

Peachtree-Martins Creek Local Watershed Plan Phase 3

**Hiwassee River Basin
Cherokee and Clay Counties, N.C.**

Watershed Management Plan

October 2007



**A Project Of
The NC Ecosystem
Enhancement Program**



**With Assistance From
Equinox Environmental
Consultation and Design, Inc.
Asheville, NC**



Executive Summary

1 Background

This report presents the Watershed Management Plan developed for the Peachtree-Martins Creek area by the NC Ecosystem Enhancement Program (NCEEP) in conjunction with the Hiwassee River Watershed Coalition (HRWC). The management plan represents Phase 3 of the Peachtree-Martins Creek Local Watershed Plan. Phase 1 produced a Preliminary Findings and Recommendations Report in early 2006. The second phase involved a detailed watershed assessment, completed in May 2007. The NC Division of Water Quality (NCDWQ), the NC Wildlife Resources Commission (NCWRC) and the Tennessee Valley Authority (TVA) also collaborated on the development of the Local Watershed Plan. Equinox Environmental Consultation and Design, Inc. (Equinox) served as the technical consultant for the project.

The area covered by this Watershed Management Plan is located primarily in Cherokee County and includes Peachtree Creek, Martins Creek, a portion of the Hiwassee River and a number of neighboring streams. The 39.3 square mile planning area includes the Hiwassee River and its tributaries from Mission Dam, outside of Brasstown, downstream to Murphy, with the exclusion of Brasstown Creek.

Important stressors that are widespread in the planning area include: lack of riparian vegetation; channel modification; sediment impacts; and nutrient and fecal coliform bacteria contamination. Additionally, a number of localized concerns exist: stormwater impacts in the Peachtree area; groundwater contamination in the vicinity of Tri-County Community College and the Clifton Precision Products/Moog Components facility; and impacts from Mission Quarry. Ongoing commercial and residential development is expected to continue in the area and is the biggest future threat to water quality and other elements of ecological function.

An assessment of ecological conditions offers both good and bad news for the Peachtree-Martins Creek area. On the positive side, about 17% of the area retains high or very high levels of ecological function. Severe degradation on the sub-watershed scale is currently limited, occurring only in the Mission Quarry area. While many individual sites in the planning area are severely impacted, at the sub-watershed level these impacts are mitigated to some degree by the areas that remain undisturbed or well-managed.

On the other hand, almost 18 square miles (about 45%) of the area has seen significant deterioration in ecological condition and is functioning at a low level or worse. Another 15 square miles (38% of the area) is functioning at a moderate level but is at risk of further degradation. Impacts of riparian vegetation removal, channel modification, and sedimentation are widespread.

The fact that much of the existing degradation is not severe makes the potential for successful rehabilitation more favorable than if the severest conditions were widespread. The fact that substantial areas remain in relatively good condition means that there is still much to lose if both ongoing activities and future growth are not handled well.

Because both the source activities and affected areas are widely dispersed, addressing these issues will require diverse strategies implemented over an extended period of time. A strong

organizational presence, as provided by the HRWC, is a major asset in pursuing both remedial and protection efforts.

2 Potential Impacts from Future Development

The primary threat for future degradation in the Peachtree-Martins Creek area is likely to come from activities associated with residential and commercial development. New development has been substantial in recent years, a trend that is expected to continue. Analyses conducted for this Watershed Management Plan indicate that:

- Substantial new development is likely to occur in the Peachtree-Martins Creek area between 2005 and 2015. The extent of land in residential use is anticipated to increase by over 40% over this period, while commercial areas are expected to increase by 77%.
- As a result, impervious cover in the planning area as a whole will increase from 3.9% to 5.5%.
- More substantial changes in impervious cover will occur in those sub-watersheds in which much of the new development is concentrated. By 2015 imperviousness in the McComb Branch and Lower Peachtree sub-watersheds will reach 17% and 13% respectively, while impervious cover in the Southern Hiwassee Tributary area will increase from 3% to 9% over the 10 year period.
- Still larger increases in imperviousness are likely for small streams experiencing development in a large portion of their drainage (e.g. Harshaw Branch, where impervious cover in the catchment may increase from 2% to 27%). Severe impacts are likely in these locations without a concerted effort to mitigate the effects of development by means of stormwater control and other measures.
- Estimates using TVA's Integrated Pollutant Source Identification (IPSI) model indicate that between 2005 and 2015, total suspended solids (TSS) loads from residential and commercial areas can be expected to increase by 44% and 77% respectively, while TSS loads from construction activity will increase by approximately 55%. Similar increases are estimated for nitrogen and phosphorus.
- A considerable portion of these pollution increases can be avoided by the implementation of a variety of local policies, most notably post-construction stormwater control, vegetative clearing limits and enhanced erosion and sediment control during construction.

3 Summary of Focus Areas and Recommended Strategies

This plan recommends several focus areas to concentrate management efforts. Recommended priority areas for addressing existing degradation are:

- The Middle Martins Creek, Lower Slow Creek and Messer Branch sub-watersheds, which should be considered primary focus areas for implementation of a broad range of remedial practices;
- The sub-watershed draining Mission Quarry, which is experiencing severe impacts from the quarry operation; and
- McComb Branch, which is subject to a variety of water quality and stormwater impacts.

Recommended priority areas for preservation include:

- The upper Peachtree drainage including the following sub-watersheds - Upper Peachtree, Moore Branch, Pipes Branch and the portion of Middle Peachtree upstream of Mission Road; and
- The Upper Martins Creek sub-watershed.

This plan recommends a number of strategies to mitigate the problems and threats noted above and thereby restore and protect watershed function. Strategies are summarized in the table below, immediately followed in the text by a listing of the full set of recommendations. The recommendations are listed in three groups: recommendations to address existing degradation, recommendations to promote ecological preservation and recommendations to mitigate the potential impacts of future development. The *Project Atlas*, a companion document to this management plan, describes the selection of potential NCEEP restoration and preservation projects and provides detailed information on these sites.

Summary of Proposed Management Strategies

Watershed Problems		Proposed Solutions	
Stressors and Issues	Major Impacts	Management Strategy	Location in Document
<i>Lack of Riparian Vegetation</i>	Stream bank instability, poor shading, insufficient woody material in streams, limited pollution removal	<ul style="list-style-type: none"> • Revegetation of riparian areas 	Section 6.1
<i>Channel Modification</i>	Habitat degradation, incision, bank erosion, sedimentation	<ul style="list-style-type: none"> • Stream channel restoration 	Section 6.1
<i>Excess Sediment Inputs</i>	Habitat degradation-loss of riffle and pool habitat; reservoir filling	<ul style="list-style-type: none"> • Conservation tillage and other crop land measures • Livestock exclusion and other BMPs for livestock operations • Stabilization of eroding road banks and ditches; drainage and grading improvements to reduce erosion from unpaved road surfaces • Education of landowners regarding property/road maintenance and design • Stabilization and revegetation of eroding areas on existing developed land • Education of landowners regarding land disturbance • Enforcement of existing regulations at Mission Quarry • Promotion of forestry BMPs • Stabilization and replanting of eroding stream banks 	Section 6.2 Section 6.2 Section 6.2 Section 6.2 Section 6.2 Sections 6.2, 8.2 Section 6.2 Section 6.2
<i>Excess Nutrient Inputs</i>	Over-enrichment of streams and reservoirs, resulting in low dissolved oxygen levels and altered aquatic communities	<ul style="list-style-type: none"> • Education of property owners and contractors regarding appropriate fertilization and lawn care practices • Removal of straight pipes; repair/replacement of faulty septic systems • Education of landowners regarding proper septic system maintenance • Livestock exclusion and other BMPs for livestock operations • Conservation tillage and other crop land measures • Replanting of riparian vegetation 	Sections 6.2, 8.2 Section 6.2 Section 6.2 Section 6.2 Section 6.2 Section 6.1
<i>Bacterial Contamination</i>	Human health risk	<ul style="list-style-type: none"> • Additional monitoring of fecal coliform bacteria • Removal of straight pipes; repair/replacement of faulty septic systems • Education of landowners regarding proper septic system maintenance • Livestock exclusion practices and other BMPs for livestock operations 	Section 6.2 Section 6.2 Section 6.2 Section 6.2
<i>Stormwater</i>	Channel erosion due to increased storm discharge; aquatic life impacts from nutrients and toxic substances	<ul style="list-style-type: none"> • Additional monitoring of stormwater impacts • Stormwater retrofits for developed areas, especially in McComb Br. area • Education of citizens regarding stormwater and pollution prevention 	Section 6.3 Section 6.3 Section 8
<i>Groundwater Contamination</i>	Human health risk (drinking water); impacts to aquatic biota	<ul style="list-style-type: none"> • Continued remediation of existing contamination in Peachtree area • Continued monitoring of organic contaminants in Peachtree area 	Section 6.5 Section 6.5
<i>Mission Quarry</i>	Sedimentation and water quality impacts	<ul style="list-style-type: none"> • Enforcement of applicable water quality, mining and health regulations 	Section 6.4
<i>New Development</i>	Future increase in sediment, nutrient and stormwater impacts	<ul style="list-style-type: none"> • Adoption of a subdivision ordinance that encourages Low Impact Development (LID) and other approaches to reduce impacts • Instituting post-construction stormwater management requirements • Developing a local erosion and sediment control program • Ongoing public education regarding watershed and stormwater issues • Evaluation of stormwater control opportunities on government properties • Adoption of hillside development standards • Expansion and revision of existing water supply and floodplain ordinances • Development of a long-term wastewater management plan • Development of a comprehensive land use plan 	Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2
<i>Multiple Stressors</i>	Diverse future impacts	<ul style="list-style-type: none"> • Preservation of priority areas through conservation easements and proper forest management 	Section 7

4 Recommended Strategies to Address Existing Degradation

Recommended actions to remediate existing degradation are summarized below, grouped by the major stressor or issue addressed.

4.1 Channel Modification and Lack of Riparian Vegetation

Recommendation 1: Where channel morphology and stability have been compromised, stream channels should be restored to a natural pattern, dimension and profile. Streams identified as channelized by TVA's IPSI analysis provide a good first approximation of the reaches where stream channel restoration projects are needed. NCEEP should undertake these projects to the extent feasible. The HRWC should take the lead to initiate projects for stream reaches where NCEEP cannot operate.

Recommendation 2: Where channel morphology does not need restoration but riparian vegetation is inadequate, woody vegetation should be replanted. Streams identified by the IPSI as having inadequate riparian revegetation provide a fairly accurate indication of reaches where riparian area enhancement projects are needed. NCEEP should undertake these projects to the extent feasible. The HRWC should take the lead to initiate projects for stream reaches where NCEEP cannot operate.

Recommendation 3: Where severely eroding stream banks exist outside of areas to be included in stream channel restoration and riparian revegetation projects, they should be stabilized and revegetated. The HRWC, Cooperative Extension Service or Cherokee Soil and Water Conservation District (SWCD) could take the lead in this work.

4.2 Sediment, Nutrients and Fecal Coliform Bacteria

Agricultural sources

Recommendation 4: Sediment and nutrients from crop land should be addressed using standard BMPs for controlling erosion, sediment and nutrients on cultivated land. These include conservation tillage, filter strips, field borders, the development of nutrient management plans and other practices. These practices are eligible for cost share from both the Natural Resources Conservation Service (NRCS) and the NC Agricultural Cost Share Program (NCACSP). These practices should be targeted at areas currently using low residue practices and other areas identified by agricultural agency staff as having a high potential for impacts. NRCS and the Cherokee SWCD should prioritize these areas for appropriate practices.

Recommendation 5: Sediment, nutrients and bacterial contamination from livestock operations should be addressed using standard BMPs for controlling these pollutants on pasture land. These include limiting livestock access to streams, the establishment of buffer areas between pastures and stream channels, heavy use area protection, rotational grazing and other practices. These practices are eligible for cost share from both the NRCS and the NCACSP. These practices should be targeted at areas with documented livestock stream access, pasture land that is in the poorest condition and other areas identified by agricultural agency staff as having a high potential for impacts. NRCS and the Cherokee SWCD should prioritize these areas for appropriate practices.

Existing developed areas

Recommendation 6: Education efforts should target property owners to inform them of the importance of a variety of activities aimed at reducing pollution sources. These include: maintaining vegetative cover; using proper erosion and sediment control methods when land disturbance is necessary; conservative use of fertilizer and other lawn and garden care products; septic system maintenance; and road design and maintenance. The HRWC, Cooperative Extension Service or a county-developed watershed education program could all be appropriate entities to carry out this work.

Recommendation 7: Sources of fecal coliform bacteria contamination should be identified and eliminated, including contamination from both domestic waste and livestock. NCDWQ, the Wastewater Discharge Elimination (WaDE) program of the NC Division of Environmental Health and local resource agencies should work together towards this goal. This work should focus on waters where violations of water quality standards were documented by NCDWQ during the summer of 2007, although additional priority areas may be identified by further investigation. The WaDE program should conduct a field survey to determine the extent of straight piping and malfunctioning septic systems in the planning area and identify sites in need of remediation.

Recommendation 8: An effort should be made to identify specific developed areas which are significant and ongoing sources of sediment. Features in these areas which are major sediment contributors should be stabilized and vegetated. The HRWC, Cooperative Extension Service or Cherokee County SWCD could take the lead in securing funding for these tasks.

New construction and disturbed areas

See Section 5, below, for this recommendation.

Roads

Recommendation 9: High priority areas of roadway and bank/ditch erosion should be identified and stabilized to the extent practicable. The HRWC, Cooperative Extension Service or Cherokee SWCD could take the lead in securing funding for these tasks.

Other recommendations

Recommendation 10: BMPs to protect water quality should be used during harvesting and other silvicultural operations, as outlined in the North Carolina Forestry Best Management Practices Manual to Protect Water Quality. Particular attention should be paid to recommended practices regarding streamside management zones, stream crossings and roads.

Recommendation 11: Landowners should be educated regarding the importance of proper maintenance and revegetation practices to limit erosion from recreational and other activities on forest land.

4.3 Stormwater in the Peachtree Area

Recommendation 12: Potential stormwater retrofit sites should be identified in the Tri-County Community College / Murphy Medical Center area, and an effort undertaken to secure funding to implement these projects. Retrofit projects would be useful even if they do not treat large areas and serve primarily educational purposes.

Recommendation 13: NCDWQ should continue its investigation into the nature of water quality degradation in McComb Branch and its tributaries, and the role of stormwater impacts in that

degradation. NCDWQ should make recommendations to improve water quality in these streams. Recommended actions should include the identification and elimination of any illicit discharges in the Tri-County Community College / Murphy Medical Center area.

4.4 Mission Quarry

Recommendation 14: In order to reduce sediment impacts to the stream below the quarry and to the Hiwassee River, the NCDWQ and the NC Division of Land Resources should continue their effort to bring the Mission Quarry operation into compliance with all operating permits. Steps should be taken to ensure that ongoing enforcement is sufficient to induce continued compliance and that additional impacts do not occur.

Recommendation 15: NCDWQ should continue its efforts to identify the source of high conductivity in the stream below the quarry, as well as high nutrient levels. The agency should make recommendations for water quality improvement upon completion of the investigation.

4.5 Groundwater Contamination

Recommendation 16: The NC Division of Waste Management (NCDWM) should conduct follow up sampling of private drinking wells in the Peachtree area to determine if a health risk exists from groundwater contamination at the Tri-County Community College or Moog sites. Sampling should be conducted in consultation with the Cherokee County Health Department.

Recommendation 17: NCDWM should continue to monitor compliance with remediation activities at the two sites to insure that reductions in contaminant concentrations continue and that required monitoring occurs.

5 Recommended Preservation Strategies

The following actions are recommended to protect existing high quality resources and to help prevent further loss of function in already impacted areas.

Recommendation 1: Governmental agencies and private organizations should work with local landowners to protect existing forested tracts in the planning area using conservation easements or other means. NCEEP can undertake these projects in situations where this is feasible. The HRWC, the Land Trust for the Little Tennessee and other local groups should work with property owners to initiate projects where NCEEP cannot operate.

Recommendation 2: Owners of private woodlands in the planning area are encouraged to practice sustainable forest management, protecting habitat and water quality while making productive use of their land.

6 Recommended Strategies to Mitigate Future Development Impacts

The actions summarized below are recommended to address potential impacts from the additional residential and commercial development expected in the Peachtree Martins Creek planning area. Without a focused effort to mitigate the impacts of this activity, further degradation of water quality, hydrologic condition and stream habitat is likely to occur in many area streams. Additionally, efforts to ameliorate current degradation may have little noticeable impact, or those impacts may be short-lived, if future development issues are not dealt with effectively and expeditiously.

The task of developing and adopting these measures will be a major undertaking for the County and will take some time to carry out. It is important that the process begin as soon as possible, so that as much future development as possible takes place under a set of standards that will more effectively mitigate environmental impacts.

Recommendation 1: Cherokee County should consider developing and adopting a subdivision ordinance to ensure that adequate planning occurs prior to land development and that design standards and development practices are adequate to address environmental and resource protection needs. The ordinance should encourage Low Impact Development and other measures to minimize water quality impacts from development and should provide developers with incentives to undertake a variety of voluntary conservation efforts.

Recommendation 2: Cherokee County should consider developing and adopting a comprehensive stormwater management program to reduce the environmental impacts of post-construction stormwater.

Recommendation 3: Cherokee County should consider development of a local erosion and sediment control program, with specific provisions to address smaller sites and road and site development on steep slopes. Staffing levels sufficient to support effective enforcement are essential. Efforts to reduce construction-related sediment will be most effective if they include not only a regulatory component, but also non-regulatory efforts to educate contractors and property owners regarding the importance of limiting disturbance and utilizing appropriate control practices. These educational functions could also be performed as part of a broader public education program.

