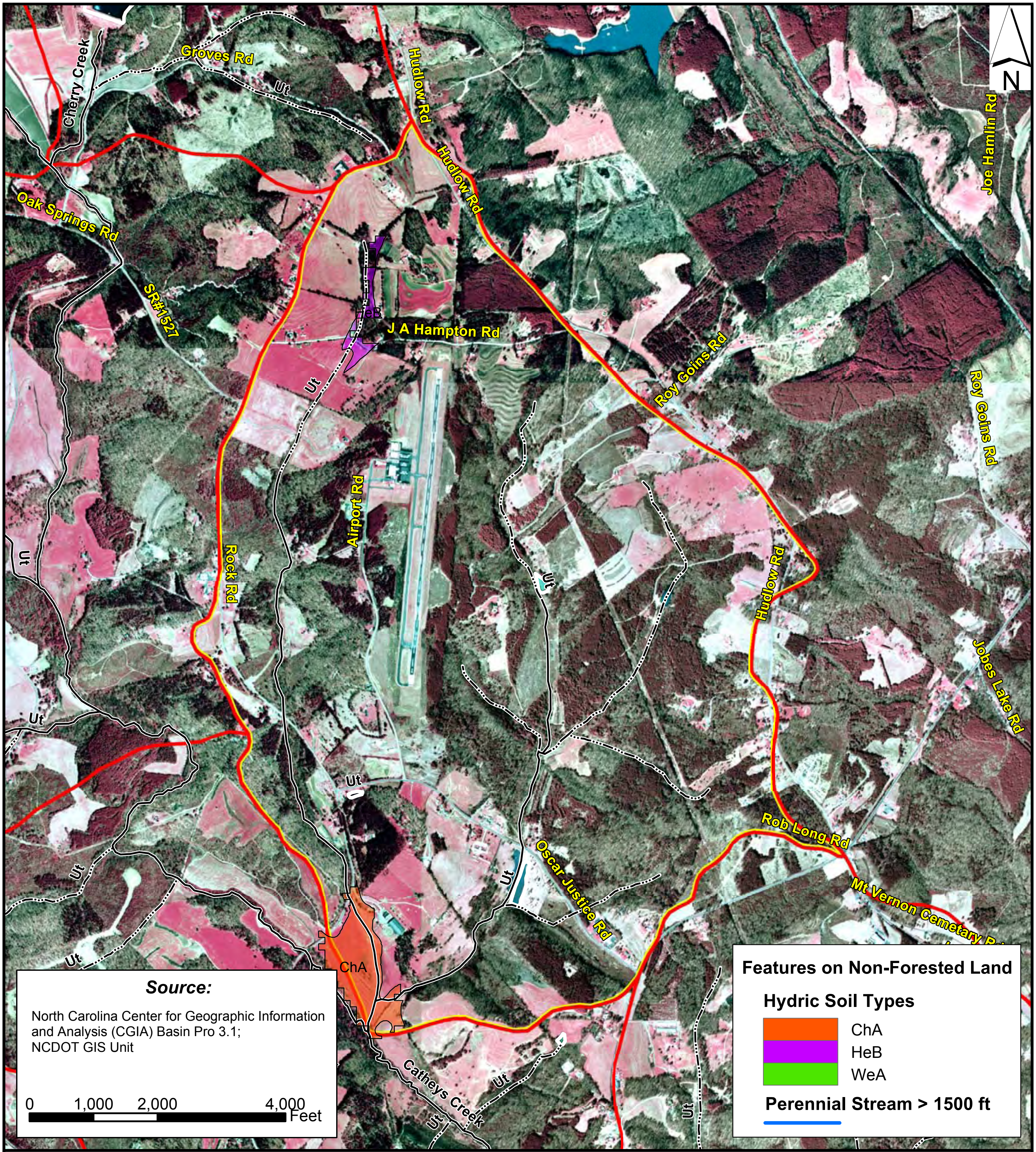


NCDENR
Ecosystem Enhancement Program

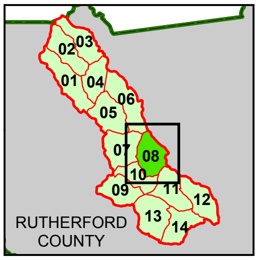
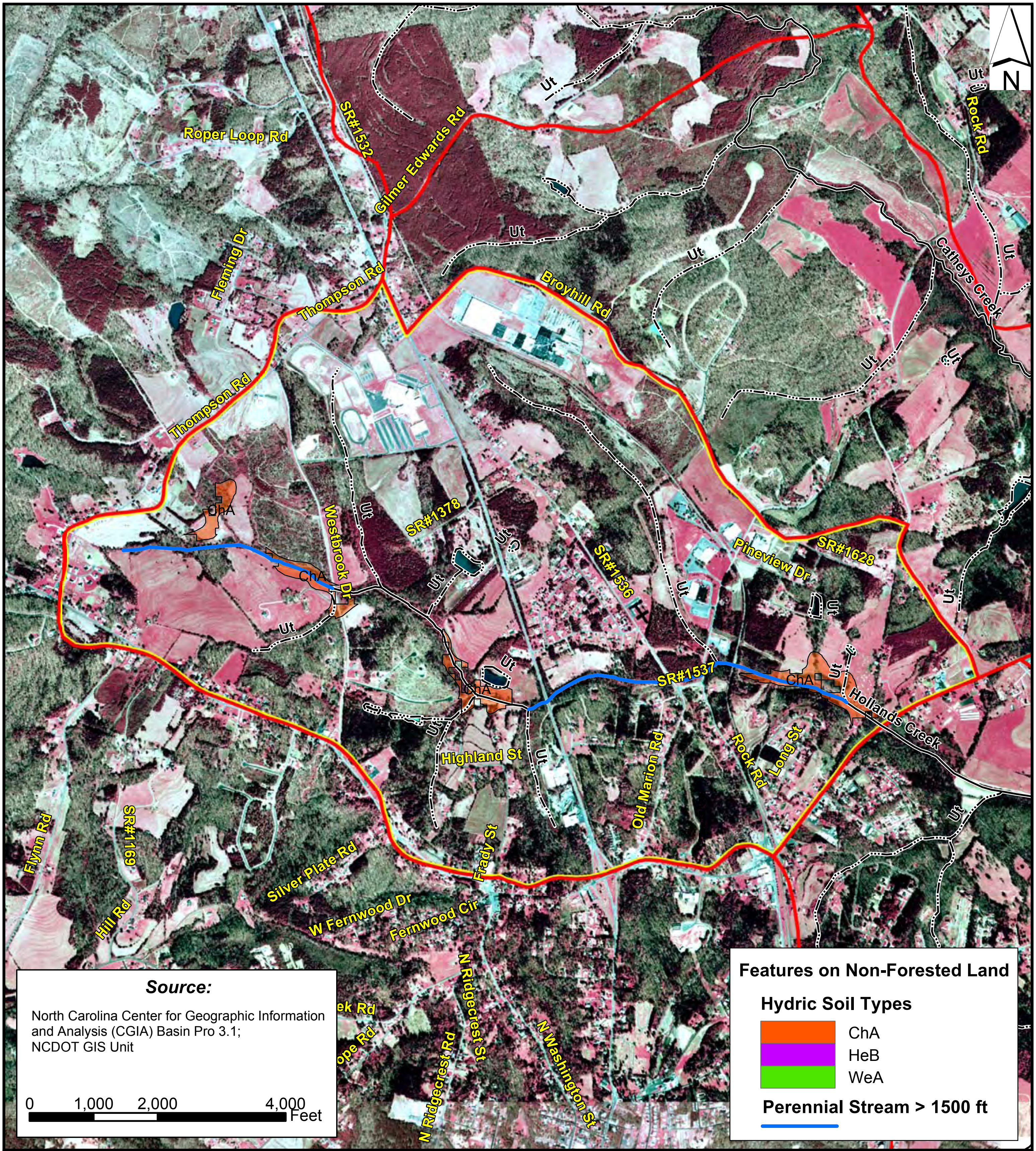


FIGURE 13-08
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina



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Ecosystem Enhancement Program

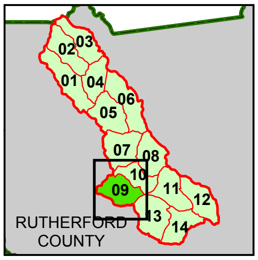

FIGURE 13-09
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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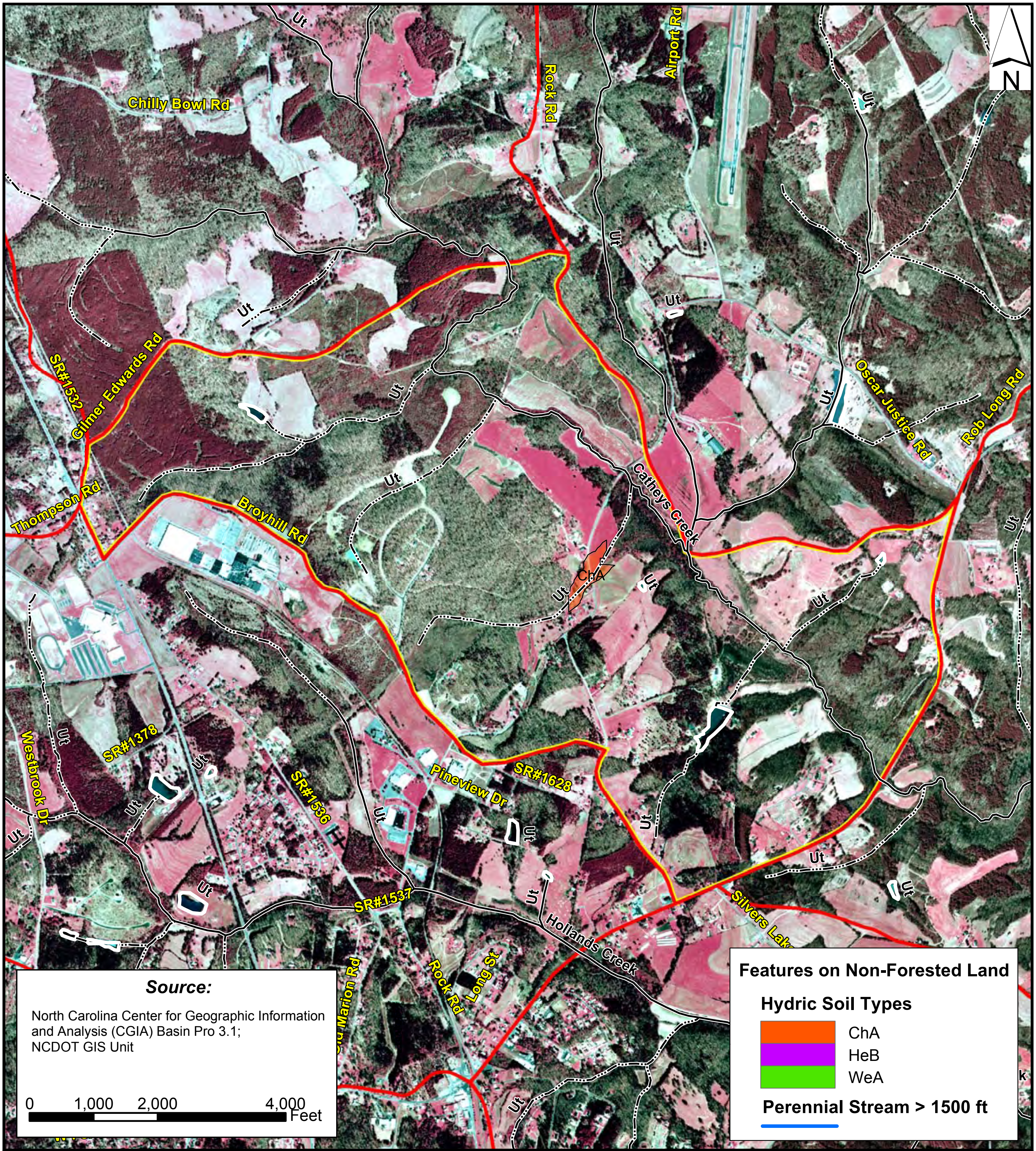

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Ecosystem Enhancement Program

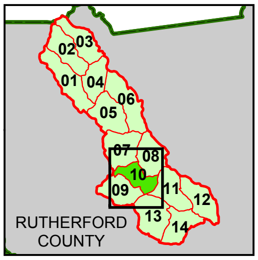

FIGURE 13-10
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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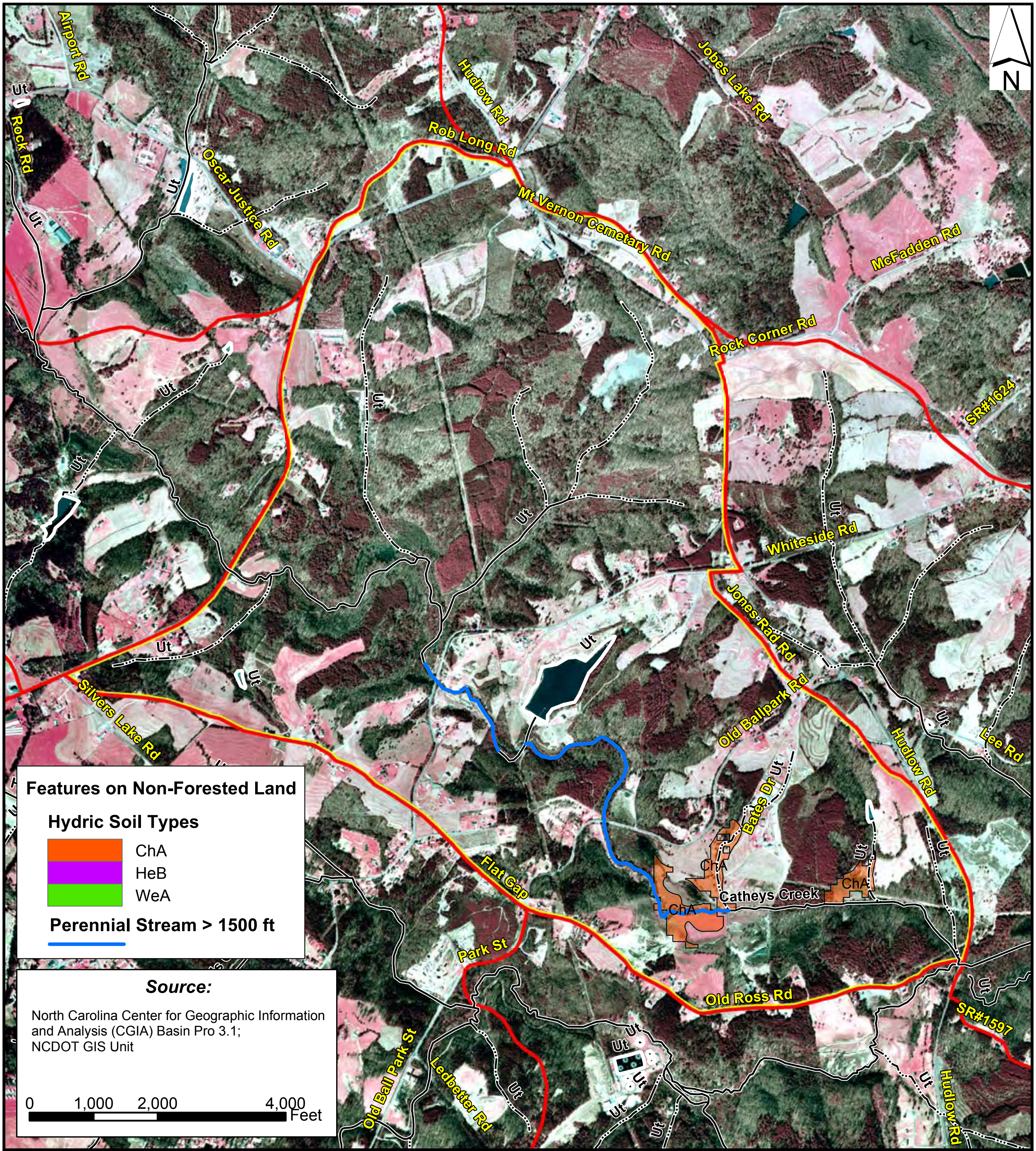

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Ecosystem Enhancement Program

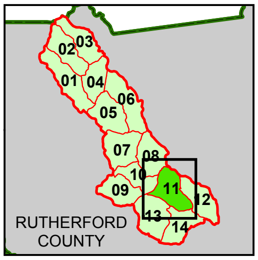

FIGURE 13-11
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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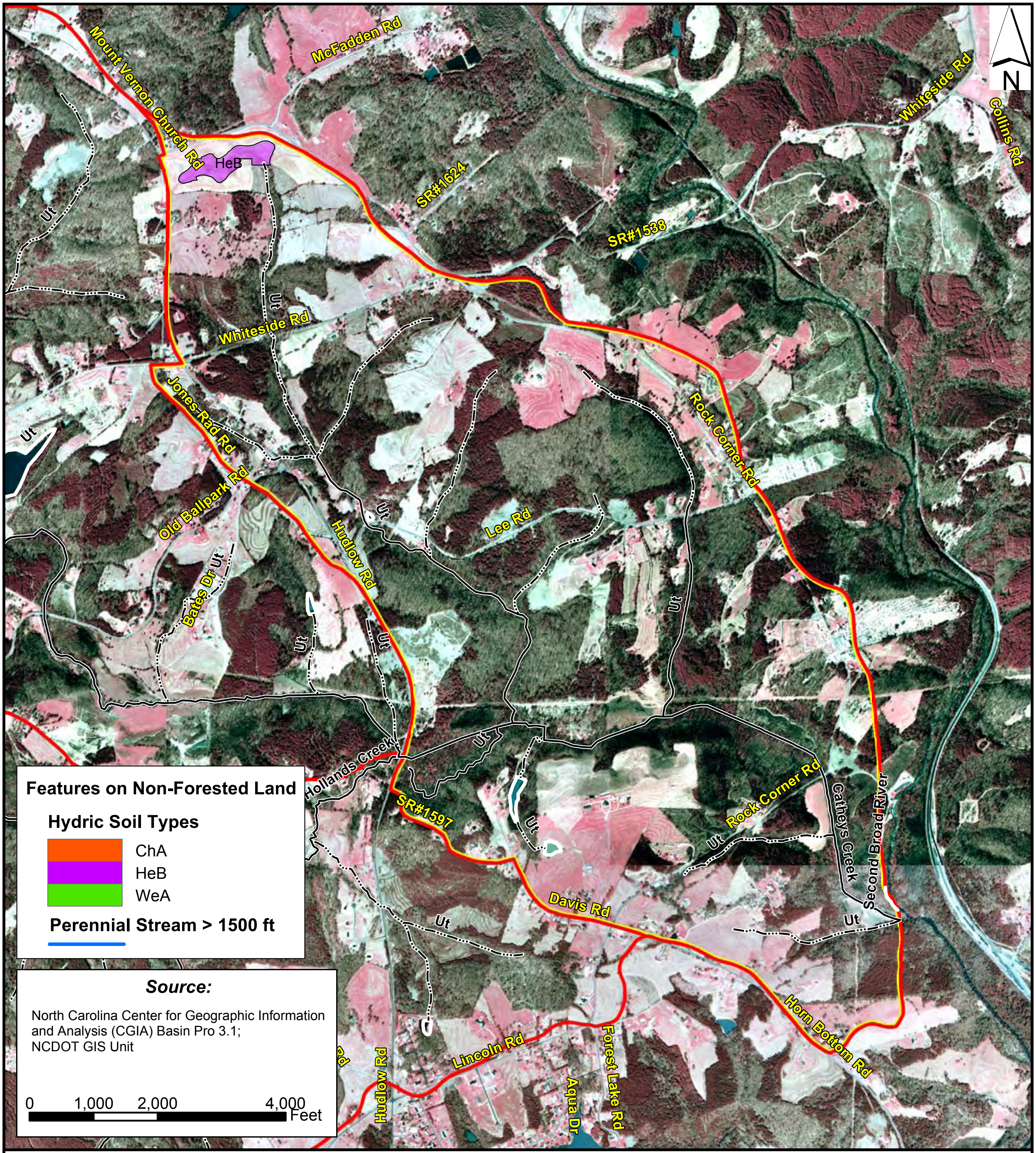

NCDENR
Ecosystem Enhancement Program

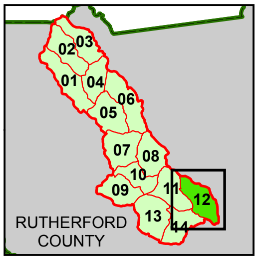

FIGURE 13-12
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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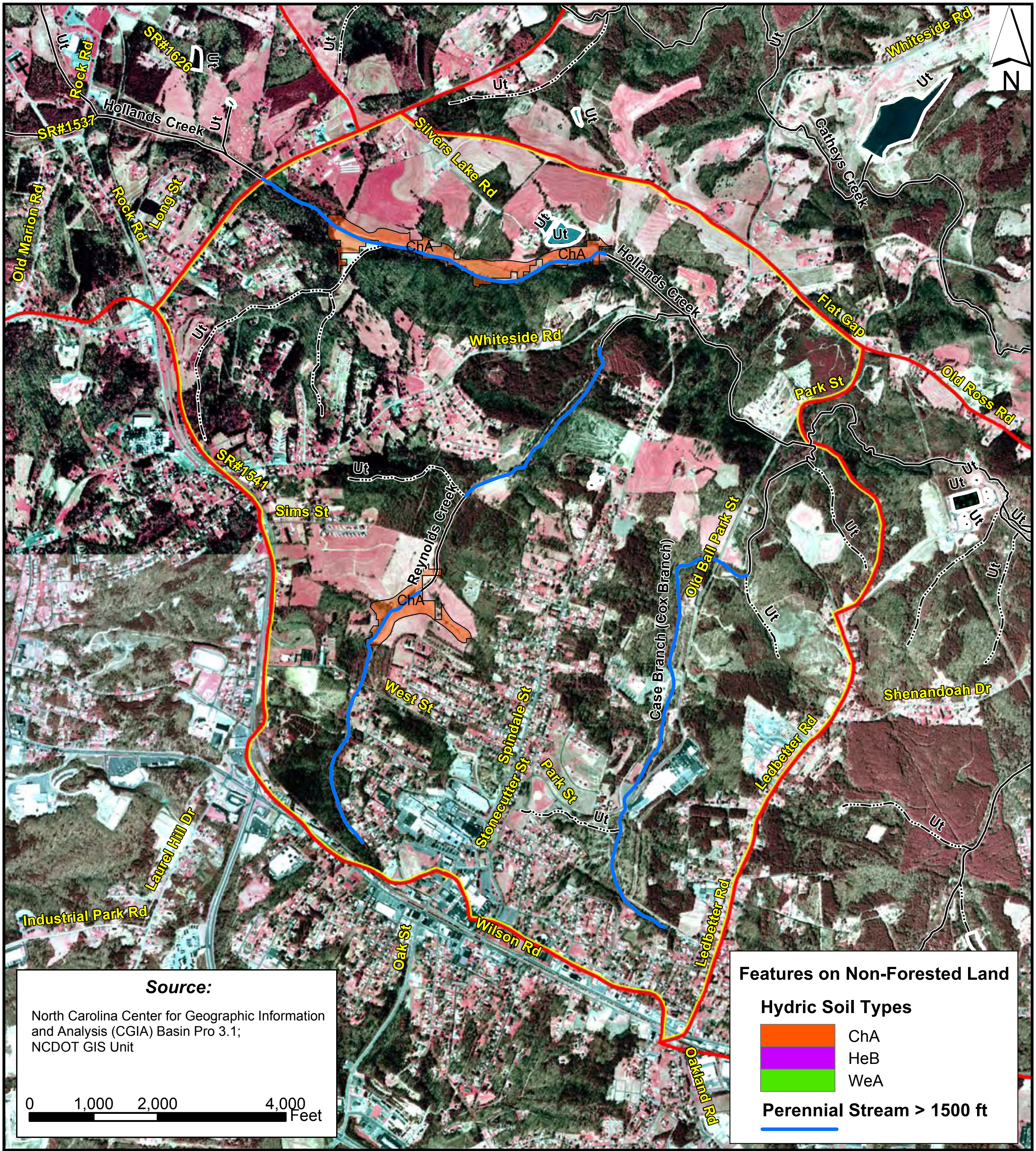

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Ecosystem Enhancement Program

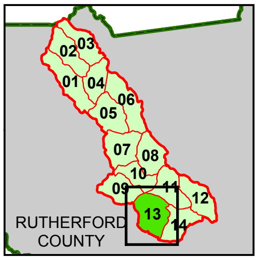
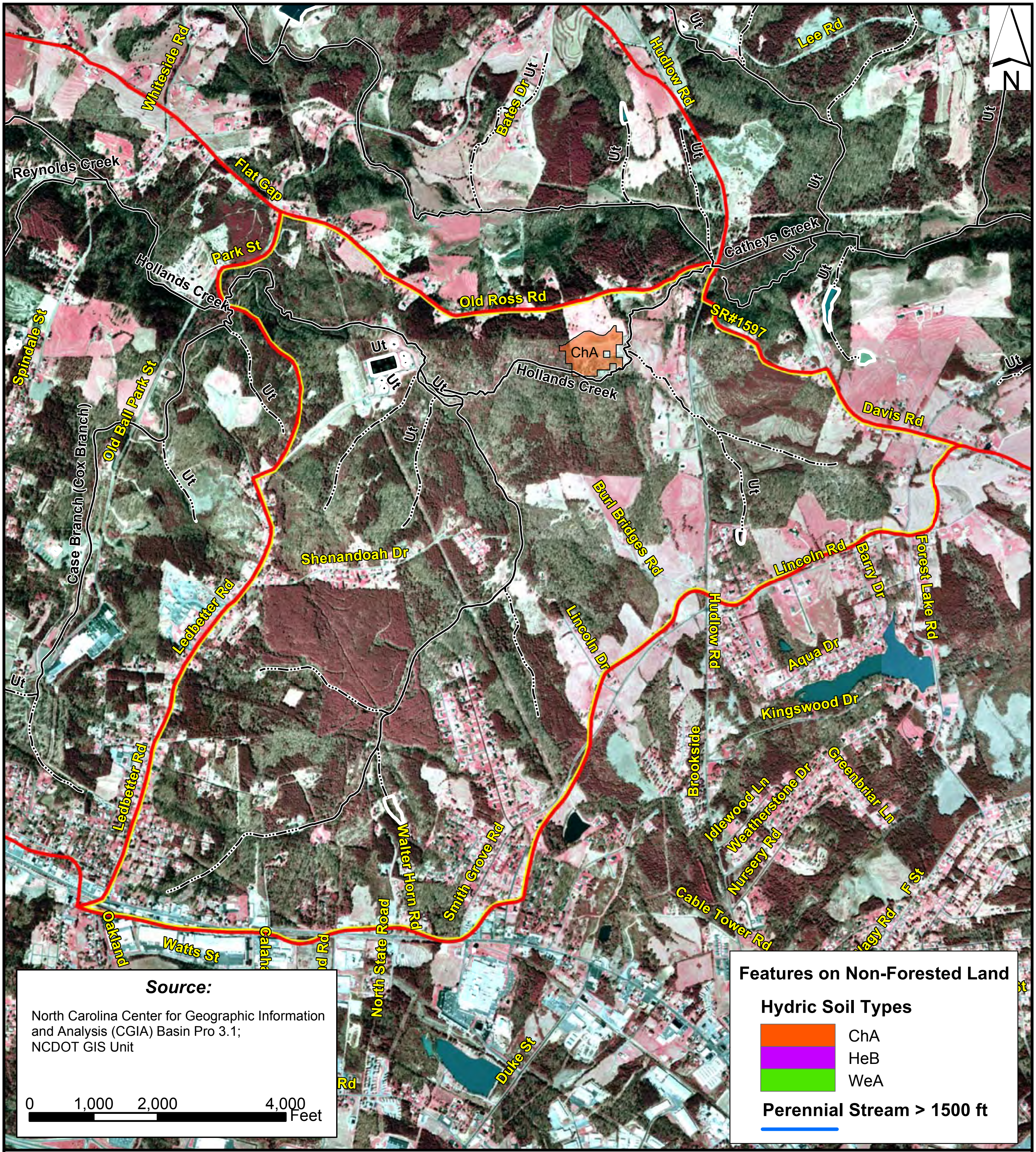


FIGURE 13-13
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina



Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
NCDOT GIS Unit

0 1,000 2,000 4,000 Feet

Features on Non-Forested Land

Hydric Soil Types

- ChA
- HeB
- WeA

Perennial Stream > 1500 ft

NCDENR
Ecosystem Enhancement Program

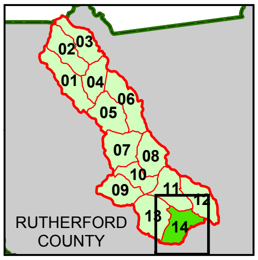


FIGURE 13-14
SUB-WATERSHED MAP

Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

K:\61794\GIS\FiguresRev1\f13-14_SubWShed.mxd 3/04

Table 15. Sub-Watershed Rankings

	Percent of						Number of		Functions				
SWs	Forested Area	Impaired Stream	Wetland Area	Streams Buffered	Impervious Area	Interior Area	Corridors	Interior Patches	Water Quality	Hydrology	Habitat	Total	Group
03	1	1	13	1	1	1	9	7	3	3	5	11	A
10	6	1	3	4	5	5	8	9	4	3	6	13	A
02	2	1	14	2	2	2	5	6	4	3	5	13	A
06	5	1	7	6	10	4	3	1	6	5	4	15	B
01	4	1	10	10	3	3	2	3	6	5	5	15	B
05	3	1	12	7	8	9	1	2	6	5	6	17	B
12	12	12	1	3	6	11	12	12	7	4	9	19	C
11	8	13	2	9	9	6	7	10	8	5	7	20	C
07	9	1	8	11	7	7	6	5	7	6	8	21	C
04	7	1	11	12	4	12	4	4	7	6	8	21	C
14	10	14	4	5	12	8	11	11	9	5	8	22	C
08	11	1	9	8	11	10	10	8	8	7	9	24	D
09	14	1	6	14	13	14	14	14	10	8	13	30	D
13	13	11	5	13	14	13	14	14	11	8	12	31	D

6.2.1 Sub-watershed Group A

The group A SWs ranked the highest in total functional status. The three SWs that make up the group are 02, 03, and 10. The main drainages in each of the SWs are the headwaters of Cathey's Creek, Harris Creek and Cobb Branch, and Cathey's Creek, respectively. The SWs all have high indicator values for all three of the watershed functions. Their land cover is dominated by forest with a good percentage of interior patches for habitat. Each of the SWs has multiple corridors to adjacent interior patches. The percentage of streams buffered by forest is high and the percentage of impervious area is low. It is interesting to note that SW 10 is located in the lower section of the watershed surrounded by SW Groups C and D. There is no presence of impaired streams within this SW group.

