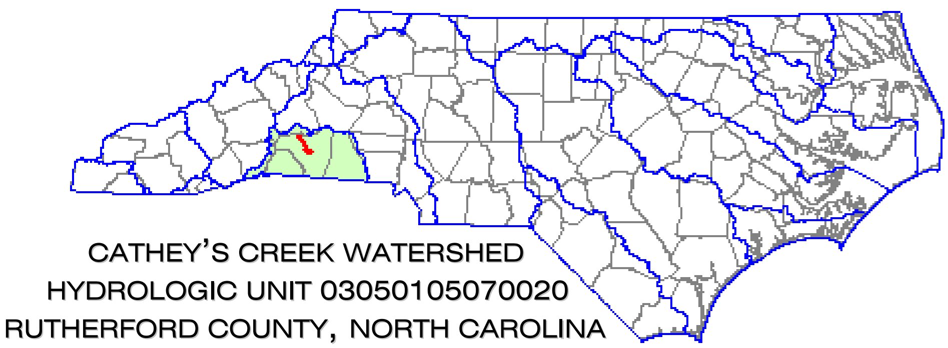
CATHEY'S CREEK TECHNICAL WATERSHED ASSESSMENT

INITIAL WATERSHED CHARACTERIZATION AND SAMPLING PLAN



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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

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.

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.

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.

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.

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.

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

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.

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.

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