Recommendation 4: Cherokee County should develop a robust public education program to increase public knowledge of water quality and watershed issues, including stormwater and other issues of concern.

Recommendation 5: Publicly owned facilities - including facilities owned by Cherokee County, NC Department of Transportation, Tri-County Community College and other government agencies - should be evaluated for their potential to treat/retain stormwater. Stormwater BMPs should be implemented on other public properties as they are developed.

Recommendation 6: Cherokee County should consider the development of hillside development or mountain protection standards to address potential problems associated with development activity on steep terrain.

Recommendation 7: Cherokee County should consider expansion of its floodplain ordinance to include relevant portions of the Peachtree-Martins Creek area and should evaluate both the floodplain and water supply protection ordinances to determine ways in which they may be improved.

Recommendation 8: Cherokee County should develop a long term plan for meeting future wastewater treatment needs.

Recommendation 9: Cherokee County should consider the development of a county-wide comprehensive land-use plan.

List of Acronyms and Abbreviations

BMPs	Best Management Practices
CWP	Center for Watershed Protection
GIS	Geographic Information System
HRWC	Hiwassee River Watershed Coalition
IPSI	Integrated Pollutant Source Identification
LAC	Local Advisory Committee
LID	Low Impact Development
LWP	Local Watershed Plan
NCACSP	NC Agricultural Cost Share Program
NCDFR	NC Division of Forest Resources
NCDLR	NC Division of Land Resources
NCDOT	NC Department of Transportation
NCDWM	NC Division of Waste Management
NCDWQ	NC Division of Water Quality
NCEEP	NC Ecosystem Enhancement Program
NCGAP	NC Gap Analysis Project
NCNHP	NC Natural Heritage Program
NCWRC	NC Wildlife Resources Commission
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
PFRR	Preliminary Findings and Recommendations Report
RAE	Riparian Area Enhancement
SCR	Stream Channel Restoration
SWCD	Soil and Water Conservation District
TCCC	Tri-County Community College
TCE	Trichloroethene (trichloroethylene)
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
USEPA	US Environmental Protection Agency
WaDE	Wastewater Discharge Elimination Program
WMP	Watershed Management Plan

Table of Contents

Executive Summary	i
List of Acronyms and Abbreviations	x
Section 1 Introduction	1
1.1 Planning Area Description	1
1.2 Planning Approach	1
1.3 Stakeholder Involvement	3
1.3.1 Introduction	3
1.3.2 Local Advisory Committee	3
1.3.3 Public Meetings	6
1.4 Organization of Report	6
Section 2 Current Watershed Conditions and Major Stressors	8
2.1 Data Sources	8
2.2 Planning Area Characteristics	8
2.2.1 Overview	8
2.2.2 Sub-Watersheds and Topographic Zones	9
2.2.3 Land Use and Impervious Cover	11
2.3 Watershed Functional Condition	12
2.4 Major Issues and Impacts	15
2.4.1 Aquatic Communities and Habitat	15
2.4.2 Stressors and Pollution Sources	17
Section 3 Future Threats to Watershed Function	23
3.1 Background on Development Impacts	23
3.2 Approach	24
3.3 Expected Changes in Land Use	25
3.4 Impact of Land Use Change on Impervious Area	25
3.5 Effects of Land Use Change on Pollutant Loads	28
3.6 Potential Impacts of Local Management Policies	30
3.6.1 Introduction	30
3.6.2 Results	31
Section 4 Overview of Recommended Strategies	36
4.1 Developing a Framework for Watershed Management	36
4.2 Recommended Strategies	36
Section 5 Identification of Focus Areas	38
5.1 Approach	38
5.2 Focus Areas for Watershed Improvement Efforts	38
5.2.1 Addressing Common Watershed Problems	38
5.2.2 Unique Areas	41
5.3 Focus Areas for Preservation Activities	41
5.3.1 Background	41
5.3.2 Recommended Focus Areas	42
Section 6 Strategies to Address Causes of Existing Degradation	43
6.1 Channel Modification and Lack of Riparian Vegetation	43
6.1.1 General Considerations	43
6.1.2 Recommended Strategies	44
6.1.3 Potential NCEEP Project Sites	44

6.2 Measures to Address Sources of Sediment, Nutrients and Fecal Coliform Bacteria	48
6.2.1 General Considerations	48
6.2.2 Strategies for Agricultural Sources	48
6.2.3 Strategies for Existing Developed Areas	49
6.2.4 Strategies for New Construction and Disturbed Areas	49
6.2.5 Strategies for Roads	50
6.2.6 Other Recommendations	50
6.3 Stormwater Issues in the Peachtree Area	51
6.4 Impacts from Mission Quarry	52
6.5 Groundwater Contamination	52
Section 7 Preservation Strategies and Priorities	54
7.1 Background	54
7.2 Preservation Recommendations	54
7.3 General Preservation Priorities	55
7.3.1 Tract Identification	55
7.3.2 Priority Tracts for Preservation	55
7.4 Potential NCEEP Project Sites	57
7.5 Management of Forested Lands	59
Section 8 Strategies to Mitigate Future Development Impacts	60
8.1 Introduction	60
8.2 Recommendations	61
Section 9 References Cited	65
Appendices	
A. Supplemental Tables and Maps	
B. Modeling of Future Development Impacts	

List of Tables

Table 2.1	Sub-Watersheds in the Peachtree-Martins Creek Planning Area	9
Table 2.2	Summary of Sub-Watershed Functional Ratings	13
Table 2.3	Sub-Watershed Functional Condition in the Peachtree-Martins Creek Planning Area	13
Table 2.4	Summary of Fecal Coliform Bacteria Data Collected in 2007	22
Table 3.1	Annual Pollutant Loads for 2010 and 2015 Base Scenarios	30
Table 3.2	Synopsis of Management Strategy Results	32
Table 3.3	Calhoun-Mission Branch Load Changes with Sewer Line Extension	35
Table 4.1	Summary of Proposed Management Strategies	37
Table 5.1	Features of Middle Martins Creek and Lower Slow Creek Focus Areas	39
Table 6.1	Summary Information for Potential NCEEP Stream Projects	46
Table 7.1	Potential NCEEP Preservation Sites	57

List of Figures

Figure 1.1	Location of Peachtree-Martins Creek Planning Area	2
Figure 2.1	Sub-Watersheds in the Peachtree-Martins Creek Planning Area	10
Figure 2.2	Land Use/Land Cover in the Peachtree Martins Creek Area, 2005	11
Figure 2.3	Tiers Representing Levels of Ecological Function, by Sub-Watershed	14
Figure 2.4	NC Division of Water Quality Biological Community Sampling Sites and NC Wildlife Resources Commission Survey Sites	16
Figure 2.5	Condition of Riparian Areas in Low Gradient Vs. High Gradient Zones	19
Figure 2.6	Distribution of Total Sediment Load by Source	19
Figure 2.7	Sites Monitored by NCDWQ for Fecal Coliform Bacteria in 2007	21
Figure 3.1	Expected Changes in Land Use for the Peachtree-Martins Creek Planning area, 2005-2015	26
Figure 3.2	Extent of New Development from 2005-2015, by Sub-Watershed	26
Figure 3.3	Projected Percent of Impervious Cover (2015) and Extent of Change in Impervious Cover (2005-2015)	27
Figure 3.4	Location of Harshaw Branch Drainage	29
Figure 3.5	Estimated Percent Reduction in Total Suspended Solids Loads from Management Strategies	33
Figure 3.6	Estimated Percent Reduction in Total Phosphorus Loads from Management Strategies	33
Figure 3.7	Estimated Percent Reduction in Total Nitrogen Loads from Management Strategies	34
Figure 3.8	Estimated Percent Reduction in Pollutant Loads from Multiple Management Strategies	34
Figure 5.1	Recommended Focus Areas for Management Activities	40
Figure 6.1	Location of Potential NCEEP Stream Project Sites	47
Figure 6.2	Location of Potential Stormwater Retrofit Sites on the Tri-County Community College Campus	53
Figure 7.1	Potential Preservation Tracts with at Least Fifty Acres of Forest Cover	56
Figure 7.2	Potential NCEEP Preservation Sites	58

Section 1

Introduction

This document presents the Watershed Management Plan developed for the Peachtree-Martins Creek area by the NC Ecosystem Enhancement Program (NCEEP) in conjunction with the Hiwassee River Watershed Coalition. The management plan represents Phase 3 of the Peachtree-Martins Creek Local Watershed Plan (LWP). Phase 1 produced a Preliminary Findings and Recommendations Report in early 2006. The second phase involved a detailed watershed assessment, completed in May 2007. The NC Division of Water Quality (NCDWQ), the NC Wildlife Resources Commission (NCWRC) and the Tennessee Valley Authority (TVA) also collaborated on the development of the LWP. Equinox Environmental Consultation and Design, Inc. (Equinox) served as the technical consultant for the project.

This introductory section of the document provides a brief description of the project area, an overview of the local watershed planning process, a discussion of the role of the Local Advisory Committee and an outline for the report.

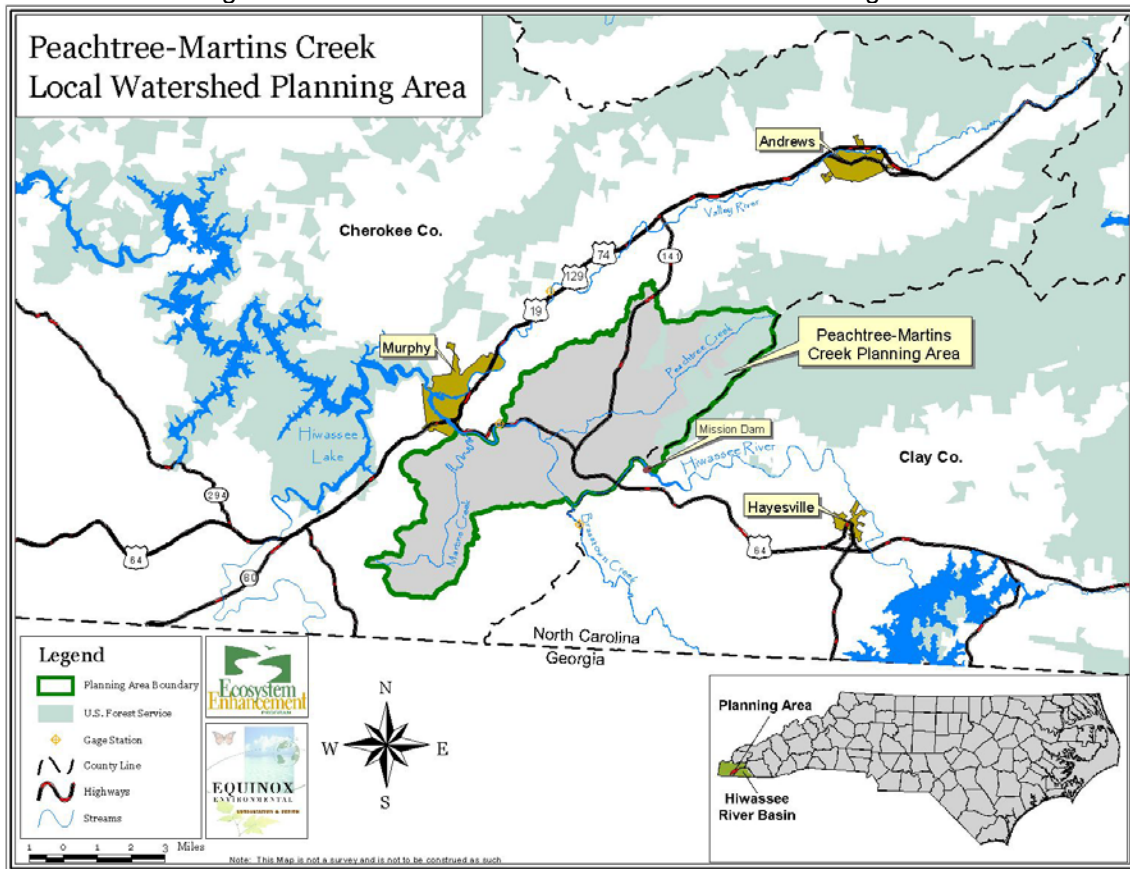
1.1 Planning Area Description

The area covered by this Watershed Management Plan is located primarily in Cherokee County. The 39.3 square mile planning area (Figure 1) includes the Hiwassee River and its tributaries from Mission Dam, outside of Brasstown, downstream to Murphy, with the exclusion of Brasstown Creek. This includes Peachtree Creek, Martins Creek and a number of neighboring streams. The Peachtree-Martins Creek planning area is located in Cataloging Unit 06020002 of the Hiwassee River basin, and consists of four 14 digit hydrologic units (090020, 170010, 100040 and 100050) and a portion of a fifth hydrologic unit (071010).

1.2 Planning Approach

Local watershed planning is a comprehensive effort initiated by the NCEEP to assess watershed condition, identify natural assets, determine deficiencies in current and future watershed functions and recommend appropriate management action for the areas selected. Local watershed plans are intended to address both ecological and community needs. They identify potential stream and wetland restoration projects to help meet the compensatory mitigation needs of the NC Department of Transportation (NCDOT) and other developers, as well as identify other ecosystem improvement and protection opportunities. These may include activities such as water supply protection strategies, land use planning, agricultural best management practices (BMPs) or BMPs for reducing urban nonpoint source pollution and controlling stormwater runoff.

Figure 1.1 Location of Peachtree-Martins Creek Planning Area



NCEEP is undertaking this planning effort in collaboration with the Hiwassee River Watershed Coalition (HRWC), a non-profit organization working since 1995 to facilitate water quality improvements in the Georgia and North Carolina portion of the Hiwassee River basin. In addition to serving the needs of the NCEEP, the Peachtree-Martins Creek planning effort is also intended to provide the HRWC with additional technical information to support its watershed protection and improvement efforts.

Phase 1 of the LWP process produced a Preliminary Findings and Recommendations report, referred to in this document as the Phase 1 report (Equinox, 2006). Phase 2 resulted in a Watershed Assessment Report (Phase 2 report) which provided a more detailed appraisal of ecological conditions and additional information on causes and sources of degradation (Equinox 2007).

The goal of this Watershed Management Plan is to serve as a framework for watershed restoration and protection activities undertaken in the Peachtree-Martins Creek area by NCEEP, HRWC and other parties. The recommendations presented here are intended to address all major issues identified in the Watershed Assessment Report.

1.3 Stakeholder Involvement

1.3.1 Introduction

Since the project's initial assessment phase began in summer 2005, local involvement in the development of the Peachtree-Martins Creek Watershed Plan has been high. The HRWC was hired to facilitate public input throughout the multi-year life of the project. HRWC's awareness of key water quality issues and established relationships with local government and agency personnel greatly assisted the planning team in developing a locally-relevant plan that not only meets NCEEP's goals for the project but is also useful to other watershed stakeholders.

1.3.2 Local Advisory Committee

One major way that local public input was obtained throughout the planning process was through a Local Advisory Committee (LAC). The purpose of the LAC was to:

- Provide a local perspective (a majority of LAC members live within the county);
- Prioritize issues to be addressed during the watershed assessment and within the final planning document;
- Recommend management strategies associated with plan implementation;
- Help prioritize areas for implementation; and
- Serve as a liaison between NCEEP and the larger local community.

LAC members and the agencies represented are as follows:

Representative

David Badger, County Manager
Glenn Carson, District Conservationist
Steve Fraley, Aquatic Non-game Coordinator
Scott Lea, Chickamauga-Hiwassee Team
Callie Moore, Executive Director
Michael Stiles, Ag Cost Share Technician
Keith Wood, Agricultural Extension Agent

Agency/Organization

Cherokee County
Natural Resources Conservation Service
NC Wildlife Resources Commission
Tennessee Valley Authority
Hiwassee River Watershed Coalition
Cherokee Co. Soil & Water Conservation District
NC Cooperative Extension, Cherokee County Center

Ten meetings of the Local Advisory Committee were held over the 2-year period between the beginning of the initial watershed characterization in August 2005 and the finalization of the watershed plan in October 2007. Members received presentations of data, assessment findings and recommendations, as well as drafts of the Preliminary Findings and Recommendations Report, the Watershed Assessment Report and the Watershed Management Plan. In turn, the planning team received input related to further data collection and assessment, local issues to be addressed, comments on documents, and recommended management strategies for implementation.

The LAC provided a significant amount of input into initial issues of concern within the planning area, the location and amount of estimated future development, the scenarios that were modeled by Equinox, preservation priorities and recommended institutional management strategies. During the initial phase of planning, the LAC was asked to discuss major issues of concern within the planning area. The highest priorities of the LAC were to:

- Obtain as much data as possible (very little data existed in the planning area prior to the assessment);
- Identify and investigate problems that might pose a public health risk (e.g. straight-piping and malfunctioning septic systems);
- Characterize impacts associated with development; and
- Follow up on concerns related to sedimentation from a rock quarry.

During Phase 2 of planning, the LAC discussed residential and commercial development that was planned or likely within various sub-watersheds and prepared modeling scenarios to describe impacts from the future development. The group decided to request 5- and 10-year scenarios due to the general feeling that the market will start to seriously slow down at 15-20 years out and that management strategies need to be implemented on a fairly short turnaround time to prevent water quality impacts.

The following input related to future land use changes was given:

- Look at both residential and commercial development;
- Currently, road networks and utilities often go in several years before actual houses are built;
- Development consists largely of single family residences at present, but some multi-family developments are starting to go in outside the planning area;
- Trends in agriculture are toward “mini-farms” (primarily horses), although beef cattle farming is still an active land use within the planning area;
- People are generally not allowing enough land for proper grazing of horses.