There are few degraded areas as identified by GIS located in these three SWs. This is expected since the SWs have a high percentage of forested area. SW 02 has one reach highlighted for possible stream and associated wetland restoration. SW 03 had no degraded areas, and SW 10 had two areas identified for potential wetlands restoration.

6.2.2 Sub-watershed Group B

Group B SWs ranked slightly below Group A, as a result of an increase in impervious area and a decrease in forested area and buffered streams. The three SWs that make up this group are 01, 05, and 06. The main drainages in the SWs are Mill Creek, Cathey's Creek, and Cherry Creek respectively. Although they ranked below Group A, they had the highest habitat indicator rankings. The SWs had a percentage of interior area much like Group A, but had the most corridors leading to the most adjacent interior patches. The percentage of wetland area was low in SWs 01 and 05, but this can be attributed to their position near the headwaters of the watershed with steeper gradient. There is no presence of impaired streams within this SW group. SW 06, Cherry Creek, contains the largest pond with the watershed.

GIS identified eleven degraded areas in this group. SW 01 has 3 degraded areas, of which one involves stream restoration. SW 05 has 5 potential wetland and 2 stream restoration projects. All of these areas are located adjacent to Cathey's Creek. SW 10, Cherry Creek, has one degraded area identified for potential wetland restoration.

6.2.3 Sub-watershed Group C

Group C SWs ranked third lowest among the four groups in total functional status. The five watersheds that make up this group are 04, 07, 11, 12, and 14. The main drainage in each of the first four SWs is Cathey's Creek, and Holland's Creek is the main drainage for SW 14. The group all had the third lowest rankings in percentage of forested area. The only other similarity among the group was that rankings were generally low for the percentage of buffered streams, impervious area, and interior area and the number of corridors and interior patches. SWs 11, 12, and 14 have sections of impaired streams. It is interesting to note that these three rank among the highest in the percentage of wetland area.

There are a total of 12 degraded areas identified by GIS in this group. This group has large areas of hydric soils in cleared areas that may have potential for wetland restoration. SWs 12 and 14 have one wetland site each. SWs 04 and 11 have 2 stream and 3 wetland sites each. SW 07 has 1 large wetland site and 1 relatively small site.

6.2.4 Sub-watershed Group D

Group D SWs ranked the lowest among the four groups in total functional status. The three watersheds that make up this group are 08, 09, and 13. There are no named drainages in SW 08, which drains the area around the County's airport. Holland's Creek is the main drainage for SW 09. SW 13 has Holland's Creek, Reynold's Creek, and Case Branch as main drainages. These three SWs had more similarities among them than all the other groups. The SWs had the lowest percentage of forested area, buffered streams, and interior area with the highest percentage of impervious area. They also contained the least amount of corridors and adjacent interior patches. The land cover and land use within these SWs inhibit the functional abilities. SWs 09 and 13 drain sections of Rutherfordton and Forest City. SW 13 has a section of an impaired stream.

This group had the largest amount of potential stream restoration. Almost the entire upper half of Holland's Creek was identified as a stream with no buffer protection, as well as the majority of Reynold's Creek and Case Branch. These stream projects, located in SWs 9 and 13, also had associated potential wetland restoration sites. SW 08 only had 2 wetlands restoration sites identified.

7.0 SUMMARY OF WATERSHED ISSUES

Based upon the findings of this study, the Cathey's Creek watershed appears to be in a transitional state. Past and current land use practices have had a moderately negative effect on the functions of the watershed, but many streams show signs of adjustment. Apparent demographic and economic trends are likely to further stress the watershed unless a management plan is implemented to improve and maintain watershed functions. The population statistics show slow growth and migration into the area. Growth in tourism and an influx of retired persons is anticipated. Development planning within the area is underway, in an effort to make the community more appealing to potential landowners and businesses while maintaining its aesthetic qualities. Specific areas of concern regarding current watershed function are discussed in the following sections.

7.1 WATER QUALITY

Urban runoff and sediment are suspected to be the leading causes of water quality impairment within the watershed. The urban runoff volumes, peak flows, and pollutant loads will continue to increase as development continues in the three municipalities. Water quality monitoring results in the urban areas of the CCW have been consistently indicative of stressed stream biota.

Given that the majority of the CCW is forested, the heavy sediment load in the streams appears to be more a result of stream bank erosion rather than overland erosion. The streams probably have been altered by increased sediment supply during times of mining, timbering, and agriculture and the past straightening of their channels. The stream bank erosion appears to be occurring through the stream system's natural tendency to move to a state of dynamic equilibrium. The now entrenched streams are trying to restore their meandering patterns and in the process are creating a large sediment supply. Increased runoff volumes and peak flows will also tend to erode stream banks and degrade channels.

Other areas of concern include the effects on water quality of the Spindale WWTP discharge and potential mercury contamination from old mining operations.

7.2 HYDROLOGY

The altering of the streams as a result of mining and farming practices along with the changes to the floodplain and upland areas (increased impervious surface, loss of forest cover, changes in soil permeability) are believed to be the main causes of impairment in the hydrologic functions of the watershed. The watershed is not efficient at absorbing overbank flows through short- or long-term storage and the channels do not handle peak flows in a stable manner. The flood control ponds also have affected the hydrologic functions by changing the timing and sediment balance of the stream flows.

7.3 HABITAT

The same causes of impairments to water quality and hydrology most likely have also impaired the habitat functions. The increased velocity and volume of urban runoff and the resulting scour, increased sediment load, and sandy substrates create a hostile environment for aquatic species. Straightened and entrenched streams lack the riffle-pool sequence that provides a variety of habitat types.

The major stressor on terrestrial habitat functions is the removal and fragmentation of native vegetation. The decline in timber and farming has resulted in reforestation in many areas, but from observations made during windshield surveys, the species richness appears to be low and exotic invasive species have become established. It is not known whether the presence of exotic species on the stream banks affects aquatic communities.

8.0 DETAILED ASSESSMENT PLAN

The issues discussed above were identified solely on the basis of the GIS analysis, windshield surveys, and interviews with local inhabitants. More detailed field studies are necessary to evaluate the severity and potential causes of these stressors to watershed function. In-stream habitat, stream morphology, actual cover of exotic species, actual presence of hydric soils, detailed buffer conditions, and up-to-date land use are all examples of functional indicators that must be evaluated in the field rather than by GIS. Also, there was no water quality data available to judge the health of streams upstream of those classified as Impaired. The objectives and methods for a detailed field assessment to address these data gaps and further evaluate watershed functional status are outlined below.

8.1 OBJECTIVES

The objectives of the detailed field assessment were selected to address the watershed functional deficiencies and concerns identified through the GIS analysis. We hope to achieve a more complete understanding of the functional status of the watershed and how the stressors and indicators are linked to the aquatic community ratings. The objectives are as follows:

- Assess the sources, severity, and causes of sedimentation and erosion
- Identify the most critical areas for stream stabilization and restoration
- Assess urban runoff
- Assess habitat degradation
- Evaluate the Spindale WWTP discharge to determine its contribution to water quality degradation
- Assess the potential mercury contamination from old mining operations

8.2 METHODS

Field assessment methods were chosen that will provide measures of the functional indicators most directly related to the perceived problems of excessive sediment, erosion, and habitat degradation. Other measures will be made of indicators that are believed to be linked to those concerns. Several locations in each sub-watershed will be selected for data collection. The sites will be chosen based on surrounding land use characteristics, so that different land uses within each sub-watershed will be represented. The indicators that will be assessed are described below.

In-stream habitat
In-stream habitat will be assessed using a standard Habitat Assessment Field Data Sheet for Mountain and Piedmont streams developed by DWQ. The form covers several categories including surrounding conditions, habitat types and quantity for benthos and fish, substrate conditions, bed diversity, and flow conditions.

Water Quality
A Horiba Instruments U-22 water quality meter will be used to measure conductivity, pH, temperature, and total dissolved solids at each location. Measurements will also be taken with a turbidity meter.

Stream morphology and function
Measures including bank height: bankfull height ratio, bank height: root depth ratio, bank angle, root density, surface protection, bank materials, and stratification will be made to provide information about stream morphology and function. A Bank Erosion Hazard Index and near-bank stress will be calculated. Bankfull height determinations will be made based on best professional judgment where possible. Where conditions make bankfull determination difficult, a pocket rod and hand level will be used to survey a stream cross-section.

Buffer condition
The width, cover type, number of breaks, degree of exotic species cover, and soil type of stream buffers will be measured to assess buffer condition and its relationship to in-stream conditions. If wetlands are present in the buffer region, a wetland rating form will be filled out.

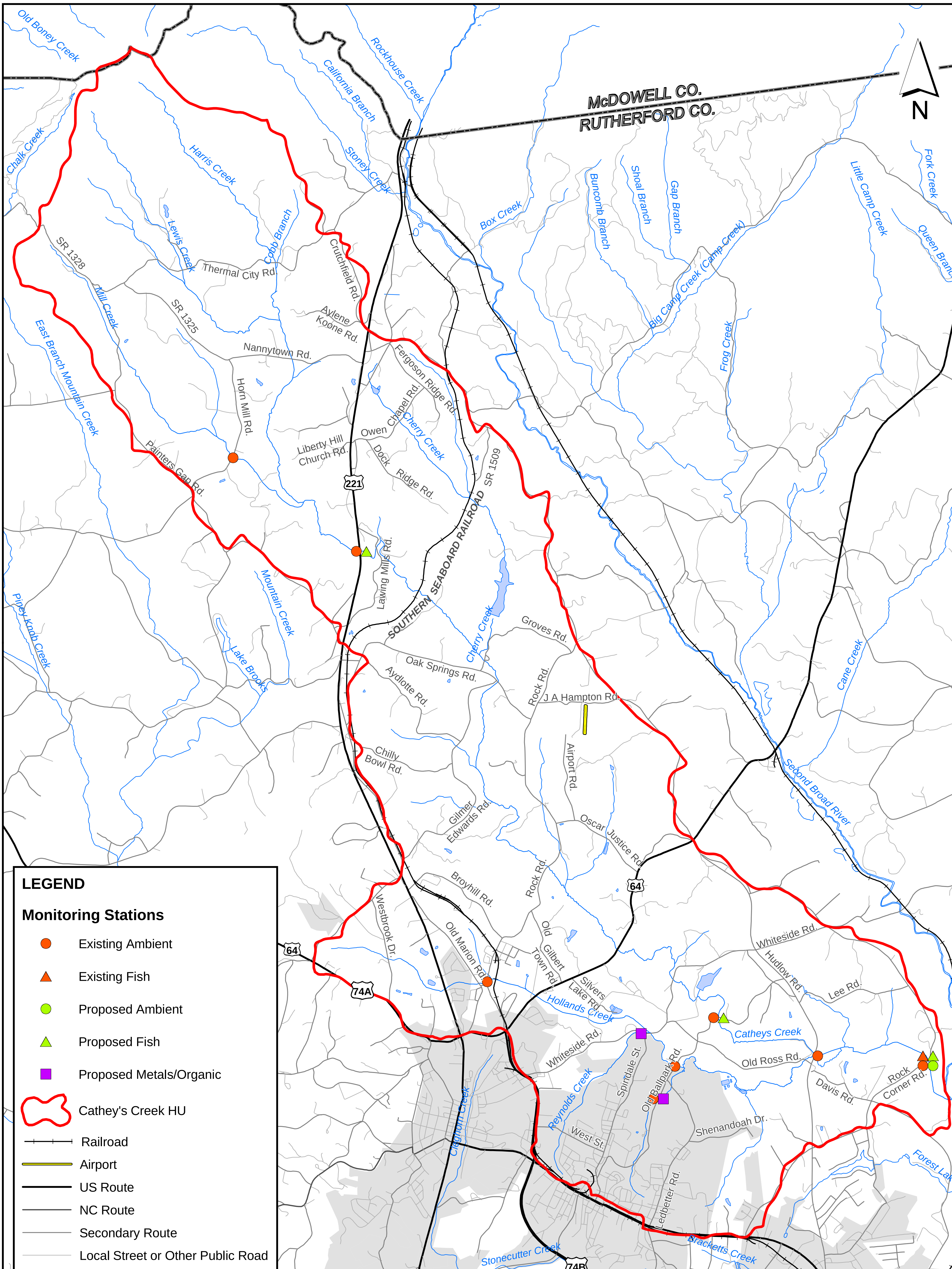
Landscape condition
Landscape conditions will be reassessed by GIS using a newer aerial photograph than was used for the initial functional analysis. Percentage of impervious cover, wetland cover, and forested cover will be determined. In addition, an erodibility index will be calculated using published soil K factors. In the field, an estimate of slope will be determined and the GIS land cover type will be verified.

Additional documentation at each site will include photographs, sketches, GPS coordinates, and notes on the potential for restoration and/or BMPs.

DWQ Monitoring
DWQ will conduct biological monitoring (fish community sampling) at the established site on Cathey's Creek at SR 1549 and at two additional sites on Cathey's Creek. Chemical and physical

water quality monitoring will be conducted at previously established monitoring sites as well as some additional ones. Benthic macroinvertebrate ratings will be determined. Metals and organic pollutants will be monitored in some urban streams during storm and base flows. See **Figure 14** for the monitoring locations and types.

The data collected from this detailed assessment will be used to refine the preliminary ranking based on the GIS analysis and to evaluate the links between the suspect indicators and water quality ratings. Critical areas will be identified where functional deficiencies are the greatest and where implementation of watershed improvements such as stream or wetland restoration and best management practices will have the greatest impact on water quality and watershed functions. These findings will be documented in a Critical Areas Analysis Report.



Ecosystem Enhancement Program

Source:

North Carolina Center for Geographic Information and Analysis (CGIA) Basin Pro 3.1;
USGS Quadrangles

0 0.25 0.5 1 1.5 Miles

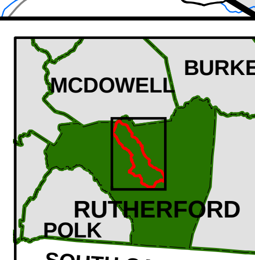


FIGURE 14
MONITORING STATIONS
Broad River Basin
Technical Watershed Assessment
Cathey's Creek Watershed
Rutherfordton, North Carolina

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FILE	FEATURE TYPE	PATH	f1vic	f2stew	f3topo	f4soils	f5Lndu	f6wtr	f7infr	f8wtrql	f9subshd	f10hydfnc	f11hab	f12sites	f13*SWs	calcs only	process only	SOURCE1	SOURCE 2	CREATED FROM	DESCRIPTION	ADDED FIELDS	CREATION/UPDATE PROCESSES	STUDY CALCS
countybnd.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\BasinPro\State	X	X	X	X	X	X	X	X	X	X	X	X	X			BasinPro 3.1			NC statewide county boundaries	none		
interstate highway.shp	Line	K:\61794\GIS\Spatial\NAD83m\BasinPro\State	X															BasinPro 3.1			NC intestate highways	none		
primary roads.shp	Line	K:\61794\GIS\Spatial\NAD83m\BasinPro\State	X															BasinPro 3.1			NC primary roads	none		
CatheysCreekHU.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\Shapef	X	X	X	X	X	X	X	X	X	X	X	X	X			NCDOT GIS			Cathey's Creek hydrological unit, Rutherfordton, NC	none		Overall HU area quantities
major river.shp	Line	K:\61794\GIS\Spatial\NAD83m\BasinPro\State	X															BasinPro 3.1			NC major rivers	none		
hydromaj.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\BasinPro\State	X															BasinPro 3.1			NC major water bodies	none		
municipalbnd.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\BasinPro\State	X				X		X									BasinPro 3.1			NC municipal boundaries	none		
dotroads.shp	Line	K:\61794\GIS\Spatial\NAD83m\Shapef\dot.av		X		X	X		X	X		X	X	X	X			NCDOT GIS			NC roads (NCDOT)	none		
dotrailrd.shp	Line	K:\61794\GIS\Spatial\NAD83m\Shapef\dot.av		X		X	X		X	X		X	X	X				NCDOT GIS			NC railroads (NCDOT)	none		
soils.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\Shapef				X								X				NCCGIA			Soil survey, Rutherford Co., NC	SOIL_DESC; Hydric	Populated "SOIL_DESC" with soil definitions based on "SOIL_ID" code; populated "Hydric" with type-A as "A", which is comprised of (FvA) Fluvaquents-Udifluvents Complex, 0-2% slopes, occasionally flooded, (HeB) Helena-Worsham Complex, 1-6% slopes, (UoA) Udorthents, loamy, 0-3% slopes, occasionally flooded, (WeA) Wehadkee silt loam, 0-2% slopes, frequently flooded; type-B as "B", which is comprised of (ChA) Chewacla loam, 0-2% slopes, occasionally flooded, (DoB) Dogue loam, 1-6% slopes, rarely flooded; and non-hydric (all other present soils) as a void.	hydric-A, hydric-B, Non-hydric area quantities
broad poly.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad	X	X		X	X	X	X	X		X	X	X				BasinPro 3.1			Broad River Basin detailed water bodies	none		
broadp_CC.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad								X		X		X				Earth Tech	BasinPro 3.1	broad poly.shp	Cathey's Creek HU detailed water bodies	Area_m; Area_ft; Area_ac	"cut" using CatheysCreekHU.shp; populated area quantities	water body area quantities for overall HU and sub-watersheds (SWs)
broad_CC.shp	Line	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad						X		X		X		X				Earth Tech	BasinPro 3.1	broad.shp	Cathey's Creek HU detailed streams	Status; Length_m; Length_ft	Created by cutting broad.shp using CatheysCreekHU.shp; populated "Status", Int = intermittent, Per = perennial based on USGS quads; updated "DWG_CLASS" C = recreation, WS-V = water supply; unpopulated stream classes were matched to the class they flowed into (perennial streams were already populated); populated linear quantities	linear quantities of general stream length, class types, status types, 303d and impaired for overall HU
broad.shp	Line	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad		X			X		X	X		X	X	X				BasinPro 3.1			Broad River Basin detailed streams	none		
demsusgs.rrd	Grid	K:\61794\GIS\Spatial\NAD83m\Cov						X										USGS			Digital Elevation Model, Rutherford Co., NC	none		spot elevations used for basic stream slopes
dotairport.shp	Line	K:\61794\GIS\Spatial\NAD83m\Shapef\dot.av							X									NCDOT GIS			NC airports (DOT)	none		
lulc_usgs_CC.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\Shapef					X					X	X					Earth Tech	USGS	lulc_usgs.shp	land use/land cover, pixel size 30 meters (98.4 feet).	AREA_M; AREA_FT; AREA_AC	Created from conversion of LULC_USGS grid file using ArcInfo, cut using CatheysCreekHU.shp; populated area quantities. Field "GRID_CODE" is a numerical code which represents a specific land use/land cover type. 11 = open water; 21 = low intensity residential; 22 = high intensity residential; 23 = commercial/industrial/ transportation; 31 = bare rock/ sand/clay; 33 = transitional; 41 = deciduous forest; 42 = evergreen forest; 43 = mixed forest; 81 = pasture/hay; 82 = row crops; 85 = urban/recreational grasses; 91 = woody wetlands; 92 = emergent herbacious wetlands. Impervious land quantities were calculated from the selection of "GRID_CODE" 21, 22, 23 on a SW basis. Cleared land quantities were calculated from selection of "GRID_CODE" 21, 22, 23, 31, 33, 82, 82, 85 on a SW basis. Forested land quantities were calculated from selection of "GRID_CODE" 41, 42, 43, 91 on a SW basis. Wetland quantities were calculated from selection of "GRID CODE" 91, 92 on a SW basis.	area quantites of cleared, forested, wetlands, impervious for SWs; area quantities for 50ft forested stream buffers; 74+ acre forested habitat quantites
parcels.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\Shapef		X														Rutherford County			parcel data	none		
gov_parcels.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\Shapef		X														Earth Tech	NCCGIA	gov_parcels.shp	government owned parcels	OWNER_TYP	Created from parcels.shp by manually selecting "NAME1" and "NAME2" which showed ownership by government and saved as a separate shapefile. Manually populated "OWNER_TYP" field from this search to reflect type of goverment ownership (federal, state, regional, county, or municipal).	
NPDES_wst.shp	Point	K:\61794\GIS\Spatial\NAD83m\Shapef								X								Earth Tech	NCDENR		Cathey's Creek HU permitted waste water discharges	Facility; Address, COC_number	Created using a printed list of NCDENR permitted waste discharge (pollutant) sources. Populated new fields with source info.	
NPDES_storm.shp	Point	K:\61794\GIS\Spatial\NAD83m\Shapef								X								Earth Tech	NCDENR		Cathey's Creek HU permitted storm water discharges	Facility; Address, COC_number	Created using a printed list of NCDENR permitted storm water discharge (pollutant) sources. Populated new fields with source info as available.	
wtank.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad\Infra								X								Earth Tech	BasinPro 3.1	wtank.shp	NC water tanks	none	Created by cutting wtank.shp using CatheysCreekHU.shp	
wpump.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad\Infra								X								Earth Tech	BasinPro 3.1	wpump.shp	NC water pumps	none	Created by cutting wpump.shp using CatheysCreekHU.shp	
streat.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad\Infra								X								Earth Tech	BasinPro 3.1	streat.shp	NC sewer treatment plants	none	Created by cutting streat.shp using CatheysCreekHU.shp	
spump.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad\Infra								X								Earth Tech	BasinPro 3.1	spump.shp	NC sewer pumps	none	Created by cutting spump.shp using CatheysCreekHU.shp	
sdish.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad\Infra								X								Earth Tech	BasinPro 3.1	sdish.shp	NC sewer discharges	none	Created by cutting sdish.shp using CatheysCreekHU.shp	
ncdams.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\Broad\Infra								X								Earth Tech	BasinPro 3.1	ncdams.shp	NC dams	none	Created by cutting ncdams.shp using CatheysCreekHU.shp	
wsw.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\State\Infrastr\Water								X								BasinPro 3.1			NC protected watersheds	none		

FILE	FEATURE TYPE	PATH	f1vic	f2stew	f3topo	f4soils	f5Lndu	f6wtr	f7infr	f8wtrql	f9subshd	f10hydfnc	f11hab	f12sites	f13*SWs	calcs only	process only	SOURCE1	SOURCE 2	CREATED FROM	DESCRIPTION	ADDED FIELDS	CREATION/UPDATE PROCESSES	STUDY CALCS
CatheysCreekWS.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\Shapef									X			X	X	X		Earth Tech	NCDOT GIS	CatheysCreekHU.shp	SWs of Cathey's Creek hydrological unit, Rutherfordton, NC	Area_m; Area_ft; Area_mi; Shed_id	Created by cutting CatheysCreekHU.shp into 14 SWs using topo lines and streams from georectified USGS quadrangles. Each SW was numbered in the field "Shed_id" with a value of 1-14, starting from the northwesternmost SW, moving left to right in a row fashion. Calculated and populated area quantities.	14 SW area quantities.
dotroads_CC.shp	Line	K:\61794\GIS\Spatial\NAD83m\Shapef														X		Earth Tech	NCDOT GIS	dotroads.shp	NC road centerlines (NCDOT) in Catheys Creek HU	Length_m; Length_mi	Created by cutting dotroads.shp using CatheysCreekHU.shp. Populated linear quantities. Used to generate the road polygon dotroadsbuff.shp.	Linear quantities of roads for overall HU and SWs
dotroadsbuff.shp	Polygon															X		Earth Tech	NCDOT GIS	dotroads_CC.shp	Polygon shapefile of roads in Cathey's Creek HU which represents 2 lane widths	Bufferdist; Area_m; Area_ac; Area_ft	Created by buffering each side of road centerlines (dotroads_CC.shp) with a 12 foot buffer (24 ft wide total), which simulates 2 paved lanes for the entire Catheys Creek HU road network). Area quantities populated, Buffer_dist populated with buffer width. Impervious road area was calculated from this 24-ft wide (per lane) buffered polygon (which simulates road surface).	Impervious surface area related to roads for overall HU and SWs
femafloodplains.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\Shapef										X						Rutherford County			Shows the FEMA floodplain boundaries for Catheys Creek HU			Area quantities of floodplain in SWs
forroad300.shp	Polygon	K:\61794\GIS\Task\HUMatrix											X					Earth Tech	USGS	lulc_usgs_CC.shp	Interior forest patches greater than or equal to 74 acres	Habitat_id	Created by selecting all forested communities, intersecting them with roads (which are buffered 300ft), then inward buffering the remaining forests 300 ft. Next, all remaining interior shapes that are greater than or equal to 74 acres are chosen. Last, assigned individual numbers for each patch under "Habitat_id" field	Area quantities of greater than or equal to 74 acres of interior forested patches (on SW basis)
habitat_cor.shp	Line	Shapefile: K:\61794\GIS\Task\HUMatrix															X	Earth Tech			Centerline habitat corridors that stretch between 74+ acre interior patches	Length_m; Length_ft; Rating; Connection	Created by connecting 74+ acre forested interior patches (forroad300.shp), with a polyline, in various combinations. The primary goal was to find entirely forested corridors. Rated each corridor based on the landuse/land cover it passed through under the field "Rating". "A" rating = entirely forested; "B" rating = mostly forested, including pasture/hay and/or row crops; "C" rating = mostly forested, including pasture/hay and/or row crops and/or other cover types. The "connection" field describes which interior shapes were connected by the corridor. These numbers assigned refer to the field "Habitat_id" of the file forroad300.shp.	Length quantities (corridor lengths) and number of combinations on a SW basis, as they relate to rating
300buff_habcor.shp	Polygon	K:\61794\GIS\Task\HUMatrix											X					Earth Tech		habitat_cor	600 ft wide corridor that stretches between 74+ acre interior patches	Bufferdist	Created by buffering habitat_cor.shp to create a 600ft wide corridor.	
npdes2_CC.shp	Point									X								Earth Tech	BasinPro 3.1	npdes2.shp	Cathey's Creek HU permitted waste water discharges	none	Created by cutting npdes2.shp using CatheysCreekHU.shp	
fcss_CC.shp	Point	K:\61794\GIS\Spatial\NAD83m\BasinPro\State\Monitoring								X								Earth Tech	BasinPro 3.1	fcss.shp	Cathey's Creek HU fish sampling community sites	none	Created by cutting fcss.shp using CatheysCreekHU.shp	
tippt.shp	Point	K:\61794\GIS\Spatial\NAD83m\NCDOT															X	NCDOT GIS			TIP Bridge Projects	none		
tipln.shp	Line	K:\61794\GIS\Spatial\NAD83m\NCDOT							X									NCDOT GIS			TIP Road Projects	none		
tippt_CC.shp	Point	K:\61794\GIS\Spatial\NAD83m\NCDOT							X									Earth Tech	NCDOT GIS	tippt.shp	TIP Bridge Projects in Cathey's Creek HU	none	Created by cutting tippt.shp using CatheysCreekHU.shp	
nl24k.shp	Polygon	K:\61794\GIS\Spatial\NAD83m\NCDOT			X						X							NCDOT GIS			USGS quadrangle grid for the State of North Carolina	none		
soilclearWS.shp	Polygon	K:\61794\GIS\Task\HUMatrix												X	X			Earth Tech	NCCGIA	soils and lulc_usgs_CC.shp	Hydric Soils that coincide with 'Cleared' land and are more than 5 acres in size.	mt5acres	Reselected 'Cleared' land use types from lulc_usgs_CC.shp. Reselected hydric soils from soils. Clipped land use with hydric soils. Reselected polygons more than 5 acres.	
strmclear	Arc (Coverage)	K:\61794\GIS\spatial\nad83m\cov												X	X			Earth Tech	NCCGIA	broad_CC.shp and lulc_usgs_CC.shp	Streams that coincide with 'Cleared' land for more than 1500 ft consecutively.	none	Reselected 'Cleared' land use types from lulc_usgs_CC.shp. Buffered by 30m to reduce edge effects. Clipped streams with buffered land use. Reselected arcs more than 1500 ft long.	
broadcc_ws.shp	Line	K:\61794\GIS\Task\HUMatrix													X			Earth Tech	NCCGIA	broad_CC.shp	Streams within the Cathey's Creek SWs	none	Created by cutting broad_CC.shp using CatheysCreekWS.shp. Used to display streams on a SW basis.	

NOTES:

In column **SOURCE1**, Earth Tech is listed as primary source of data when a GIS file is created by Earth Tech or significantly modified by geoprocessing such as cutting. In cases where Earth Tech did not generate the original data, **SOURCE2** is populated with the original source. In cases where additional fields were added, but no other modifications were performed, the *original* source is listed in **SOURCE1**

Subwatershed Analysis Data

Subwatershed Number	Area	Forested Area	Cleared Area	Road Area (100% Impervious)	Low Intensity Developed (50% Impervious)	High Intensity Developed (80% Impervious)	Municipal (80% Impervious)	Total Impervious Area (Roads x 100% + LID x 50% + HID x 80% + Mun x 80%)	Pond Area	Wetland Area	Floodplain Area	Stream Length	Length of 303d Listed Streams
01	2,554	2,202	334	*30.2*	*0.0*	*0.0*	*0.0*	30.2	1.2	4.2	33	42,200	0
02	2,041	1,945	93	*17.8*	*0.0*	*0.0*	*0.0*	17.8	2.9	0.2	0	39,633	0
03	1,853	1,817	28	*9.8*	*0.0*	*0.0*	*0.0*	9.8	0.0	1.1	33	42,521	0
04	1,638	1,215	420	*24.8*	*1.9*	*0.0*	*1.9*	27.2	2.6	2.7	134	37,061	0
05	2,234	2,061	336	*32.5*	*47.8*	*0.0*	*9.5*	63.9	0.5	2.3	216	54,081	0
06	2,464	2,055	379	*32.3*	*66.9*	*0.0*	*15.3*	78.0	40.1	9.2	76	66,273	0
07	2,303	1,610	693	*29.6*	*38.1*	*0.1*	*8.9*	55.8	0.8	6.9	160	42,242	0
08	1,981	1,312	669	*29.7*	*38.7*	*0.0*	*51.4*	90.1	3.2	4.3	41	40,075	0
09	1,854	873	978	*40.4*	*176.3*	*3.1*	*116.5*	224.3	7.9	14.2	74	37,978	0
10	1,445	1,108	330	*23.6*	*6.6*	*0.0*	*2.3*	28.8	4.9	61.5	177	37,219	0
11	2,108	1,538	557	*39.5*	*40.3*	*0.0*	*12.0*	69.3	16.2	77.2	246	50,158	10,819
12	1,940	1,261	677	*32.6*	*19.4*	*0.0*	*9.3*	49.8	3.0	79.7	181	51,571	10,286
13	2,437	1,158	1,275	*42.4*	*409.2*	*82.3*	*250.4*	513.2	5.2	15.8	112	50,641	3,476
14	1,801	1,236	563	*22.9*	*153.9*	*23.2*	*56.6*	163.6	7.4	30.9	113	44,824	11,504

***Units: Areas are displayed in acres, Lengths are displayed in feet**

Subwatershed Number	Length of Fully Supporting Streams	Length of Partially Supporting Streams	Length of Non-Supporting Streams	Length of Non-Rated Streams	Length of Streams classified as WS V	Length of Streams classified as C	Length of 50 foot Buffered Intermittent Streams	Length of 50 foot Buffered Perennial Streams	Total Length of 50 foot Buffered Streams	Interior Patch Area	Number of Patches	Number of Corridors	Number of Adjacent Patches
01	0	0	0	23,602	42,200	0	14,343	17,372	31,715	2,747	2	10	5
02	0	0	0	28,238	39,633	0	14,245	21,512	35,757	2,408	2	7	4
03	0	0	0	22,042	42,521	0	25,107	16,993	42,100	2,286	1	3	4
04	0	0	0	14,684	37,061	0	16,377	10,544	26,920	82	1	7	5
05	0	0	0	17,592	54,081	0	31,061	14,913	45,973	228	2	11	6
06	0	0	0	27,570	66,273	0	25,550	23,490	49,040	1,310	2	7	8
07	0	0	0	11,850	42,242	0	11,109	17,883	28,992	248	2	6	5
08	0	0	0	0	40,075	0	17,160	13,143	30,303	124	1	3	4
09	13,400	0	0	0	37,978	0	11,617	06,966	18,582	0	0		
10	0	0	0	13,266	37,219	0	18,019	11,974	29,993	227	1	4	4
11	0	10,819	0	8,058	27,291	22,867	17,244	19,736	36,980	270	1	5	4
12	422	10,286	0	0	422	51,148	22,507	21,338	43,845	113	1	2	2
13	18,740	0	3,476	10,266	17,040	33,602	13,564	19,978	33,541	0	1		
14	0	113	11,392	0	0	44,824	16,323	19,556	35,878	193	0	3	3

***Units: Areas are displayed in acres, Lengths are displayed in feet**

Procedure for defining 74-acre interior habitat patches

Union
K:\61794\GIS\Spatial\NAD83m\Shapef**dotroadsbuff_CC**
and
K:\61794\GIS\spatial\nad83m\cov**lufordis**.

Created
K:\61794\GIS\Spatial\NAD83m\Shapef**UnionRoadFor**.

Buffer 300 feet
K:\61794\GIS\Spatial\NAD83m\Shapef**UnionRoadFor300.shp**

Convert
K:\61794\GIS\Spatial\NAD83m\Shapef**UnionRoadFor300.shp**
To a coverage to get interior polygons.
K:\61794\GIS\spatial\nad83m\cov**forroad300**

Don't Cut with subwatershed boundaries.

Procedure for defining stream with 50' forested buffers.

Intersect streams
K:\61794\GIS\Task\HUMatrix\broadcc_ws.shp
with dissolved forest
K:\61794\GIS\spatial\nad83m\cov\lufordis
To make
K:\61794\GIS\Task\HUMatrix\IntStrmForDis.shp

Sel by attributes from lufordis, rings_ok = 0. (not forest)
Sel by location intstrmfordis.shp whose center is within selected polygons of lufordis.
Delete.

Shapearc
K:\61794\GIS\Task\HUMatrix\IntStrmForDis.shp
To
K:\61794\GIS\SPATIAL\NAD83M\COV\ STRMFORINT

build strmforint node

Buffer streams that coincide with forest, with square ends.
Usage: BUFFER <in_cover> <out_cover> {buffer_item} {buffer_table}
{buffer_distance} {fuzzy_tolerance} {LINE | POLY | POINT | NODE}
{ROUND | FLAT} {FULL | LEFT | RIGHT}

K:\61794\GIS\SPATIAL\NAD83M\COV\ STRMFORINT
buffer strmforint strmfor50 # # 50 # line flat

Select portions of rectangles that entirely encompass forest.
K:\61794\GIS\Task\HUMatrix**strm50mlength**
Summarize on shed_id for lengths.

Redone using 50 Feet as Criteria.

Mill US @ Painter's Gap Rd. 1

Mill US @ US Painter's Gap Rd. 1

Mill US @ Painter's Gap Rd. 2

Mill US @ US Painter's Gap Rd. 2

Mill US @ Painter's Gap Rd. 3

Mill US @ US Painter's Gap Rd.

Mill DS @ Painter's Gap Rd.

2nd Mill Creek Logging Crossing @ Painter's Gap Rd./Thermal City Rd. 1

2nd Mill Creek Logging Crossing @ Painter's Gap Rd./Thermal City Rd. 2

2nd Mill Creek Logging Crossing @ Painter's Gap Rd./Thermal City Rd. 3

2nd Mill Creek Logging Crossing @ Painter's Gap Rd./Thermal City Rd. 4

2nd Mill Creek Logging Crossing @ Painter's Gap Rd./Thermal City Rd 5

1st Mill Creek Logging Crossing @ Painter's Gap rd./Thermal City Rd. 1

1st Mill Creek Logging Crossing @ Painter's Gap Rd/Thermal City Rd. 2

Lewis DS @ Thermal City Rd. 1

Lewis US @ Thermal City Rd. 2

Lewis US @ Thermal City Rd. 3

Lewis US @ Gravel off Thermal City Rd. 1

Lewis DS @ Gravel off Thermal City Rd. 2

Lewis DS @ Gravel off Thermal City Rd. 3

Harris US @ Thermal City Rd 1

Harris US @ Thermal City Rd. 2

Harris US @ Thermal City Rd. 3

Harris US @ Thermal City Rd. 4

Harris US @ Thermal City Rd. 5

Harris US @ Thermal City Rd. 6

UT Harris US @ Thermal City Rd

Cathey's US @ US 221 1

Cathey's US @ US 221 2

Cathey's US @ US 221 3

Holland's US @ Rock Rd. 3

Holland's US @ Rock Rd. 1

Holland's US @ Rock Rd. 4

Holland's US @ Rock Rd. 2

Holland's US @ Rock Rd. 5

Holland's US @ Rock Rd. 6

Holland's US @ Rock Rd. 7

Reynolds US @ Whiteside Rd. 1

Reynolds US @ Whiteside Rd. 2

Reynolds US @ Whiteside Rd. 3

Reynolds US @ Whiteside Rd. 4

Holland's DS @ Whiteside Rd. 3

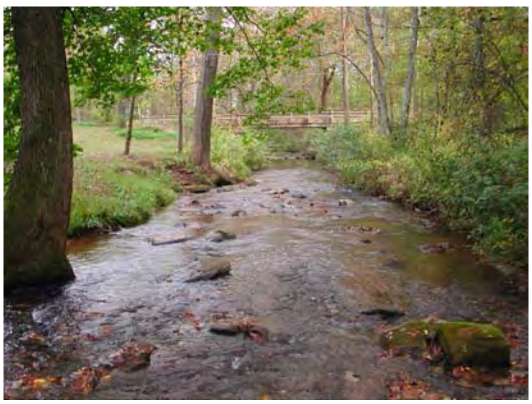
Holland's DS @ Whiteside Rd. 1

Holland's US @ Old Ballpark Rd. 1

Holland's DS @ Whiteside Rd. 2

Holland's US @ Old Ballpark Rd. 2

Holland's US @ Old Ballpark Rd. 3



Holland's US @ Old Ballpark Rd. 4

Catheys Creek Head

Lewis Creek Head

Catheys Creek at Nanneytown Road

Catheys Creek at US 221

Untrib at SR 916

Catheys Creek at US64

Pasture Area in Watershed

Impervious Area in Watershed

Summer 2003

Cathey's Creek Newsletter

Watershed Education for Communities and Local Officials

Kick off meeting for New Watershed Planning Project Held

On June 23, NC Wetlands Restoration Program (NCWRP) held a public workshop to kick-off a new project in the Cathey's Creek watershed.

NCWRP is a non-regulatory program within NC Department of Environment and Natural Resources (NCDENR) that is charged with restoring streams and wetlands throughout the state.

NCWRP prefers to choose their restoration projects through a holistic method which considers a community's needs and local ecology. They do this by sponsoring *local watershed planning* in targeted watersheds throughout the state.

A ***watershed*** *contains all the land that drains to a particular water body*

The Cathey's Creek watershed in Rutherford County has been selected as an area for local watershed planning.

NCWRP has hired Earth Tech of North Carolina, Inc. to conduct a technical assessment of the watershed, and has hired Watershed Education for Communities and Local Officials (WECO) to facilitate community involvement in the planning process. WECO is a NC Cooperative Extension Program based at NC State University.

The kick-off meeting was hosted by the Rutherford County Cooperative Extension Center. Kristin Cozza, NCWRP, provided information about her program and how the local watershed planning process works. Ben Goetz, Earth Tech of NC, Inc., explained what their watershed assessment involves and what they are learning about the watershed.

Christy Perrin and Patrick Beggs, WECO, then engaged participants in activities to hear from them about important issues in the watershed.

Please read further to learn more about the kick-off meeting and the opportunities that this new project presents for the community!

Catheys Creek Watershed Advisory Committee To Be Formed

A technical watershed advisory committee is being convened to oversee the watershed planning effort. Potential members were contacted based on suggestions of stakeholder interests provided at the public meeting. The committee will meet about 5 times between now and December 2004 to review the watershed assessment results and to help identify projects for the watershed plan. The first meeting of the committee will be held on:

Monday, September 29, 2003

2:00 p.m.-4:00 p.m. at the

Rutherford County Cooperative Extension Center in Spindale.

Inside this issue:

New Watershed Project	1
Advisory Committee description & meeting date	1
What is Local Watershed Planning?	2
A watershed Assessment	2
What should be considered in watershed plan?	3
Why are wetlands important	4

At the first Watershed Advisory Committee Meeting:

- *Watershed Advisory Committee will see the preliminary results of the watershed assessment*
- *The committee will provide feedback regarding the preliminary results and next steps for the watershed assessment*

What is Local Watershed Planning?

The NC Wetlands Restoration Program (NCWRP) is a non-regulatory program that is charged with wetlands and stream mitigation in the state.

What is mitigation? The NC Department of Transportation must compensate the public for impacts that road building has on streams and wetlands. NCWRP ensures that projects are created to offset these impacts.

NCWRP needs to implement restoration projects in the Broad River Basin to mitigate impacts from road projects. NCWRP chose the Cathey's Creek watershed since Cathey's Creek and Holland's Creek (known historically as Sheppard's Creek) is on the 303(d) list– the state's list of impaired waters.

Rather than just picking out projects randomly, NCWRP would rather identify projects in the context of a *watershed plan*.

Local watershed planning involves two major components:

1. Gathering technical and scientific information about the watershed.

2. Involving local stakeholders to ensure that local priorities are incorporated in the plan.

Watershed Planning includes all stakeholders who can impact or are impacted by water resource decisions

The resulting watershed plan will include an assessment of the watershed, and recommendations of management actions needed to reach the goals for the watershed. Local stakeholders help to determine what are appropriate goals for the watershed.

NCWRP has funds to pay for stream and wetland restoration projects, and potentially for land conservation. They can also help identify funding sources for other management strategies that may be identified in the watershed plan.

A Watershed Assessment of Cathey's Creek

Ben Goetz and Jane Almon, Earth Tech of NC, Inc. are conducting a watershed assessment of Catheys Creek.

There are 3 steps to the watershed assessment:

1. Watershed Characterization

- Collecting Data
- Stakeholder Interviews
- Windshield Surveys (driving around watershed looking)

2. Detailed Analysis

- Field work
- Monitoring water quality
- Identify focus areas for action

3. Identify specific solutions

Ideal projects will save pastureland, help fish, improve water quality, provide mitigation credit for road projects, and address local goals.

What have we learned so far?

Watershed Focus

⇒ In 1970's flood prevention was key. Four impoundments were created in watershed to alleviate flooding.

⇒ 1980's farming practices were improved. No-till methods and other practices decreased erosion from farming.

⇒ Currently, livestock exclusion from streams is a local focus, with money available from the federal Environmental Quality Incentives Program (EQIP).

Ben and Jane spent some time looking around the streams in the watershed. They commented that Mill Creek looked very nice, as it was heavily vegetated around the streams.

They showed photos of other areas in the watershed where streambank erosion was prevalent. Streambank erosion can cause a loss of land, including pastureland, as the land falls into the stream.

They let participants know that they will be out in the streams taking measurements to conduct the watershed assessment. They will send letters to landowners before they do so, to inform people as to why they are wading in streams with equipment.

Anyone who has information about conditions in the watershed that they would like to share can contact Ben at 919-854-6243, or at

ben.goetz@earthtech.com

Cathey's Creek and Holland's (also called Sheppard's) are listed as impaired (or degraded) by the State of NC

What should be considered in this watershed planning effort?

Participants of the public meeting were invited to provide their ideas on what should be considered in the watershed planning effort. Participants then categorized their responses and provided heading titles to help organize the information. These responses follow.

Education Needs

- We need more education about wetlands - define the word wetland

Erosion – (from timbering)

- Projected Population Levels
- Non-point-source pollution increases
- erosion along creek
- Damage to streamb anks
- What can you do to keep water from running down a hill into the stream?
- Where you see trees you don't see erosion
- Terrible logging practices
- Logging equipment in water bodies
- Trees and leaves hold moisture, not grass

Catheys Creek Individual Discharges

- How to mitigate the effects of having the Spindale waste water treatment being dumped into Cathey's Creek at Hudlow Road
  Vegetation is dying/dead
  Concerned about lack of critters
- Concerned about water quality below discharge into Catheys Creek (below bridge on Hudlow Road)

Projects displacing people, or new people changing landscapes

- What happens to the people?
- Any people relocated due to watershed (activities)

Private Property Rights & community partnerships

- Private Property Rights
- Affected communities involved

Agricultural Impacts

- Keeping cattle out of our creeks
- Agricultural & urban water needs

Comments about watershed Maps

- The maps need to reflect local landmarks
- Accurate names need to be on maps (roads, churches, ? sites)
- Map needs to replace names all the names in Cathey's creek. Watershed with creeks and roads. Most reflect local landmarks, i.e. historical towns, schools, churches.

Development (disturbance of land)

- Large timber tracts being sold for development?
- Clearcutting to pay taxes
- Clearcutting activities
- Clear-cuts are often needed to pay taxes.
- High Property Tax
- People have to sell to developers, more erosion.
- When trees are cut and converted to pines.
- The best managed practice is "globally pines" according to tax office
- Can't afford property tax on timberland – timber companies selling because of tax
- Small farmers losing factory jobs, pressure to sell land to developers?
- Cathey's Creek individual discharge
- How to mitigate the effects of having the Spindale waste water treatment being dumped into Cathey's Creek at Hudlon Road
  Vegetation is dying/
  Concerned about critters (lack of)
- Concerned about water quality below the (cleaned waste water) discharge into Cathey's Creek (just below bridge in Hudlow Rd)

The headwaters of Cathey's Creek are in Union Mills, on Pinnacle Mountain.

Historical Sites

- Historical sites

Plants Quality

- Quality of plant community on banks – native vs exotics
- What plants can be put in to absorb pollution?

Flooding

- Flooding for Holland's
- Flooding of streams getting out of its banks
- Flooding
- Potential water reservoirs (Need for additional water retention)

Watershed Education for Communities and Local Officials
NCSU Campus Box 8109
Raleigh, NC 27695-8109

Phone: 919-515-4542
Email: christy_perrin@ncsu.edu
Patrick_beggs@ncsu.edu

We're on the web!
Www.ces.ncsu.edu/WECO/catheys

Why are wetlands important?

Bog, swamp, salt marsh, pond, riparian forest, vernal pool, mangrove forest: what do these all have in common? That's right, they are all wetlands.

Wetlands are areas that have the following similar characteristics:

1. WATER: Inundated (flooded) or saturated with water for a certain number of days in a row that add up to 7.5% of the growing season in an area. The growing season begins when the first buds on plants appear and ends with the first frost. For the rest of the year the area could have no water at all.

2. SOIL: Presence of hydric soil. The soil in wetlands is a special kind of soil called hydric soil. Hydric soils are those that are wet long enough during the growing season that anoxic (without oxygen) conditions are created in which hydrophytes (water-loving plants) will grow.

3. PLANTS: Presence of wetland plants. Wetland plants are hydrophytes, which simply means that they are water (hydro) lovers (phytes). They can grow in water or in soils that are anoxic (without oxygen).

You may have seen bumper stickers in NC that say "No wetlands, no seafood". While wetlands are important for providing habitat where marine life spawns, they also provide many other services in the NC foothills and piedmont that are critical for our lives and enjoyment. These services include:

⇒ Filtering pollution such as pesticides, herbicides, or heavy metals
⇒ Filtering nutrients that can otherwise cause algae blooms, which deplete oxygen in water bodies so that aquatic animals can't survive
⇒ Absorbing water that might otherwise cause downstream flooding
⇒ Preventing loss of land due to erosion
⇒ Providing habitat to a multitude of fish, birds, mammals
⇒ Providing recreational opportunities like hunting, bird-watching, fishing

This watershed planning project will identify existing and former wetlands in the watershed as part of the watershed assessment. For more information about wetlands, visit www.wetland.org or www.epa.gov/OWOW/wetlands/

What should be considered in this watershed planning effort cont.

DOT Projected 221 widening impacts

- What affect the widening of Hwy 64 had on Cathey's Creek and what else needs to be done to correct any resulting problems.
- Affected Roads
- DOT impacts/projects on flooding?

Wildlife and Aquatics

- Wildlife overpopulation- of predators
- What kind of fish are in the streams?
- Losing calves to predators (coyotes, wolves)
- Wildlife officers need to change attitude (property owners need rights to shoot)
- Wildlife is not where it supposed to be (in urban areas)
- Wildlife taking over our land - Help!

The information provided by participants will be considered while conducting the watershed planning effort.

Thank you to everyone who participated in this exercise!

A follow-up public meeting will be held when the watershed plan is almost complete, in Summer or Fall 2004.

Alphabetical Contact Listing

	Contact Name	Company Name	Title	Work Phone	Ext.	Fax Number
A						
	Almon, Jane	Earth Tech	Project Biologist	(919) 854-7745		(919) 854-6259
B						
	Bleeker, Hope	NC-DOT	Transportation Planner, RPO Contact	(828) 287-2281	1221	
	Blose, Jim	NCDENR-DWQ, Water Quality Section	Modeling, TMDL	(919) 716-1924		
	Brown, Harlow	Broad River Water Authority				
C						
	Cozza, Kristin	NC-WRP	Watershed Planner	704-572-0955		(919) 733-5321
	Cristo, Greg	Isothermal Planning and Development Commission		(828) 287-2281	1226	
D						
	Duncan, Bonnie	NC-WRP	Watershed Planner	(919) 733-5315		
E						
	Edwards, Gilmer	Landowner	Past AFSC (Farm Services)			
	Edwards, Roger	NCDENR-DWQ, Division of Water Quality	Asheville Regional Office, WWTPC	(828) 251-6208		

	Contact Name	Company Name	Title	Work Phone	Ext.	Fax Number
F						
	Faltraco, Lynne	Concerned Citizens of Rutherford County	Coordinator	(828) 287-4429		
	Ferguson, Nancy	Rutherford County	County Historian	(828) 287-3509		
H						
	Halley, Jim	Natural Systems Engineering	Principal, PE	(757) 227-6012		(757) 227-6013
	Hargett, Dave	Pinnacle Consulting Group, Inc.	Ph.D., Principal	(864) 467-0811	113	(864) 467-9758
	Hess, George	NCSU Department of Forestry	Assistant Professor	(919) 515-7437		
	Hollifield, Jim	Rutherford Cnty Soil & Water Conservation District	District Conservationist	(828) 287-4817		(828) 287-8081
	Howell, Yvonne	EarthTech	Planner	(919) 854-6213		(919) 854-6259
L						
	Lancaster, Jim	Economic Development Commission		(828) 248-1719	3	(828) 248-1771
	Leslie, Andrea	Division of Water Quality Quality	Planning and Assessment Unit	(828) 251-6208	226	
M						
	McGuinn, Jan	Rutherford County Cooperative Extension Service	Extension Specialist	(828) 287-6015		
	McKerrow, Alexa	NC Gap Analysis Project	Coordinator	(919) 513-2853		
	Moore, Albert D.	NRCS	District Conservationist	(828) 287-4220	3, 3310	(828) 287-8081

	Contact Name	Company Name	Title	Work Phone	Ext.	Fax Number
N						
	Nance, Chuck	Isothermal Planning and Development Commission		(828) 287-2281	1251	
	Nance, Kathy		Landowner	(828) 287-0069		
	Nanney, Loyd	Thermal City Gold Mining		(828) 286-3016		
P						
	Perrin, Christy	WECO	Program Coordinator	(919) 515-4542		(919) 515-1824
R						
	Robson, Forrest	NCDOT GIS Branch		(919) 212-6000		
	Rourk, Matt	Rutherford County	GIS Specialist	(828) 287-1226		
S						
	Shelton, Roy	NCDOT, PDEA	Staff Engineer	(919) 733-7844		
	Sprouse, Barbara	Rutherford Cnty Soil & Water Conservation District	District Conservationist	(828) 287-4817		
	Stevenson, Jr., George	NC Office of Archives and History	Special Collections	(919) 733-3952		
W						
	Weatherfield, Morgan	NCDOT GIS Branch	GIS Technician	(919) 212-6011		
	Whisnant, Richard	School of Government, UNC-Chapel Hill	Associate Professor Public Law & Government	(919) 962-9320		(919) 962-0654
	Williams, Beverly	NCDOT Statewide Planning	Mtn.Unit Supervisor, Western Planning Group	(919) 715-5737		
	Woolfolk, Michelle	NCDENR-DWQ, Water Quality Section	Modeling, TMDL	(919) 733-5083	505	

Fall 2003

Cathey's Creek Newsletter

Watershed Education for Communities and Local Officials

First Meeting of Cathey's Creek Watershed Technical Advisory Committee

The Cathey's Creek Technical Advisory Committee was convened for the first time on September 29. The group learned about the local watershed planning process being sponsored by NC Ecosystem Enhancement Program (formerly the NC Wetlands Restoration Program), and reviewed a *Working Charter*, which outlined the goals of the process and the committee's roles.

The Committee heard from Andrea Leslie about a *biological assessment* that NC Division of Water Quality conducted in Cathey's Creek Watershed this year.

Ben Goetz, Earth Tech Inc., presented an overview of the watershed assessment that Earth Tech is conducting, and suggested a proposal for proceeding with the assessment.

The group also provided a list of their expectations for participating in the watershed planning process.

Summaries of all of these activities are included within this newsletter. You can view the complete powerpoint presentations shown at this meeting on our website at

www.ces.ncsu.edu/WECO/catheys

You can also submit anonymous comments at this site.

The Next Technical Committee Meeting will be held on

Tuesday, Feb.3, 2003

2:00-4:00 p.m.

at the Rutherford Co. Cooperative Ext. center in Spindale

- *Earth Tech will provide an update on the Technical Watershed Assessment*

Hopes and Expectations for the Planning Process

How will this watershed planning process help you?

Participants were asked to answer this question, so that everyone could understand each other's expectations. Answers follow.

- Saving Gilbert Town
- Preventing excess runoff
- Historical interest
- Keeping track of Extension activities
- Getting to know others in county
- Paddlers are interested in water quality
- Providing a model for obtaining grant $
- Identifying projects to meet goals
- Protecting water quality for citizens
- Water and the process of involvement is critical
- Learning timbering impacts on water quality and restoring problems
- Town wants to help with projects
- Clean water key for habitat
- Better ideas for benefiting non-game wildlife species
- Protecting and restoring stream health
- See what impact development may have on water quality

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Expectations…continued

- Interested in how process unfolds
- Isothermal Planning & Devel. Comm.(IPDC) interested in any planning process and can provide technical assistance
- Alternative cost share programs to help landowners install best management practices (BMPs)
- Stream quality and erosion control
- Lack of public access
- Cultural resources as it involves stream channel changes

Note from WECO staff: Staff from NCEEP, WECO and Earth Tech, Inc. hoped to learn about the expectations of participants so they could let them know up-front if the planning process was not going to address any of those expectations. After hearing them, we feel that it is possible that many of those expectations could be addressed in some way by the planning process.

Purpose of Planning Process

Kristin Cozza, NC Ecosystem Enhancement Program (NCEEP), explained to the group NCEEP's purpose for sponsoring the watershed planning process, and what they were asking from the Advisory Committee.

NCEEP is trying to fund restoration projects that benefit the community and improves watershed functions. The watershed plan will outline problems and solutions, and the NCEEP will use the plan to guide where to implement projects. The plan is a non-regulatory tool, meaning that participation in the projects is entirely voluntary.

Benefits of the planning process:

- It will provide an opportunity to learn about Cathey's Creek
- It can serve as a model for other watersheds nearby
- Community can use the study as a leveraging tool for funds

The role of the committee will be to provide oversight of the watershed assessment, to inform the staff of important community issues, and to assist with implementing the plan.

Bugs in the Creek- what does it mean?

Andrea Leslie, a biologist with the NC Division of Water Quality (DWQ), provided a presentation on a 2003 Aquatic Community study that NCDWQ conducted.

This aquatic community study involved looking at aquatic macroinvertebrate and fish communities. Aquatic macroinvertebrates are organisms such as insects and clams that are also referred to as "benthos" meaning bottom dwelling.

Benthos and fish are sensitive to water quality and stream habitat, so they are a good measure of stream health. If you have a stream with good water quality and habitat quality, you would expect to see a certain number and diversity of macroinvertebrate species and fish.

Water quality factors that influence organism populations include:

- Oxygen, temperature, pH
- Pollutants (toxins, nutrients, suspended sediments

Habitat quality factors that influence organism populations include:

- Morphology (or structure) of the stream channel– are there pools, riffles (areas of fast flow over rocks), bends?
- Bottom substrate– sand, gravel, rock
- Organic substrate– large wood, sticks, leaves

DWQ monitored macroinvertebrates at seven sites in the watershed in 2003. All sites sampled hosted impacted macroinvertebrate communities, and no excellent sites were found in the watershed. The map on the opposing page marks these sites with symbols to illustrate how healthy the aquatic communities were at the sites.

Habitat Issues in Cathey's Creek:

- Many streams are very sandy, limiting aquatic macroinvertebrate diversity
- Sandy substrates are susceptible to scour during storms
- Eroding banks are an issue

Anomalies found here:

- Found some good habitat but very impacted benthos at Mill Creek and Upper Hollands Creek:
    - -May be an effect from a pond on Mill Creek?
    - -Upper Holland's Creek: potential water quality issues?
- Case Creek had better benthos than expected since it is an urban stream

Looked at Spindale Wastewater Treatment Plant to see effects:

- Catheys Creek has decreases in community health downstream of plant outfall, but stormwater runoff from the urban Spindale area may be contributing to it. It's not possible to attribute the decrease in health to one or the other without further research.

Continued on page 3

Bugs in the creek, continued from page 2

What is going on? Stream habitat here is pretty limited since many streams are very sandy. This is characteristic of streams in the lower broad. However, Cathey's Creek is doing more poorly than other creeks with similar characteristics.

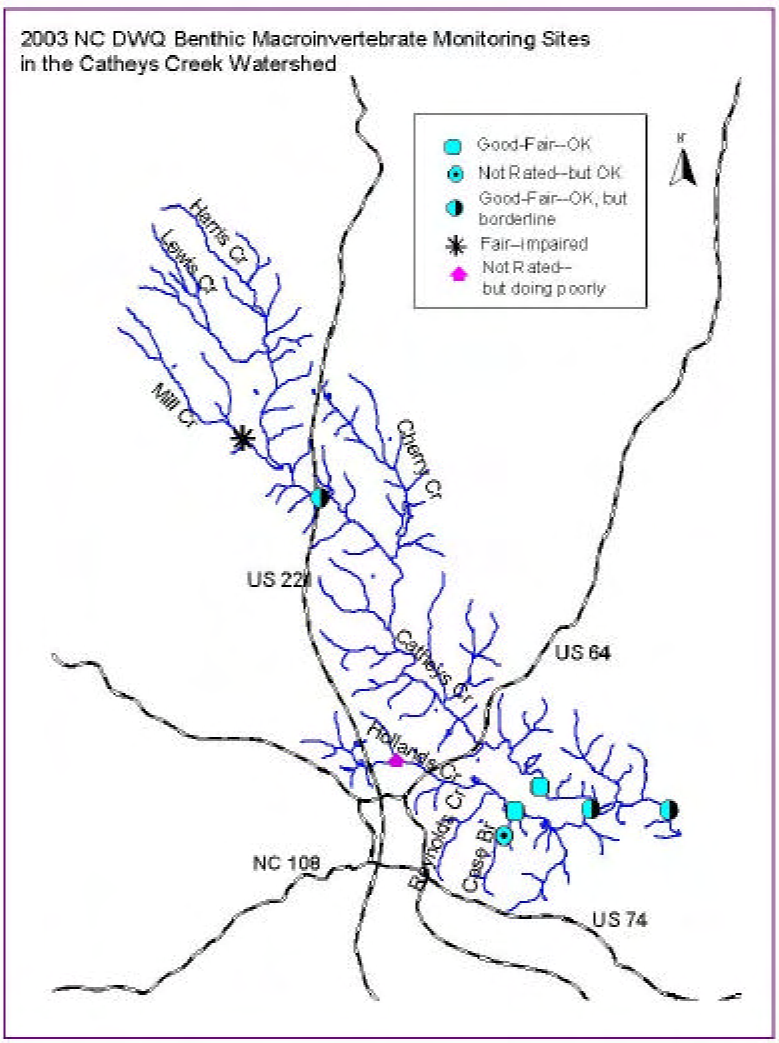
Questions/Discussion with participants

Removing trees for navigation: Participants wondered if downed trees can be removed from streams for recreational access. It is best to remove only enough so that boats can pass through– these trees provide good habitat and can not be too numerous in that respect.