The LAC worked around a large map showing parcel boundaries, and large tracts likely to be developed within either 5 or 10 years were identified. The development was described as residential and/or commercial as was applicable. In a follow-up meeting, the situation was reversed and LAC members advised the planning team related to areas that might be good candidates for preservation.



LAC members then developed scenarios to be modeled within the planning area. The team came up with six different management/policy ideas; each had 2-3 scenarios. Not all of the modeling scenarios were feasible and some tested the creative abilities of Equinox to implement; however, the discussion was very valuable leading into decision-making related to future management strategies.

The management scenarios proposed by the LAC are as follows:

I. Vegetative Clearing

S1 (current): assume that 75% of woody vegetation is removed from forested tracts during development;

S2: ordinance that only allows 50% of woody vegetation to be removed from forested tracts during development;

S3: ordinance that only allows 30% of woody vegetation to be removed from forested tracts during development.

II. Minimum Lot Sizes

S1 (current): assume ½-acre lots are developed in areas with sewer lines (shown on map) and ¾-acre lots in all other areas;

S2: 1-acre minimum lot size in areas not served by sewer system; ½-acre minimum in areas with sewer lines;

S3: extend sewer lines out as shown on map and reapply S2 minimum lot size criteria.

III. High Elevation Development

S1 (current): no restriction on development of ridgetops or high elevation tracts;

S2: assume restrictions on development above 2,000 feet in elevation.

IV. Stormwater Management

S1 (current): no post-construction stormwater BMPs;

S2: development of more than 10,000 square feet of impervious area on a tract designed to 10% Effective Impervious Area;

S3: development of more than 5,000 square feet of impervious area on a tract designed to 10% Effective Impervious Area.

V. Erosion & Sedimentation (E&S) Control

S1 (current): ≥1-acre requires E&S plans; very little enforcement of BMPs;

S2: ≥1-acre requires E&S plans, but local control (increased enforcement);

S3: ≥½-acre requires E&S plans; local control (more enforcement due to more sites covered under the ordinance).

VI. Road Design

S1 (current): no road requirements (assume quite a bit of erosion/washout);

S2: reduce erosion through better road layout and design.

The LAC also discussed at-length the feasibility of implementing ordinances and/or incentive programs to achieve various water quality protections. The following institutional measures were recommended:

- Establish a local sediment & erosion control program;
- Review and consider expansion of the existing water supply and floodplain ordinances;
- Evaluate County properties for potential to treat/retain stormwater; implement stormwater BMPs as County properties are newly developed;
- Develop and adopt a subdivision ordinance that encourages Low Impact Development and other measures that minimize water quality impacts from development;
- Develop a robust water quality/watershed public education program;
- Plan for future wastewater treatment needs (both on-site and sewer);

- Consider adoption of a “Mountain Protection” type of ordinance that limits vegetative clearing in headwaters or higher elevations;
- Develop a steep slope ordinance;
- Develop and implement a stormwater management plan; and
- Consider developing a County-wide comprehensive land-use plan.

1.3.3 Public Meetings

In addition to input from the LAC, HRWC held a public meeting during the initial watershed characterization in October 2005. The purpose of the meeting was to make the public aware of the project and to gather input from citizens within the planning area. A survey was developed to help facilitate this process. The survey was available for download from the HRWC website after the meeting and throughout the assessment phase of the project.

The survey asked the following six questions of watershed residents:

1. What do you like about living here?
2. What do you think our communities will look like in 10 years?
3. Do you think these are positive or negative changes? Why?
4. How would you like the future picture to be different?
5. Are there places within the focus area where you are concerned about water pollution?
6. How has fishing changed (improved or declined) in the Hiwassee River?

Although limited response to the survey was received, respondents liked the natural beauty of the area and were very concerned about rapid residential and commercial development that they observed in Cherokee County. Concerns were both about quality of life and safety, as well as water quality.

A second public meeting is planned for October 2007 to present this document to the public. Additional presentations to local organizations are also planned. HRWC will continue to host a web page for the Peachtree-Martins Creek Local Watershed Plan throughout NCEEP’s Implementation Phase: <http://www.hrwc.net/peachtreemartinslwp.htm>.

1.4 Organization of Report

The remainder of this report is organized as follows:

- Section 2 consists of a summary of current watershed condition and major stressors as documented in the Phase 2 report.
- Section 3 analyzes future threats to watershed function from development activities and includes estimates of future development growth and the potential environmental impacts of that growth.
- Section 4 presents an overview of the management strategies presented in the plan.
- Focus areas for management activities are discussed in Section 5.
- Detailed recommendations are presented in Sections 6 through 8, with Section 6 discussing recommendations for addressing existing impacts, Section 7 discussing preservation strategies, and Section 8 addressing institutional strategies to prevent future degradation.

The *Project Atlas*, a companion document to this management plan, describes the selection of potential NCEEP restoration and preservation projects and provides detailed information on these sites.

Section 2

Current Watershed Conditions and Major Stressors

This section discusses the major features of the planning area, current watershed condition and major stressors, summarizing the findings of the Phase 2 report (Equinox, 2007).

2.1 Data Sources

The Phase 2 report drew upon three primary data sources:

- Water quality monitoring conducted by NCDWQ, including fish community monitoring (4 sites), benthic community monitoring (23 sites), chemical monitoring (33 sites) and toxicity monitoring (6 sites).
- An Integrated Pollutant Source Identification (IPSI) analysis conducted by TVA. The IPSI included the development of a geographic database (including land cover, assessment of riparian vegetation, identification of channelized streams and other features) and the development of a pollutant loading model for the planning area.
- A field assessment of stream habitat and physical condition at 62 sites, coordinated by Equinox and conducted jointly by Equinox and NCDWQ staff. Field activities included habitat assessment, substrate evaluation (pebble counts and embeddedness), bank erosion assessments and other data collection.

A number of secondary data sources were also used, including: field observations made by Equinox and NCDWQ staff during windshield surveys and watershed reconnaissance; investigations by NCDWQ into specific water quality problems; and a survey of crayfish and mussel taxa conducted by the NCWRC in August 2006.

2.2 Planning Area Characteristics

2.2.1 Overview

The 39.3 square mile project area is located primarily in eastern Cherokee County, with approximately 181 acres, or less than 0.3 square miles, located in Clay County. About 29 acres of the project area lie within the town limits of Murphy, which is located just outside the western boundary of the area. Peachtree Creek and Martins Creek are the largest streams in the area, draining 18.4 and 9.3 square miles, respectively. Several dozen smaller creeks, generally draining 2 square miles or less, are also included, among them Hampton Creek, Fall Branch, McComb Branch, Mission Branch and Calhoun Branch. The area also includes approximately 9 miles of the Hiwassee River between Mission Dam and the mouth of Martins Creek.

The area is largely rural, containing substantial forested areas as well as significant agricultural activity. The estimated population of the area was approximately 3500 in 2000. Commercial and institutional activity is concentrated along US 64 and in the Peachtree area.

The area has become increasingly attractive for second home development in recent years, due to proximity to the Atlanta area and other factors. In Cherokee County as a whole, the number of building permits issued for single family residential units almost doubled between 2000 and 2005 (Equinox, 2006).

The State of North Carolina classifies all waters within the project area as class C, except for the mainstem of the Hiwassee River and selected Hiwassee River tributaries above McComb Branch, all of which are classified for water supply. NCDWQ considers all of the monitored waters in the project area to be meeting their designated uses except for Martins Creek. Martins Creek is considered to be impaired for its entire length because of failure to meet aquatic life criteria.

2.2.2 Sub-Watersheds and Topographic Zones

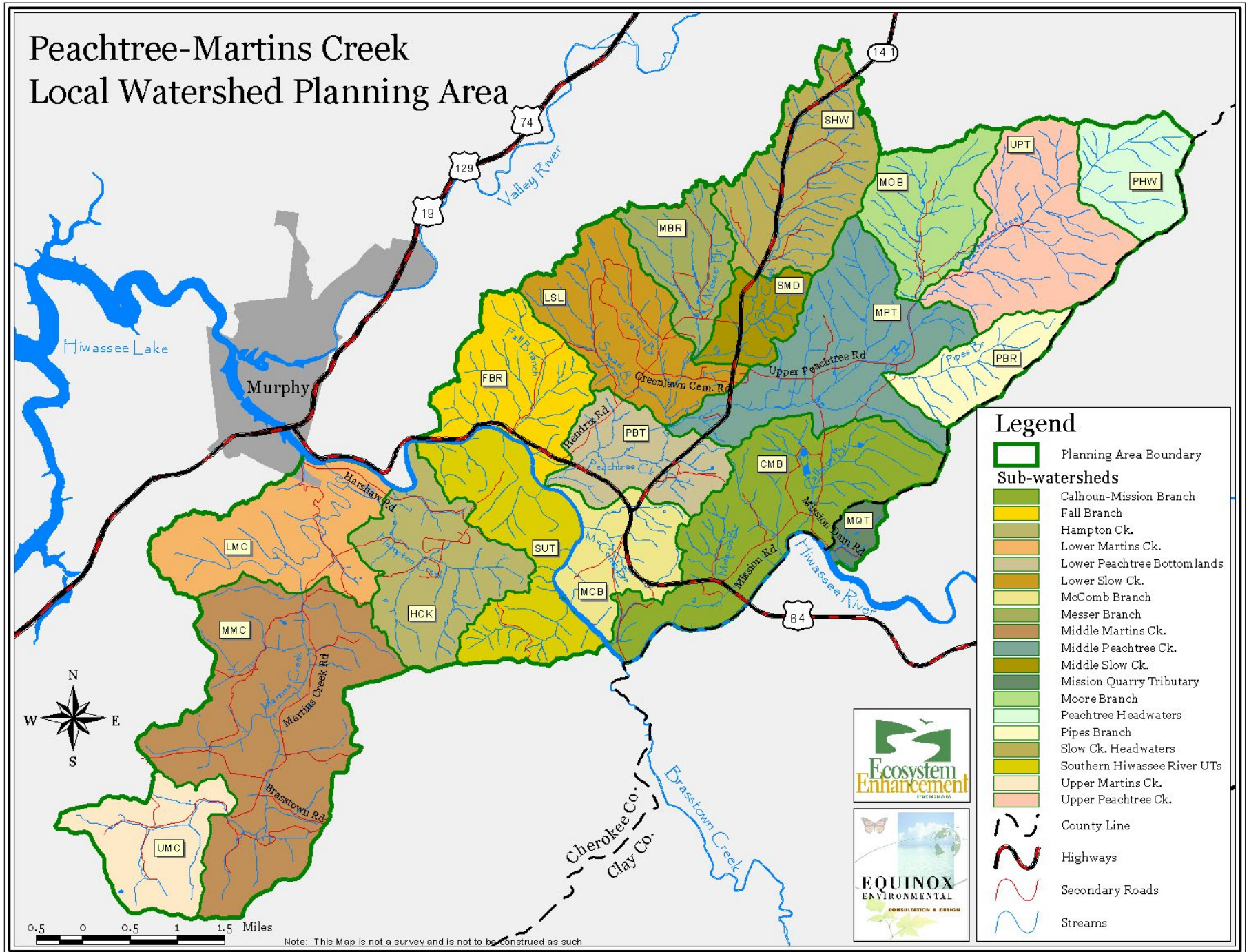
The three major drainages in the planning area (Peachtree Creek, Martins Creek and a group of several smaller Hiwassee River tributaries) were divided into 19 sub-watersheds for purposes of this local watershed plan (Table 2.1 and Figure 2.1).

Additionally, two topographic zones were delineated as an overlay on the sub-watersheds--a low gradient zone (slopes of 10% or less), which has historically been subject to extensive modification due to human activity, and a high gradient zone (slopes exceeding 10%), which has generally been less intensively modified (for a map of these zones see Figure A1 in Appendix A).

Table 2.1 Sub-Watersheds in the Peachtree-Martins Creek Planning Area

<i>ID</i>	<i>Sub-Watershed Name</i>	<i>Area (sq. miles)</i>	<i>ID</i>	<i>Sub-Watershed Name</i>	<i>Area (sq. miles)</i>
<i>Peachtree Creek Drainage</i>			<i>Martins Creek Drainage</i>		
PHW	Peachtree Ck. Headwaters	1.22	UMC	Upper Martins Creek	1.60
UPT	Upper Peachtree Ck.	2.68	MMC	Middle Martins Creek	5.27
MOB	Moore Branch	1.65	LMC	Lower Martins Creek	2.41
PBR	Pipes Branch	1.09	<i>Other Hiwassee River Tributaries</i>		
MPT	Middle Peachtree Ck.	3.23	MQT	Mission Quarry tributary	0.29
SHW	Slow Creek Headwaters	2.48	CMB	Calhoun -Mission Br	3.50
SMD	Mid Slow Creek	0.80	MCB	McComb Branch	1.37
MBR	Messer Branch	1.22	FBR	Fall Branch	1.98
LSL	Lower Slow Creek	2.36	SUT	Southern un-named Hiwassee tributaries	2.30
PBT	Lower Peachtree Bottomlands	1.51	HCK	Hampton Creek	2.32
Total Planning Area 39.27 Square Miles					

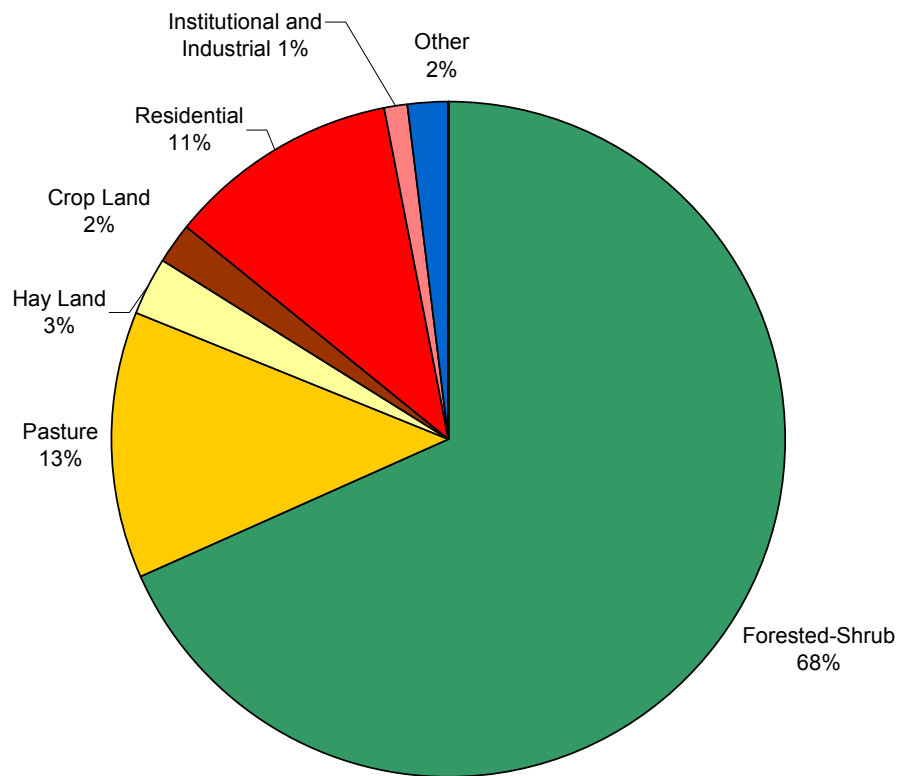
Figure 2.1 Sub-Watersheds in the Peachtree-Martins Creek Planning Area



2.2.3 Land Use and Impervious Cover

Over two-thirds of the planning area is forested, while 18% is in agricultural use, predominately pasture (Figure 2.2). Twelve percent of the area is developed, the vast majority of this being low density residential land (< 2 dwellings per acre). Land cover differences between the low gradient and high gradient topographic zones are substantial, indicating the differences in historic patterns of human activity in these areas. The high gradient zone is largely forested (81%) with limited development (11%) and agricultural activity (7%). Conversely, almost 60% of the low gradient zone is used for agriculture, while about 23% is developed. Forest comprises only 16% of the low gradient zone.

Figure 2.2 Land Use/Land Cover in the Peachtree Martins Creek Area, 2005 (IPSI Database, TVA)



Impervious areas, such as rooftops, roads, and parking lots, prevent infiltration of precipitation into the soil. Their extent in a watershed is an important measure of the hydrologic and biological impact of development. Research indicates that stream ecosystems begin to show evidence of degradation when the total impervious cover reaches approximately 10 percent. Ecological effects can generally be expected to become severe when total impervious area reaches about 25 percent (Booth and Jackson, 1994; Schueler, 1994; Arnold and Gibbons, 1996, Center for Watershed Protection, 2003).

Total impervious cover in the study area was estimated to be approximately 4% in March 2005, with 15 of the 19 sub-watersheds having less than 5% impervious cover and only the McComb

Branch sub-watershed (11% impervious cover) exceeding 10% (for map see Figure A2 in Appendix A). As of 2005 impervious cover in most sub-watersheds was below levels where substantial and widespread hydrologic impacts are likely.

2.3 Watershed Functional Condition

An analysis of ecological condition at the sub-watershed scale was conducted using a suite of 14 indicators in three broad functional areas. Sub-watersheds were rated as Excellent (score = 4), Good (score =3), Moderately Impacted (score =2) or Poor (score =1) on each of the following:

- **Hydrology Indicators** - forest area extent, impervious cover, extent of stream channelization and streambank stability;
- **Habitat/Biological Community Indicators** - overall aquatic habitat quality, benthic macroinvertebrate community integrity, microhabitat diversity and abundance, riffle embeddedness and pool frequency/variety;
- **Water Quality Indicators** - specific conductance, riparian area condition, total suspended solids load, benthic macroinvertebrate community integrity and nitrogen concentration.