Fish sampling: Sampling was conducted in 1997 and 2002 at a lower reach of Cathey's Creek. A drop in fish community health was seen, possibly due to some event that may have wiped out the population. The group discussed whether this was due to the drought, or perhaps a toxic chemical spill that occurred 4 years ago. Most streams throughout the state didn't suffer such drops in fish populations during the drought as Cathey's Creek did, so Andrea thinks something else caused it. They would like to re-sample the fish community in the fall.

Impacts of small ponds: In-stream ponds cut a stream off from the upstream and downstream portions, which changes the dynamics of the biological community. Fish cannot migrate. There is not currently a program to mitigate stream impacts from ponds.

Sand dredging impacts: This has an impact on a localized area as it kicks up fine sediments. It has been argued that dredging benefits the stream long-term since it is removing sediments, but on the whole it is detrimental.



Overview of Technical Watershed Assessment

Ben Goetz, Earth Tech, Inc., provided an overview of the watershed assessment.

The assessment process includes:
A *Characterization* that involved gathering mostly GIS based information.
A *Detailed Analysis* that involves fieldwork, water quality monitroing, and identifying areas to focus more investigation upon.
Identifying Specific Solutions to identified issues, which could include education, restoration projects, and ordinance recommendations.

Results of Characterization
History of land: mining, timbering, and farming are historical uses. Streams show adjustment from the impacts of these uses.
Land use/cover: highly vegetative (74%), with young forests, exotic invasive plants (like kudzu). Many overland and streambank BMP's have been implemented. Land use changes in recent history include nursery crops and development.
Subwatershed Conditions: **Water quality** problems include nonpoint sources (not from a pipe but from various and diffuse sources) and streambank erosion. **Hydrology** (the movement of water in a system) in the watershed exhibits realigned and incised channels, and in stream impoundment which may be negatively affecting water quality. **Habitat** in the watershed is characterized by cleared areas and managed land.
Continued on page 4...

Watershed Education for Communities and Local Officials

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We're on the web!
www.ces.ncsu.edu/WECO/catheys

Participants at the September meeting included:

Boyce Abernathy
Pat Allen, Union Mills community
Tim Barth, Town of Spindale
Patrick Beggs, WECO
Walt Bumgarden, NC Cooperative Extension, Rutherford County
Kristin Cozza, NC Ecosystem Enhancement Program (NCEEP)
Roger Edwards, NC DWQ, Asheville Office
Lynne Faltraco, Concerned Citizens of Rutherford County
Nancy Ellen Ferguson, County historian
Ben Goetz, Earth Tech, Inc.
Andrea Leslie, NCDWQ
Jason Mayo, Rutherford County Planning Dept.
Albert Moore, USDA/NRCS
Lois Moove
Chuck Nance, Isothermal Planning and Devpt. Commission (IPDC)
Hicks Owens Rutherford County Planning
Tom Padgett
Christy Perrin, WECO
Jerry Stensland, Rutherford Outdoor Coalition
Dennis Taylor, Daily Courier
Win Taylor, NC Wildlife Resources Comm.

Watershed Assessment continued…

The detailed analysis may include:
Water Quality Monitoring of oxygen, nitrogen, phosphorus, sediment, and temperature.
Macroinvertebrate Sampling will look at the variety of types and percentage of each type.
A Stream Assessment will look at the bed, bank, floodplain of streams, will quantify conditions, and note special impacts.
Sediment Sampling, and Fish Sampling.

Earth Tech will be investigating **Watershed Functions**, which are services provided by the watershed that we want to protect. The assessment proposes to look at three functions: 1)*Water quality*, which includes nutrients, sediment, and temperature for the study; 2)*Hydrology,* which includes flood frequency, stream network, and channel stability; and 3)*Habitat,* which includes land cover and plant types.

Earth Tech will examine *Indicators of watershed functions* that will be measured to determine the *"health"* of the watershed functions. For each function, these indicators may include:

Water Quality
- chemical content
- bug community
- fish community

Hydrology
- available floodplain
- channel shape, pattern, profile
- bed material

Habitat
- amount, type, variety
- geographical location

> ***I like to see a man proud of the place in which he lives.***
>
> ***I like to see a man live so that his place will be proud of him.***
>
> *Abraham Lincoln*

Discussion about Watershed Functions– How else can we measure the "health" of the Cathey's Creek Watershed?

Q: *Will you establish a baseline chemical analysis?*
Yes, we will try to measure a "control".

Q: *Will you look at heavy metals– mercury and arsenic?*
Ben and Andrea will monitor. In relation to the gold mines if the data suggests it could be an impact and resources are available, we may consider checking sediment samples.

Q: *Do you have guidelines for developers?*
We will outline guidelines in the watershed plan.

Q: *Most homes have septic systems. Can we assess septic systems and straight piping?*
We will look for straight pipes while walking the streams
Comment: Let locals, the CCRC, contact people if they have straight pipes rather than approaching them yourselves– property rights is a sensitive issue.

Q: *Is there any data that CCRC may have regarding timbering impacts?*
Info available on logging roads, cutting that occurs adjacent to waterbodies. Sites are located on topographic maps that CCRC has.
Comment: The watershed plan could identify better places to timber.

Group Working Charter

Cathey's Creek Watershed Advisory Committee

Background

The North Carolina Wetlands Restoration Program (NCWRP) is a non-regulatory program charged with wetland, stream and riparian buffer restoration across the state. To implement restoration projects where both locally specific restoration needs and opportunities exist, the NCWRP has initiated Local Watershed Planning within several small watersheds (14-digit Hydrologic Units or HUs) statewide. Local watershed planning is a comprehensive planning effort to investigate all sources of pollution/degradation in a local watershed and recommend a comprehensive strategy for improving water quality. The NCWRP will use Local Watershed Plans to identify potential stream and wetland restoration projects that the NCWRP can implement to offset permitted impacts to streams and wetlands caused by future NC Department of Transportation road improvement projects in the Broad River Basin. Ideally, these restoration projects will be linked to other water quality improvement and protection efforts initiated at the local level, such as stormwater management projects, water supply protection strategies, land use planning or best management practices for reducing nonpoint source pollution and controlling stormwater runoff. Local communities can also use the plans to solicit grant funds for watershed improvement projects and to augment other local planning initiatives.

Based on local input, water quality data, natural resource information and projected wetland and stream impacts from NC Department of Transportation road improvement projects in the Broad River Basin, the NCWRP has selected the Cathey's Creek Watershed as a focus area for local watershed planning. This area includes all the land and tributaries that drain into Cathey's Creek, including Harris Creek, Lewis Creek, Mill Creek, Holland's Creek, Reynolds Creek, Cherry Creek, and of course, Cathey's Creek. Through this planning initiative, the NCWRP will seek input from the local community to develop a Local Watershed Plan that will include three key components: 1) An inventory of the specific causes of watershed degradation identified through a detailed assessment; 2) A plan that links watershed problems with specific restoration strategies that are developed with assistance from the local community; and 3) A strategy for implementing restoration projects and other watershed initiatives identified in the plan.
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Philosophy of NCWRP Local Watershed Planning

The NCWRP believes that it is important to work with local stakeholders to develop comprehensive solutions for local watershed degradation issues. The NCWRP is committed to implementing wetland and stream restoration projects identified through the local watershed planning effort and will work with local communities to use technical data gathered and generated through the local watershed planning process to establish local priorities for watershed protection and restoration. The Local Watershed Planning process allows local communities to use technical resources provided by the state to identify watershed problems and evaluate alternative management solution within a scientific framework. The NCWRP believes watershed improvement strategies should be based on sound science and should where feasible target issues of concern to the community. Watershed improvement can not occur without local understanding of the issues and solutions to address identified problem areas. Stakeholders have a vested interest in working toward watershed restoration and protection efforts in the watersheds where they live and work.

Purpose of the Group

The primary purpose of the Cathey's Creek Watershed planning initiative is to develop recommendations for improving and protecting the watershed. To help develop these recommendations, the Advisory Committee [also referred to as the Group] will provide input at critical points during the watershed assessment process to ensure that watershed problems are accurately characterized and that issues under evaluation are important to the community. The key tasks to be conducted by the Group are outlined below.

Group Tasks

- *Assisting with landowner contacts and education in the conduct of watershed assessment & monitoring activities. [Please note that all participation by landowners is completely voluntary.]*

- *Assisting the NCWRP watershed assessment consultants in identifying issues for detailed analysis. Issues might include evaluating impacts to water quality from project growth and development or evaluating the magnitude of sources of nonpoint source pollution. .*

- *Helping identify optimal sites (and landowner contacts) for traditional stream, wetlands and buffer restoration projects.*

- *Helping to identify watershed restoration strategies, such as storm water BMPs (best management practices) and new local development ordinances, that are technically, economically, and politically feasible within the watersheds.*

- *Helping identify high-priority preservation opportunities and contacts.*

- *Helping identify additional funding assistance, i.e. for watershed projects or initiatives not fund-able by NCWRP.*

- *Fitting projects into the development of an overall watershed restoration/protection strategy.*

- *Introducing and promoting recommended watershed solutions to local governments and the community.*

<u>Authority of the Group</u>
The Cathey's Creek Watershed Advisory Committee has the authority to provide input in the development of recommendations for the Cathey's Creek Watershed Plan.

<u>Nature of the Final Product</u>
The Cathey's Creek Watershed Advisory Committee will provide input to a report that contains a set of recommendations for protecting and improving water quality, habitat and water quantity issues in the watershed. Recommendations will be delivered to local governments in the watershed, as well as other appropriate organizations and government entities as requested by those groups.

<u>Local Watershed Planning Group - Members</u>
The Cathey's Creek Watershed Advisory Committee consists primarily of NCWRP support staff and local resource professionals who represent various interests related to water quality, water quantity and habitat management in the watersheds described above. The following are organizations/entities whose participation is necessary to make this process successful [this list may be expanded as additional interested local or regional watershed stakeholders are identified]:

(Local government representation can include planning departments, storm water management staff, parks & rec. staff, etc.)

- **Town of Spindale**
- **Rutherford County**
- **Rutherford County Cooperative Extension**
- **Rutherford County Chamber of Commerce**

- **Rutherford County Farm Bureau**
- **Rutherford County NRCS staff**
- **The Foothills Conservancy**
- **Concerned Citizens of Rutherford County**
- **The Union Mills community**
- **NC DENR - Asheville Regional Office**
- **NC Wildlife Resources Commission**
- **NC Division of Forest Resources**

Support Staff

- **Jane Almon,** Earth Tech of North Carolina, Inc.
- **Patrick Beggs**, Watershed Education for Communities and Local Officials (WECO) NCSU
- **Kristin Cozza**, N.C. Wetlands Restoration Program (NCWRP)
- **Ben Goetz,** Earth Tech of North Carolina, Inc.
- **Christy Perrin**, Watershed Education for Communities and Local Officials (WECO) NCSU

Defined Roles and Responsibilities of Various Group Participants

- **Advisory Commitee Members**

-Role: Committee members are considered to be the people who have a seat at the table and directly participate in the process to provide input and feedback on the development of the Local Watershed Plan. Members can provide technical support and lend local expertise to the process with regard to various watershed characteristics and activities going on in the watershed. These people ideally represent a broad cross-section of various interests within the watershed, i.e. agriculture, forestry, wildlife/habitat, local government, economic development, etc. They are expected to participate in all meetings or send an alternate to represent their identified interest or agency.

-Responsibilities:

- Attend Meetings
- Provide Alternate Representative(s) to Meetings, if necessary
  [Each stakeholder interest represented will have one voice in the decision-making process.]
- Clearly Identify their Constituent/Agency Representation
- Keep Constituents/Agencies Informed of Key Outcomes of the Process
- Prepare for Meetings by reviewing any pertinent materials provided in advance
- Assist NCWRP and their consultants as outlined in "Group Tasks" above
- Review and provide comment on specific recommendations that come out of the process

- **Support Staff**

-Role: Support staff are the individuals and agencies working to initiate, facilitate, organize, guide (through the development of technical information) and support the development and implementation of recommendations contained in the Final Cathey's Creek Local Watershed Plan.

Responsibilities of the Facilitators**:** Watershed Education for Communities and Local Officials at NCSU will provide primary facilitation.

Watershed Education for Communities and Local Officials (WECO) has been contracted by the NCWRP for facilitation of stakeholder meetings for the Local Watershed Planning Process as a neutral, nonbiased party. WECO is an educational program sponsored by the North Carolina Cooperative Extension Service and is based at North Carolina State University in Raleigh, North Carolina. The main objective of the WECO Program is to improve water quality through education of citizens and government officials who live and work in the watershed.

During Meetings

The primary task of the facilitators is to guide the meetings of the Group and/or task groups within the group charter and ground rules. The facilitators will not express their views on any substantive issues and will be solely concerned with the process of the group.

If the facilitator needs to express his/her own views or provide technical information to the group, he/she should ask the group for their permission to "switch hats" before doing so.

Outside of Meetings

Outside of meetings the facilitators will write up meeting summaries and make them available to the members of the Group. Meeting summaries will be recorded and distributed to Group members and Technical Advisors prior to the next scheduled meeting by the facilitators. Summaries shall include an attendance record, a summary of actions taken at the meeting, and other information pertaining to the deliberations.

If requested, the facilitators will also assist Group members to communicate with Group members' constituencies.

Agendas

At the end of each meeting, the support staff will work with the Group to specify a tentative agenda for the following meeting. The facilitator will develop draft meeting agendas with the assistance of the Group prior to each meeting.

Decision Process

Use of Consensus

The Group will operate by consensus. When the group needs to make decisions, those decisions will be made with concurrence of all members represented at the meeting. It will be the responsibility of the facilitator to assist the group in reaching consensus.

Consensus requires sharing of information, allows building of trust, which leads to mutual education, which, in turn provides the basis for crafting workable and acceptable alternatives. Consensus promotes joint thinking of a diverse group and leads to creative solutions. Also, because parties participate in the deliberation, they understand the reasoning behind the recommendations and are willing to support them. Consensus does not mean that everyone will be equally happy with the decision, but all do accept that the decision is the best that could be made at the time.

The group will reach consensus when it agrees upon an alternative and each participant can honestly say:

- I believe that other participants understand my point of view;
- I believe I understand other participants' points of view;
- Whether or not I prefer this decision, I support it because it was arrived at openly and fairly, and it is the best solution for us at this time.

If Consensus Cannot be Reached
If the Group is unable to reach consensus on a decision, the pros and cons of the decision will be presented to decision makers. The lack of consensus will be noted and the points of disagreement will be documented in the meeting summary.

Ground Rules
In order to have the most efficient and effective process possible, the following ground rules are required, Group members agree to:

A. Make every effort to attend the meetings.
B. Treat each other with respect at all times and put personal differences aside in the interest of a successful team.
C. Stick to the topics on the agenda, be concise.
D. Speak one at a time.
E. Work as team players and share all relevant information.
F. Ask if they do not understand.
G. Openly voice any disagreement with other members.
H. Look for mutually beneficial solutions.
I. Follow through on their commitments.
J. Share information discussed in the meeting with the appropriate people in the group they are representing.
K. Encourage free thinking and the sharing of all ideas.
L. Commit to issues in which they have an interest.

Input From and Information to the Public
The Group is intended to be representative of the public through the members' own organizations or affiliations, as well as through their work with coalitions of groups. All Group meetings are open to observation by the public. Group members may assist in getting broader public input at scheduled public meetings.

Members of the press are welcome to attend Group meetings. Group members will not address specific positions held by other Group members, or negatively characterize other Group members in the media.

Schedule and Duration
The Group will meet as often as 5 times at dates and locations that they agree upon. The group effort is anticipated to last for no longer than 18 months. The following major steps will be undertaken during the stated timeline (approximate).

September 2003-December 2004:

- Issue identification, characterization and prioritization
- Action/solution identification and prioritization
- Matching actions and solutions with appropriate resources
- Delivery of recommendations to appropriate entities
- Development of final report
- Communicate findings and recommendations to community and other appropriate groups

A consulting firm (Earth Tech) is conducting a detailed technical assessment of the local watershed conditions. The consultant will share information and data with the group on various occasions. The consultant will also get feedback from the group on the direction of their study and on their specific findings and recommendations.

Changes to the Charter
Changes to the charter can be made at any meeting of the Group with their approval.

NLCD Code	Gap Map Unit Name	NC GAP Map Code	NVC Alliance Code	NVC Alliance Name	NHP Equivalent
41	Mesic Hardwood Forests	230	I.B.2.N.a.17	FAGUS GRANDIFOLIA - QUERCUS RUBRA - QUERCUS ALBA FOREST ALLIANCE	Mesic Mixed Hardwood
	Successional Forests	36	I.B.2.N.a.22	LIQUIDAMBAR STYRACIFLUA FOREST ALLIANCE	None
	Successional Forests	36	I.B.2.N.a.24	LIRIODENDRON TULIPIFERA FOREST ALLIANCE	None
	Dry-mesic Oak Forests	228	I.B.2.N.a.27	QUERCUS ALBA - (QUERCUS RUBRA, CARYA SPP.) FOREST ALLIANCE	Dry Mesic Oak Hickory Forest, Basic Oak Hickory Forest, Dry Oak Hickory Forest
	Dry-mesic Oak Forests	382	I.B.2.N.a.29	QUERCUS ALBA - QUERCUS (FALCATA, STELLATA) FOREST ALLIANCE	Dry Mesic Oak Hickory Forest, Xeric Hard Pan Forest, Chestnut Oak Forest, Dry Mesic Oak Hickory Forest, Dry Oak Hickory Forest
	Dry-mesic Oak Forests	382	I.B.2.N.a.36	QUERCUS PRINUS - (QUERCUS COCCINEA, QUERCUS VELUTINA) FOREST ALLIANCE	Dry Mesic Oak Hickory Forest, Xeric Hard Pan Forest, Chestnut Oak Forest, Dry Mesic Oak Hickory Forest, Dry Oak Hickory Forest
	Dry-mesic Oak Forests	382	I.B.2.N.a.38	QUERCUS PRINUS - QUERCUS RUBRA FOREST ALLIANCE	Dry Mesic Oak Hickory Forest, Xeric Hard Pan Forest, Chestnut Oak Forest, Dry Mesic Oak Hickory Forest, Dry Oak Hickory Forest
	Successional Forests	36	III.A.2.N.a.1	LIGUSTRUM SINENSE SHRUBLAND ALLIANCE	None
42	Timber Plantations	21	I.A.8.C.x.10	PINUS VIRGINIANA PLANTED FOREST ALLIANCE	None
	Timber Plantations	21	I.A.8.C.x.9	PINUS TAEDA PLANTED FOREST ALLIANCE	None
	Managed or Modified Forests	222	I.A.8.N.b.16	PINUS TAEDA FOREST ALLIANCE	None
43	Xeric Oak - Pine Forests	220	I.A.8.N.b.17	PINUS VIRGINIANA FOREST ALLIANCE	Pine Oak Heath
	Shortleaf Pine Woodlands and Forests	232	I.C.3.N.a.15	PINUS ECHINATA - QUERCUS (COCCINEA, FALCATA, PRINUS) FOREST ALLIANCE	Dry Oak Hickory Forest
	Xeric Oak - Pine Forests	226	I.C.3.N.a.21	PINUS STROBUS - QUERCUS (ALBA, RUBRA, VELUTINA) FOREST ALLIANCE	Xeric Hardpan Forest
81	Herbaceous Alien-dominated Vegetation	205	III.B.2.N.a.11	PUERARIA MONTANA VINE-SHRUBLAND ALLIANCE	None
	Herbaceous Alien-dominated Vegetation	205	V.A.5.N.c.3	ANDROPOGON VIRGINICUS HERBACEOUS ALLIANCE	None
	Herbaceous Alien-dominated Vegetation	205	V.A.5.N.c.8	FESTUCA SPP. HERBACEOUS ALLIANCE	None
91	Mixed Hardwood Bottomland Forests	384	I.B.2.N.d.14	PLATANUS OCCIDENTALIS - (LIQUIDAMBAR STYRACIFLUA, LIRIODENDRON TULIPIFERA) TEMPORARILY FLOODED FOREST ALLIANCE	Piedmont/Mountain Alluvial Forest, Piedmont/Mountain Levee Forest
	Mixed Hardwood Bottomland Forests	384	I.B.2.N.d.5	BETULA NIGRA - (PLATANUS OCCIDENTALIS) TEMPORARILY FLOODED FOREST ALLIANCE	Piedmont/Mountain Alluvial Forest, Piedmont/Mountain Levee Forest
	Eastern Interior Rocky Riverbed Herbaceous Vegetation	267	III.A.2.N.g.2	LIGUSTRUM SINENSE TEMPORARILY FLOODED SHRUBLAND ALLIANCE	Sand and Mud Bar
	Riverbank Shrublands	267	III.B.2.N.d.7	SALIX NIGRA TEMPORARILY FLOODED SHRUBLAND ALLIANCE	Sand and Mud Bar

41-DECIDUOUS FOREST

ELEMENT IDENTIFIERS

NVCS association: Fagus grandifolia - Quercus rubra / Cornus florida / Polystichum acrostichoides - Hexastylis virginica Forest
Database Code: CEGL008465
Formation: Lowland or submontane cold-deciduous forest
Alliance: **FAGUS GRANDIFOLIA-QUERCUS RUBRA-QUERCUS ALBA FOREST ALLIANCE (I.B.2.N.a.17)**

ELEMENT CONCEPT

Summary: This association represents the more typical mesic mixed hardwood forest of the Piedmont. The canopy of stands of this association is dominated by mesophytic trees such as *Fagus grandifolia, Quercus rubra, Liriodendron tulipifera, Acer rubrum*, and in the western Piedmont, *Tsuga canadensis*. Typical understory trees include *Cornus florida, Oxydendrum arboreum, Acer rubrum*, and *Ilex opaca*. Shrub species may include *Vaccinium stamineum, Viburnum rafinesquianum, Euonymus americana*, and sometimes *Kalmia latifolia*. The herb layer is often moderately dense and diverse, though it may be sparse under heavy shade. Herb species may include *Polystichum acrostichoides, Viola* spp., *Dichanthelium* spp. (= *Panicum* spp.), *Galium circaezans, Hexastylis arifolia, Hexastylis minor, Desmodium nudiflorum, Erythronium umbilicatum ssp. umbilicatum, Chamaelirium luteum, Epifagus virginiana, Tiarella cordifolia var. collina, Heuchera americana, Stellaria pubera, Podophyllum peltatum, Prenanthes serpentaria, Thalictrum thalictroides, Chrysogonum virginianum var. virginianum, Hepatica nobilis var. obtusa, Thelypteris noveboracensis*, and *Botrychium virginianum*. Exact composition varies locally with position on slope and nature of soil. Western Piedmont sites often have increasing importance of *Tsuga canadensis, Rhododendron* spp., and other species that are more typical of the Southern Blue Ridge.
Environment: Examples of this association predominantly occur on steep but sheltered slopes adjacent to creeks or rivers in the Piedmont. They can occur further upslope, but occurrences are much more likely as one gets closer to streams.
Dynamics: Under natural conditions these forests are uneven-aged, with old trees present. Reproduction occurs primarily in canopy gaps. Rare, severe natural disturbances such as wind storms may allow pulses of increased regeneration and allow the less shade-tolerant species to remain in the community. However, Skeen, Carter, and Ragsdale (1980) argued that even the shade-intolerant *Liriodendron* could reproduce enough in gaps to persist in the climax Piedmont forests (Schafale and Weakley 1990).

The natural fire regime of the Piedmont is not known but fires certainly occurred periodically. Because Mesic Mixed Hardwood Forests generally occur in moist and topographically sheltered sites, they probably burned only rarely and with low intensity (Schafale and Weakley 1990).

Disturbed areas have increased amounts of pines and weedy hardwoods such as *Liriodendron tulipifera* and *Liquidambar styraciflua*. Many areas have been selectively cut many times and have increased importance of *Fagus grandifolia* and other noncommercial hardwoods relative to oaks (Schafale and Weakley 1990). Other areas that were disturbed in the distant past may be younger and, therefore, may have a higher proportion of oaks with beeches mainly in the understory.

ELEMENT IDENTIFIERS

NVCS association: Liquidambar styraciflua - Quercus (alba, falcata) Forest
Database Code: CEGL007217
Formation: Lowland or submontane cold-deciduous forest
Alliance: **LIQUIDAMBAR STYRACIFLUA FOREST ALLIANCE (I.B.2.N.a.22)**

ELEMENT CONCEPT

Summary: Stands of this successional forest association are dominated by some combination of *Liquidambar styraciflua, Quercus alba*, and *Quercus falcata*. This forest is successional to mixed *Quercus - Carya* forests, and develops following disturbance such as clearcut logging and agriculture. This vegetation type would be more prevalent or more likely to be encountered to the north of the range of *Quercus nigra*, i.e., in the interior and Piedmont rather than in the Coastal Plain.

ELEMENT IDENTIFIERS

NVCS association: Liriodendron tulipifera - Acer rubrum - Quercus spp. Forest
Database Code: CEGL007221
Formation: Lowland or submontane cold-deciduous forest
Alliance: **LIRIODENDRON TULIPIFERA FOREST ALLIANCE (I.B.2.N.a.24)**

ELEMENT CONCEPT

Summary: The canopy of this semi-natural upland association is dominated by *Liriodendron tulipifera*. *Acer rubrum* is common in the understory along with *Quercus* spp. These early successional forests often follow cropping, clearcut logging, or other severe disturbance, and are successional to mixed *Quercus - Carya* forests. They are potentially widespread. The oak in these stands will frequently be multi-stemmed, resulting from coppicing. Lesser amounts of *Pinus virginiana* and *Pinus echinata* may be present in severely disturbed sites.
Environment: These semi-natural upland deciduous forests are found primarily in areas which were once clearcuts, old fields, or were cleared by fire or other natural disturbances. These non-wetland forests are also found along mesic stream terraces.

ELEMENT IDENTIFIERS

NVCS association: Quercus alba - Quercus (rubra, coccinea) - Carya (alba, glabra) / Vaccinium pallidum Piedmont Dry-Mesic Forest
Database Code: CEGL008475
Formation: Lowland or submontane cold-deciduous forest
Alliance: **QUERCUS ALBA - (QUERCUS RUBRA, CARYA SPP.) FOREST ALLIANCE (I.B.2.N.a.27)**

ELEMENT CONCEPT

Summary: This forest is found on submesic to dry-mesic to subxeric upland sites of mid- to upper-slope position with northerly or easterly aspects, or mid to lower slopes with more southerly aspects. In drier landscapes, this type could occupy habitats considered relatively mesic (e.g., concave slopes, lower slopes, shallow ravines). These sites are described as dry to intermediate in soil moisture. The soils are acidic and nutrient-poor, being weathered from felsic metamorphic and sedimentary rocks, or composed of unconsolidated sediments. Stands of this forest are closed to somewhat open, and are dominated by mixtures of oaks and hickories, with *Quercus alba* being most prevalent, along with *Quercus rubra, Quercus coccinea, Quercus velutina, Carya alba, Carya ovalis*, and *Carya glabra*. The *Carya* spp. are common in this type, but often most abundant in the understory. In Virginia examples, *Quercus prinus* is inconstant but sometimes important. In addition, *Pinus* spp., *Liriodendron tulipifera, Liquidambar styraciflua*, and *Acer rubrum* may be common. Understory species include *Acer rubrum, Cornus florida, Oxydendrum arboreum, Ilex opaca*, and *Nyssa sylvatica*. Shrubs include *Vaccinium stamineum, Vaccinium pallidum, Viburnum acerifolium, Viburnum rafinesquianum*, and *Euonymus americana*. In Virginia, *Vaccinium pallidum* is the principal ericad of patchy low-shrub layers, and stands may contain *Calycanthus floridus* (G. Fleming pers. comm. 2001). The woody vines *Vitis rotundifolia* and *Toxicodendron radicans* often are present. Herbs are fairly sparse, with *Hexastylis* spp., *Goodyera pubescens, Chimaphila maculata, Desmodium nudiflorum, Maianthemum racemosum, Polygonatum biflorum, Viola hastata, Tipularia discolor*, and *Hieracium venosum* as some common components (Schafale and Weakley 1990). This association is less nutrient-rich than *Quercus rubra - Quercus alba - Carya glabra / Geranium maculatum* Forest (CEGL007237).

ELEMENT IDENTIFIERS

NVCS association: Quercus falcata - Quercus alba - Carya alba / Oxydendrum arboreum / Vaccinium stamineum Forest
Database Code: CEGL007244
Formation: Lowland or submontane cold-deciduous forest
Alliance: QUERCUS ALBA - QUERCUS (FALCATA, STELLATA) FOREST ALLIANCE (I.B.2.N.a.29)

ELEMENT CONCEPT

Summary: This southern red oak - white oak dry forest is found in the Piedmont of Georgia, South Carolina, North Carolina, and Virginia, and in the interior uplands and Cumberland Plateau of Kentucky and Tennessee. It has also been reported from the Upper East Gulf Coastal Plain of Mississippi and Georgia. It generally is a second-growth forest on low fertility Ultisols. The vegetation is dominated by *Quercus* spp. and lesser amounts of *Carya* spp. The canopy is continuous, and several species of *Quercus* may be present (e.g., *Quercus falcata, Quercus alba, Quercus velutina, Quercus coccinea*, and *Quercus stellata*). The subcanopy closure is variable, ranging from less than 25% to more than 40% cover, and the shrub and herb layers generally are sparse. Subcanopy species include canopy species and *Acer rubrum, Liriodendron tulipifera, Oxydendrum arboreum, Liquidambar styraciflua, Ulmus alata, Cornus florida, Nyssa sylvatica, Juniperus virginiana var. virginiana*, and *Vaccinium arboreum*. The tall-shrub stratum may contain *Rhododendron canescens* and *Vaccinium arboreum*. The low-shrub stratum is dominated by various ericaceous shrubs such as *Vaccinium pallidum, Vaccinium stamineum, Vaccinium fuscatum*, and *Gaylussacia baccata*. *Smilax glauca* and *Vitis rotundifolia* are common vines. Herbaceous species that may be present include *Aristolochia serpentaria, Symphyotrichum dumosum (= Aster dumosus), Clitoria mariana, Desmodium nudiflorum, Euphorbia corollata, Galium circaezans, Chimaphila maculata, Polystichum acrostichoides, Asplenium platyneuron, Hexastylis arifolia, Coreopsis major, Solidago odora, Tephrosia virginiana, Potentilla simplex, Porteranthus stipulatus, Pteridium aquilinum, Lespedeza* spp., *Dichanthelium* spp., and *Hieracium venosum*.

ELEMENT IDENTIFIERS

NVCS association: Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens) Forest
Database Code: CEGL006271
Formation: Lowland or submontane cold-deciduous forest
Alliance: QUERCUS PRINUS (QUERCUS COCCINEA, QUERCUS VELUTINA) FOREST ALLIANCE (I.B.2.N.a.36)

ELEMENT CONCEPT

Summary: This community includes xeric ridgetop forests in the Southern Blue Ridge, ranging south and east into the upper Piedmont and north into the Central Appalachians, and possibly west into the Ridge and Valley. This community occurs over shallow, rocky soils, primarily on south- to west-facing slopes and ridgetops. It includes forests with canopies strongly dominated by *Quercus prinus* and/or *Quercus coccinea*, with lesser amounts of *Quercus velutina, Quercus rubra, Quercus falcata, Oxydendrum arboreum, Nyssa sylvatica*, and *Acer rubrum var. rubrum*, occurring over a typically dense shrub stratum dominated by ericaceous species. The shrub layer may vary between evergreen and deciduous dominance. Typical shrub species include *Kalmia latifolia, Rhododendron maximum, Vaccinium stamineum, Vaccinium pallidum, Gaylussacia ursina, Gaylussacia baccata*, and *Leucothoe recurva*. *Castanea dentata* may occur abundantly as root sprouts. The herb layer is typically sparse and includes subshrubs such as *Epigaea repens* and *Gaultheria procumbens*. Other common species include *Chamaelirium luteum, Chimaphila maculata, Galax urceolata, Magnolia fraseri, Sassafras albidum, Symplocos tinctoria, Smilax rotundifolia*, and *Smilax glauca*. This community is distinguished by its overall floristic composition, with a high abundance of acid-loving ericaceous species, which are indicative of this community's extremely infertile, acid soils.

ELEMENT IDENTIFIERS

NVCS association: Quercus prinus - (Quercus rubra) - Carya spp. / Oxydendrum arboreum - Cornus florida Forest
Database Code: CEGL007267
Formation: Lowland or submontane cold-deciduous forest
Alliance: **QUERCUS PRINUS - QUERCUS RUBRA FOREST ALLIANCE (I.B.2.N.a.38)**

ELEMENT CONCEPT

Summary: This community is known from low to intermediate elevations of the Southern Blue Ridge escarpment and Piedmont transition areas. It occurs on relatively exposed landforms below 3000 feet elevation (1200-2900 feet), on moderately steep to steep, convex, middle to upper slopes and ridges, with mostly northern to southwestern aspects. Canopies are dominated by *Quercus prinus*, with *Acer rubrum* often codominating. Other species that can have significant canopy coverage include *Carya glabra, Liriodendron tulipifera*, and *Quercus rubra*. The subcanopy is commonly dominated by *Cornus florida*. Additional canopy and subcanopy species can include *Quercus velutina, Carya alba, Halesia tetraptera var. monticola, Nyssa sylvatica, Robinia pseudoacacia, Magnolia fraseri*, and *Oxydendrum arboreum*. The shrub stratum is sparse with no clear dominant. Some typical shrub species include *Gaylussacia ursina, Hydrangea arborescens, Hydrangea radiata, Kalmia latifolia, Magnolia fraseri, Sassafras albidum*, and, *Vaccinium pallidum*. Common vines are *Smilax rotundifolia, Smilax glauca, Vitis aestivalis, Vitis rotundifolia*, and *Vitis vulpina*. Herb cover is sparse, but diversity and species composition vary among occurrences. Some of the more typical species include *Eurybia divaricata (= Aster divaricatus), Chimaphila maculata, Desmodium nudiflorum, Dichanthelium* spp. (e.g., *Dichanthelium boscii, Dichanthelium commutatum, Dichanthelium dichotomum), Dioscorea quaternata, Galium latifolium, Houstonia purpurea, Lysimachia quadrifolia, Maianthemum racemosum ssp. racemosum, Polystichum acrostichoides, Prenanthes* spp., *Thalictrum thalictroides, Thelypteris noveboracensis, Uvularia perfoliata, Uvularia puberula, Uvularia sessilifolia*, and *Viola* spp. (e.g., *Viola blanda, Viola hastata, Viola X palmata, Viola tripartita*). Some occurrences may have areas of exposed rock.

ELEMENT IDENTIFIERS

NVCS association: Ligustrum sinense Upland Shrubland
Database Code: CEGL003807
Formation: Temperate broad-leaved evergreen shrubland
Alliance: **LIGUSTRUM SINENSE SHRUBLAND ALLIANCE (III.A.2.N.a.1)**

ELEMENT CONCEPT

Summary: Upland areas heavily infested with *Ligustrum sinense*.

42-EVERGREEN FOREST

ELEMENT IDENTIFIERS

NVCS association: Pinus virginiana Planted Forest
Database Code: CEGL004730
Formation: Planted/cultivated temperate or subpolar needle-leaved evergreen forest
Alliance: **PINUS VIRGINIANA PLANTED FOREST ALLIANCE (I.A.8.C.x.10)**

ELEMENT CONCEPT

Summary: This association includes planted stands of *Pinus virginiana* with little understory, but may have admixtures of other native or off-site pines. These are cultivated forests and are not considered natural or near-natural vegetation. They are maintained as plantations for the harvest of forest products, or for production of Christmas trees and on strip-mined sites. Stands have suffered some damage from the Southern Pine Beetle (*Dendroctonus frontalis*).

ELEMENT IDENTIFIERS

NVCS association: Pinus taeda Planted Forest
Database Code: CEGL007179
Formation: Planted/cultivated temperate or subpolar needle-leaved evergreen forest
Alliance: **PINUS TAEDA PLANTED FOREST ALLIANCE (I.A.8.C.x.9)**

ELEMENT CONCEPT

Summary: This association represents young, monospecific plantation stands of *Pinus taeda*. The core concept of these stands are those which support dense, often perfect rows of planted *Pinus taeda* or otherwise dense, young stands which are managed and maintained for the extraction of forest products (usually pulpwood). In most cases these stands support almost no other tree species in the overstory, and typically very little understory. This association rarely exceeds 20-40 years of age on most timberlands. Stands are typically established with mechanical planting, but may also be established through other means. Excluded from this association are plantation stands which have "broken up" with age to approximate a more natural structure. Dense planting in rows, if successful, tends to result in nearly complete canopy closure which persists until the stand has either been regenerated or transitions into a different association. Herbaceous ground cover of any kind tends to be sparse due to reduction during site preparation, the typically dense canopy cover, and to the fact that many young plantations are infrequently burned at best.

In the Coastal Plain of South Carolina, these include mature loblolly plantations, often with *Prunus serotina* in the understory, that have been prescribed burned (based on seven plots at Savannah River Site). In the Ouachita Mountains planted loblolly is found with a variable amount of *Quercus alba, Quercus falcata, Quercus marilandica, Quercus stellata*, and *Quercus velutina*; on drier sites *Pinus echinata, Carya alba*, and *Carya texana*; and *Acer rubrum, Liquidambar styraciflua*, and *Quercus nigra* on wetter sites. The understory can be thick especially after thinning and/or burning. Common understory species are *Vaccinium pallidum, Vaccinium arboreum, Vaccinium stamineum, Cornus florida, Ulmus alata*, and others. Vines are an important component, including *Berchemia scandens, Vitis* spp., *Smilax* spp., and *Toxicodendron radicans*. In dense stands the herbaceous layer is suppressed by dense needle litter. In thinned and burned stands the plantations are often grazed. Herbaceous species can include *Solidago ulmifolia, Chasmanthium sessiliflorum, Schizachyrium scoparium, Danthonia spicata, Tephrosia virginiana, Lespedeza* spp., *Symphyotrichum patens (= Aster patens), Eupatorium* spp., and others. In Oklahoma, associates include *Rhus copallinum, Hypericum densiflorum, Liquidambar styraciflua*, and *Toxicodendron radicans*.

ELEMENT IDENTIFIERS

NVCS association: Pinus taeda - Liquidambar styraciflua Semi-natural Forest
Database Code: CEGL008462
Formation: Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: **PINUS TAEDA FOREST ALLIANCE (I.A.8.N.b.16)**

ELEMENT CONCEPT

Summary: This community type is broadly defined to accommodate upland forests strongly codominated by *Pinus taeda* and *Liquidambar styraciflua*, resulting from past disturbance (such as agricultural or other land clearing) followed by forest succession. Understory composition differs based on edaphic site and on age and history. This broadly defined type occupies a variety of edaphic sites, ranging from mesic through dry-mesic sites on a wide variety of (generally acidic) soils. If left unmanaged or undisturbed, this can be a short-lived forest type, which is likely to succeed with greater age into various oak- and oak-pine-dominated forests.

43-MIXED FOREST

ELEMENT IDENTIFIERS

NVCS association: Pinus virginiana - (Pinus rigida, Pinus pungens) / Schizachyrium scoparium Forest
Database Code: CEGL008500
Formation: Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: **PINUS VIRGINIANA FOREST ALLIANCE (I.A.8.N.b.17)**

ELEMENT CONCEPT

Summary: This community includes *Pinus virginiana*-dominated vegetation of low-elevation ridges and steep slopes, occurring primarily in the transition zone between the Southern Blue Ridge and Piedmont / Cumberlands and Southern Ridge and Valley, from eastern Tennessee, western North Carolina, western South Carolina and northern Georgia. It occurs on thin soils over a variety of rocky substrates including quartzite, sandstone, phyllite, and others. The canopy varies from open to closed and may be solely dominated by *Pinus virginiana*, or an admixture of other species, including *Pinus pungens, Pinus echinata, Pinus rigida, Quercus coccinea, Quercus prinus*, and *Quercus velutina*. An open midstory of often stunted hardwoods, including *Quercus marilandica, Quercus falcata, Oxydendrum arboreum*, and *Acer rubrum*, may also be present. The open shrub layer typically includes *Vaccinium pallidum* and may include other members of the Ericaceae, including *Vaccinium arboreum, Vaccinium stamineum, Gaylussacia dumosa, Kalmia latifolia, Vaccinium hirsutum, Gaultheria procumbens*, and *Epigaea repens*. The structure of the herbaceous layer is variable, but may provide up to 75% cover. It is dominated by *Schizachyrium scoparium*. Other characteristic herbaceous components include *Tephrosia virginiana, Coreopsis major, Solidago odora, Sorghastrum nutans, Solidago speciosa, Silphium compositum, Dichanthelium commutatum*, and *Eurybia surculosa*.

ELEMENT IDENTIFIERS

NVCS association: Pinus echinata - Quercus (prinus, falcata) / Oxydendrum arboreum / Vaccinium pallidum Forest
Database Code: CEGL007493
Formation: Mixed needle-leaved evergreen - cold-deciduous forest
Alliance: **PINUS** ECHINATA - QUERCUS (COCCINEA, PRINUS) FOREST ALLIANCE (I.C.3.N.a.15)

ELEMENT CONCEPT

Summary: This association includes crests of low-elevation slopes and ridges on the fringes of the Southern Blue Ridge, extending into the southern Ridge and Valley and Cumberland Plateau, where *Pinus echinata* and dry-site oaks characteristic of lower elevations codominate in association with other Appalachian flora. This forest is known from the southern Blue Ridge Escarpment region of North Carolina, South Carolina, and Georgia, particularly in the Blue Ridge/Piedmont transition, where it occurs on exposed, rocky ridges and upper, convex slopes, at elevations at or below 2200 feet. It also extends into the southern Ridge and Valley and Cumberland Plateau, but more information is needed to characterize the variation in that part of the range. Canopies are codominated by *Pinus echinata* and combinations of dry-site oaks that may include *Quercus falcata, Quercus coccinea, Quercus prinus, Quercus stellata*, and *Quercus velutina*. On rocky sites, canopies may be slightly stunted. Mid-canopy trees can be scattered or form a well-developed subcanopy. Common subcanopy trees can include *Oxydendrum arboreum, Ilex opaca var. opaca, Cornus florida, Quercus marilandica, Quercus stellata*, and *Carya pallida*. The shrub stratum varies in composition and density but is typically dominated by *Vaccinium pallidum*. Other shrubs may include *Vaccinium stamineum, Gaylussacia ursina, Gaylussacia baccata, Rhododendron calendulaceum, Rhododendron minus, Castanea pumila*, and *Kalmia latifolia*. On some sites *Symplocos tinctoria* can be important. *Vitis rotundifolia* and *Smilax glauca* are common vines. The herb stratum is poorly developed with scattered species such as *Chimaphila maculata, Iris verna, Pteridium aquilinum var. latiusculum, Goodyera pubescens, Hexastylis arifolia, Coreopsis major (= var. rigida), Tipularia discolor, Schizachyrium scoparium, Pityopsis graminifolia var. latifolia, Tephrosia virginiana, Silphium compositum, Dichanthelium* spp., and *Galax urceolata*.

ELEMENT IDENTIFIERS

NVCS association: Pinus strobus - Quercus alba - (Carya alba) / Gaylussacia ursina Forest
Database Code: CEGL007517
Formation: Mixed needle-leaved evergreen - cold-deciduous forest
Alliance: **PINUS STROBUS - QUERCUS (ALBA, RUBRA, VELUTINA) FOREST ALLIANCE (I.C.3.N.a.21)**

ELEMENT CONCEPT

Summary: This association covers mesic pine-oak-hickory in the Southern Blue Ridge Escarpment and in the Piedmont transition, found below 2900 feet elevation, on protected ridges, mid to upper slopes, and in disturbed bottoms. Canopies are dominated by variable mixtures of *Pinus strobus, Quercus alba, Quercus velutina, Carya alba*, and *Acer rubrum*. Other canopy species may include *Liriodendron tulipifera, Tsuga canadensis, Quercus rubra, Quercus falcata, Quercus prinus*, and *Magnolia fraseri*. Subcanopy and saplings include canopy species and *Cornus florida, Halesia tetraptera, Oxydendrum arboreum*, and *Nyssa sylvatica*. Shrub layers are moderate to dense, with *Gaylussacia ursina* and *Kalmia latifolia* most commonly dominating. Other shrubs include *Rhododendron minus, Rhododendron maximum, Symplocos tinctoria, Arundinaria gigantea, Castanea dentata, Sassafras albidum, Amelanchier arborea, Pyrularia pubera*, and *Hydrangea radiata*. The herb stratum is sparse, although ferns (*Thelypteris noveboracensis, Dennstaedtia punctilobula* and *Polystichum acrostichoides*) may occasionally dominate. Common herbs include *Chimaphila maculata, Viola hastata, Goodyera pubescens, Maianthemum racemosum, Polygonatum biflorum, Monotropa uniflora, Trillium catesbaei, Desmodium nudiflorum, Eupatorium purpureum, Galium circaezans, Galium latifolium, Galax urceolata, Hexastylis shuttleworthii, Medeola virginiana, Mitchella repens*, and *Houstonia purpurea*.

81-AGRICULTURE-HAY, PASTURE

ELEMENT IDENTIFIERS

NVCS association: Pueraria montana var. lobata Vine-Shrubland
Database Code: CEGL003882
Formation: Temperate cold-deciduous shrubland
Alliance: **PUERARIA MONTANA VINE-SHRUBLAND ALLIANCE (III.B.2.N.a.11)**

ELEMENT CONCEPT

Summary: This vine-dominated vegetation is dominated by *Pueraria montana var. lobata*, a fast-growing vine native to Asia. The species was introduced into the United States in 1885, primarily as an ornamental and as a potential source for cattle forage. It was subsequently widely used for erosion control in the southeastern United States. This association occupies a variety of sites throughout most physiographic provinces in the Southeast, ranging in size from less than a hectare to 5-10 hectares or more. It chokes out existing vegetation. Edges of examples of this vegetation may consist of small to large trees in the process of being overwhelmed by kudzu. More than 2 million acres of forest land in Alabama, Georgia, Mississippi, Tennessee, North Carolina, and South Carolina are estimated to be infested with kudzu. This association is also known to occur north to central Kentucky, Virginia, and Maryland, and as far west as eastern Texas and Oklahoma.

ELEMENT IDENTIFIERS

NVCS association: Andropogon virginicus var. virginicus Herbaceous Vegetation
Database Code: CEGL004044
Formation: Medium-tall sod temperate or subpolar grassland
Alliance: ANDROPOGON VIRGINICUS HERBACEOUS ALLIANCE (V.A.5.N.c.3)

ELEMENT CONCEPT

Summary: This association includes vegetation that occurs on old fields, pastures, and rocky sites which is dominated by *Andropogon virginicus var. virginicus*. This is a very common and wide-ranging association. Additional components include typical pioneer species; these and other associated species will vary with geography and habitat.

ELEMENT IDENTIFIERS

NVCS association: Lolium (arundinaceum, pratense) Herbaceous Vegetation
Database Code: CEGL004048
Formation: Medium-tall sod temperate or subpolar grassland
Alliance: **LOLIUM (ARUNDINACEUM, PRATENSE) HERBACEOUS ALLIANCE (V.A.5.N.c.8)**

ELEMENT CONCEPT

Summary: This association includes grassland pastures and hayfields, more-or-less cultural, though sometimes no longer actively maintained. The dominant species in this type are the European 'tall or meadow fescues,' of uncertain and controversial generic placement. *Lolium pratense* and *Lolium arundinaceum* are two closely related species which were traditionally treated as *Festuca pratensis (= Festuca elatior)* and *Festuca arundinacea*, and could alternately be treated as *Schedonorus pratensis* and *Schedonorus arundinaceus*. These communities are sometimes nearly monospecific but can also be very diverse and contain many native species of grasses, sedges, and forbs. This vegetation is currently defined for the southern Appalachians, Ozarks, Ouachita Mountains, and parts of the Piedmont and Interior Low Plateau, but it is possible throughout much of the eastern United States and southern Canada.

91-WOODY WETLAND

ELEMENT IDENTIFIERS

NVCS association: Platanus occidentalis - Liquidambar styraciflua / Asimina triloba Forest
Database Code: CEGL007340
Formation: Temporarily flooded cold-deciduous forest
Alliance: **PLATANUS OCCIDENTALIS - (LIQUIDAMBAR STYRACIFLUA, LIRIODENDRON TULIPIFERA) TEMPORARILY FLOODED FOREST ALLIANCE (I.B.2.N.d.14)**

ELEMENT CONCEPT

Summary: This forest, dominated by *Platanus occidentalis* and *Liquidambar styraciflua*, occurs on active first bottoms and possibly on levees where flooding may be frequent but is of short duration. The community occurs in the Piedmont of Virginia, North Carolina, South Carolina and Georgia. It may occur in the Cumberlands, the Ridge and Valley, and adjacent provinces of Tennessee and Kentucky. Other woody species common to this community include *Aesculus sylvatica, Cornus florida, Alnus serrulata, Fraxinus americana, Acer rubrum, Asimina triloba, Toxicodendron radicans, Parthenocissus quinquefolia, Ulmus americana, Fagus grandifolia*, and *Euonymus americana*. In addition, *Arundinaria gigantea* may be present or even abundant. Herbaceous species that may be found include *Arisaema triphyllum, Sanicula canadensis, Saururus cernuus, Campanula divaricata, Laportea canadensis, Salvia lyrata, Chasmanthium latifolium, Dichanthelium dichotomum var. dichotomum, Viola sororia*, and *Carex crinita*. Because of repeated flooding, this community may remain on a site indefinitely. It develops from communities dominated by *Salix* spp. and *Populus* spp., and probably from others.

ELEMENT IDENTIFIERS

NVCS association: Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica Forest
Database Code: CEGL007312
Formation: Temporarily flooded cold-deciduous forest
Alliance: BETULA NIGRA - (PLATANUS OCCIDENTALIS) TEMPORARILY FLOODED FOREST ALLIANCE (I.B.2.N.d.5)

ELEMENT CONCEPT

Summary: This riverfront forest, dominated by *Betula nigra* and *Platanus occidentalis*, occurs primarily on levees along small rivers and streams. It also is found along flowages of larger rivers ('artificial oxbows'). It ranges from Virginia to southern Georgia in the Piedmont and Coastal Plain (and into the southern and lower-elevation parts of the Southern Blue Ridge, excluding the highest elevations of the Mountains) and west to eastern Texas, and possibly the Cumberland Plateau of northern Alabama. No effort has been made to subdivide this type into northern and southern, or Coastal Plain and Interior variants, although there are undoubtedly some floristic differences between these extremes, at least in the lower strata.

Platanus occidentalis may be codominant, or at least prominent, with large individuals overtopping the *Betula*, which tends to have a greater number of stems, but *Platanus occidentalis* may be more conspicuous because of its larger size. Other canopy associates include *Liriodendron tulipifera, Liquidambar styraciflua, Acer rubrum, Acer negundo, Ulmus americana, Ulmus rubra, Celtis* spp., and *Quercus* spp. The subcanopy or tall-shrub strata may include *Cornus florida* and *Carpinus caroliniana*, along with *Acer rubrum, Ilex opaca, Ulmus alata, Prunus serotina*, and *Carya* spp. Shrubs and woody vines may include *Alnus serrulata, Euonymus americana, Parthenocissus quinquefolia, Smilax rotundifolia, Toxicodendron radicans*, and *Vitis rotundifolia*. Herbs may include *Boehmeria cylindrica, Polygonum virginianum, Rudbeckia laciniata, Sanicula* sp., *Symphyotrichum lateriflorum (= Aster lateriflorus), Thalictrum dioicum, Viola sororia, Polystichum acrostichoides, Woodwardia areolata, Botrychium dissectum, Botrychium virginianum*, and *Impatiens capensis*. The exotics *Ligustrum sinense, Lonicera japonica, Microstegium vimineum*, and *Rosa multiflora* may spread into disturbed examples of this community**.**

ELEMENT IDENTIFIERS

NVCS association: Ligustrum sinense Temporarily Flooded Shrubland
Database Code: CEGL003837
Formation: Temporarily flooded temperate broad-leaved evergreen shrubland
Alliance: LIGUSTRUM SINENSE TEMPORARILY FLOODED SHRUBLAND ALLIANCE (III.A.2.N.g.2)

ELEMENT CONCEPT

Summary: Wetland bottomlands heavily infested with *Ligustrum*.

ELEMENT IDENTIFIERS

NVCS association: Salix nigra Temporarily Flooded Shrubland
Database Code: CEGL003901
Formation: Temporarily flooded cold-deciduous shrubland
Alliance: SALIX NIGRA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (III.B.2.N.d.7)

ELEMENT CONCEPT

Summary: This broadly defined type represents vegetation dominated by scrubby forms of *Salix nigra* across the southeastern and northeastern United States, and possibly into Canada. Stature and closure may vary depending on disturbance. Additional types may be developed as more information becomes available.

Species Under Federal Protection in Rutherford County

Vertebrates

***Myotis sodalis* (Indiana bat)** **Endangered**

Family: Vespertilionidae
Federally Listed: 1967

The Indiana bat is a medium-sized myotis, less than two inches (5 cm) long, with a wingspan of nine to eleven inches (23-28 cm). They weigh only 0.3 ounces (8.5 grams). Fur is brownish to grayish black above and buff to light brown below. The feet are small and delicate and the calcar is strongly keeled.

Though extremely rare this bat is found in 27 states in the eastern United States. Hibernation occurs from October to April primarily in limestone caves or mines that usually have standing water on the floor. These areas usually have a stable temperature between 38^o and 43^{o}F, and a relative humidity averaging 87 percent. The bats form large, dense clusters up to several thousand individuals. During the summer, Indiana bat maternity colonies require dead or dying trees with loose bark, a nearby water source, and areas to hunt for insects. They seem to prefer roosting near small to medium-sized streams. Males roost nearby, and have the same habitat requirements. The bats roost under the loose bark for warmth and protection from the elements or predators

Optimum foraging is over streams with mature riparian vegetation overhanging the water by more than 9 feet (3 m). Streams that have been stripped of their riparian vegetation do not appear to offer suitable foraging habitat. Rivers as foraging areas and as migration routes are extremely important to this species.

Vascular Plants

***Hexastylis naniflora* (Dwarf-flowered heartleaf)** **Threatened**

Plant Family: Aristolochiaceae
Federally Listed: 1989

Also known as dwarf-flowered wild ginger, the dwarf-flowered heartleaf is distinguished from other members of the genus *Hexastylis* by the size of the flower. It is the smallest flower in the genus, measuring less than 0.4 inches (10 mm) across. The sepal tubes are never more than 0.02 or 0.03 inches (6 or 7 mm) wide, even in flower. The jug-shaped flowers are beige to dark brown, sometimes green or purplish. As the common name implies, the evergreen leaves are heart-shaped with a leathery texture.

The dwarf-flowered heartleaf requires acidic, sandy loam soils along bluffs and nearby slopes, in boggy areas adjacent to creekheads and streams, and along slopes of hillsides and ravines. It can tolerate either moist or dry conditions if the soil requirement is met. Maximum flowering occurs when plenty of sunlight is available in early spring. The flowering season is from mid-March to early June.

There are 24 known populations of the dwarf-flowered heartleaf in the upper piedmont of North Carolina and South Carolina. In North Carolina, the plant is known from Catawba, Lincoln, Rutherford, Cleveland, and Burke counties.

***Isotria medeoloides* (Small whorled pogonia)** **Threatened**

Family: Orchidaceae
Federally Listed: 1982

The specific epithet of the small whorled pogonia comes from the resemblance of this perennial orchid to young plants of Indian cucumber root (*Medeola virginiana*). However, the small whorled pogonia has a stout, hollow stem in contrast to the solid, slender stem of Indian cucumber root. The stem is 3.7 to 9.8 in (9.5 to 25 cm) tall, with a terminal whorl of 5 or 6 light green leaves that are elliptical in shape and measure up to 3 in by 1.5 in (8 by 4 cm). One or two flowers are borne at the top of the stem, appearing from mid-May to mid-June. The flowers lack fragrance and nectar guides, and apparently are self-pollinating.

The small whorled pogonia was formerly scattered in 48 counties in 16 eastern states. Currently, the majority of populations are found in New England at the foothills of the Appalachian Mountains and in northern coastal Massachusetts. The habitat of the small whorled pogonia varies widely throughout its range, although there are a few common characteristics among the majority of sites. These include sparse to moderate ground cover; a relatively open understory; and proximity to features that create extensive, stable breaks in the canopy, such as logging roads or streams. The pogonia has been found in mature forests as well as stands as young as 30 years old. Forest types include mixed-deciduous/ white pine or hemlock in New England, mixed deciduous in Virginia, white pine/mixed-deciduous or white pine/oak-hickory in Georgia, and red maple in Michigan. Understory components in the southern part of the range are most commonly found to be flowering dogwood (*Cornus florida*), sourwood (*Oxydendron arboreum*), mountain laurel (*Kalmia latifolia*), American chestnut (*Castanea dentata*), witch hazel (*Hamamelis virginiana*), and flame azalea (*Rhododendron calendulaceum*). Early descriptions placed the small whorled pogonia on dry sites, but it has since been found on sites with high soil moisture.

***Sisyrinchium dichotomum* (White irisette)** **Endangered**

Family: Iridaceae
Federally Listed: September 26, 1991

This perennial herb grows in a dichotomously-branching pattern, reaching heights of approximately 4.3-7.8 inches (11-20 cm). The basal leaves, usually pale to bluish green, are from one-third to one-half the height of the plant. The tiny white flowers (0.3 inches (7.5 mm) long) appear from late May through July in clusters of four to six at the ends of winged stems. The fruit is a round, pale to medium brown capsule containing three to six round or elliptical black seeds. The dichotomous branching pattern and white flowers combine to distinguish this herb from other species within the genus.

This species occurs on rich, basic soils probably weathered from amphibolite. It grows in clearings and the edges of upland woods where the canopy is thin and often where down-slope runoff has removed much of the deep litter layer ordinarily present on these sites. The irisette is dependent on some form of disturbance to maintain the open quality of its habitat. Currently, artificial disturbances, such as power line and road right-of-way maintenance (where they are accomplished without herbicides and during a season that does not interfere with the reproductive cycle of this species), are maintaining some of the openings that may have been provided historically by native grazing animals and naturally occurring periodic fires.

White irisette is endemic to the upper piedmont of North and South Carolina. It is currently known from four populations in North Carolina and one in South Carolina. The single extant site in South Carolina is in Greenville County. North Carolina's extant populations are in the following counties: Polk (six populations; Henderson (one population), and Rutherford (one population). The Greenville County, South Carolina, site is contiguous with one of the Polk County, North Carolina, sites. This species has apparently always been a narrow endemic, limited to an area in the Carolinas bounded by White Oak Mountain, Sugerloaf Mountain, Chimney Rock, and Melrose Mountain. Two of the remaining populations are within highway rights-of-way and a third is inside a commercial recreation area.