Scores for each of the three functional areas are summarized in Table 2.2. Based on the overall patterns of function, sub-watersheds were arranged into five tiers (Table 2.3 and Figure 2.3). Overall ecological condition is best (*very high function and high function tiers*) in the portion of the Peachtree drainage upstream of the Slow Creek confluence. Seven sub-watersheds exhibit a *moderate level of ecological function*. These areas exhibit many characteristics of good ecological function but have sufficient impacts to be considered at risk of becoming functionally compromised if additional deterioration occurs. Seven other sub-watersheds are considered to exhibit a *low level of ecological function*. These sub-watersheds are significantly degraded, although they retain some indication of adequate ecological function. Severe sub-watershed degradation (*very low function*) is limited to the Mission Quarry area. While many individual sites are severely impacted, at the sub-watershed level these impacts are mitigated to varying degrees by the areas that remain undisturbed or well-managed.

Functional condition is notably more degraded in the low gradient topographic zone than in steeper terrain. Land in this zone is less likely to be forested, with much more intensive residential and agricultural activity. Riparian zones were in poorer condition and channel modification more widespread. The high gradient zone received ratings of Good on virtually all indicators, while ratings as high as Good were unusual for the low gradient zone.

Table 2.2 Summary of Sub-Watershed Functional Ratings

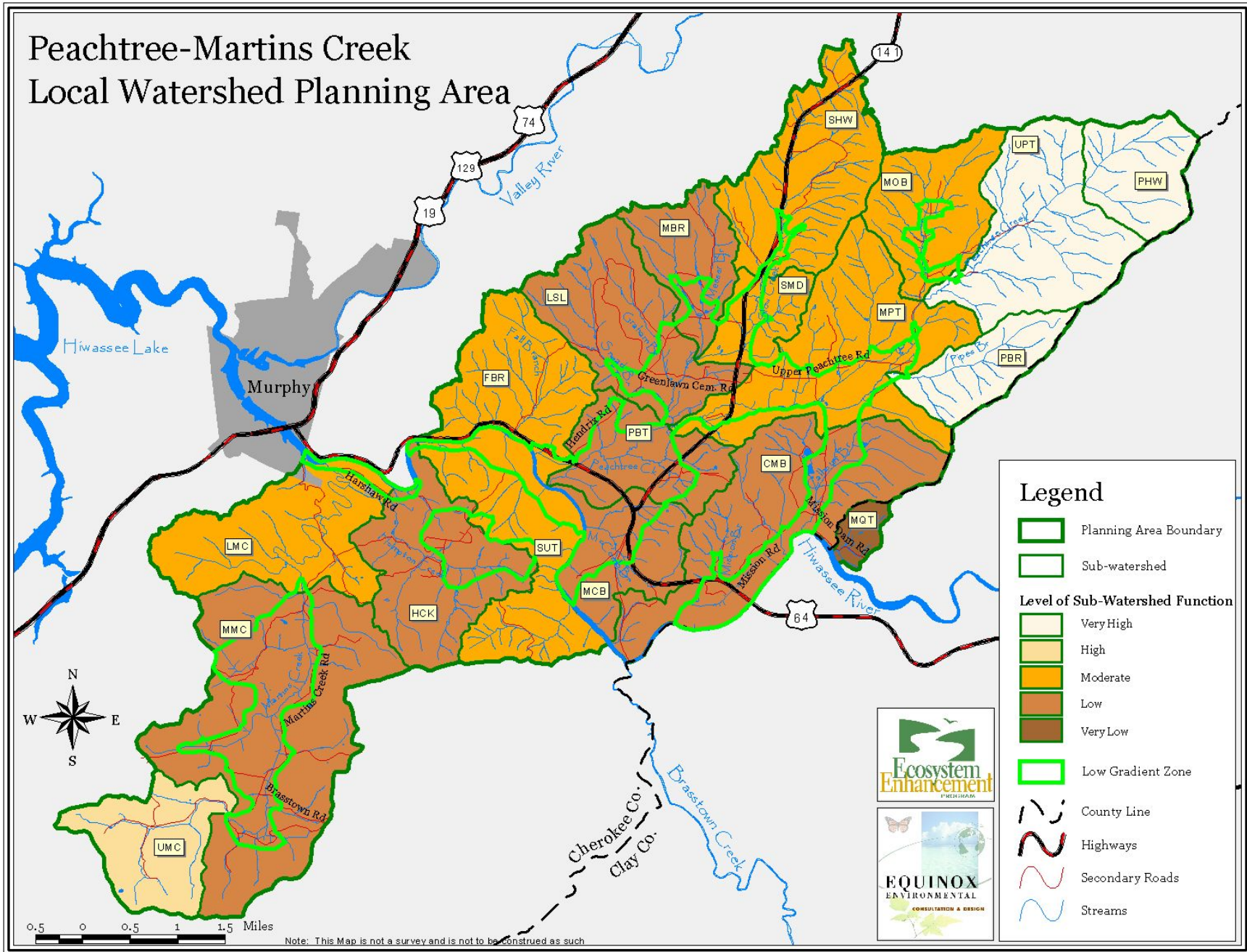
Sub-Watershed		Hydrologic Function	Habitat-Biological Community Function	Water Quality Function	Overall Function Score
Peachtree Creek Drainage					
PHW	Peachtree Ck. Headwaters	4.00	4.00	4.00	4.00
UPT	Upper Peachtree Ck.	3.75	3.40	4.00	3.72
MOB	Moore Branch	3.25	2.00	3.00	2.75
PBR	Pipes Branch	4.00	3.40	4.00	3.80
MPT	Middle Peachtree Ck.	2.75	3.20	2.80	2.92
SHW	Slow Creek Headwaters	3.00	3.00	2.75	2.92
SMD	Mid Slow Creek	3.00	3.00	2.33	2.78
MBR	Messer Branch	2.50	1.80	2.25	2.18
LSL	Lower Slow Creek	2.25	2.60	2.20	2.35
PBT	Lower Peachtree Bottomlands	2.25	2.80	2.00	2.35
Martins Creek Drainage					
UMC	Upper Martins Creek	3.50	3.20	3.00	3.23
MMC	Middle Martins Creek	2.25	2.00	2.60	2.28
LMC	Lower Martins Creek	3.50	2.20	2.40	2.70
Other Tributaries					
MQT	Mission Quarry Tributary	2.25	1.20	1.00	1.48
CMB	Calhoun -Mission Branch	2.50	2.00	2.60	2.37
MCB	McComb Branch	2.50	2.40	1.40	2.10
FBR	Fall Branch	3.00	2.60	3.20	2.93
SUT	Southern Un-named Hiwassee Trib.	3.25	2.25	2.67	2.72
HCK	Hampton Creek	2.50	2.00	2.20	2.23

Scoring: Excellent = 4, Good = 3, Moderately Impacted = 2, Poor = 1. Overall function score is the average of the three component scores.

Table 2.3 Sub-Watershed Functional Condition in the Peachtree-Martins Creek Planning Area

Functional Condition Tier		Sub-Watershed	% of Planning Area
1	Very High	Peachtree Creek Headwaters Upper Peachtree Creek Pipes Branch	13%
2	High	Upper Martins Creek	4%
3	Moderate	Fall Branch Middle Peachtree Creek Slow Creek Headwaters Mid Slow Creek Moore Branch Southern Un-named Hiwassee Tributaries Lower Martins Creek	38%
4	Low	Calhoun -Mission Branch Lower Slow Creek Lower Peachtree Bottomlands Middle Martins Creek Hampton Creek Messer Branch McComb Branch	45%
5	Very Low	Mission Quarry Tributary	< 1%

Figure 2.3 Tiers Representing Levels of Ecological Function, by Sub-Watershed



2.4 Major Issues and Impacts

2.4.1 Aquatic Communities and Habitat

NCDWQ sampled benthic macroinvertebrate communities at 23 sites in 2000 (see Figure 2.4 for a map of site locations, and Table A1 in Appendix A for list of sites and a summary of monitoring results). Streams in the planning area represented a wide range of conditions, from relatively pristine headwater creeks with diverse and pollution-intolerant benthic communities, to highly impacted streams with a limited capacity to support aquatic life. No sites were rated Fair or Poor by NCDWQ (ratings which would be indicative of impairment), though some streams that were too small to receive a formal rating were highly degraded. While high quality aquatic habitat remains within the headwater areas of Peachtree Creek, varying degrees of degradation are evident in most other areas and the overall picture is indicative of a system that has been subjected to a variety of impacts. Streams with the most significant deterioration in the benthic community were the following (site numbers refer to Figure 2.4):

- *Site 3 - George Creek at SR 1576/Crisp Rd (MMC sub-watershed)*. NCDWQ data indicate that both nutrient enrichment and degraded habitat are an issue for this tributary of Martins Creek, most likely due to upstream livestock operations.
- *Site 13 - McComb Branch at Hiwassee River confluence (MCB sub-watershed)*. The benthic macroinvertebrate community at this site was one of the most impacted of all sites sampled. Potential impacts from siltation and upstream inputs of nutrients and toxicants are a concern.
- *Site 19 - Sudderth Branch at SR 1544/Mission Rd (CMB sub-watershed)*. NCDWQ noted both habitat impacts and indicators of enrichment. It is not clear whether the impacts are due to agricultural activities or to water quality problems from rural residential areas upstream.
- *Site 23 - UT Hiwassee River at SR 1537B/below quarry (MQT sub-watershed)*. The benthic community was decimated at this site and habitat poor. Sediment inputs from Mission Quarry are a major impact on this stream. Water quality is also a concern.

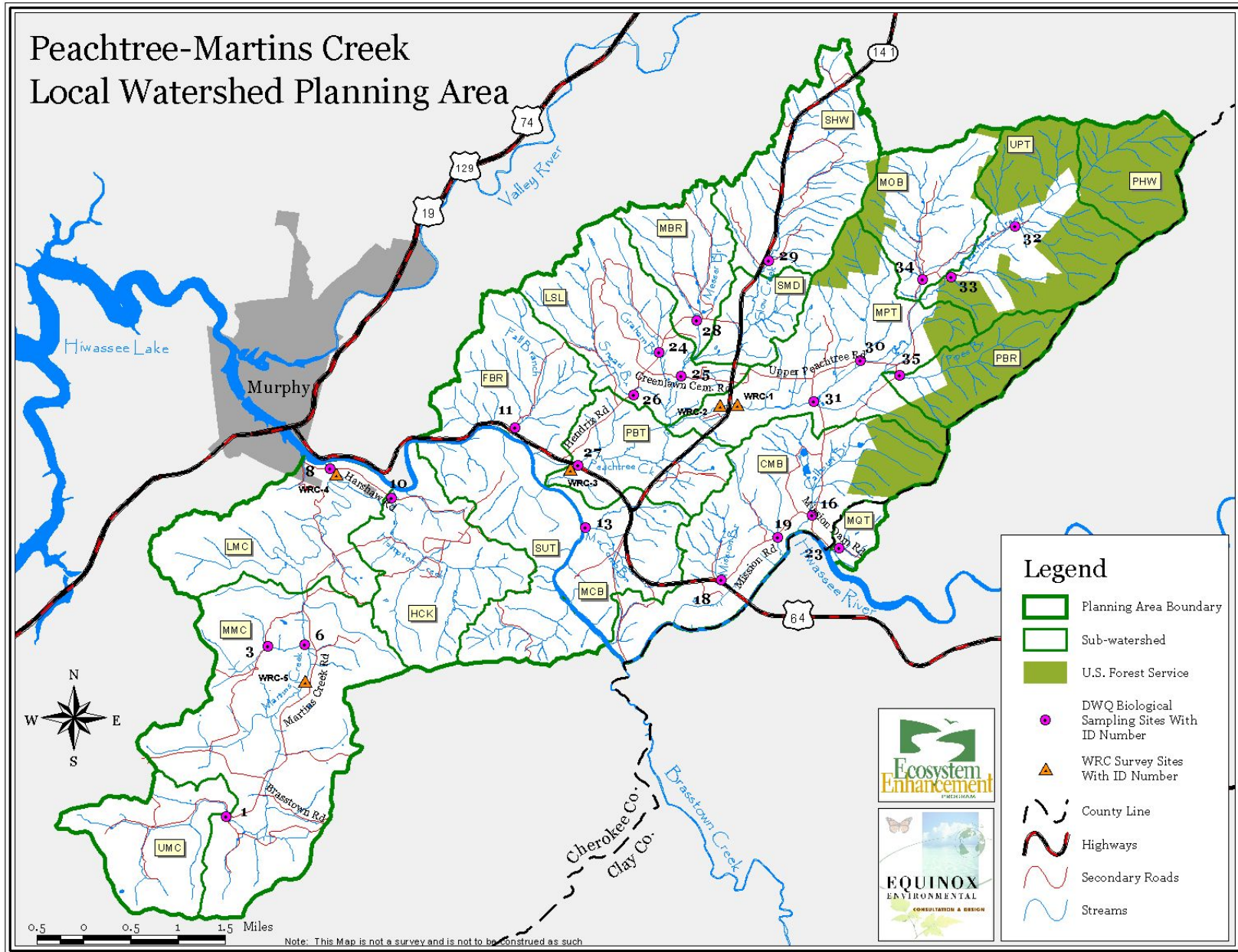
Other streams with notable benthic community deterioration include:

- *Site 6 – Martins Creek at SR 1576/Crisp Rd (MMC sub-watershed);*
- *Site 8 – Martins Creek at SR 1558/Harshaw Road (LMC sub-watershed);*
- *Site 11 - Fall Branch at US 64 (FBR sub-watershed);*
- *Site 25 – Slow Creek at SR 1670/Greenlawn Cemetery Rd (LSL sub-watershed);*
- *Site 28 – Messer Branch at SR 1531/Hendrix Rd (MBR sub-watershed); and*
- *Site 34 - Fate Puett Cove Creek (Moore Branch) at SR 1535/Upper Peachtree Rd (MOB sub-watershed).*

NCDWQ considers Martins Creek to be impaired for its entire length based on fish community data collected at Harshaw Road in 2004. The 2006 data do not appear to be consistent with the impaired designation. It is not clear whether conditions in Martins Creek have improved or whether differences between the two years merely reflect typical variability in stream conditions, with minor variations being sufficient to affect the bioclassifications.

During 2006 the NCWRC monitored mussels and crayfish at five sites in Martins and Peachtree Creeks (Figure 2.4). The mountain creekshell (*Villosa vanuxemensis*), a state-threatened mussel, was found at four of these locations.

Figure 2.4 NC Division of Water Quality Biological Community Sampling Sites and NC Wildlife Resources Commission Survey Sites*



*See Table A1 (Appendix A) for a list of biological sampling sites corresponding to the site numbers on this map.

2.4.2 Stressors and Pollution Sources

A stressor is an environmental factor - whether physical, chemical or biological - that can potentially impact watershed integrity. Stressors often interact to produce complex impacts on ecological systems. Phase 2 of the Peachtree-Martins Creek LWP identified a number of stressors that are important in the planning area. Some of these are widespread in the region. These include the lack of riparian vegetation, channel modification, sediment impacts, and nutrient and fecal coliform bacteria contamination. In addition to these widespread stressors, a number of localized concerns were identified, including stormwater impacts in the Peachtree area, groundwater contamination in the Peachtree area and impacts from Mission Quarry.

Lack of riparian vegetation

The lack of riparian vegetation is probably the most widespread stressor in the planning area (Photos 1 -3). In areas with slopes under 10%, only 10% of stream length has adequate vegetation on both banks, which is defined as a zone of woody vegetation at least 30 feet wide (Figure 2.5). Both banks have inadequate riparian vegetation about 65% of the time. The situation is not nearly as severe in higher gradient areas, where two thirds of stream banks have adequate riparian zones on both banks. See Figures A3 and A4 in Appendix A for additional information on riparian area condition.

A zone of woody vegetation along streams is critical to the maintenance of adequate shading, bank stability, the supply of woody debris and other organic material (for stream habitat and food supply for aquatic organisms), the removal of pollutants from storm runoff, and the provision of habitat for terrestrial animals.

Channel modification

Channelization from stream relocation, straightening, dredging and similar activities is also widespread (Photo 1). There are approximately 26 miles of channelized stream in the planning area (13% of total stream length). In the low gradient areas, about 36% of streams have been modified (see Figure A5 in Appendix A). Channelization commonly occurs in conjunction with other disturbances, especially the removal of riparian vegetation. While much of the channelization is historic, and some streams are recovering, channel disturbance in other areas is ongoing. Channel modification is associated with a variety of impacts on habitat and stream quality, including incision, habitat degradation, sedimentation and bank erosion.

Sediment impacts

Sediment deposition is widespread in area streams, though severity varies. Both riffles and pools are impacted by sediment deposition. IPSI estimates of total suspended solids loads indicate that sediment source areas are related to a variety of land uses and are widely dispersed (Figure 2.6). Mission Quarry is the largest single source of sediment, but developed areas, agricultural activities, road and stream erosion (Photo 2) and new construction are all important sources and contribute to the problem (see Figures A6 and A7 in Appendix A). Potential impacts from future development are also a concern, since development is likely to result in an increase in many factors related to sediment.

Photo 1. Channelized reach of Martins Creek. Note lack of woody riparian vegetation in all three photos.



Photo 2. Eroding portion of Slow Creek.

Photo 3. Small modified tributary of Slow Creek.