<u>Non-vascular Plants</u>

***Gymnoderma lineare* (Rock gnome lichen)** **Endangered**

Family: Cladoniaceae
Federally Listed: 1994

The rock gnome lichen is a squamose lichen in the reindeer moss family. The lichen can be identified by its fruiting bodies, which are borne singly or in clusters, are black in color, and are found at the tips of the squamules. The fruiting season of the rock gnome lichen occurs from July through September.

The rock gnome lichen is a narrow endemic, restricted to areas of high humidity. These high-humidity environments occur on high-elevation 4000 feet (1220 m) mountaintops and cliff faces that are frequently bathed in fog, or lower elevation 2500 feet (762 m) deep gorges in the southern Appalachians. The rock gnome lichen primarily occurs on vertical rock faces where seepage water from forest soils above flows only at very wet times. The rock gnome lichen is almost always found growing with the moss *Adreaea* in these vertical intermittent seeps. The major threat of extinction to the rock gnome lichen relates directly to habitat alteration/loss of high elevation coniferous forests. These coniferous forests usually lie adjacent to the habitat occupied by the rock gnome lichen. The high elevation habitat occurs in Ashe, Avery, Buncombe, Graham, Graham, Mitchell, Swain, and Yancey counties. The lower elevation habitat of the rock gnome lichen can be found in Jackson, Rutherford, and Transylvania counties.

Species on State List of Threatened and Endangered Species

Common Name	Scientific Name	Status
Vertebrates		
Northern Myotis	*Myotis septentrionalis*	SC
Oldfield Mouse	*Peromyscus polionotus**	SR
Peregrine Falcon	*Falco peregrinus*	E
Loggerhead Shrike	*Lanius ludovicianus ludovicianus*	SC
Timber Rattlesnake	*Crotalus horridus*	SC
Smooth Green Snake	*Liochlorophis vernalis*	SC
Crevice Salamander	*Plethodon yonahlossee* pop 1	SC
Santee Chub - Piedmont Population	*Cyprinella zanema* pop 1	SR
Invertebrates		
Broad River Stream Crayfish	*Cambarus lenati*	SR
a lampshade spider	*Hypochilus coylei*	SR
Appalachian Azure	*Celastrina neglectamajor*	SR
Diana fritillary	*Speyeria diana*	SR
Mottled Duskywing	*Erynnis martialis*	SR
Cahaba Sand-filtering Mayfly	*Homoeoneuria cahabensis*	SR
Vascular Plant		
Roundleaf Serviceberry	*Amelanchier sanguinea*	SR-P
Piedmont Indigo-bush	*Amorpha schwerinii*	SR-T
Spreading Rockcress	*Arabis patens*	SR-T
Lobed Spleenwort	*Asplenium pinnatifidum*	SR-P
Thin-pod White Wild Indigo	*Baptisia albescens**	SR-P
Alabama Grape-fern	*Botrychium jenmanii*	SR-P
Porter's Reed Grass	*Calamagrostis porteri*	SR-P
Blue Ridge Bindweed	*Calystegia catesbeiana* ssp *sericata*	SR-T
Dissected Toothwort	*Cardamine dissecta**	SR-P
Biltmore Sedge	*Carex biltmoreana*	SR-L
Broadleaf Coreopsis	*Coreopsis latifolia*	SR-T
Bleeding Heart	*Dicentra eximia*	SR-P
Eastern Shooting Star	*Dodecatheon meadia* var *meadia*	SR-P
Branching Draba	*Draba ramosissima*	SR-P
Purple Coneflower	*Echinacea purpurea**	SR-P
Large Witch-alder	*Fothergilla major*	SR-T
Smooth Sunflower	*Helianthus laevigatus*	SR-P
Crested Coralroot	*Hexalectris spicata*	SR-P
Appalachian Fir-clubmoss	*Huperzia appalachiana*	SR-P
Rock Fir-clubmoss	*Huperzia porophila*	SR-P
Piedmont Quillwort	*Isoetes piedmontana*	T
Small-head Blazing Star	*Liatris microcephala*	SR-P
Earle's Blazing Star	*Liatris squarrulosa*	SR-P
Shale-barren Blazing Star	*Liatris turgida*	SR-T
Red Canada Lily	*Lilium canadense* ssp *editorum***	SR-P
Fen Orchid	*Liparis loeselii**	SR-P
Yellow Honeysuckle	*Lonicera flava*	SR-P
Glade Milkvine	*Matelea decipiens**	SR-P

Species Continued

Single-flowered Sandwort	*Minuartia uniflora*	E
Dwarf Chinquapin Oak	*Quercus prinoides**	SR-P
Northern White Beaksedge	*Rhynchospora alba*	SR-P
Pursh's Wild-petunia	*Ruellia purshiana**	SR-O
Rock Skullcap	*Scutellaria saxatilis*	SR-T
Granite Dome Goldenrod	*Solidago simulans*	SR-L
Appalachian Golden-banner	*Thermopsis mollis sensu stricto*	SR-P
Deerhair Bulrush	*Trichophorum cespitosum*	SR-D
Sweet White Trillium	*Trillium simile*	SR-L
Non-Vascular Plant		
Dwarf Apple Moss	*Bartramidula wilsonii**	SR-D

*Historic
**Obscure

Division of Water Quality
Biological Assessment Unit
August 15, 2003

MEMORANDUM

To: Jimmie Overton
Kristin Cozza, Wetlands Restoration

Through: Trish Finn MacPherson

From: David Lenat

Subject: Catheys Creek/Hollands Creek WRP Study, Rutherford County, Broad subbasin 02, June 2003

Background

Catheys Creek and Hollands Creek were selected as a WRP study area based on Fair macroinvertebrate ratings assigned to some sections of these streams, especially below the Spindale wastewater treatment plant. Fish collections also indicated problems in Catheys Creek, producing a Poor rating for this stream in 2000.

Hollands Creek originates just west of Spindale, while Catheys Creek originates in a forested and agricultural area upstream of the Spindale-Rutherfordton area. The city of Spindale originally discharged to Hollands Creek, with an instream waste concentration of 67% at 7Q10 flow. This facility was found to have problems with chronic toxicity and mercury concentrations. The wastewater plant relocated the discharge further downstream to Catheys Creek in April 1999, in order to achieve greater dilution. Spindale is currently permitted to discharge 4.5 MGD with an instream waste concentration of 26% at 7Q10 flow. The current facility has few reported problems, with no failed toxicity tests since September 2001.

Prior Studies

Spindale WWTP, March 1988. At the time of this study, the Spindale WWTP discharged to the lower portion of Hollands Creek. Benthic macroinvertebrates were sampled above and below the discharge in Hollands Creek and further downstream in Catheys Creek (B-880429). The Spindale WWTP had a severe effect on Hollands Creek (Poor) with impairment also found further downstream in Catheys Creek (Fair).

Stream	Site	Total S	EPT S*	Biotic Index*	Rating
Hollands Cr	SR 1547	62	24 (27)	5.5 (5.0)	Good-Fair
Hollands Cr	SR 1548	29	2 (3)	8.0 (7.5)	Poor
Catheys Cr	SR 1549	-	16 (15)	-	Fair

*Corrected for season and/or collection method, uncorrected value in parentheses.

Second Broad River Study, June 1994. This survey included a single collection from the downstream location on Catheys Creek. Water levels were high at the time of sample collection, but a high specific conductance (352 µmhos/cm) was recorded. Catheys Creek at SR 1549 had roughly the same EPT taxa richness that was observed in 1988, but a relatively low biotic index value resulted in a Good-Fair rating. Snag and leaf pack sampling produced five abundant stonefly species: *Perlesta*, *Pteronarcys*, *Neoperla*, *Acroneuria abnormis* and *Paragnetina fumosa*. Only one of these taxa had been abundant in 1988.

Stream	Site	Total S	EPT S	Biotic Index	Rating
Catheys Cr	SR 1549	49	17	5.3	Good-Fair

Fish sampling from this site in 1994 yielded 16 species, although there were only 119 total fish. Two sucker species and four intolerant species were collected, suggesting that toxicity was not a problem.

The low numbers of total fish and the absence of darters, however, suggested that some prior event prevented colonization. The abundance of bluehead chub (*Nocomis leptocephalus*, 45% of fish collected) suggested nutrient enrichment, and water chemistry data confirmed high levels of total phosphorus in lower Catheys Creek. Based on an IBI of 46, this site was given a fish rating of Good-Fair (Report B-950215).

Basinwide Monitoring, 1995 and 2000. Collections in the Broad River basin include a basinwide site on the lower part of Catheys Creek, the same site sampled for macroinvertebrates and fish in prior surveys. The last two samples at this site both yielded 18 EPT with a 4-sample collection, equivalent to 21 EPT taxa with a standard 10-sample qualitative collection. Only one more EPT taxon would have been required to change the bioclassification to Good-Fair. This site continued to have high stonefly richness (5-6 species). Although the bioclassification for this site varied between Good-Fair and Fair, there did not appear to be any significant change in water quality over time.

Stream (Date)	Site	Total S	EPT S*	Biotic Index	Rating
Catheys Cr (7/95)	SR 1549	-	21 (18)	-	Fair
Catheys Cr (8/00)	SR 1549	-	21 (18)	-	Fair

*Corrected to value for standard (10-sample) qualitative sample, uncorrected value in parentheses

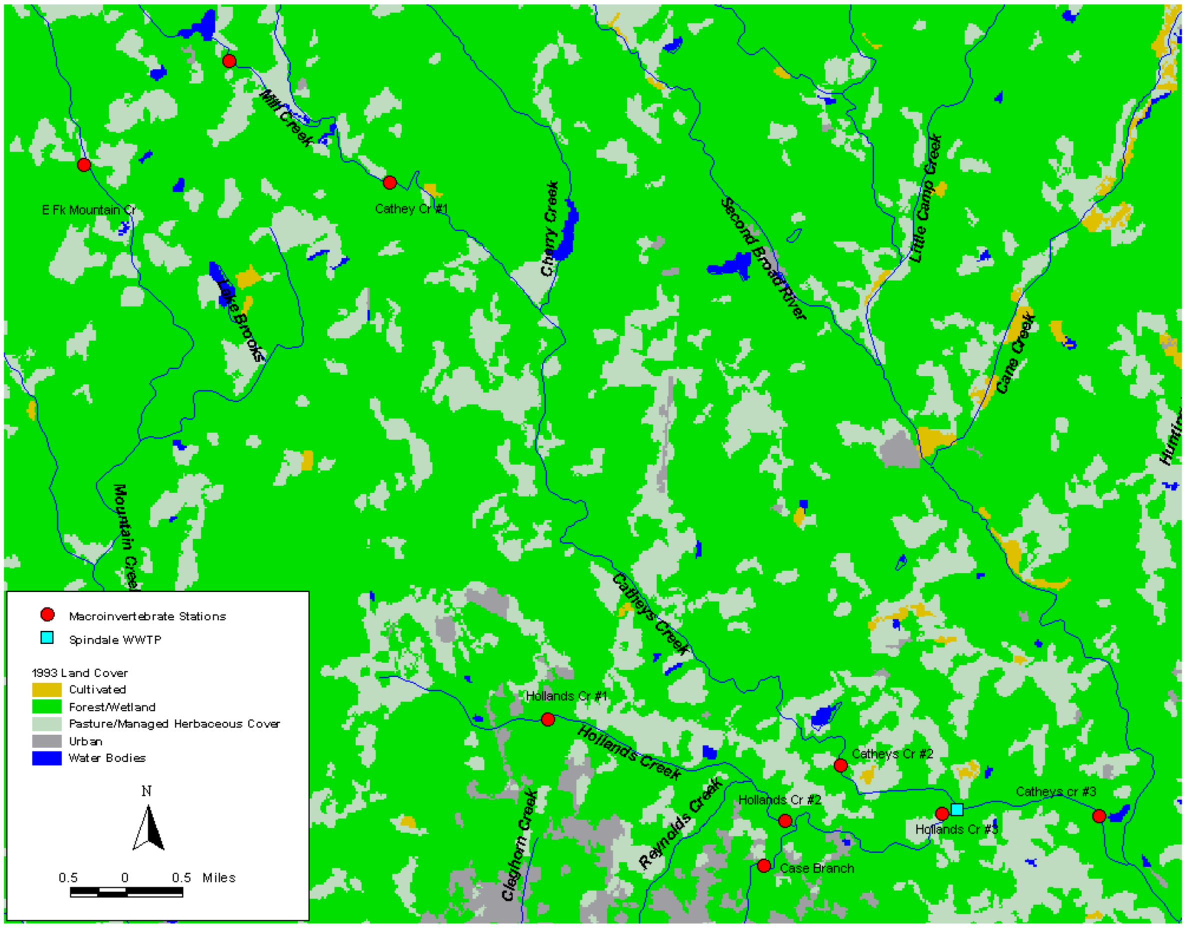
Fish collections in May 2000 produced a Poor rating, with low number of fish, low diversity of darters, low diversity of sunfish/bass/trout, skewed trophic structure, and poor reproduction of many species. This information suggested a decline in water quality between 1994 and 2000. Bluehead chub was still the dominant fish species. During the fish collection in 2000, the water was “plum-colored” with a specific conductance of 240 µmhos/cm.

Spindale WWTP, July 2000. After the Spindale WWTP removed its effluent from Hollands Creek, this portion of the stream was resampled to evaluate recovery. This study documented improvement from Poor in 1988 to Fair (almost Good-Fair) in 2000 (Report B-010126)

Stream	Site	Total S	EPT S*	Biotic Index	Rating
Hollands Cr	SR 1548	-	20 (17)*	-	Fair

*Corrected for value for standard qualitative sample, uncorrected value in parentheses.

Figure 1. Land use information (1993), sampling sites (June 2003) and NPDES discharger locations. Catheys Creek and Hollands Creek catchment, Rutherford County, Broad River subbasin 02.



Station Descriptions (All sites are in Rutherford County). Table 1, Figure 1.

All sites were sampled following a heavy rainfall in early June, and water levels were high throughout the spring of 2003 (see appended flow data for Second Broad River). Flows were high and the water was very turbid at all sites in the Catheys Creek catchment during our collections June 10-12.

Catheys Creek

All sites on Catheys Creek were very sandy and filled-in, largely lacking riffles or pools. Bank erosion was noted at all sites, although the severity increased at the middle and lower sites.

Catheys Creek #1, US 221. Catheys Creek #1 was selected to represent portions of the stream above the urban areas of Spindale and Rutherfordton. This site has a drainage area of 13 mi^2, and land use is a mostly a combination of agriculture and forest, with some residential areas. Only an EPT sample as collected at this site, but field notes indicated that both snails (*Elimia*) and clams (*Corbicula*) were abundant. The headwater area had more gravel than was recorded at the two downstream sites, producing a habitat score of 62.

Catheys Creek #2, SR 1547. This site was selected to be upstream of Hollands Creek, with a drainage area of 31 mi^2. The catchment is a mixture of forest, agriculture and residential areas. Although rubble and boulder were not found in this part of Catheys Creek, snag habitats supported a diverse fauna. The habitat score declined from 62 at site #1 to 38 at site #2, reflecting the loss of any rubble or gravel substrate at site #2, as well as increased bank erosion, loss of pools, and a decline in the riparian buffer zone.

Catheys Creek #3, SR 1549. This site is downstream of Hollands Creek, as well as downstream of the Spindale discharge. It has a drainage area of 44 mi^2. This portion of Catheys Creek had been severely scoured by the recent rains, and bank areas were eroded at high flow. Conductivity increased between sites #2 and #3 (49 vs. 66 µmhos/cm), reflecting the influence of the WWTP discharge. We would expect a larger between-site increase in conductivity during low-normal flow conditions. Large snags were the only substrate that produced high numbers of benthic invertebrates, but such snags harbored large numbers of stoneflies and caddisflies.


Bank Erosion, Catheys Creek Site #3

Hollands Creek

Hollands Creek #1, SR 1520. This upper portion of Hollands Creek drains a residential and urban area in the northern part of Rutherfordton. Stream width here was only three meters (drainage area 3 mi^2), so a bioclassification could not be assigned to this site. A few rubble-boulder riffles were found, but most of the stream-bed was sand and reddish silt.

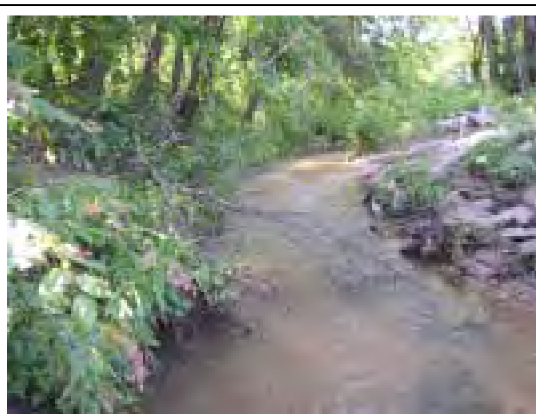
Hollands Creek #2, SR 1547. This middle segment of Hollands Creek was quite atypical in terms of habitat. Most streams in this area were very sandy, but this stream segment had large amounts of boulder and rubble substrate. This difference in substrate type appears to reflect local geology, rather than any change in land use. Drainage area increased at this site to 5.4 mi^2, and adjacent land use is residential.

Hollands Creek #3, SR 1548. This segment of Hollands Creek had been downstream of the Spindale discharge, but it is now affected only by nonpoint source land use (urban, residential, and agricultural). Drainage area (8 mi^2) is not very different from that recorded at site #2. The boulder-rubble substrate recorded at Hollands Creek #2 was replaced by an unstable sand-silt substrate.

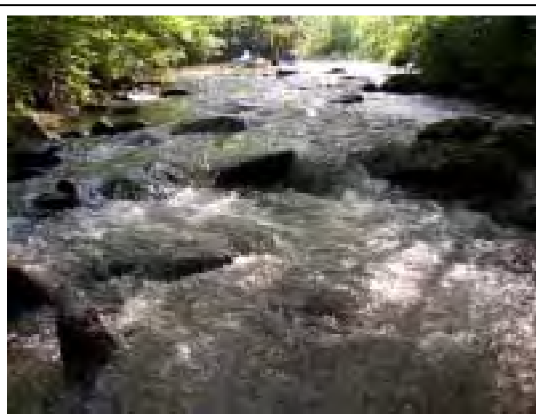
Tributary and Reference Sites

Case Branch (Urban site), SR 1547. This was the largest urban tributary of Hollands Creek. It had much better than expected habitat (habitat score = 68), and the water was fairly clear. The urban influence, however, was reflected in high conductivity (124 µmhos/cm). Case Brach was only 3 meters wide (drainage area = 3 mi^2), so it could not be assigned a bioclassification. The high quality habitat may reflect the same local geology-observed at the nearby Hollands Creek site #2.

Mill Creek (headwaters of Catheys Creek), SR 1347. In an attempt to locate an area of good water quality in the upper portion of the Catheys Creek segment, we collected samples from Mill Creek. While this site had good habitat, the fauna clearly indicated a water quality problem. The high water temperature recorded for this site (22^{o}C) suggested an upstream impoundment and 1993 land use maps (Figure 1) do indicate a pond in this area. This pond did not appear on older USGS topographic maps. This stream was big enough to rate, with a drainage area of 6 mi^2.



East Fork Mountain Creek (small stream control site), SR 1331. Although we did not find high quality habitat at this site, the biology suggested good water quality. This stream was only three meters wide (drainage area = 3 mi^2), so it could not be assigned a bioclassification. Data from East Fork Mountain Creek, however, can be used to produce expectations for the macroinvertebrate community in upper Hollands Creek and Case Branch. Adjacent land use was agricultural, but much of the headwater area is forested.



Taylor Creek (large stream control site), SR 1314. We examined many streams in the Rutherford/Spindale area in order to establish a large-stream reference site. Most of the sites we examined, however, were either too small or had obvious habitat problems. Taylor Creek is a tributary of Cove Creek, with similar size and temperature to Catheys Creek. The gradient appears to be greater than Catheys Creek and the watershed has less development. Taylor Creek is generally much rockier than Catheys Creek, although long sandy segments were observed in low gradient areas further downstream.

Methods

Benthic macroinvertebrates were collected using three different methods, depending on stream size and the need to sample the more tolerant groups. These methods included Standard Qualitative (= Full Scale, = Qual 10) samples, Qual 5 samples, and EPT samples.

Standard Qualitative. This method includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms were classified as Rare (1-2 specimens), Common (3-9 specimens), or Abundant (≥10 specimens).

Several data-analysis summaries (metrics) can be produced from standard qualitative samples to detect water quality problems. These metrics are based on the idea that unstressed streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

EPT taxa richness (EPT S) is used with DWQ criteria to assign water quality ratings (bioclassifications). "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect groups that are generally intolerant of many kinds of pollution. Higher EPT taxa richness values usually indicate better water quality. Water quality ratings also are based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI). Both tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions. Water quality ratings assigned with the biotic index numbers were combined with EPT taxa richness ratings to produce a final bioclassification, using criteria for mountain streams.

EPT abundance (EPT N) and total taxa richness calculations also are used to help examine between-site differences in water quality. When the EPT taxa richness rating and the biotic index differ by one bioclassification, the EPT abundance value was used to produce the final site rating.

Qual 5 samples. This collection method is similar to the standard qualitative sample described above, but only five samples were collected: 1 kick, 1 sweep, 1 leafpack, 1 wash and visuals. The Qual 5 sample produced information similar to a Standard Qualitative sample, including both a biotic index and EPT taxa richness. Analysis of Qual 5 samples indicates that either a Not Rated or Not Impaired bioclassification can be assigned based on the minimum rating that would be assigned using EPT criteria for larger streams. Qual 5 samples were collected from streams less than four meters in width.

EPT samples. EPT collections use only four samples: 1 kick, 1 sweep, I leafpack and visuals. Only the Ephemeroptera, Plecoptera and Trichoptera are collected and identified. These samples are rated based solely on EPT taxa richness, but have lower expectations than a Full Scale collection method. The 10-sample EPT value, however, can be estimated from the 4-sample value by multiplying by a correction factor of 1.15.

Results and Discussion

June 2003 Survey (Table 1, Appendix 1)

Flows. The June 2003 survey was conducted after a major rainfall event, producing high flow and turbid water at most sites. Sampling under these conditions should maximize nonpoint source problems, and make point source problems harder to detect. All sites were wadeable during our collections, and we were able to verify that the high flows in early June 2003 had not reduced taxa richness at control sites. USGS flow data for the Second Broad River near Logan (appended), indicated that flow levels were well above normal since February 2003, with at least seven major storms influencing flow and water levels. Small streams in this area also may still be recovering from the extreme low flows recorded in the summer of 2002.

Habitat. Habitat quality varied from very good to very poor for sites in the Catheys Creek catchment, depending on land use, slope, geology, soils, and antecedent flow. Streams in areas of high gradient, or in more forested catchments, were able to maintain rocky substrate: Mill Creek, Taylors Creek. If a stream was able to maintain even few small areas of rubble and some gravel riffles, this was often adequate to maintain a diverse macroinvertebrate fauna (East Fork Mountain Creek). Geological anomalies (especially where bedrock was close to the surface) also influenced habitat, resulting in surprisingly good habitat for Case Branch and Hollands Creek site #2. The latter two sites were very close together, and appeared to be affected by the same rock formation.

Most low gradient streams around Spindale and Rutherfordton are extremely sandy, often lacking rocky riffle areas. This type of habitat was observed for most stations on Catheys Creek and Hollands Creek. This report focuses on these two streams, but similar habitat problems are widespread through Broad River subbasins 02 and 04 in Rutherford and Cleveland counties. For other examples, see the Basinwide Assessment Report for the Broad River basin (NCDENR 1998)[1], also available on the web at http://www.esb.enr.state.nc.us/bar.html. Specific examples include:

Subbasin 02

Stream	Location	%Gravel	%Sand	%Silt	Bioclass
Mountain Cr	SR 1149, Rutherford	0-10	80-100	0-10	Good, Good-Fair
Second Broad R	SR 1538, Rutherford	10	70-90	0-20	Good, Good-Fair
Second Broad R	US 74 Bus, Rutherford	-	85	15	Good-Fair
Cleghorn Cr	SR 1149, Rutherford	15-30	60-70	10	Good-Fair
Roberson Cr	SR 1561, Rutherford	20-35	60-70	5-10	Good-Fair

Subbasin 04

Stream	Location	%Gravel	%Sand	%Silt	Bioclass
First Broad R	SR 1140, Cleveland	0-30	70-100	0-10	Good, Good-Fair
Brushy Cr	SR 1308, Cleveland	10	85	5	Good
Brushy Cr	SR 1323, Cleveland	20	50-70	5-10	Good
Buffalo Cr	NC 198, Cleveland	0-20	60-95	5-10	Good, Good-Fair
Knob Cr	SR 1004, Cleveland	5	85	-	Good
Hickory Cr	NC 18, Cleveland	15-20	80	0-5	Not Rated
Beaverdam Cr	NC 150, Cleveland	5-15	60-70	10-20	Good, Good-Fair
Hinton Cr	NC 226, Cleveland	25	60	0-10	Good-Fair
Wards Cr	SR 1533, Cleveland	20	70	-	Good-Fair

These sandy streams typically rate as Good-Fair or Good; ratings may be slightly higher in Cleveland County where some streams are evaluated with Piedmont criteria. Other sandy streams observed in Rutherford County during the June 2003 survey included Camp Creek and Little Camp Creek.

The heavy rains in spring of 2003 caused extensive bank erosion, and the June survey resulted in lower habitat scores than had been previously recorded in Hollands Creek and Catheys Creek (Table 2). The substrate for Catheys Creek site #3 and Hollands Creek site #3 was entirely unstable coarse sand. Not only is this substrate type unsuitable for most invertebrates, during high flow the sand becomes re-suspended and may cause scour in other habitat types. Most of the stream fauna in these very sandy streams was associated with woody debris (“snags”), leaf packs and root mats along the banks.

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[1] North Carolina Department of Environment and Natural Resources, Division of Water Quality, May 2001. Basinwide Assessment Report Broad River Basin, Raleigh, NC.

Table 1. Taxa richness (by group), macroinvertebrate summary parameters and site descriptions. Catheys Creek/Hollands Creek and tributaries, Broad subbasin 02, Rutherford County, June 2003. Mod = Moderate, NR = Not Rated, G-F = Good-Fair

Parameter	Catheys EPT #1	Catheys Full #2	Catheys Full #3	Hollands Full #2	Hollands Full #3	Taylor EPT 1314	Hollands Qual5 #1	Case Qual5 1547	Mill EPT 1327	E Fk MC EPT 1331
Ephemeroptera	7	14	7	10	9	18	3	6	5	19
Plecoptera	7	7	5	6	5	9	3	2	0	5
Trichoptera	5	5	8	7	6	16	7	8	6	7
Coleoptera		4	4	4	3		5	2		
Odonata		6	4	4	8		5	4		
Megaloptera		2	0	1	1		1	0		
Diptera: Chironomidae		12	14	19	25		7	7		
Misc. Diptera		3	3	6	5		7	5		
Oligochaeta		2	2	2	2		0	3		
Crustacea		1	1	1	1		1	2		
Mollusca		1	0	1	0		1	1		
Other				1						
Total Taxa Richness	-	57	48	62	65	-	40	40	-	-
10-sample EPT Richness	22*	26	20	23	20	49*	13	16	13*	36*
4-sample EPT Richness	19	-	-	-	-	43	-	-	11	31
EPT Abundance	50	119	68	88	39	219	36	82	44	132
EPT Biotic Index	4.0	4.4	4.5	4.1	4.2	2.7	3.6	3.8	4.8	4.1
Biotic Index	-	4.9	5.2	5.2	5.5	-	4.7	4.6	-	-
Rating	G-F	G-F	G-F	G-F	G-F	Excellent	NR	NR	Fair	Not Impaired
Width	8	9	12	7	7	9	3	3	5	3
Drainage Area (mi^2)	13	31	44	5.4	9.6	-	1.9	1.3	3.1	3.0
Depth (m)										
Average	0.5	0.6	0.7	0.3	0.3	0.7	0.2	0.2	0.4	0.2
Maximum	0.7	1.0	>1.5	0.5	0.6	1.3	0.4	0.4	0.7	0.5
Canopy	80	75	80	65	60	70	75	70	80	70
Aufwuchs	Slight	Slight	Slight	Mod	Slight	Mod	Mod	Slight	Mod	Slight
Bank Erosion	Mod	Severe	Severe	Mod	Severe	Slight	Severe	Mod	Mod	Mod-Sev
Substrate (%)										
Boulder	0	0	0	30	0	20	10	15	30	0
Rubble	0	0	0	25	0	30	20	30	15	15
Gravel	25	0	0	15	15	20	10	20	20	40
Sand	70	85	90	30	70	25	35	35	35	45
Silt	5	15	10	0	15	5	25	0	0	0
Water Chemistry										
Temperature (^{o}C)	20	20	20	17	20	18	18	17	22	18
Dissolved Oxygen (mg/l)	8.4	8.4	8.2	9.6	8.6	9.2	8.5	9.2	8.8	8.7
Specific Conductance										
µmhos/cm	43	49	66	54	37	22	49	124	37	36
pH	6.9	7.1	7.3	7.2	7.0	7.3	6.9	7.2	7.2	6.8
Habitat Score (0-100)	62	40	38	86	35	88	68	78	71	45

*Estimated per SOP by multiplying 4-sample value by 1.15

Severe scour effects at high flow can be diagnosed through the abundance of the mayfly family Baetidae. Baetids were very sparse in June 2003 at Catheys Creek sites #1 and #3, Hollands Creek sites #1 and #3, and Mill Creek. It is not clear why Catheys Creek site #2 was able to maintain good populations of baetid mayflies in spite of the sandy substrate. A very different pattern might be observed under low-flow conditions, as some baetid mayflies can attain high densities on stable sand substrate.

Benthos Results for Individual Stations.