Figure 2.5 Condition of Riparian Areas in Low Gradient Vs. High Gradient Zones (IPSI Database, TVA)

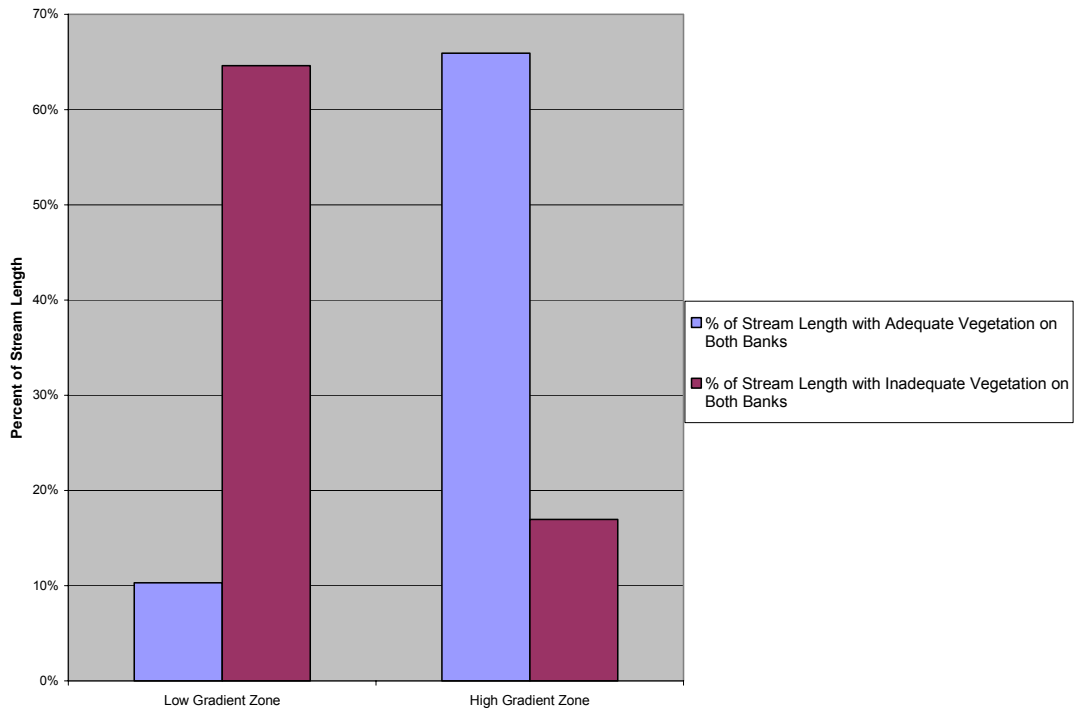
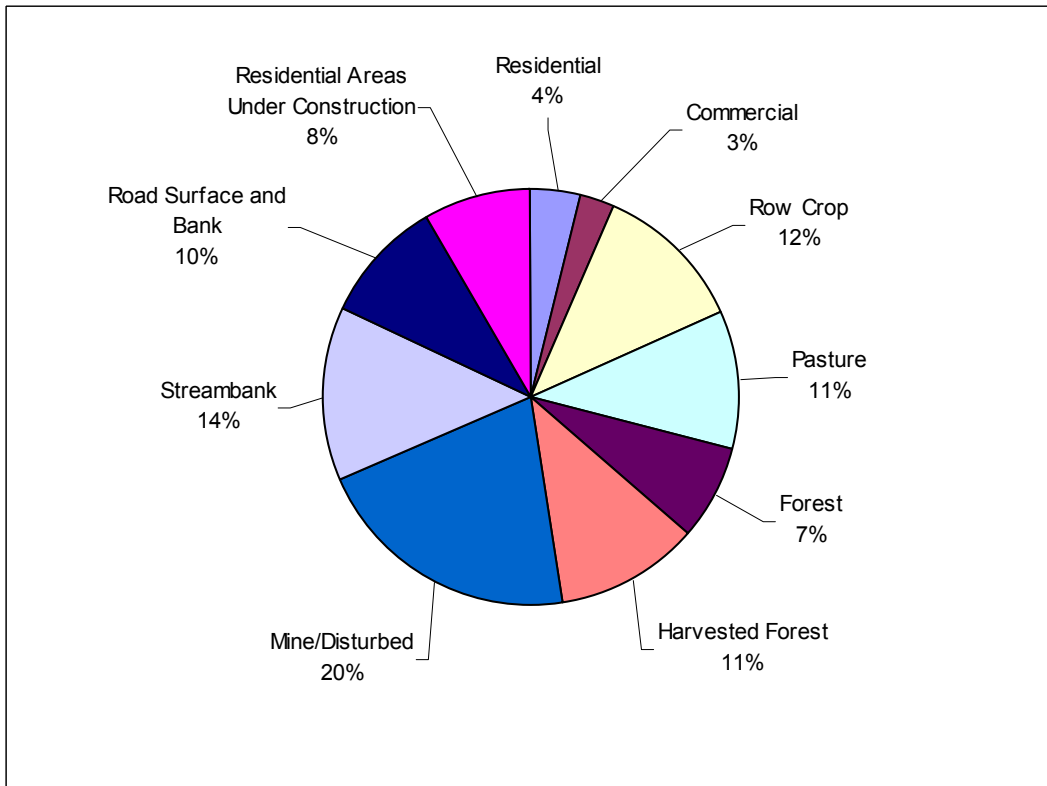


Figure 2.6 Distribution of Total Sediment Load by Source, IPSI Model Estimates (TVA)



Nutrients

Nutrients are a fairly common stressor in the planning area, though impacts are not currently severe in most places. Moderate baseflow nitrite-nitrate concentrations were found in Martins Creek, Slow Creek, Moore Branch and lower Peachtree Creek, while elevated storm concentrations were observed in McComb Branch. IPSI data on nitrogen and phosphorus loads indicate that both developed and agricultural areas are major nutrient sources.

Fecal Coliform Bacteria

Fecal coliform bacteria sampling conducted in 2005 and 2006 (Equinox, 2007) was not frequent enough to document whether state water quality standards were violated (a minimum of five samples collected within a 30-day period are required). However, those results indicated that levels were high enough to be of concern in a number of streams, especially Martins Creek and Slow Creek. More extensive sampling conducted by NCDWQ in May and June 2007 (Figure 2.7) confirmed widespread contamination in the planning area. Concentrations above the state standard of 200 col/100 ml (geometric mean) were found in Martins Creek, Slow Creek, Lamb Branch, Peachtree Creek and Mission Branch (Table 2.4). Fecal coliform bacteria levels in McComb Branch also appear to exceed the state standard, although this is based on only four samples. Livestock have extensive access to Slow Creek, Martins Creek and other streams (see Figure A8 in Appendix A), though other sources of contamination may be a factor as well. Straight-piping and septic system malfunction no doubt occur in the planning area, but data on their extent are currently unavailable.

Localized Stressors

In addition to these widespread stressors, there are several localized concerns. Widespread *stormwater impacts* appear unlikely at the present time, given the generally dispersed nature of development in the planning area and relatively low levels of impervious cover. However some impacts from the relatively dense development in the Peachtree area are likely, including at the Murphy Medical Center and Tri-County Community College. Both nutrient and toxic impacts are a concern in McComb Branch and its tributaries, which drain much of this area. Impacts are likely to increase in the future as additional development occurs in the US 64-NC141 vicinity and elsewhere in the planning area.

An investigation of the source of degraded conditions in a small tributary entering the Hiwassee River just below Mission Dam indicated that *Mission Quarry* is the primary source of the problem. NCDWQ identified the quarry, which operates under a state stormwater permit, as the major source of sediment to this creek. Enforcement actions by NCDWQ are underway. The reason for elevated conductivity in the stream remains unclear, but both process water and untreated storm runoff from the quarry are likely possibilities.

Groundwater contamination by trichloroethylene (TCE) exists at two sites in the Peachtree area—the Clifton Precision Products/Moog Components facility and Tri-County Community College. Remediation is ongoing at these locations. The potential for human health impacts via drinking water may be limited, as few residences in the area of contamination are believed to be using well water. Impacts on aquatic life in adjacent streams also appear unlikely. The Superfund Section of the NC Division of Waste Management intends to conduct follow-up monitoring in private wells in the Peachtree area during 2007.

Figure 2.7 Sites Monitored by NCDWQ for Fecal Coliform Bacteria in 2007

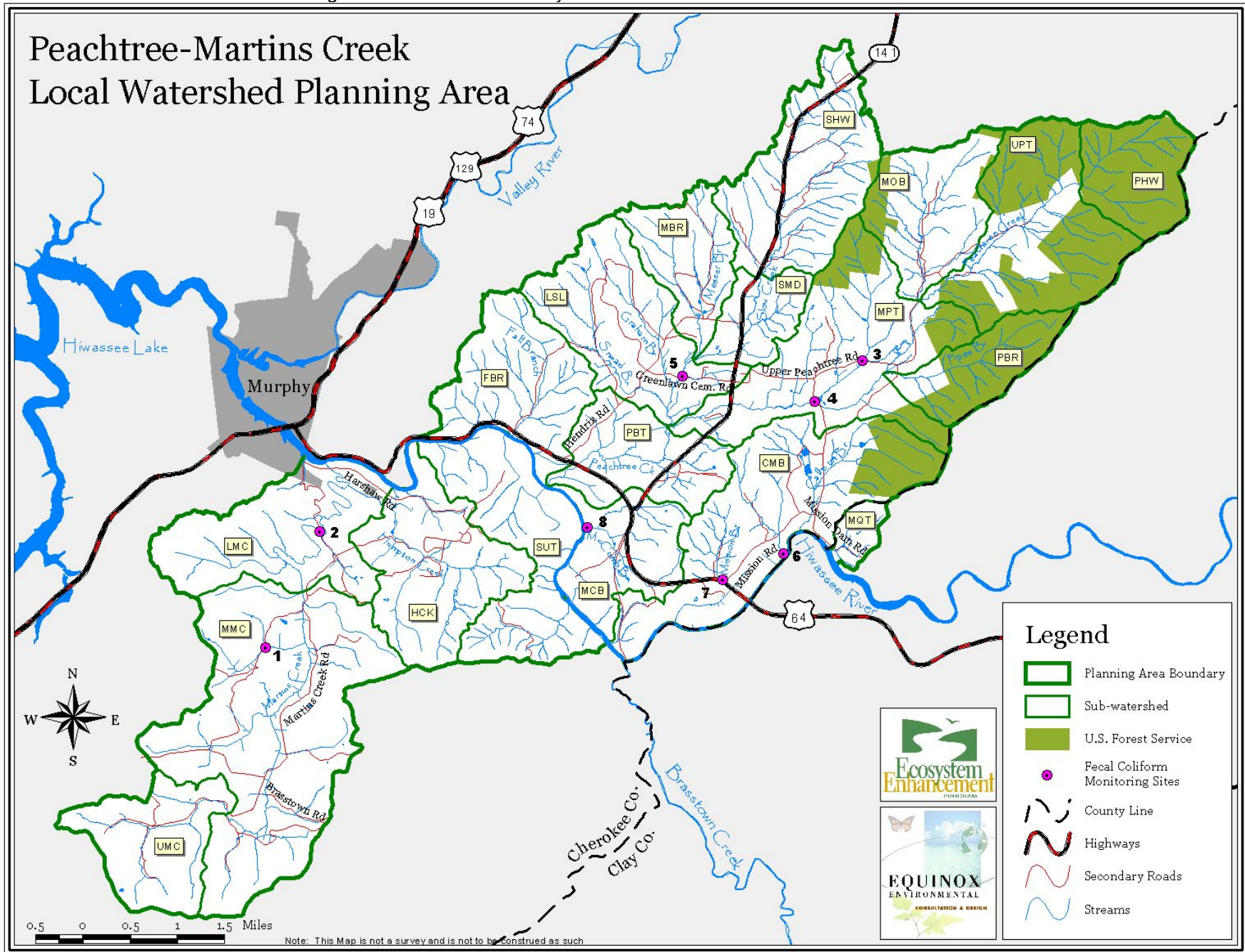


Table 2.4 Summary of Fecal Coliform Bacteria Data Collected in 2007

Site ID*	Stream	Site Location	No. of Samples	Geometric Mean (col/100ml)**
1	George Creek	Above Crisp Road (SR 1576)	5	140
2	Martins Creek	Martins Creek Road (SR 1556)	5	550
3	Lamb Branch	Upper Peachtree Road (SR 1535)	5	1540
4	Peachtree Creek	Mission Road (SR 1537)	5	520
5	Slow Creek	Greenlawn Cemetery Road (SR 1670)	5	1043
6	Sudderth Branch	Below Mission Road (SR 1544)	4	122
7	Mission Branch	Myers Branch Road (SR 1545)	5	631
8	McComb Branch	Hiwassee River confluence	4	518

Source: NCDWQ

*See Figure 2.7.

**Cells shaded in yellow indicate violations of the NC standard for fecal coliform bacteria (geometric mean of 200 col/100ml). While McComb Branch also exceeds this level, a minimum of five samples within a 30 day period are required to determine if water quality standards are met.

Section 3

Future Threats to Watershed Function

While the causes of existing degradation in the planning area are diverse, the primary threat for future degradation is likely to come from activities associated with residential and commercial development. Significant increases in agriculture, forestry, mining and other activities are not likely in the Peachtree-Martins Creek area, and some of these may decline in the near future. New development has been substantial in recent years, a trend that is expected to continue.

This plan analyzed the extent of new development anticipated in the near future, as well as the increases in impervious cover and pollutant loads likely to result from this activity. The potential of several local policy measures to mitigate pollution load increases was also investigated.

This analysis found that:

- Substantial new development is likely to occur in the Peachtree-Martins Creek area between 2005 and 2015. The extent of land in residential use is anticipated to increase by over 40% over this period, while commercial areas are expected to increase by 77%.
- As a result, impervious cover in the planning area as a whole will increase from 3.9% to 5.5%.
- More substantial changes in impervious cover will occur in those sub-watersheds in which much of the new development is concentrated. By 2015 imperviousness in McComb Branch and Lower Peachtree will reach 17% and 13% respectively, while impervious cover in the Southern Hiwassee Tributary area will increase from 3% to 9% over the 10 year period.
- Still larger increases in imperviousness are likely for small streams experiencing development in a large portion of their drainage (e.g. Harshaw Branch, where impervious cover in the catchment may increase from 2% to 27%). Severe impacts are likely in these locations without a concerted effort to mitigate the effects of development by means of stormwater control and other measures.
- Estimates from the IPSI model indicate that between 2005 and 2015, total suspended solids (TSS) loads from residential and commercial areas can be expected to increase by 44% and 77% respectively, while TSS loads from construction activity will increase by approximately 55%. Similar increases are estimated for nitrogen and phosphorus.
- A considerable portion of these pollution increases can be avoided by the implementation of a variety of local policies, most notably post-construction stormwater control, vegetative clearing limits and enhanced erosion and sediment control during construction.

These findings are discussed further in this section. Recommended policies to address development impacts are discussed in Section 8.

3.1 Background on Development Impacts

The development of land alters environmental factors which impact water quality and other elements of ecological function in a variety of ways. As is the case with agriculture and forestry, these impacts can be significantly mitigated if appropriate management steps are taken.

Land disturbance associated with the construction phase of development - including land clearing, grading, road construction and excavation for home sites - removes vegetation and greatly increases the potential for erosion. Though generally short lived, construction can generate large amounts of sediment unless proper control techniques are used.

New development also has important long term impacts. First, vegetated areas are replaced with impervious cover. This alters watershed and stream hydrology by increasing the volume of surface runoff, as well as the velocity and peak discharge of streams. Common effects of this include accelerated stream bed and bank erosion, habitat degradation and downstream flooding. Secondly, ongoing activities associated with developed areas - from lawn fertilization to septic systems to automobile traffic - generate many pollutants that can harm aquatic life and pose human health threats. Thirdly, the drainage network constructed to allow runoff to flow from developed areas, including both open channels and storm sewers, worsens both of the above by routing runoff more quickly to streams and serving as an efficient delivery mechanism for pollutants.

3.2 Approach

Future land use was estimated for two time periods: a 5 year period extending from the month the IPSI aerial photography was flown (March 2005), and a 10 year period extending from the same month. These scenarios thus represent anticipated land use conditions in March 2010 and March 2015 and are termed the 2010 and 2015 base scenarios. Pollutant loads for each of these scenarios were estimated using the IPSI nonpoint source model (TVA, 2006). Initial modeling assumed that development would occur under current regulatory requirements. Pollutant loading was then modeled assuming the implementation of various management measures intended to mitigate potential development impacts. For these scenarios it was assumed that measures were implemented in March 2005.

Equinox worked with the Hiwassee River Watershed Coalition (HWRC) and the Local Advisory Committee (LAC) to quantify the extent and location of expected development and to develop land use scenarios for the IPSI model based upon these expectations. Equinox also worked with the HWRC and LAC to identify several strategies for mitigating potential development impacts that could be examined using the IPSI model. Details of the methods used are discussed in Appendix B.

Modeling of the pollutant loads associated with land use changes and potential management actions is intended to represent anticipated loads as closely as possible given the tools and data available. Load estimation is subject to a number of constraints however. As a spreadsheet-based screening level tool, the IPSI nonpoint source model makes many simplifying assumptions about the complex processes by which pollutant loads are generated. There is considerable uncertainty regarding how well model assumptions reflect real world processes in any particular watershed area. Given limited ability to anticipate future land use patterns and limited scientific knowledge about the effects of management policies, there are additional uncertainties associated with the land use change projections and with estimates of the likely impacts of potential management actions. Readers should exercise caution in using the estimates reported here, which should be considered rough approximations of anticipated trends in pollution loads rather than precise estimates of impact. Despite these limitations, the load estimates can be useful in assisting the LAC and members of the Peachtree-Martins

Creek community in visualizing the expected impacts of development activity as well as possible management options.

3.3 Expected Changes in Land Use

The LAC anticipated that over the next ten years (2005-2015) residential development would continue in the planning area at roughly the same rate as in the recent past. Residential development is expected to increase by approximately 1145 acres over this period, representing a 41% increase in the amount of residential land in the planning area (Figure 3.1). Commercial land is expected to increase by 373 acres, or 77%. Other land classifications (forest, crop land and pasture) will decline somewhat as additional land is converted to residential and commercial use.

It was the judgment of the LAC that new commercial development would be concentrated in the US 64 – NC 141 area (McComb Branch, Peachtree Bottomlands and Middle Peachtree sub-watersheds), as well as in the Southern Unnamed Tributary sub-watershed, along Harshaw Road near the new US 64 Bypass (Figure 3.2). New residential development is expected to be scattered more widely, though LAC members anticipated that it would be concentrated in areas south of the Hiwassee River (Martins Creek drainage and the Southern Unnamed Tributary sub-watershed) as well as in the Middle Peachtree and Fall Branch sub-watersheds (see Appendix B).

3.4 Impact of Land Use Change on Impervious Area

Equinox estimated the additional impervious area acreage likely to be added to each sub-watershed by this development activity, as well as by the US 64 Bypass currently under construction. Methods were consistent with those used by TVA to estimate 2005 impervious cover (see Appendix B).

This analysis indicates that by 2015 approximately 420 additional impervious acres will be added to the Peachtree-Martins Creek area. This represents an increase of more than 40% from the 969 acres of impervious cover estimated for 2005, raising the extent of impervious cover in the planning area from 3.9% to 5.5%. While this is not a level at which significant environmental impacts would be expected, a 40% increase in impervious cover in a 10 year period represents a substantial change for a 39 square mile area.

More importantly, much of the additional impervious cover is concentrated in a few sub-watersheds, where notable impacts are more likely (Figure 3.3). While only McComb Branch exceeded the impact threshold of 10% in 2005 (see Section 2.2.3), two additional sub-watersheds are likely to surpass or approach this level by 2015. Impervious cover in the Lower Peachtree Bottomlands (PBT) area will increase from 6% to 13%, while the Southern Hiwassee tributary area (SUT) will increase from 3% to 9%. The extent of impervious cover in the McComb Branch (MCB) sub-watershed will rise further (from 11% to 17%), indicating the likelihood of additional impacts from hydrologic change and pollution. In several other sub-watersheds (Lower Martins Creek, Upper Martins Creek, Middle Peachtree Creek and Fall Branch) the extent of impervious cover will increase by about half. While overall imperviousness in these areas remains fairly low (4 to 6%), these sub-watersheds may approach threshold levels in the future as additional development occurs here.

Figure 3.1 Expected Land Use Distribution for the Peachtree-Martins Creek Planning area, 2005-2015

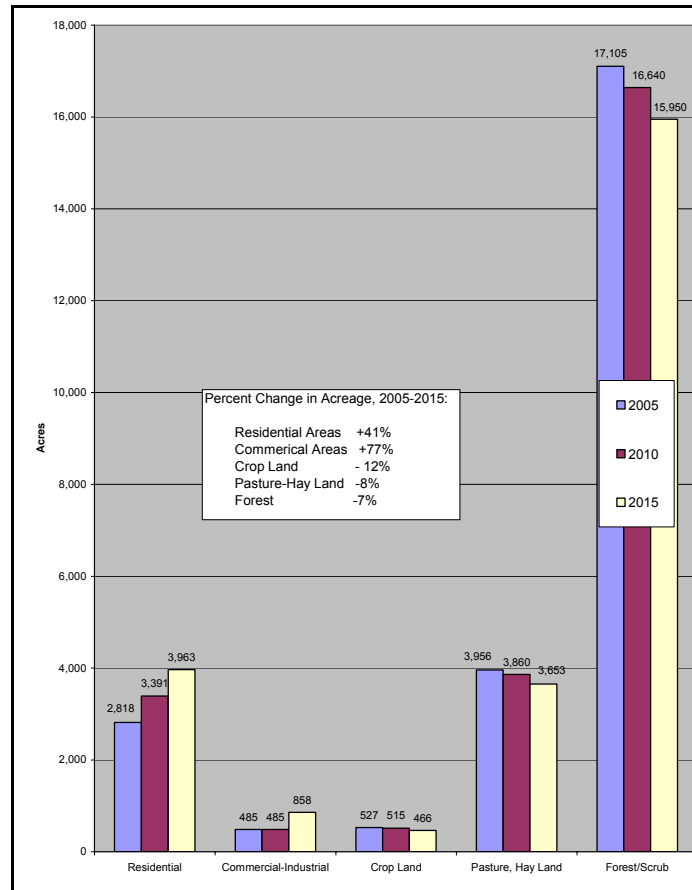
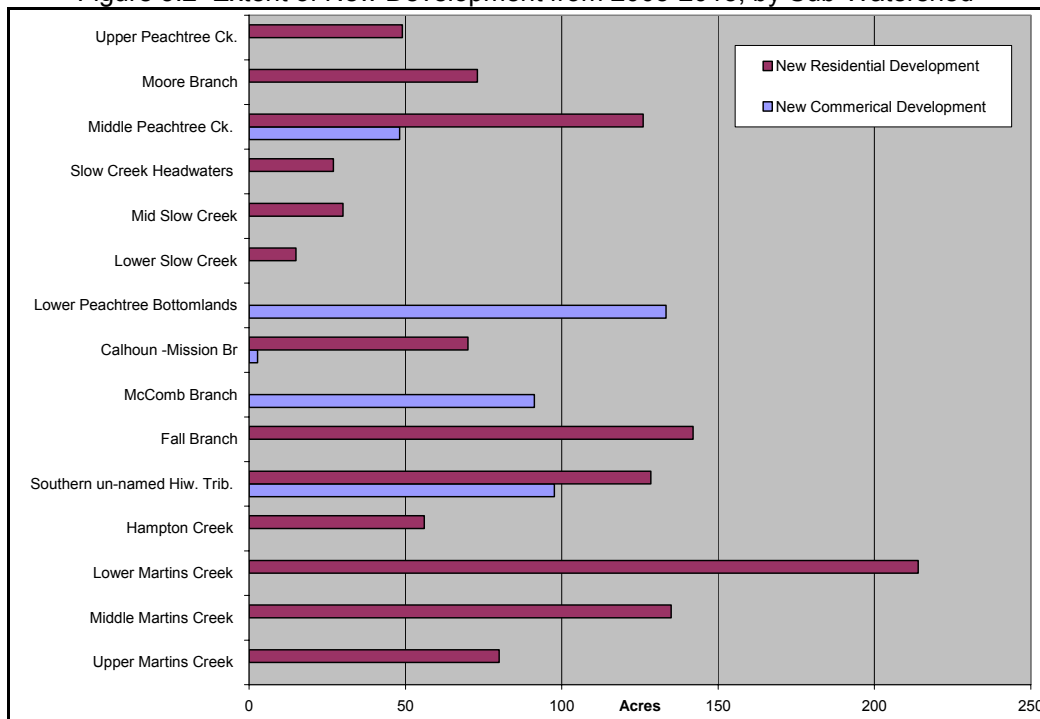
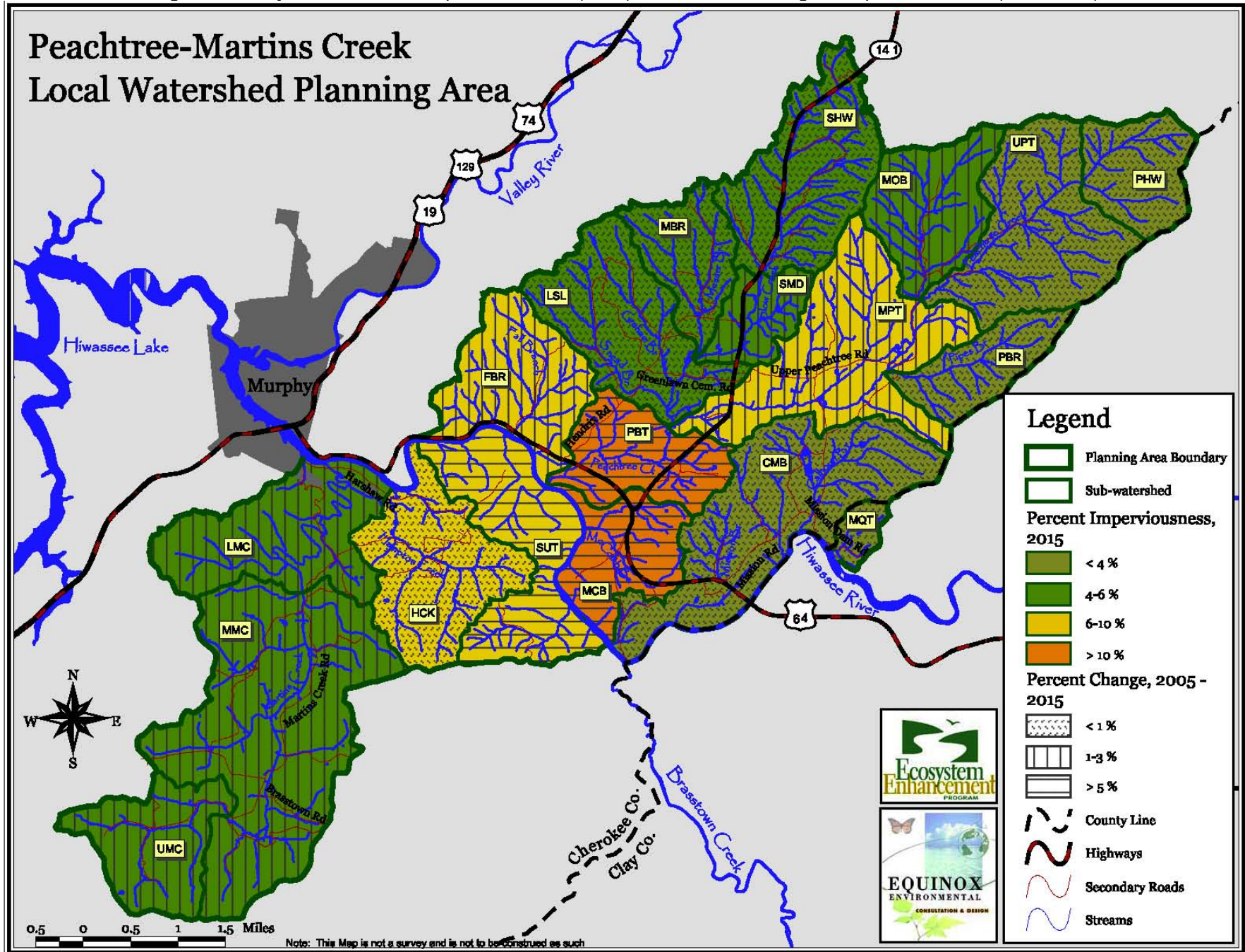


Figure 3.2 Extent of New Development from 2005-2015, by Sub-Watershed*



* The following sub-watersheds are expected to experience no or limited development and are not shown: Peachtree Headwaters (PHW), Pipes Branch (PBR), Messer Branch (MBR) and Mission Quarry (MQT).

Figure 3.3 Projected Percent of Impervious Cover (2015) and Extent of Change in Impervious Cover (2005-2015)



To illustrate the impacts of development on a more limited scale, Equinox examined a small tributary to the Hiwassee River draining approximately 250 acres in the Harshaw Road area (Figure 3.4). This tributary, termed Harshaw Branch for purposes of this plan, was largely a mix of forest and agricultural land in 2005, with an estimated imperviousness of 2.4% (about 6 acres). The area drained by this stream is now bisected by the US 64 Bypass. Additionally, most of it is contained in a large parcel identified by the LAC as likely to see mixed use development (commercial use along Harshaw Road, medium density residential use elsewhere) within the next 10 years. If this land is developed as anticipated, an additional 62 acres of roads, parking areas and rooftops will be added, raising the overall extent of impervious cover in this small drainage to approximately 27% (Appendix B). This is a level at which severe ecological and hydrologic impacts to the stream would be expected. While it is very unlikely that the Peachtree-Martins Creek area as a whole will experience levels of impervious cover this high in the foreseeable future, it is quite plausible that development intensity at or approaching this level will occur in areas drained by other small streams. *Severe impacts are likely in these situations without a concerted effort to mitigate the hydrologic and other effects of development by means of stormwater control and other measures.*

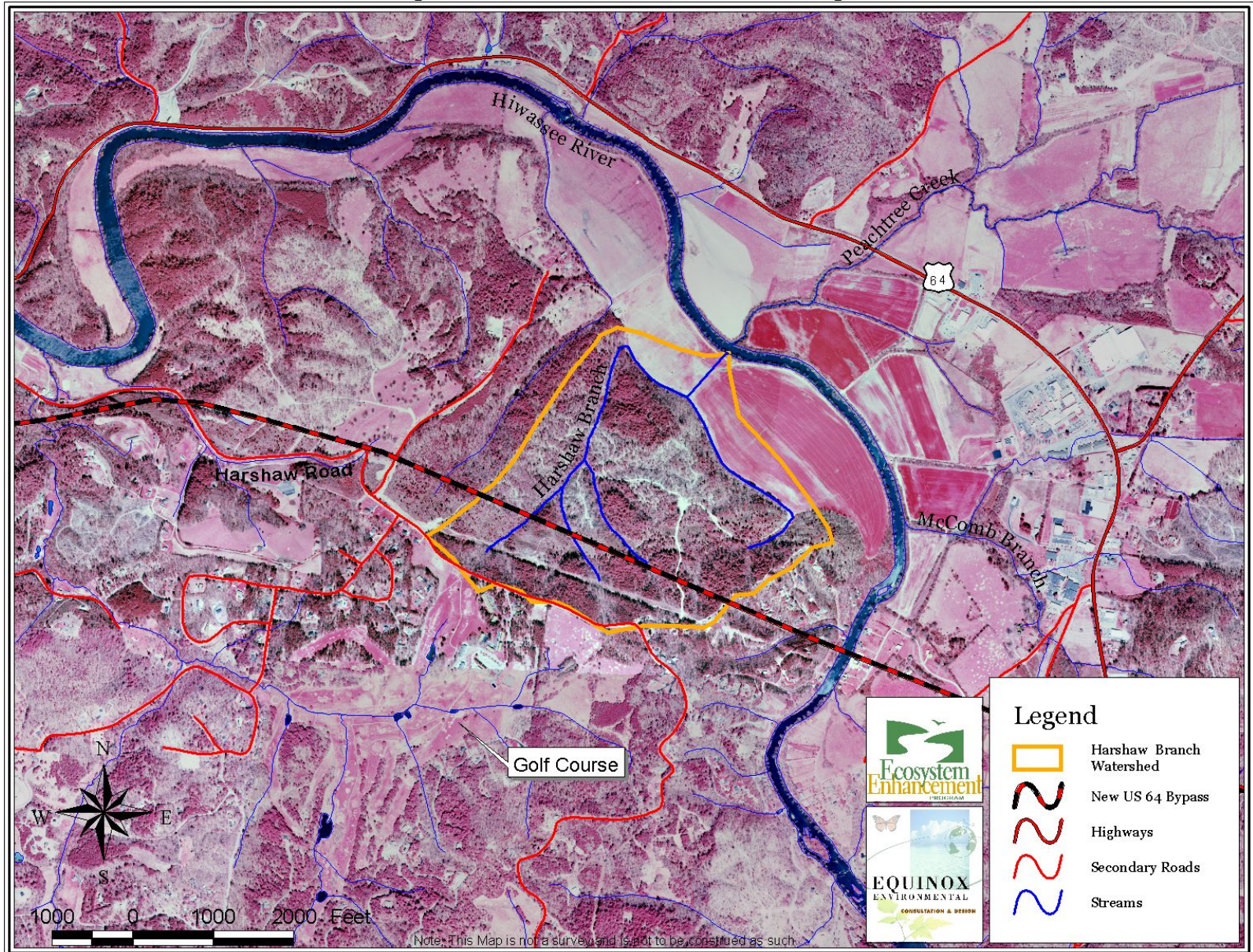
3.5 Effects of Land Use Change on Pollutant Loads

The increased development described above is expected to result in a sharp increase in pollutant loads from developed areas (Table 3.1). Between 2005 and 2015 total suspended solids (TSS) loads from completed residential and commercial areas are expected to increase by 44% and 77% respectively. TSS loads from land under construction (comparing land under construction in 2015 to land under construction in 2005) will increase by more than half (55%). The percentage increases expected for total phosphorus (TP) and total nitrogen (TN) loads from developed areas are similar (Table 3.1). Impacts on individual sub-watersheds are variable, depending upon the extent and nature of development changes. From 2005 to 2015, the largest increases in the total TSS load are expected in the following sub-watersheds:

- Upper Martins Creek – 52% increase due to residential development;
- McComb Branch – 36% increase due to commercial development;
- Moore Branch – 33% increase due to residential development;
- Peachtree Bottomlands – 32% increase due to commercial development;
- Falls Branch – 31% increase due to residential development; and
- Southern Unnamed Tributaries – 29% increase due to mixed use development;

The percentage increases in nutrient loads generally exceeded the TSS increase in these sub-watersheds. Additional sub-watershed data are presented in Appendix B.

Figure 3.4 Location of Harshaw Branch Drainage*



*This figure depicts the area as of March 2005, with the addition of the US 64 Bypass.