Control Site #1: Taylors Creek. We were unable to find an adequate large-stream control site in the immediate vicinity of Spindale and Rutherfordton, although we inspected many tributaries. Taylors Creek is a higher gradient site than most of Catheys Creek or Hollands Creek sites, but it had similar water chemistry characteristics (Table 1). There was a residential development upstream of SR 1314, but this development placed a high priority on conservation measures. Taylors Creek was shown to have high EPT taxa richness and an Excellent bioclassification, even though the stream had been subjected to recent high flows.

Control Site #2: East Fork Mountain Creek. This site was selected to generate comparison data for other small streams (3 meters wide) in the Hollands Creek/Catheys Creek study. Much of the catchment is forested, although the land adjacent to the SR 1327 site was being used for pasture and row crops. There were many breaks in the riparian zone, producing a high sediment load and some bank erosion. This stream had gravel riffles and a few small areas of rubble substrate. The number of EPT taxa recovered from the East Fork site (31) would produce a Good rating using the criteria for mountain streams >4 meters wide, so it can be classified as "Not Impaired". The high diversity of Baetidae (8 taxa) suggested that physical scour was not a significant problem in this stream, although the rarity of Philopotamidae indicated some water quality problems.

Mill Creek, SR 1327. This site was sampled in an effort to find a high quality site in the upper part of the Catheys Creek catchment. Although this stream had good habitat characteristics (Habitat score = 71), the stream only received a Fair bioclassification. Only 11 EPT taxa were collected from Mill Creek, with a very tolerant species (*Hydropsyche betteni*) being dominant. This species is a filter-feeder, and its abundance suggested the input of particulate organics. No stoneflies were collected from Mill Creek. One clue to problems in this stream was the elevated temperature (22^{o}C), suggesting the effects of either a discharge or an upstream pond. Although we did not know that a pond existed in this catchment during our survey, it does occur on land use maps made in 1993.

Urban Stream #1: Case Branch. Case Branch drains the northern portion of Spindale, although the catchment is mostly residential. Based on our experience with other small urban streams in North Carolina, we predicted severe water quality problems in Case Branch. The high specific conductance (124 µmhos/cm) was in line with our expectations, but it was surprising to find good habitat (Habitat score = 68) and some intolerant taxa. Intolerant taxa that were abundant in Case Branch included *Dolophilodes*, *Acroneuria abnormis*, and *Elimia*. The most abundant baetid mayfly in urban streams is usually *Baetis flavistriga*, but the most abundant baetid taxa in Case Branch were more intolerant species: *Acentrella* sp. and *Baetis pluto*. This stream was too small for a bioclassification, but the low Biotic index (4.6) did not suggest any severe water quality problems. Comparisons with East Fork Mountain Creek, however, indicated that EPT taxa richness was much lower than expected.

Urban Stream #2, Hollands Creek site #1. The most upstream site on Hollands Creek was also too small for a bioclassification, but it may be compared to the other small-stream sites in the June 2003 survey. This upstream site had the most amount of silt relative to other streams in this survey (25%), although there were several rocky riffle areas. Much of this silt may have originated from bank erosion. EPT taxa were extremely sparse at this site, with only *Stenacron pallidum* being abundant. Even this "abundant" species was very patchy, being found in only a few small pool areas with large rubble substrate. Both the low EPT taxa richness (13) and low EPT abundance (36) suggested water quality and/or habitat quality problems. The complete absence of baetid mayflies indicated that scour contributed to the problems in this part of Hollands Creek. No indicator species were abundant, however, and a few intolerant taxa were present: *Eccoptura xanthenes* (common), *Elimia* (abundant). Pollution indicator species might become more abundant at low-normal flows.

Hollands Creek #2. Hollands Creek site #2 (SR 1547) had a habitat quite different from other sites on either Hollands Creek or Catheys Creek, as this site had large amounts of boulder and rubble substrate (see site pictures). These differences reflected between-site changes in geology, not changes in land use. This middle portion of Hollands Creek received a Good-Fair rating, based on both EPT taxa richness (23) and the Biotic Index (5.2). The fauna was dominated by facultative species, but some more intolerant taxa were at least common: *Dolophilodes*, *Acroneuria abnormis*, and *Pteronarcys*. The snail *Elimia* was abundant at site #1 and continued to be abundant at site #2. The boulder-rubble substrate probably reduced the effects of scour, and four different baetid mayfly taxa were collected here.

Hollands Creek #3. In contrast to site #2, Hollands Creek site # 3 lacked any rubble-boulder substrate. This change in substrate is probably the cause for the sharp drop in EPT taxa richness between sites (88→39), but there were only slight between site changes in EPT taxa richness (23→20) and biotic index (5.2→5.5). The bioclassification remained at Good-Fair, suggesting no significant change in water quality. All baetid species were sparse at Hollands site #3, suggesting that the change in habitat led to great scour at the downstream site.

Catheys Creek #1. The upstream site on Catheys Creek is well above any residential or urban land use, so we expected good water quality. The relatively poor habitat in this portion of the stream, however, resulted in high scour following the June 2003 storms. Most EPT taxa were sparse at this site, including baetid mayflies. The dominant species for the headwaters of Catheys Creek were stoneflies associated with leafpacks: *Perlesta* and *Tallaperla*. This habitat type is above the stream bottom, and is less subject to scour effects. No long-lived species were common or abundant and philopotamid caddisflies (intolerant filter-feeders) were absent. Both of these patterns suggested water quality problems. Field notes indicated blackflies (Simuliidae) and snails (*Elimia*) also were abundant at this site. Based on EPT taxa richness, Catheys Creek was just barely into the Good-Fair bioclassification.

Catheys Creek #2. There was significant improvement between Catheys Creek site #1 and site #2, even though the habitat declined (Habitat score 62→40), and specific conductance was largely unchanged (43→49 µmhos/cm). There was a small increase in EPT taxa richness (10 sample value = 26), largely due to a greater number of mayfly species. More significant was the increase in EPT abundance between site #1 and site #2 (50→119). There were only three abundant EPT taxa at site #1, but nine abundant EPT taxa at site #2. Significant increases in abundance were seen for *Stenonema modestum*, 2 baetids (*Baetis propinquus*, *B*. *pluto*), *Isonychia*, *Caenis,* and *Pteronarcys. Pteronarcys* is a long-lived intolerant species, and its increased abundance suggests better water quality in this portion of Catheys Creek. Several of these taxa are slow-water taxa (*Baetis propinquus*, *Caenis*) suggesting more refuge from scour relative to site #1. The only negative sign was the loss of snails (*Elimia*) between site #1 and site #2. This portion of Catheys Creek received a Good-Fair rating.

Catheys Creek #3. Catheys Creek is downstream of the Spindale WWTP, although there was only a slight increase in specific conductance (49→66 µmhos/cm) under conditions of high flow and high dilution. This site had very poor habitat, with a highly unstable sand substrate and very severe bank erosion. Large snags and leaf packs, however, still harbored a diverse and abundant stonefly assemblage. This is good evidence for adequate water quality, in spite of the poor instream habitat. Like Catheys Creek site #1, this stream segment is borderline between Fair and Good-Fair ratings, but just barely achieved a Good-Fair bioclassification. The rarity of baetid mayflies suggested that scour affected the invertebrate fauna of lower Catheys Creek.

Trends (Table 2, Appendix 2)

Three sites have been sampled more than once: Hollands Creek site #2 at SR 1547(above the old WWTP), Hollands Creek site #3 at SR 1548 (below the old WWTP)), and Catheys Creek at SR 1549 (Catheys Creek Site #3). All of these sites were sampled to help evaluate the effects of the Spindale discharge.

Hollands Creek site #2. The atypical rocky substrate was found at this site in both 1988 and 2003. Seasonally adjusted results were very similar, indicating no significant change in water quality over this 15-year period.

Hollands Creek site #3. This site showed a large improvement between 1988 and 2000, after the Spindale discharge was moved further downstream. The 10-sample EPT taxa richness was the same for both July 2000 and June 2003, suggesting no change in water quality over this time period. The change in bioclassification from Fair in 2000 to Good-Fair in 2003 reflected the change in sampling method from EPT to Full Scale collections, so that the biotic index also contributed to the bioclassification in 2003.

Catheys Creek site #3. There is a fairly extensive data set for this site, with five collections from 1988-2003. This site has remained on the borderline between Fair and Good-Fair: EPT taxa richness is usually in the Fair range, but the biotic index is in the Good-Fair range. Because of this borderline classification, very small changes can shift the rating. For example, one less EPT taxon in the 2003 sample would have produced a Fair rating. Overall, the community seems fairly stable over the entire 15-year period. There was a diverse and abundant stonefly fauna in all years, although one of the more intolerant taxa (*Acroneuria abnormis*) was less common in 2000 and disappeared in 2003.

Table 2. Taxa richness (by group) and summary parameters, Hollands Creek and Catheys Creek, 1983-2003
Abbreviations: Mod=Moderate, Abun=Abundant, G-F=Good-Fair

	Hollands Creek					Catheys Creek				
	SR 1547		SR 1548			SR 1549				
	03/88	06/03	03/88	07/00	06/03	03/88	06/94	07/95	08/00	06/03
Parameter	Full	Full	Full	EPT	Full	EPT	Full	EPT	EPT	Full
Ephemeroptera	12	10	2	4	9	7	5	8	7	7
Plecoptera	7	6	1	6	5	6	7	6	5	5
Trichoptera	8	7	0	7	6	2	6	4	6	8
Coleoptera	3	4	1		3		4			4
Odonata	5	4	6		8		4			4
Megaloptera	2	1	1		1		2			0
Diptera: Chironomidae	19	19	10		25		14			14
Misc. Diptera	3	6	4		5		4			3
Oligochaeta	1	2	4		2		3			2
Crustacea	1	1	0		1		1			1
Mollusca	1	1	0		0		0			0
Total Taxa Richness	62	62	29	-	65	-	50	-	-	48
4-sample EPT Richness	-	-	-	17	-	15	-	18	18	-
10-sample EPT Richness	27	23	3	20*	20	17*	18	21*	21*	20
Seasonal Adjustment**	24	-	2	-	-	16	-	-	-	-
EPT Abundance	150	88	5	70	39	70	94	64	70	68
Biotic Index	5.0	5.2	7.5	-	5.5	-	5.3	-	-	5.1
Rating	G-F	G-F	Poor	Fair	G-F	Fair	G-F	Fair	Fair	G-F
Width	7	7	5	5	7	8	11	8	5	12
Depth										
Average	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.2	0.7
Maximum	0.5	1.0	0.3	0.5	0.6	1.0	1.2	1.0	1.0	>1.5
Canopy	80	65	40	-	60	70	90	100	-	80
Aufwuchs	Mod	Mod	Abun	Slight	Slight	Mod	Mod	Abun	-	Slight
Bank Erosion	Mod	Mod	Severe	Severe	Severe	Severe	Mod	Mod	Mod	V Severe
Substrate (%)										
Boulder	20	30	0	0	0	10	0	0	0	0
Rubble	30	25	0	0	0	0	0	0	10	0
Gravel	20	15	10	35	15	20	0	0	0	0
Sand	30	30	80	55	70	60	90	60	90	90
Silt	0	0	10	10	15	10	10	40	0	10
Water Chemistry										
Temperature	-	17	-	22	20	-	22	24	21	20
Dissolved Oxygen	-	9.6	-	7.6	8.6	-	10.3	7.0	5.6	8.2
Specific Conductance	-	54	-	67	37	-	330	350	58	66
pH	-	7.2	-	6.8	7.0	-	7.3	6.7	6.7	7.3
Habitat Score (0-100)	-	86	-	52	35	-	-	62	-	38

*Estimated from 4-sample value per SOP by multiplying by 1.15.
**Only for March samples, subtracted winter stonefly taxa.

Conclusions

Habitat.

-Habitat is generally very poor in Catheys Creek and Hollands Creek, characterized by severe bank erosion, lack of boulder-rubble substrate, and few pools. Agricultural and urban areas often have narrow buffer zones with many breaks. We did not observe severe erosion problems, however, in areas adjacent to these streams, so much of the sediment may originate as bank erosion. Habitat scores were lowest in 2003, due to fresh bank erosion that followed high spring flows. Although most streams were very sandy, local geology (bedrock close to the surface?) produced a rocky substrate in the middle part of Hollands Creek and Case Branch.

-High flows in 2003 caused a reduction in EPT abundance, but EPT taxa richness values were not significantly affected. Sampling of both large and small control sites (Taylor Creek, East Fork Mountain Creek) showed that the extremely high flows in spring 2003 should not cause a drop in bioclassification.

-There was a poor relationship between habitat and bioclassification, suggesting that focusing on habitat improvements may have limited benefits in Catheys Creek and Hollands Creek. While there was a very large change in habitat between the lower two sites on Hollands Creek, there was only a small change in the invertebrate community, and both sites were rated as Good-Fair. Very sandy substrate is normal for low-gradient streams in Broad River subbasins 2 and 4. Comparisons with these other streams suggest that habitat improvements and greater buffer zones might improve borderline Fair/Good-Fair streams to borderline Good-Fair/Good streams.

Temporal changes in water quality/habitat quality

-Significant improvements in lower Hollands Creek were observed after the Spindale discharge was moved in 1999.

-All other sites have fairly stable water quality/habitat quality over a 15-year period. Although some sites have fluctuated between Fair and Good-Fair ratings, these reflect borderline classifications and very small changes in the stream fauna. In some cases, a change in sampling method (EPT vs. Full Scale), rather than any change in the invertebrate community caused a change in bioclassification. EPT taxa richness is low in Catheys Creek and Hollands Creek (producing Fair ratings), but most sites include some fairly intolerant taxa. These intolerant taxa produce low biotic index values, so that Full Scale samples produce better bioclassifications than simple EPT collections.

-No collections from Hollands Creek or Catheys Creek have included assemblages that suggest either low dissolved oxygen or organic loading problems. Toxic indicators have not been collected since the initial sampling in 1988.

Spatial differences in water quality/habitat quality

-The worst problems were observed in Mill Creek and the upstream site on Hollands Creek. The community at Mill Creek suggested input of particulate organics from an upstream pond. This pond may also alter dissolved oxygen, flow regime, and temperature. Problems at Hollands Creek site #1 appeared to reflect urban runoff plus habitat problems. This site had the largest amount of silt (25%).

-All rateable sites (>3 meters) on Catheys Creek and Hollands Creek received a Good-Fair rating in June 2003, but these ratings were borderline Fair/Good-Fair for Catheys Creek site #1, Catheys creek site #3, and Hollands Creek site #3. Catheys Creek site #3 is downstream of the Spindale WWTP, although there is no data to indicate that this discharger is having an impact on stream fauna. All of these sites have very poor habitat, especially the most downstream sites on both Hollands Creek and Catheys Creek. Agricultural runoff is a potential pollutant at all sites, and urban runoff also may affect downstream areas. Data from Case Branch, however, did not indicate substantial impacts from the residential part of Spindale.

-Most sites on Hollands Creek and Catheys Creek had a diverse and abundant stonefly fauna (an intolerant group), with between five and seven Plecoptera taxa per site. These assemblages often included long-lived taxa (Perlidae, *Pteronarcys*) which further indicated better water quality. While this information suggested that habitat problems are more important than water quality problems, the single site with good habitat (Hollands Creek site #2) did not have a substantially better invertebrate community. In fact, the site with the best invertebrate community among the Hollands Creek and

Catheys Creek stations (Catheys Creek site #2) had extremely poor habitat. This mixture of conflicting signals indicates that both habitat and water quality problems exist in these streams.

Fish vs. Macroinvertebrate ratings

-Fish sampling may give significantly lower ratings than macroinvertebrate ratings, although there is fish data only for the downstream site on Catheys Creek. A Good-Fair was given to this site in 1994, prior to the time when the Spindale discharge was moved and upgraded. This collections indicated no toxic problems, although high nutrients and habitat problems appear to have influenced the fish community. Macroinvertebrate sampling at this site in 1994 and 1995 produced either a Fair or Good-Fair rating.

-This downstream site on Catheys Creek declined to Poor in 2000, substantially lower than the Good-Fair macroinvertebrate rating. This fish sample clearly suggests a decline in the fish community of lower Catheys Creek, although the causes are not clear. Analysis of problems in the Rutherford-Spindale area would benefit from a more extensive survey of the fish community in the Hollands Creek and Catheys Creek watershed.

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Appendix 1. Taxa list and relative abundance: Hollands Creek, Catheys Creek and tributaries, Rutherford County, June 2003. R=Rare, C=Common, A=Abundant.

	Catheys			Hollands		Taylor	Hollands Case		Mill	E Fk MC
Sample Type:	EPT	Full	Full	Full	Full	EPT	Qual5	Qual5	EPT	EPT
Taxon / Location:	#1	#2	#3	#2	#3	1314	#1	1547	1327	1331
EPHEMEROPTERA										
Baetidae										
ACENTRELLA SP					C	A		A	R	R
BAETIS ARMILLATUS	R									C
BAETIS DUBIUS				A				R		A
BAETIS FLAVISTRIGA				R	R	R		C		R
BAETIS INTERCALARIS		C	R		R					R
BAETIS PLUTO		A	R	C		A		A	R	C
BAETIS PROPINQUUS	R	A	R	C	R			C		C
BAETIS TRICAUDATUS						A				
BARBAETIS GLOVERI										R
PROCLOEON SPP		R								
CAENIS SPP	R	A	A	R	R					A
BRACHYCERCUS NITIDUS		C	R							R
DANNELLA SIMPLEX		R				R				R
DRUNELLA CORNUTELLA						R				
EPHEMERELLA CATAWBA				R		A				
EPHEMERELLA DOROTHEA						C	R			
EPEORUS RUBIDUS						A				
EURYLOPHELLA SPP		R				R				C
EURYLOPHELLA VERISIMILIS	R	R		R	R					
HEPTAGENIA SPP									R	
HEXAGENIA SPP		R								
ISONYCHIA SPP	C	A	R	R		C				A
LEUCROCUTA SPP						C				
PARALEPTOPHLEBIA SPP		R				C				R
STENONEMA INTEGRUM		R								
STENONEMA MODESTUM	C	A	C	A	C	A	C	C	R	A
STENONEMA PUDICUM					R	C			C	C
SERRATELLA CAROLINA						R				
SERRATELLA DEFICIENS	R					A				C
SERRATELLA SERRATA										R
STENACRON PALLIDUM				A	R	A	A			R
PLECOPTERA										
Seasonal taxa (emerge in spring)										
REMENUS BILOBATUS						C				
ISOPERLA NR SLOSSONAE				R		C				
Nonseasonal taxa										
ACRONEURIA ABNORMIS	R	R		C	R	A		A		C
AMPHINEMURA SPP				R						R
ECCOPTURA XANTHENES							C			
ISOPERLA HOLOCHLORA						A				
LEUCTRA SPP	R	R		C	R	C	R			
MALIREKUS HASTATUS						R				
NEOPERLA SPP	R	C	C							
PARAGNETINA FUMOSA	R	C	A		R					
PERLESTA SPP	A	A	A	C	A	C		R		A
PTERONARCYS SPP	R	A	C	C	R	A				A
PTERONARCYS DORSATA		C	C							
TALLAPERLA SPP	A					C	C			C
TRICHOPTERA										
BRACHYCENTRUS NIGROSOMA		C								
BRACHYCENTRUS SPINAE										R
CHEUMATOPSYCHE SPP	A	A	A	A	C	A	C	A	A	A
DIPLECTRONA MODESTA			R		R	A				
HYDROPSYCHE BETTENI	R	R		C			C	C	A	
HYDROPSYCHE VENULARIS			C							
SYMPHITOPSYCHE MACLEODI							R			
SYMPHITOPSYCHE SPARNA			R	C	R	C				
CHIMARRA SPP										R
DOLOPHILODES SPP				C		A		A		
GLOSSOSOMA SPP						C		R		C
GOERA SPP						R				

Appendix 1. Continued

Taxon	Catheys EPT #1	Catheys Full #2	Catheys Full #3	Hollands Full #2	Hollands Full #3	Taylor EPT 1314	Hollands Qual5 #1	Case Qual5 1547	Mill EPT 1327	E Fk MC EPT 1331
LEPIDOSTOMA SPP						C				
LYPE DIVERSA			R					C		
MICRASEMA WATAGA						C				
NEOPHYLAX MITCHELLI						R				
NEOPHYLAX OLIGIUS	R			R		A	C	C	C	A
POLYCENTROPUS SPP						C				
PSYCHOMYIA FLAVIDA									A	
PSYCHOMYIA NOMADA						A				
PYCNOPSYCHE SPP	R	A	C	A	C	R	C	A	C	A
PYCNOPSYCHE LEPIDA	R		R		C		R			
RHYACOPHILA CAROLINA						R				
RHYACOPHILA FUSCULA				C		C				
RHYACOPHILA NIGRITA						R				
TRIAENODES IGNITUS		R	R		R		R	R	R	C
MOLLUSCA										
CORBICULA FLUMINEA	A*	R								
ELIMIA SP	A*	-	-	A	-	A*	A	A	A*	A*
COLEOPTERA										
ANCHYTARSUS BICOLOR							A			
ANCYRONYX VARIEGATUS		R								
DINEUTUS SPP		C	C	R	C		R			
ECTOPRIA NERVOSA				R			R			
HELICHUS SP		C	R	C	C		C	R		
HYDROPORUS MELLITUS			R							
MACRONYCHUS GLABRATUS		A	A	R	A					
NEOPORUS SPP							R			
STENELMIS CRENATA								R		
ODONATA										
ARGIA SPP					R					
CALOPTERYX SPP				C	C		R	R		
BOYERIA VINOSA		C	C		R		R	R		
CORDULEGASTER SPP		R					R			
GOMPHUS SPP		C	R	R	C		R			
HAGENIUS BREVISTYLUS		R								
MACROMIA SPP				R	R					
OPHIOGOMPHUS SPP		C	R	C	R		R	R		
PROGOMPHUS OBSCURUS			R		R					
STYLOGOMPHUS ALBISTYLUS		R			R			R		
MEGALOPTERA										
CORYDALUS CORNUTUS		R								
NIGRONIA FASCIATUS					R					
NIGRONIA SERRICORNIS			R	C			C			
DIPTERA: CHIRONOMIDAE										
ABLABESMYIA MALLOCHI		R	R		C			R		
APSECTROTANYPUS JOHNSONI					R					
BRILLIA SPP		A	A	A	A		C			
CRICOTOPUS BICINCTUS: C/O SP1				R				R		
ORTHOCLADIUS (EUORTHOCLADIUS): C/O SP20				C						
CRICOTOPUS VARIPES GR: C/O SP6		R			R		C			
CARDIOCLADIUS SPP				A						
CHIRONOMUS SPP			R	C	R					
CONCHAPELOPIA GROUP		C	C	C	C		C	R		
CORYNONEURA SPP			R	R						
CORYNONEURA LOBATA					R					
CRYPTOCHIRONOMUS SPP				R	R					
DIAMESA SPP								R		
TVETENIA BAVARICA GR (E SP1)		R		C	R			R		

*Field notes

Appendix 1. Continued

Taxon	Catheys Full #2	Catheys Full #3	Hollands Full #2	Hollands Full #3	Hollands Qual5 #1	Case Qual5 1547
EUKIEFFERIELLA CLARIPENNIS GR (E SP11)			R		C	
MICROTENDIPES SPP				R		
NATARSIA SPP	R			R		
NILOTANYPUS SPP				R		
POLYPEDILUM CONVICTUM/AVICEPS	A	A	A	C	C	
POLYPEDILUM FALLAX	C	C	C	A		
POLYPEDILUM ILLINOENSE			R			
PARAMETRIOCNEMUS LUNDBECKI		R	A	A	A	C
PARATANYTARSUS SPP				R		
PARATENDIPES SPP			R	C		
PHAENOPSECTRA FLAVIPES		R				
POTTHASTIA LONGIMANUS			R	R		
PROCLADIUS SPP				R		
PSECTROCLADIUS SORDIDELLUS GR.			R			
RHEOCRICOTOPUS ROBACKI		R		R		
RHEOTANYTARSUS SPP	C	C		A		
STICTOCHIRONOMUS SPP			R			
TANYTARSUS SP5				R		
TANYTARSUS SP6		R				
THIENEMANIELLA XENA	C	A	A	A	R	C
TRIBELOS SPP		R		C		
TRISSOPELOPIA				R		
XYLOTOPUS PAR		C				
MISC. DIPTERA						
ANTOCHA SPP			A		R	A
DIXA SPP		R	C		R	
EMPIDIDAE				R	R	R
PALPOMYIA (COMPLEX)		R	R	R	R	
SIMULIUM SPP	A	A	A	A	C	A
SIMULIUM VENUSTUM	C	C	A	A	A	C
TIPULA SPP			C	R	C	A
OLIGOCHAETA						
CAMBARINICOLIDAE	R					R
ENCHYTRAEIDAE						R
LIMNODRILUS SPP				R		
LUMBRICULIDAE	R	R	C	C		R
NAIS SPP		R	A			
CRUSTACEA						
CAMBARUS SPP	C	R	A	A	C	A
OTHER						
CORIXIDAE			R			

Appendix 2. Taxa list and relative abundance, Hollands Creek and Catheys Creek, 1988-2003, Rutherford County. R=Rare, C=Common, A=Abundant.

	Hollands Cr #2		Hollands Cr #3			Catheys Cr				
Site:	SR 1547		SR 1548			SR 1549				
Taxon / Date:	3/88	6/03	3/88	7/00	6/03	3/88	6/94	7/95	8/00	6/03
EPHEMEROPTERA										
Spring species (found mainly in March samples)										
ACENTRELLA AMPLA	A									
EPHEMERELLA CATAWBA	A	R				A				
EPHEMERELLA ROTUNDA	R					C				
EPHEMERELLA SEPTENTRIONALIS	C									
EURYLOPHELLA VERISIMILIS	R	R	C		R	A				
LEPTOPHLEBIA SPP						C				
NEOEPHEMERA PURPUREA	R									
Nonseasonal species (present in summer)										
ACENTRELLA SP					C					
BAETIS DUBIUS		A						R		
BAETIS FLAVISTRIGA		R			R					
BAETIS INTERCALARIS					R				A	R
BAETIS PLUTO		C					R	R		R
BAETIS PROPINQUUS		C			R		C	A	R	R
BAETISCA CAROLINA	R			R						
CAENIS SPP		R			R					A
BRACHYCERCUS SP										R
HEPTAGENIA SPP							C	R		
HEXAGENIA SPP	A		R	C		R		A	A	
ISONYCHIA SPP		R					C	R	C	R
PARALEPTOPHLEBIA SPP									R	
STENONEMA MODESTUM	A	A		C	C	R	C	C	A	C
STENONEMA PUDICUM					R					
SERRATELLA DEFICIENS	R			R		R		R	C	
STENACRON PALLIDUM	A	A			R					
PLECOPTERA										
Spring species										
CLIOPERLA CLIO	R									
DIPLOPERLA DUPLICATA	A									
ISOPERLA BILINEATA	A		R			A				
ISOPERLA NR SLOSSONAE		R								
Nonseasonal species (present in summer)										
ACRONEURIA ABNORMIS	A	C		A	R	A	A	A	C	
ACRONEURIA ARENOSA								R		
AMPHINEMURA SPP		R								
ECCOPTURA XANTHENES	R			A						
LEUCTRA SPP		C		R	R					
NEOPERLA SPP							A	R		C
PARAGNETINA FUMOSA					R	C	A	C	C	A
PERLESTA SPP		C		R	A	R	A			A
PTERONARCYS SPP	C	C		A	R	C	C	R	C	C
PTERONARCYS DORSATA						C	C	C	C	C
TALLAPERLA SPP	R			C			C		R	
TRICHOPTERA										
CHEUMATOPSYCHE SPP	A	A		A	C		A		A	A
HYDROPSYCHE BETTENI	A	C		R		R				
HYDROPSYCHE VENULARIS						A	A	C		C
SYMPHITOPSYCHE SPARNA	A	C			R					R
DIPLECTRONA MODESTA					R					R
CHIMARRA SPP	A	C							R	
GLOSSOSOMA SPP	R									
HYDROPTILA SPP				R						
LYPE DIVERSA							C			R
NECTOPSYCHE EXQUISITA									R	
NEOPHYLAX OLIGIUS		R								
BRACHYCENTRUS NIGROSOMA				R			C	C		
OECETIS NOCTURNA				R						
OECETIS PERSIMILLIS							C			

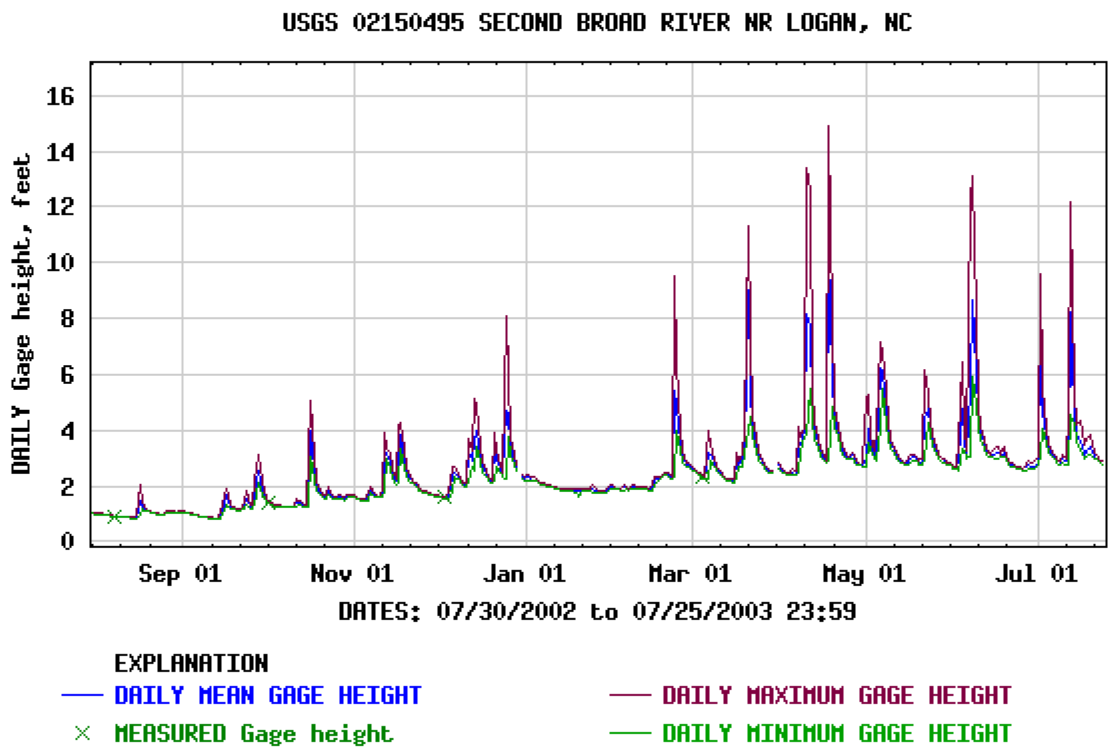
Appendix 2. Continued

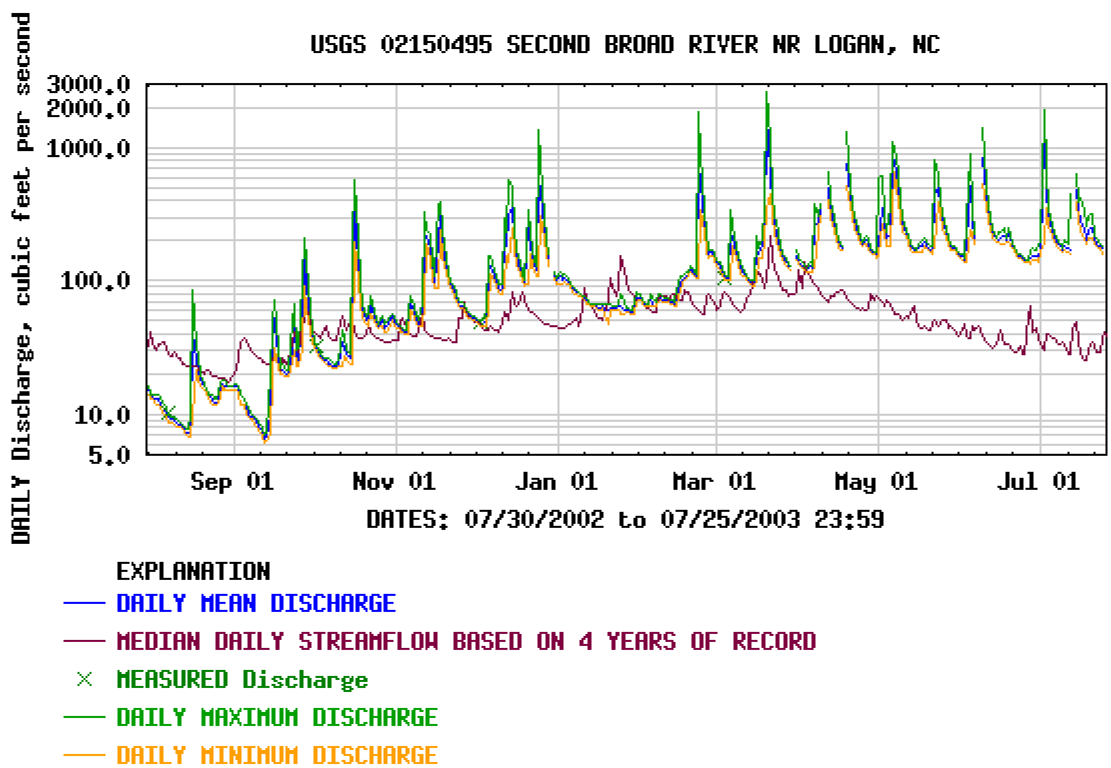
	Hollands Cr #2		Hollands Cr #3			Catheys Cr				
Site:	SR 1547		SR 1548			SR 1549				
Taxon / Date:	3/88	6/03	3/88	7/00	6/03	3/88	6/94	7/95	8/00	6/03
POLYCENTROPUS SPP	R								R	
PYCNOPSYCHE SPP	R	A		A	C			R	C	C
PYCNOPSYCHE LEPIDA					C					R
RHYACOPHILA FUSCULA	A	C								
TRIAENODES IGNITUS				C	R		C	A	C	R
COLEOPTERA										
ANCYRONYX VARIEGATUS							C			
MACRONYCHUS GLABRATUS		R			A		R			A
DINEUTUS SPP	R	R	C		C		A			C
ECTOPRIA NERVOSA		R								
ENOCHRUS SPP	R									
HELICHUS SP	R	C			C					R
HYDROPORUS MELLITUS										R
SPERCHOPSIS TESSELLATUS							R			
ODONATA										
ARGIA SPP			A		R		R			
CALOPTERYX SPP	C	C	A		C		R			
BOYERIA VINOSA	R		A		R		A			C
GOMPHUS SPP	C	R	A		C		A			R
LANTHUS SPP	R									
MACROMIA SPP		R	R		R					
OPHIOGOMPHUS SPP		C			R					R
PROGOMPHUS OBSCURUS	R		C		R					R
STYLOGOMPHUS ALBISTYLUS					R					
MEGALOPTERA										
CORYDALUS CORNUTUS	C		R				C			
NIGRONIA FASCIATUS					R					
NIGRONIA SERRICORNIS	C	C								
SIALIS SPP							R			
DIPTERA: CHIRONOMIDAE										
CHIRONOMUS SPP		C	R		R					R
POLYPEDILUM ILLINOENSE	R	R	A				A			
CRICOTOPUS BICINCTUS: C/O SP1	A	R								
CRICOTOPUS INFUSCATUS GR: C/O SP5	C									
CRICOTOPUS VARIPES GR: C/O SP6					R					
CARDIOCLADIUS SPP	R	A								
CONCHAPELOPIA GROUP	A	C	A		C		R			C
ABLABESMYIA MALLOCHI					C		R			R
ABLABESMYIA PARAJANTA/JANTA	R									
APSECTROTANYPUS JOHNSONI					R					
BRILLIA SPP	R	A	R		A		R			A
ORTHOCLADIUS OBUMBRATUS GR: C/0 SP10	A									
ORTHOCLADIUS (EUORTHOCLADIUS): C/O SP20		C								
ORTHOCLADIUS CLARKEI GR: C/O SP54	R									
CORYNONEURA SPP		R			R					R
CRYPTOCHIRONOMUS SPP		R	R		R					
TVETENIA BAVARICA GR (E SP1)		C			R					
EUKIEFFERIELLA CLARIPENNIS GR (E SP11)	C	R								
HETEROTRISSOCLADIUS SPP	R									
LARSIA SPP			R							
MICROTENDIPES SPP	R				R					
NANOCLADIUS DOWNESI							R			
NANOCLADIUS SPP							C			
NATARSIA SPP					R		R			
NILOTANYPUS SPP					R		R			
ODONTOMESA FULVA	R									
POLYPEDILUM AVICEPS		A			C					A
POLYPEDILUM FALLAX	R	C	A		A		A			C
POLYPEDILUM SCALAENUM			R							

Appendix 2. Continued

Taxon	Hollands Cr #2 SR 1547 3/88	Hollands Cr #2 SR 1547 6/03	Hollands Cr #3 SR 1548 3/88	Hollands Cr #3 SR 1548 6/03	Catheys Cr SR 1549 6/94	Catheys Cr SR 1549 6/03
PARAMETRIOCNEMUS LUNDBECKI	C	A		A		R
PARATENDIPES SPP		R		C		
PHAENOPSECTRA SPP	C				R	
PHAENOPSECTRA FLAVIPES						R
POTTHASTIA LONGIMANUS		R		R		
PROCLADIUS SPP				R		
PSECTROCLADIUS SORDIDELLUS GR.		R				
RHEOCRICOTOPUS ROBACKI	R		C	R	A	R
RHEOCRICOTOPUS TUBERCULATUS			C			
RHEOTANYTARSUS SPP				A	A	C
PARATANYTARSUS SPP				R		
ROBACKIA DEMEIJEREI	C					
STENOCHIRONOMUS SPP					R	
STICTOCHIRONOMUS SPP		R				
TANYTARSUS SP3	C					
TANYTARSUS SP5				R		
TANYTARSUS SP6						R
THIENEMANIELLA XENA		A		A	C	A
TRIBELOS SPP				C		
TRISSOPELOPIA				R		
XYLOTOPUS PAR						C
MISC. DIPTERA						
ANTOCHA SPP	C	A				
ATHERIX LANTHA					C	
DIXA SPP		C				R
EMPIDIDAE			R	R	R	
PALPOMYIA (COMPLEX)	R	R		R		
SIMULIUM SPP		A	R	A	A	A
SIMULIUM VENUSTUM		A		A		C
TABANUS SPP			R			
TIPULA SPP	A	C	C	R	C	
OLIGOCHAETA						
CAMBARINICOLIDAE					A	
LIMNODRILUS SPP (HOFFMEISTERI?)	R		C	R	C	
LUMBRICULIDAE		C	C	C		R
NAIS SPP		A	A		R	R
STYLARIA LACUSTRIS			A			
CRUSTACEA						
CAMBARUS SPP	C	A		A	A	R
GASTROPODA						
ELIMIA SP	A	A				
OTHER						
CORIXIDAE		R				

Appendix 3. Flow data from the Second Broad River.





Subwatershed Analysis Data

Subwatershed Number	Area	Forested Area	Cleared Area	Road Area (100% Impervious)	Low Intensity Developed (50% Impervious)	High Intensity Developed (80% Impervious)	Municipal (80% Impervious)	Total Impervious Area (Roads x 100% + LID x 50% + HID x 80% + Mun x 80%)	Pond Area	Wetland Area	Floodplain Area	Stream Length	Length of 303d Listed Streams
01	2,554	2,202	334	*30.2*	*0.0*	*0.0*	*0.0*	30.2	1.2	4.2	33	42,200	0
02	2,041	1,945	93	*17.8*	*0.0*	*0.0*	*0.0*	17.8	2.9	0.2	0	39,633	0
03	1,853	1,817	28	*9.8*	*0.0*	*0.0*	*0.0*	9.8	0.0	1.1	33	42,521	0
04	1,638	1,215	420	*24.8*	*1.9*	*0.0*	*1.9*	27.2	2.6	2.7	134	37,061	0
05	2,234	2,061	336	*32.5*	*47.8*	*0.0*	*9.5*	63.9	0.5	2.3	216	54,081	0
06	2,464	2,055	379	*32.3*	*66.9*	*0.0*	*15.3*	78.0	40.1	9.2	76	66,273	0
07	2,303	1,610	693	*29.6*	*38.1*	*0.1*	*8.9*	55.8	0.8	6.9	160	42,242	0
08	1,981	1,312	669	*29.7*	*38.7*	*0.0*	*51.4*	90.1	3.2	4.3	41	40,075	0
09	1,854	873	978	*40.4*	*176.3*	*3.1*	*116.5*	224.3	7.9	14.2	74	37,978	0
10	1,445	1,108	330	*23.6*	*6.6*	*0.0*	*2.3*	28.8	4.9	61.5	177	37,219	0
11	2,108	1,538	557	*39.5*	*40.3*	*0.0*	*12.0*	69.3	16.2	77.2	246	50,158	10,819
12	1,940	1,261	677	*32.6*	*19.4*	*0.0*	*9.3*	49.8	3.0	79.7	181	51,571	10,286
13	2,437	1,158	1,275	*42.4*	*409.2*	*82.3*	*250.4*	513.2	5.2	15.8	112	50,641	3,476
14	1,801	1,236	563	*22.9*	*153.9*	*23.2*	*56.6*	163.6	7.4	30.9	113	44,824	11,504

***Units: Areas are displayed in acres, Lengths are displayed in feet**

Subwatershed Number	Length of Fully Supporting Streams	Length of Partially Supporting Streams	Length of Non-Supporting Streams	Length of Non-Rated Streams	Length of Streams classified as WS V	Length of Streams classified as C	Length of 50 foot Buffered Intermittent Streams	Length of 50 foot Buffered Perennial Streams	Total Length of 50 foot Buffered Streams	Interior Patch Area	Number of Patches	Number of Corridors	Number of Adjacent Patches
01	0	0	0	23,602	42,200	0	14,343	17,372	31,715	2,747	2	10	5
02	0	0	0	28,238	39,633	0	14,245	21,512	35,757	2,408	2	7	4
03	0	0	0	22,042	42,521	0	25,107	16,993	42,100	2,286	1	3	4
04	0	0	0	14,684	37,061	0	16,377	10,544	26,920	82	1	7	5
05	0	0	0	17,592	54,081	0	31,061	14,913	45,973	228	2	11	6
06	0	0	0	27,570	66,273	0	25,550	23,490	49,040	1,310	2	7	8
07	0	0	0	11,850	42,242	0	11,109	17,883	28,992	248	2	6	5
08	0	0	0	0	40,075	0	17,160	13,143	30,303	124	1	3	4
09	13,400	0	0	0	37,978	0	11,617	06,966	18,582	0	0		
10	0	0	0	13,266	37,219	0	18,019	11,974	29,993	227	1	4	4
11	0	10,819	0	8,058	27,291	22,867	17,244	19,736	36,980	270	1	5	4
12	422	10,286	0	0	422	51,148	22,507	21,338	43,845	113	1	2	2
13	18,740	0	3,476	10,266	17,040	33,602	13,564	19,978	33,541	0	1		
14	0	113	11,392	0	0	44,824	16,323	19,556	35,878	193	0	3	3

***Units: Areas are displayed in acres, Lengths are displayed in feet**

EXISTING WATERSHED IMPROVEMENT PROGRAMS

FEDERAL

Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration projects. Grant money awarded for work in the Cathey's Creek watershed totaled $50,000 in 2002 and $25,000 in 2003. This money has primarily been used for livestock exclusion. Another project in the Broad River basin, the Upper Broad River Watershed Protection Program, has been funded (federal Section 319 money must be matched with nonfederal dollars) through the Section 319 base program between 1990 and 2000.

USDA – NRCS Environmental Quality Improvement Program (EQIP)

The Environmental Quality Incentives Program provides technical, educational and financial assistance to eligible farmers and ranchers. This program addresses soil, water, and related natural resource concerns in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with federal and state environmental laws and encourages environmental enhancement. The purposes of the program are achieved through the implementation of a conservation plan that includes structural, vegetative, and land management practices on eligible land. Five to ten-year contracts are made with eligible producers. Cost share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree plantings, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices (*i.e.*, nutrient management, pest management, and grazing land management). Fifty percent of the funding available for this program is targeted at natural resource concerns relating to livestock production. The program is carried out primarily in priority areas that may be watersheds, regions or multi-state areas, and for significant statewide natural resource concerns that are outside of geographic priority areas. Areas north and east of the Broad River in Rutherford County, including all or part of the Mountain Creek, Cleghorn Creek, McKinney Creek, Floyds Creek, Cathey's Creek, Second Broad River, Cane Creek, Camp Creek, Puzzle Creek, Roberson Creek, Hills Creek and Big Horse Creek watersheds, make up the Broad EQIP Priority Area (2001). This priority area covers approximately 220,800 acres of privately owned land, all in Rutherford County. Primary resource concerns include streambank stabilization, sedimentation, exclusion of livestock, and establishment of resource management systems on pastureland. In 2001, $35,000 was allocated to this priority area in Rutherford County, but the requests exceeded $86,000. In 2002, $100,000 was allocated and this year $85,000 has been allocated for the Rutherford County priority areas.

Rutherford County Drinking Water Protection Project

The Environmental Finance Center at the University of North Carolina at Chapel Hill has received funding from the US Environmental Protection Agency (EPA) to develop a source water protection plan for a group of communities in North Carolina. This planning effort will be one of approximately 20 pilot projects around the United States attempting to determine how well multiple units of local government can work together to protect their shared drinking water resources. In particular, EPA is interested in getting protection plans in place for water supplies that are likely to be rated moderately to severely threatened by potential contaminants under the Source Water Assessment Program that all the states are conducting.

The center consulted with the State of North Carolina's Public Water Supply Section to come up with a list of candidate communities and chose the communities that rely on the Broad River and the Second Broad River for their drinking water for the pilot project. This water supply watershed includes the towns of Forest City, Spindale, Rutherfordton, Ellenboro, Bostic, and Ruth as well as the Town of Lake Lure, Rutherford County, and any other water users in the area. The goal of the Rutherford County Drinking Water Protection Project is to protect the watershed and reduce the risk of contamination of drinking water.

A local steering committee has been established to provide leadership for the project and includes representatives from the Broad River Water Authority, the NC Cooperative Extension Service, Rutherford County Soil and Water District, the USDA-Natural Resource Conservation Service, and numerous county and municipal officials. The steering committee, with the input of technical advisors and stakeholders throughout the community, reviewed all the information available on known threats to the purity of the public water supply sources in the project area and has prepared a plan to minimize these threats. They are currently seeking resources to implement the source water protection plan.

In a later phase, the steering committee also plans to discuss and consider how to identify and reduce the impact from other sources of contamination in streams and rivers. These sources of contamination include runoff from construction, forestry, and agriculture.

STATE

Broad River Basinwide Water Quality Plan

Basinwide water quality planning is a non-regulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. The NC Division of Water Quality (DWQ) prepares Basinwide water quality plans for each of the seventeen major river basins in the state. While these plans are prepared by the DWQ, the implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments, and stakeholders in the state. The first basinwide plan for the Broad River basin was completed in 1998 and the latest update was released in February 2003.

The goals of DWQ's basinwide program are to: identify water quality problems and restore full use to impaired waters; identify and protect high value resource waters; protect unimpaired waters while allowing for reasonable economic growth; develop appropriate management strategies to protect and restore water quality; assure equitable distribution of waste assimilative capacity for dischargers; and improve public awareness and involvement in the management of the state's surface waters.

Clean Water Management Trust Fund

North Carolina's Clean Water Management Trust Fund (CWMTF) was established by the General Assembly in 1996 (Article 13A; Chapter 113 of the North Carolina General Statutes). At the end of each fiscal year, 6.5 percent of the unreserved credit balance in North Carolina's General Fund (or a minimum of $30 million) goes into the CWMTF. Revenues from the CWMTF are then allocated in the form of grants to local governments, state agencies, and conservation nonprofit organizations to help finance projects that specifically address water pollution problems. The 18-member, independent, CWMTF Board of Trustees has full responsibility over the allocation of moneys from the Fund. The CWMTF funds 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. In the Broad River basin, six projects have been funded for a total of $6,521,460. The Rutherfordton Soil and Water Conservation District was awarded a $400,000 grant for restoration through the use of agricultural BMPs. Livestock exclusion was the main emphasis of the BMPs, ranging from fencing of waterways to alternative watering sources.

NC Agriculture Cost Share Program

The North Carolina Agriculture Cost Share Program was established in 1984 to help reduce the sources of agricultural nonpoint source pollution to the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using Best Management Practices (BMPs). These BMPs include vegetative, structural, or management systems that can improve the efficiency of farming operations while reducing the potential for surface water and groundwater pollution. The Agriculture Cost Share Program is a voluntary program that reimburses farmers up to 75 percent of the cost of installation of an approved BMP. The cost share funds are paid to the farmer once the planned control measures and technical specifications are completed. The annual statewide budget for BMP cost sharing is approximately $6.9 million. Over $2 million was expended in the Broad River basin from 1996 through 2000 on a variety of nonpoint source pollution reduction projects.

Wildlife Resources Commission Fisheries Management Direction

The NC Wildlife Resources Commission (WRC) completed a Draft Fisheries Management Direction for the Broad River Basin in July 1998. The document summarizes WRC's general direction for managing fisheries resources in the Broad River basin. Specific habitat related problems that impair a stream's ability to support quality fisheries are identified. The focus of the plan is on riparian and wetland areas. WRC fisheries management activities within the Broad River basin include monitoring the abundance of fish populations, establishing harvest and size limit regulations, stocking fish, and protecting or enhancing habitat.

REGIONAL AND LOCAL

Rutherford County Soil and Water Conservation District

The Rutherford County Soil and Water Conservation District develops programs and manages the natural resources of Rutherford County. The district board is comprised of five members that determine local conservation problems and develops programs to solve them. They work with other state and federal agencies to carry out the program objectives. They also provide educational opportunities for the county schools. The district offers engineering and design assistance to landowners for the implementation of conservation practices such as ponds, terraces, groundcover, waterways, access roads, sediment basins, animal waste systems, diversions, culverts, drainage systems, and other practices to control erosion or enhance water quality.

Early on in the program emphasis was on critical area stabilization for sites with excessive erosion. A total of 604 acres of gullies in the entire county were stabilized of which; 100 acres were in the Cathey's Creek watershed. Corrective measures included regrading, installing any necessary pipe, seeding with fescue and sericea (*Lespedeza* sp.), and planting trees (loblolly and Virginia pines). The NRCS would supply the materials and the landowners would implement the measures.

The Conservation District, in the 1980's, concentrated on reducing overland erosion by implementing farming practices that included no-till practices, mainly for soybean fields. Their programs direction then shifted in the mid 1990's to concentrating on streambank erosion and livestock exclusion from waterways.

The District Board last year spent $250,000 on livestock exclusion. It was a 75% costshare program where normally a 35 foot fenced offset was implemented along streams, although small streams only required a 15-foot offset. Alternative watering sources, mainly wells, and stabilized and controlled cattle crossings were installed with the fencing. The Farm Service Agency provides funding for these riparian buffers and there has been good participation by landowners, according to Albert Moore of the NRCS. Landowners that implement the program turn around and sell the program to neighbors and friends. Many farmers like the program, because the fencing eliminates the task of hunting the cattle that remain in streams when it is time to feed or work the cattle. The recent drought has also prompted farmers to create reliable water sources making them willing to exchange a buffer for a good watering source. The fences also facilitate better grazing management through paddock rotation. The amount of grazing land lost is minimal, approximately 1 acre of pasture per 1,000 feet of stream. Albert Moore also indicated that most farmers are not grazing their land to capacity either.

Mountain Valleys RC&D

The Mountain Valleys Resource Conservation and Development Council is a nonprofit organization that covers Buncombe, Cleveland, Henderson, Madison, McDowell, Polk, Rutherford, and Transylvania counties. The Soil and Water Conservation Districts and County Commissioners of those eight counties, in addition to the Region B and C Councils of Governments, sponsor the RC&D council. The council carries out a program of natural resource conservation and community development with the overall goal of achieving "communities in harmony with their environment". In addition to water quality and stream and watershed restoration projects, the council's current priorities include new income opportunities for the rural economy of the region, farmland and family farm preservation, and community recreation development. The Mountain Valleys RC&D Council has been very active in the Upper Broad River Watershed Protection Project, which is striving to stabilize eroding areas to reduce sedimentation of Lake Lure.

Conservation Trust for North Carolina

The mission of the Conservation Trust of North Carolina (CTNC) is to conserve land resources through direct action and by helping communities, private land trusts, and individual landowners protect lands most important to them for their natural, scenic, historic, and recreational values. CTNC helps government agencies allocate funds to local trusts or districts seeking funding for activities including land acquisition and water quality projects. The organization also acts as a service/resource center for local land trusts, as well as a mentor to help start new local trusts. A Land Trust Council was established to distribute information to the various land trusts statewide and to represent them at the legislature. The Pacolet Area Conservancy, Carolina Mountain Land Conservancy and the Foothills Conservancy are three organizations that are associated with CTNC that work in the Broad River basin and surrounding watersheds.

Carolina Mountain Land Conservancy

The Carolina Mountain Land Conservancy (CMLC) is a partnership of people working in Henderson, Transylvania, Buncombe, and Rutherford counties to ensure that, as the North
Carolina mountain region changes, important land is not lost forever. The CMLC is a nonprofit, voluntary organization that: works to directly protect the natural diversity and beauty of the region by preserving significant natural lands and scenic areas; helps families meet their conservation and financial goals while preserving their forest, farm and natural lands for future generations; provides communities and individuals with a range of conservation tools and tax-saving techniques, such as land acquisition and conservation easements; and fosters a greater understanding and appreciation of natural heritage.

Foothills Conservancy

The Foothills Conservancy was formed in 1994 to preserve and protect important natural areas and open spaces of the Foothills region, including Alexander, Burke, Caldwell, Catawba, Cleveland, Lincoln, McDowell, and Rutherford counties. Highlights of the Foothills Conservancy's work include the first conservation easement to protect 114 acres of forestland and open space along the Broad River in Rutherford County and an agricultural conservation easement for 305 acres on a Rutherford County farm via the NC Farmland Preservation Program. There are several tracts under farmland preservation in the Cathey's Creek watershed.

Volunteer Water Information Network (VWIN)
The Volunteer Water Information Network (VWIN) is a partnership of groups and individuals dedicated to preserving water quality in western North Carolina. The University of North Carolina at Asheville (UNCA) Environmental Quality Institute provides technical assistance through laboratory analysis of water samples, statistical analysis of water quality results, and written interpretation of the data. Volunteers, trained by VWIN, collect monthly water quality samples from streams and rivers throughout the Network area. There are 32 VWIN sites in the Broad River basin, but none are located in the Cathey's Creek watershed.

The Nature Conservancy
The Nature Conservancy, an international private nonprofit organization, works with members, contributors and partners to acquire conservation land. The North Carolina Chapter of The Nature Conservancy has helped to protect 72,000 acres across the state. Some of the land is owned and managed by The Nature Conservancy and other sites are acquired on behalf of state and federal conservation agencies to be placed in public ownership. The North Carolina Chapter works in conjunction with the NC Natural Heritage Program of the NC Division of Parks and Recreation to identify and inventory unique natural areas and habitats. Currently there are no protected lands in the Cathey's Creek watershed.

The Concerned Citizens of Rutherford County's Forest Watch Program
In May 2000, the Concerned Citizens for Rutherford County, in response to calls from local citizens distressed about forest clear-cutting and its water quality impacts, developed its Forest Watch Program. The Forest Watch Program is a volunteer monitoring program that documents logging and forestry activities by taking pictures and video and filling in site evaluation forms based on the North Carolina's Division of Forest Resources (NCDFR) Site Evaluation Form. Information gathered at the forestry and logging operation is sent to the NCDFR for review and possible inspection of the site.

Subwatershed Analysis Data

Subwatershed Number	Area	Forested Area	Cleared Area	Road Area (100% Impervious)	Low Intensity Developed (50% Impervious)	High Intensity Developed (80% Impervious)	Municipal (80% Impervious)	Total Impervious Area (Roads x 100% + LID x 50% + HID x 80% + Mun x 80%)	Pond Area	Wetland Area	Floodplain Area	Stream Length	Length of 303d Listed Streams
01	2,554	2,202	334	30.2	0.0	0.0	0.0	30.2	1.2	4.2	33	42,200	0
02	2,041	1,945	93	17.8	0.0	0.0	0.0	17.8	2.9	0.2	0	39,633	0
03	1,853	1,817	28	9.8	0.0	0.0	0.0	9.8	0.0	1.1	33	42,521	0
04	1,638	1,215	420	24.8	1.9	0.0	1.9	27.2	2.6	2.7	134	37,061	0
05	2,234	2,061	336	32.5	47.8	0.0	9.5	63.9	0.5	2.3	216	54,081	0
06	2,464	2,055	379	32.3	66.9	0.0	15.3	78.0	40.1	9.2	76	66,273	0
07	2,303	1,610	693	29.6	38.1	0.1	8.9	55.8	0.8	6.9	160	42,242	0
08	1,981	1,312	669	29.7	38.7	0.0	51.4	90.1	3.2	4.3	41	40,075	0
09	1,854	873	978	40.4	176.3	3.1	116.5	224.3	7.9	14.2	74	37,978	0
10	1,445	1,108	330	23.6	6.6	0.0	2.3	28.8	4.9	61.5	177	37,219	0
11	2,108	1,538	557	39.5	40.3	0.0	12.0	69.3	16.2	77.2	246	50,158	10,819
12	1,940	1,261	677	32.6	19.4	0.0	9.3	49.8	3.0	79.7	181	51,571	10,286
13	2,437	1,158	1,275	42.4	409.2	82.3	250.4	513.2	5.2	15.8	112	50,641	3,476
14	1,801	1,236	563	22.9	153.9	23.2	56.6	163.6	7.4	30.9	113	44,824	11,504

***Units: Areas are displayed in acres, Lengths are displayed in feet**

Subwatershed Number	Length of Fully Supporting Streams	Length of Partially Supporting Streams	Length of Non-Supporting Streams	Length of Non-Rated Streams	Length of Streams classified as WS V	Length of Streams classified as C	Length of 50 foot Buffered Intermittent Streams	Length of 50 foot Buffered Perennial Streams	Total Length of 50 foot Buffered Streams	Interior Patch Area	Number of Patches	Number of Corridors	Number of Adjacent Patches
01	0	0	0	23,602	42,200	0	14,343	17,372	31,715	2,747	2	10	5
02	0	0	0	28,238	39,633	0	14,245	21,512	35,757	2,408	2	7	4
03	0	0	0	22,042	42,521	0	25,107	16,993	42,100	2,286	1	3	4
04	0	0	0	14,684	37,061	0	16,377	10,544	26,920	82	1	7	5
05	0	0	0	17,592	54,081	0	31,061	14,913	45,973	228	2	11	6
06	0	0	0	27,570	66,273	0	25,550	23,490	49,040	1,310	2	7	8
07	0	0	0	11,850	42,242	0	11,109	17,883	28,992	248	2	6	5
08	0	0	0	0	40,075	0	17,160	13,143	30,303	124	1	3	4
09	13,400	0	0	0	37,978	0	11,617	06,966	18,582	0	0		
10	0	0	0	13,266	37,219	0	18,019	11,974	29,993	227	1	4	4
11	0	10,819	0	8,058	27,291	22,867	17,244	19,736	36,980	270	1	5	4
12	422	10,286	0	0	422	51,148	22,507	21,338	43,845	113	1	2	2
13	18,740	0	3,476	10,266	17,040	33,602	13,564	19,978	33,541	0	1		
14	0	113	11,392	0	0	44,824	16,323	19,556	35,878	193	0	3	3

***Units: Areas are displayed in acres, Lengths are displayed in feet**