Table 3.1 Annual Pollutant Loads for 2010 and 2015 Base Scenarios

Pollutant	Total Load	Constructed Residential Areas ¹	Constructed Commercial Areas ¹	Areas Under Construction ²
Total Suspended Solids				
Annual Load (tons/yr)				
2005	6721.4	255.3	198.3	565.8
2010	6754.6	310.8	198.3	571.9
2015	7179.8	367.0	351.0	877.0
% Change from 2005				
2010	0.5%	21.7%	0.0%	1.1%
2015	6.8%	43.7%	77.0%	55.0%
Total Phosphorus				
Annual Load (tons/yr)				
2005	2.34	0.51	0.54	0.06
2010	2.44	0.62	0.54	0.07
2015	2.97	0.73	0.94	0.10
% Change from 2005				
2010	4.4%	21.7%	0.0%	1.1%
2015	27.1%	43.7%	75.9%	54.9%
Total Nitrogen				
Annual Load (tons/yr)				
2005	19.9	3.1	4.1	0.9
2010	20.5	3.8	4.1	0.9
2015	24.6	4.5	7.3	1.4
% Change from 2005				
2010	3.1%	22.2%	0.0%	1.1%
2015	23.7%	45.0%	76.1%	55.0%

1. Includes all developed areas where construction has been completed, including both pre 2005 and post 2005.

2. Includes areas under construction during 2005, 2010 or 2015.

3.6 Potential Impacts of Local Management Policies

3.6.1 Introduction

The results presented above are based on the assumption that new development occurs under current practices, regulations, design standards and enforcement mechanisms. Though development can result in significant increases in pollution, some of this can be mitigated through various management actions, including measures implemented by governmental agencies as well as voluntary measures undertaken by developers. The number of management policies that could be considered is large. In consultation with the LAC, six measures were represented to illustrate a range of options:

- Limiting vegetative clearing to 50% of parcels;
- Limiting vegetative clearing to 30% of parcels;
- Implementing ‘Mountain Protection’ or similar standards for development at elevations over 2000 feet (for example, revegetation requirements or requirement of engineering certification based upon slope);
- Implementing a post-construction stormwater management program;

- Developing a local erosion and sediment control program with enhanced enforcement; and
- Developing road design standards to reduce the potential for ongoing road erosion.

The impact of these measures on annual pollutant loads was estimated using the IPSI model for the 2015 base scenario. An additional scenario was run to estimate the joint effect of implementing multiple measures. The nature of these measures and the manner in which they are dealt with in the model is discussed in Appendix B. Additionally, the LAC desired to explore the impact of extending sewer service along US 64 east of the Tri County Community College, extending along Mission Branch Road through the Calhoun-Mission Branch sub-watershed. This extension was included as an additional scenario.

3.6.2 Results

The effects of management policies are viewed below from two perspectives:

1. Their ability to reduce pollutant loads from the new development anticipated from 2005 to 2015 (the development activity which is assumed to be subject to these policies); and
2. Their impact on overall loads, including the loading from all developed areas, both those subject to management actions and development completed prior to 2005, which is unaffected by any of the management measures simulated.

Table 3.2 summarizes overall results from these two perspectives, while additional data on overall loads are presented in Figures 3.5, 3.6 and 3.7 for TSS, TP and TN respectively.

The management measures selected have the potential to substantially reduce the load increases that would otherwise accompany new development (Column B in Table 3.2). The impact is greatest for stormwater management measures and enhanced erosion and sediment control. As one would expect, the impact of these management policies on overall loads is much smaller (Column C in Table 3.2), since areas developed prior to 2005 are not affected by the measures, nor are the policies applicable to other sources of pollution such as agricultural activities.

If multiple policies are implemented concurrently, reductions are much higher than for any of the individual measures (Table 3.2 and Figure 3.8).

- Loads from areas under construction are reduced by 41% for all pollutants.
- TSS loads for commercial areas (including both new areas and existing areas not subject to the regulations) drop by 25%, with smaller reductions for nutrients.
- TSS loads for residential areas (including both new areas and existing areas not subject to the regulations) experience a 15% reduction, with smaller decreases for nutrients.

Table 3.2 Synopsis of Management Strategy Results

(A) Management Measure	(B) Reduction in Anticipated Pollution Load from New Development from 2005-2015	(C) Reduction in Overall Pollution Loads from Developed Areas*
(1) Vegetative Clearing Limited to 50%	<ul style="list-style-type: none"> ● 8% reduction in all pollutants for areas under construction ● 8% reduction in post construction loads for all pollutants 	<ul style="list-style-type: none"> ● 2-4% reduction in loads from developed areas (all pollutants) ● 1-2% reduction in total pollutant loads (all pollutants)
(2) Vegetative Clearing Limited to 30%**	<ul style="list-style-type: none"> ● 16% reduction in all pollutants for areas under construction ● 16% reduction in post construction loads for all pollutants 	<ul style="list-style-type: none"> ● 4-7% reduction in loads from developed areas(all pollutants) ● 2-4% reduction in total pollutant loads (all pollutants)
(3) Standards for High Elevation Development	<ul style="list-style-type: none"> ● 15% reduction in loads for all pollutants for areas to which the standards apply (elevations >2000 feet) 	<ul style="list-style-type: none"> ● 1% reduction in loads from developed areas (all pollutants) ● <1% reduction in total pollutant loads(all pollutants)
(4) Post-Construction Stormwater Management**	<ul style="list-style-type: none"> ● 49% reduction for TSS ● 35% reduction for TP ● 21% reduction for TN 	<ul style="list-style-type: none"> ● TSS reductions: 13% for residential areas, 21% for commercial ● TP reductions: 9% for residential areas, 15% for commercial ● TN reductions: 6% for residential areas, 9% for commercial
(5) Erosion and Sediment Control**	<ul style="list-style-type: none"> ● 30% reduction in TSS from areas under construction 	<ul style="list-style-type: none"> ● 4% reduction in total TSS load ● 1-2% reduction in total TP and TN loads
(6) Road Design Standards	<ul style="list-style-type: none"> ● 40% reduction loads (all pollutants) from unstable road banks and ditches 	<ul style="list-style-type: none"> ● <1% reduction in total load for all pollutants
(7) Multiple Measures Implemented	<ul style="list-style-type: none"> ● 41% reduction (all pollutants) for areas under construction ● 34 to 57% reduction in post construction load, depending upon pollutant 	<ul style="list-style-type: none"> ● TSS reductions: 15% for residential areas, 25% for commercial ● TP reductions: 12% for residential areas, 20% for commercial ● TN reductions: 9% for residential areas, 15% for commercial

*Includes the total loading from all developed areas (or from all sources, as specified in Column C), including those subject to management actions (2005-2015) and development completed prior to 2005, which is unaffected by any of the management measures simulated.

**Management measure is included in the multiple measure scenario (7).

Figure 3.5 Estimated Percent Reduction in Total Suspended Solids Loads from Management Strategies

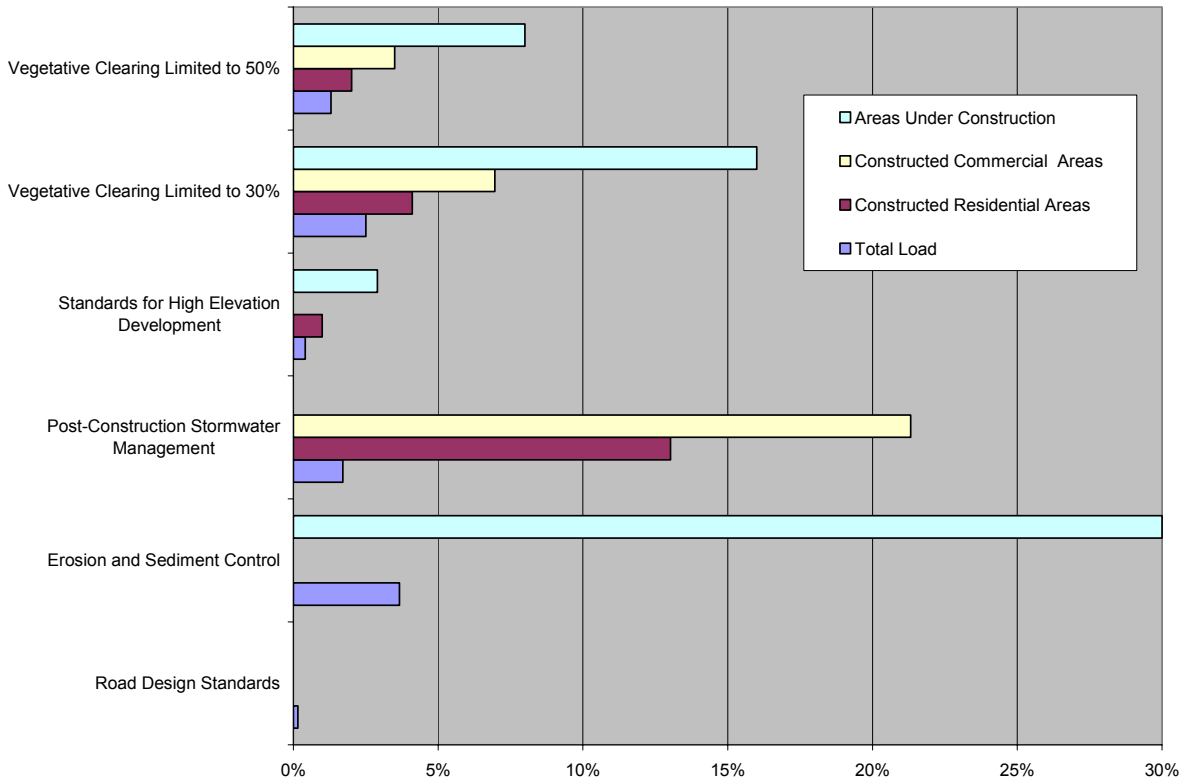


Figure 3.6 Estimated Percent Reduction in Total Phosphorus Loads from Management Strategies

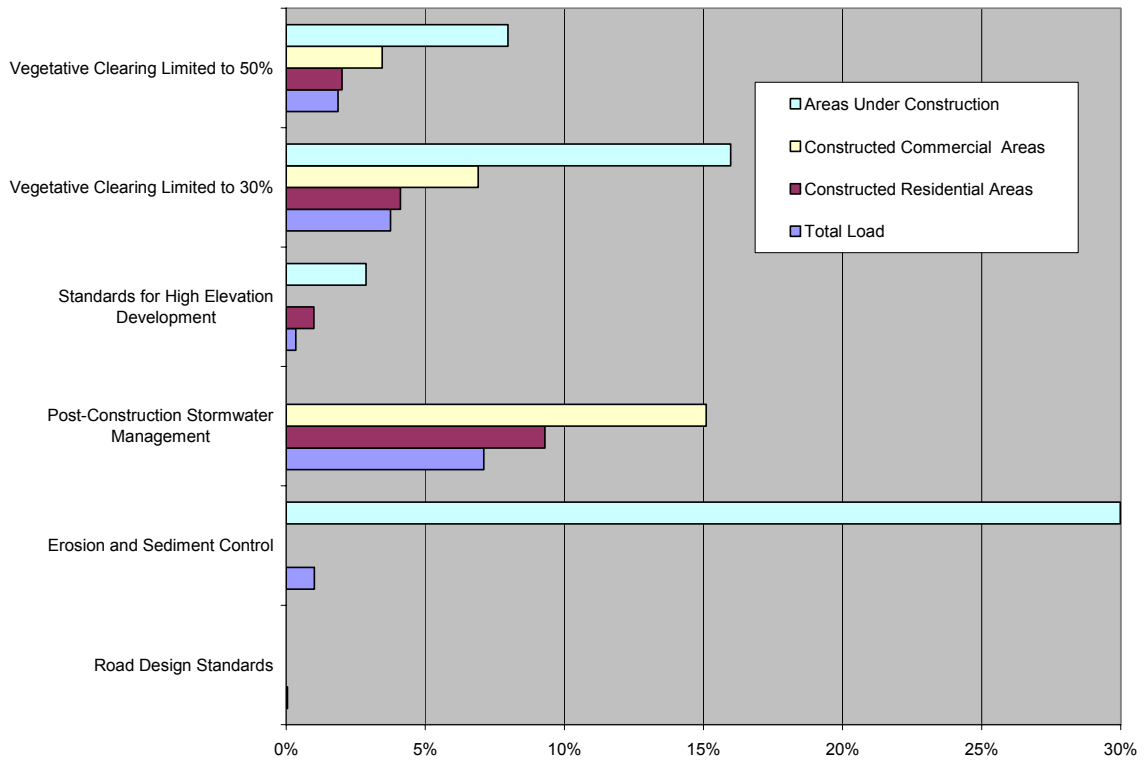


Figure 3.7 Estimated Percent Reduction in Total Nitrogen Loads from Management Strategies

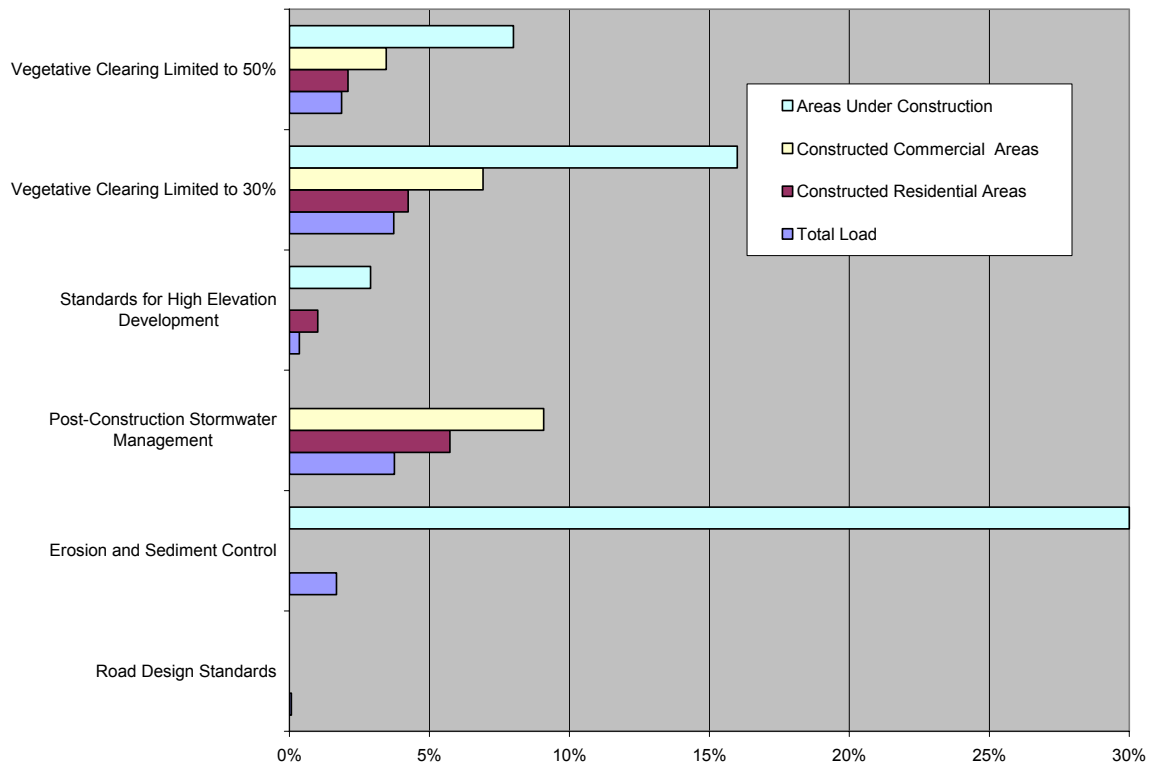
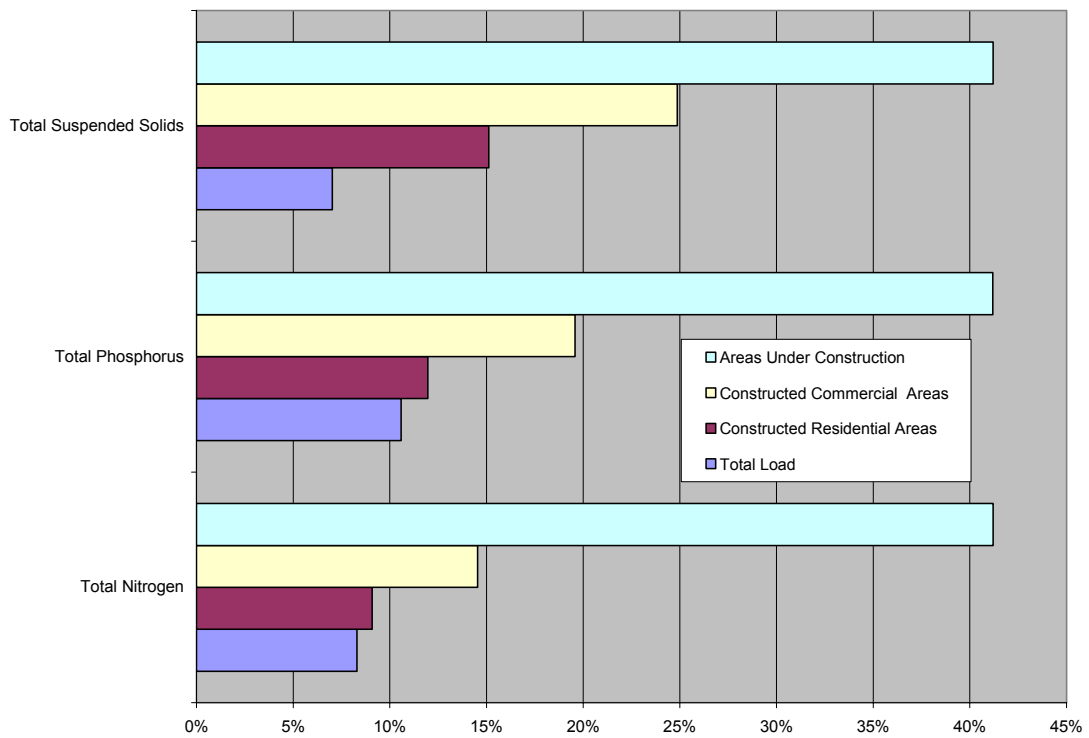


Figure 3.8 Estimated Percent Reduction in Pollutant Loads from Multiple Management Strategies



The sewer line extension impacted development only in the Calhoun-Mission Branch area, where it increases development density. Estimated TN loads from developed areas in this sub-watershed increased by about one quarter, with smaller increases for other pollutants (Table 3.3).

Table 3.3 Calhoun-Mission Branch Load Changes with Sewer Line Extension

Pollutant	% Increase in Load with Sewer Extension	
	Total Load	Load from Residential Areas
Total Suspended Solids	<1%	10%
Total Phosphorus	2%	10%
Total Nitrogen	3%	26%

Section 4

Overview of Recommended Management Strategies

This section provides a framework for the implementation of watershed management strategies and offers a brief overview of the practices recommended for the Peachtree-Martins Creek area. These strategies are intended to restore and protect watershed function by addressing the problems and threats discussed in previous sections of this plan.

4.1 Developing a Framework for Watershed Management

The broad picture of ecological conditions described in previous sections offers both good and bad news for the Peachtree-Martins Creek area. On the positive side, about 17% of the area retains high or very high levels of ecological function. Severe degradation on the sub-watershed scale is currently limited, occurring only in the Mission Quarry area. While many individual sites in the planning area are severely impacted, at the sub-watershed level these impacts are mitigated to some degree by the areas that remain undisturbed or well-managed.

On the other hand, almost 18 square miles (45%) of the area has seen significant deterioration in ecological condition and is functioning at a low level or worse. Another 15 square miles (38% of the area) is functioning at a moderate level but is at risk of further degradation. Impacts of riparian vegetation removal, channel modification, and sedimentation are widespread.

The fact that much of the existing degradation is not severe makes the potential for successful rehabilitation more favorable than if the severest conditions were widespread. The fact that substantial areas remain in relatively good condition means that there is still much to lose if both ongoing activities and future growth are not handled well.

Because both the source activities and affected areas are widely dispersed, addressing these issues will require diverse strategies implemented over an extended period of time. A strong organizational presence, as provided by the Hiwassee River Watershed Coalition, is a major asset in pursuing both remedial and protection efforts.

An organizational framework for ongoing watershed management is essential to provide oversight over project implementation, to evaluate how current strategies are working, and to plan for the future. While state agencies can play an important role, planning is often more effectively initiated and managed at the local level. The HRWC is well-suited to perform this role. The HRWC has a track record of effective project implementation, and has established productive relationships with local governments and other stakeholders. NCEEP can implement some projects in the area but cannot effectively perform a long-term coordinating role.

4.2 Recommended Strategies

Table 4.1 summarizes the strategies recommended to address problems associated with each important stressor identified during Phase 2 of the planning process. These strategies are described in more detail in Sections 6, 7 and 8, as listed in the Table.

Table 4.1 Summary of Proposed Management Strategies

Watershed Problems		Proposed Solutions	
Stressors and Issues	Major Impacts	Management Strategy	Location in Document
<i>Lack of Riparian Vegetation</i>	Stream bank instability, poor shading, insufficient woody material in streams, limited pollution removal	<ul style="list-style-type: none"> • Revegetation of riparian areas 	Section 6.1
<i>Channel Modification</i>	Habitat degradation, incision, bank erosion, sedimentation	<ul style="list-style-type: none"> • Stream channel restoration 	Section 6.1
<i>Excess Sediment Inputs</i>	Habitat degradation-loss of riffle and pool habitat; reservoir filling	<ul style="list-style-type: none"> • Conservation tillage and other crop land measures • Livestock exclusion and other BMPs for livestock operations • Stabilization of eroding road banks and ditches; drainage and grading improvements to reduce erosion from unpaved road surfaces • Education of landowners regarding property road maintenance and design • Stabilization and revegetation of eroding areas on existing developed land • Education of landowners regarding land disturbance • Enforcement of existing regulations at Mission Quarry • Promotion of forestry BMPs • Stabilization and replanting or eroding stream banks 	Section 6.2 Section 6.2 Section 6.2 Section 6.2 Section 6.2 Sections 6.2, 8.2 Sections 6.2, 6.4 Section 6.2 Section 6.2
<i>Excess Nutrient Inputs</i>	Over-enrichment of streams and reservoirs, resulting in low dissolved oxygen levels and altered aquatic communities	<ul style="list-style-type: none"> • Education of property owners and contractors regarding appropriate fertilization and lawn care practices • Removal of straight pipes; repair/replacement of faulty septic systems • Education of landowners regarding proper septic system maintenance • Livestock exclusion and other BMPs for livestock operations • Conservation tillage and other crop land measures • Replanting of riparian vegetation 	Sections 6.2, 8.2 Section 6.2 Section 6.2 Section 6.2 Section 6.2 Section 6.1
<i>Bacterial Contamination</i>	Human health risk	<ul style="list-style-type: none"> • Additional monitoring of fecal coliform bacteria • Removal of straight pipes; repair/replacement of faulty septic systems • Education of landowners regarding proper septic system maintenance • Livestock exclusion practices and other BMPs for livestock operations 	Section 6.2 Section 6.2 Section 6.2 Section 6.2
<i>Stormwater</i>	Channel erosion due to increased storm discharge; aquatic life impacts from nutrients and toxic substances	<ul style="list-style-type: none"> • Additional monitoring of stormwater impacts • Stormwater retrofits for developed areas, especially in McComb Br. area • Education of citizens regarding stormwater and pollution prevention 	Section 6.3 Section 6.3 Section 8
<i>Groundwater Contamination</i>	Human health risk (drinking water); impacts to aquatic biota	<ul style="list-style-type: none"> • Continued remediation of existing contamination in Peachtree area • Continued monitoring of organic contaminants in Peachtree area 	Section 6.5 Section 6.5
<i>Mission Quarry</i>	Sedimentation and water quality impacts	<ul style="list-style-type: none"> • Enforcement of applicable water quality, mining and health regulations 	Section 6.4
<i>New Development</i>	Future increase in sediment, nutrient and stormwater impacts	<ul style="list-style-type: none"> • Adoption of a subdivision ordinance that encourages Low Impact Development (LID) and other approaches to reduce impacts • Instituting post-construction stormwater management requirements • Developing a local erosion and sediment control program • Ongoing public education regarding watershed and stormwater issues • Evaluation of stormwater control opportunities on government properties • Adoption of hillside development standards • Expansion and revision of existing water supply and floodplain ordinances • Development of a long-term wastewater management plan • Development of a comprehensive land use plan. 	Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2 Section 8.2
<i>Multiple Stressors</i>	Diverse future impacts	<ul style="list-style-type: none"> • Preservation of priority areas through conservation easements and proper forest management 	Section 7

Section 5

Focus Areas

This section outlines the sub-watersheds recommended as focus areas for targeting management activities. Recommended priority areas for addressing existing degradation are:

- The Middle Martins Creek (MMC), Lower Slow Creek (LSL) and Messer Branch (MBR) sub-watersheds, which should be considered primary focus areas for implementation of a broad range of remedial practices;
- The sub-watershed draining Mission Quarry (MQT), which is experiencing severe impacts from the quarry operation; and
- McComb Branch, which is subject to a variety of water quality and stormwater impacts.

Recommended priority areas for preservation include:

- The upper Peachtree drainage including the following sub-watersheds - Upper Peachtree (UPT), Moore Branch (MOB), Pipes Branch (PBR) and the portion of Middle Peachtree (MPT) upstream of Mission Road; and
- The Upper Martins Creek sub-watershed (UMC).

5.1 Approach

It is necessary to focus watershed management activities for remediation and protection to proceed efficiently and effectively. Firstly, it is not possible to do everything at once. With a broad range of problems and problem areas, as well as actions to be initiated, it is necessary to identify where to begin. Secondly, obtaining measurable improvements in water quality, habitat or hydrologic condition will be more likely if efforts are concentrated in clearly identified portions of the planning area, rather than spreading available resources more widely. To this end, specific focus areas were identified for watershed improvement efforts and for protection activities.

5.2 Focus Areas for Watershed Improvement Efforts

The process of selecting areas to focus watershed improvement efforts emphasized those areas with notable degradation. These include the eight sub-watersheds with Low or Very Low function, as shown in Figure 2.3. The search for focus areas considered two goals.

- Targeting restoration to address problems which are common in the planning area; and
- Assuring that areas with unique needs were addressed.

5.2.1 Addressing Common Watershed Problems

Degradation in much of the planning area is primarily the cumulative result of multiple stressors that are common in the region (the removal of riparian vegetation, channel modification, sedimentation, nutrient and fecal coliform bacteria inputs as well as new development). In the long term, these issues should be addressed throughout the planning area. However, two areas stand out for both the scope of potential problems and the possibility of solutions—Middle

Martins Creek (MMC) and the Lower Slow Creek (LSL) / Messer Branch (MBR) area. Both are large areas of low function, with a mix of physical stressor and water quality problems (Table 5.1). Both have a number of potential NCEEP restoration projects (see Section 6.1), and are areas visible to the local community.

This plan recommends the Middle Martins Creek sub-watershed and the lower Slow Creek drainage (Lower Slow Creek and Messer Branch sub-watersheds) as primary focus areas for the implementation of watershed improvement activities (Figure 5.1). Areas upstream of these sub-watersheds can have a significant impact on water quality and other functional areas and should be considered secondary focus areas. The secondary focus areas include the following sub-watersheds: Upper Martins Creek (UMC), Slow Creek Headwaters (SHW) and Middle Slow Creek (SMD).

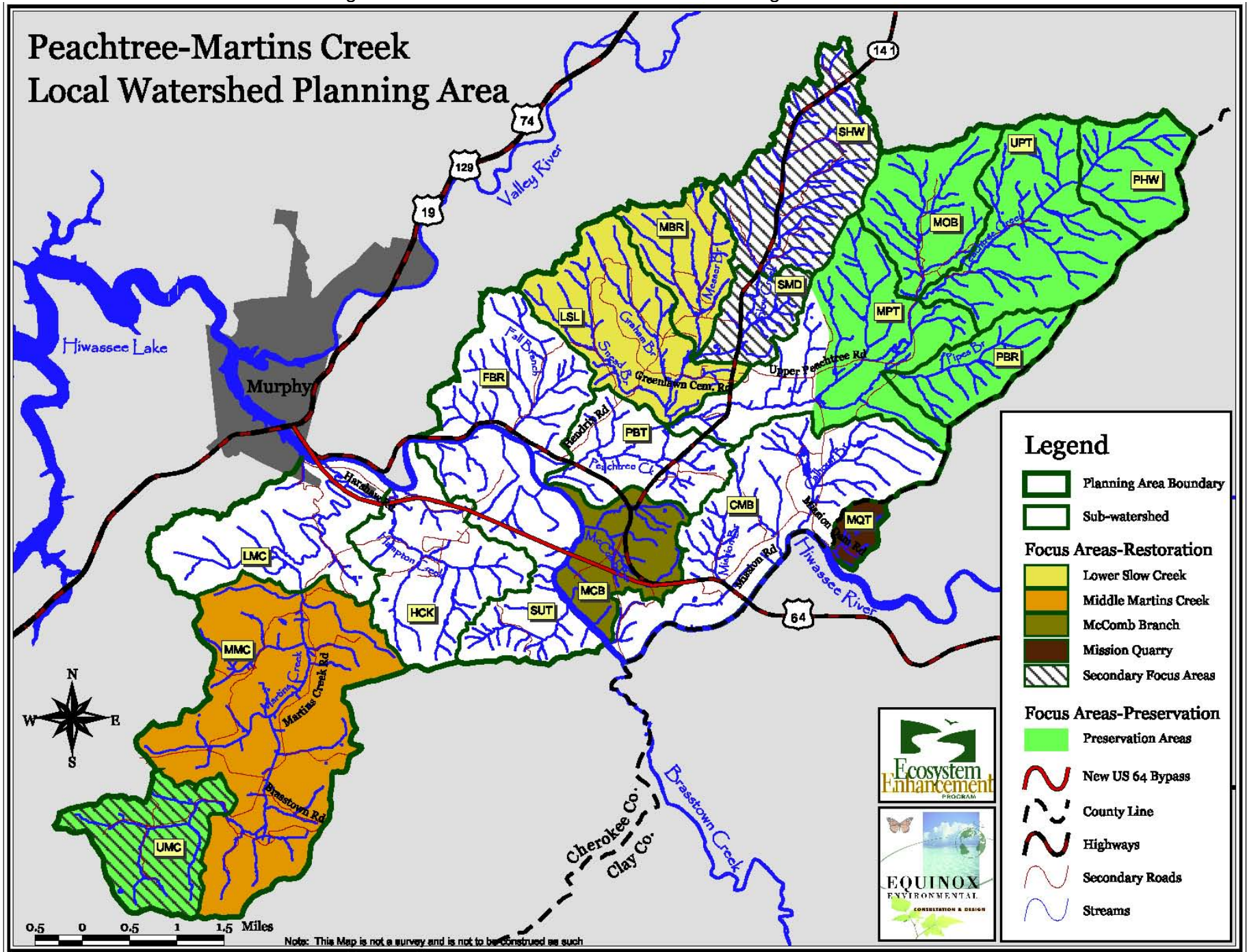
Remedial activity should be concentrated in these sub-watersheds, including actions intended to address the full range of problems present. It is recommended that all parties working to improve degraded conditions in the Peachtree-Martins Creek area – including NCEEP, HRWC, the Cherokee Soil and Water Conservation District and Cherokee County - focus primary attention on these areas.

Table 5.1 Features of Middle Martins Creek and Lower Slow Creek Focus Areas

Feature	Middle Martins Creek	Lower Slow Creek – Messer Branch
Need for Riparian Revegetation and Channel Restoration	High	High
% of streams channelized	37% (rank = 1)*	32% and 20%(rank = 2 and 4)*
% of all channelized streams in planning area	27%	20%
% of riparian areas inadequate	52% (rank = 3)*	54% and 58% (rank = 2 and 1)*
NCEEP Stream Project Opportunity	20,000 linear feet	17,000 linear feet
Notable Water Quality Concerns	Yes	Yes
Nitrate	Highest baseflow concentration (rank = 1)*	2nd highest baseflow concentration (rank =2)*
Fecal coliform bacteria	2nd highest concentration (rank = 2)*	Highest concentration (rank = 1)*
Villosa present	Yes	No survey
Livestock access and operations	High	High (also high upstream)

* For stream channel and riparian condition, rank indicates position among the nineteen sub-watersheds. For water quality parameters, rank indicates position among the sites sampled. See Equinox (2007) for additional information.

Figure 5.1 Recommended Focus Areas for Management Activities



5.2.2 Unique Areas

It is clear from the Phase 2 report that there are two sub-watersheds experiencing significant degradation due to problems that are unique in the planning area. These are the sub-watershed draining Mission Quarry (MQT), and the McComb Branch (MCB) sub-watershed (Figure 5.1). Each of these is recommended as a focus area for specific activities, as outlined below.

Mission Quarry drainage (MQT)

The tributary draining Mission Quarry is unique in the study area in the severity of the impacts it experiences and in the fact that these impacts appear to be due largely to a single facility, the Mission Quarry operation. Addressing these impacts will depend on remedial actions taken by the quarry, with the oversight of state regulatory agencies. This sub-watershed is a recommended focus area, indicating that addressing these issues should be a high priority. Specific recommendations are discussed in Section 6.4.

McComb Branch (MCB)

This sub-watershed has the most extensive impervious cover in the planning area and the most extensive commercial development. It is unique in the extent of stormwater-related degradation and the potential for toxic impacts. Specific actions to address these issues are discussed in Section 6.3.

5.3 Focus Areas for Preservation Activities

Within the context of this LWP, preservation refers to efforts to retain existing ecological function through the protection of forested areas, both upland areas and broad wooded riparian areas along water bodies. Preservation is most commonly accomplished through the use of conservation easements, though properties may sometimes be purchased. Sustainable management of forest lands is also important.

The identification and prioritization of specific tracts for potential preservation is discussed in Section 7. The focus here is on the identification of broader areas within which preservation activities should be concentrated.

5.3.1 Background

Ecological preservation priorities should ideally be developed in light of information on the status of ecological communities within the planning area, giving consideration to existing priorities of other agencies and organizations. Natural heritage data for the planning area are sparse. The Wildlife Resources Commission (NCWRC) has identified a state threatened mussel, the mountain creekshell (*Villosa vanuxemensis*), at several sites in the Peachtree Creek and Martins Creek. Since these drainages constitute the majority of the planning area, however, this provides little basis upon which to prioritize specific sub-drainages. A natural heritage inventory has not yet been conducted in Cherokee County, and little additional information is available for the area.

The Land Trust for the Little Tennessee, which has recently become active in the Hiwassee River basin, has not yet developed specific protection priorities for the area. The HRWC's protection priorities include riparian areas and wetlands throughout the upper Hiwassee River

basin. However, no specific sub-watersheds within this portion of the basin have yet been prioritized by HWRC. Protection of habitat for the mountain creekshell is considered a conservation priority in the NCWRC's Wildlife Action Plan (NCWRC, 2005), though the NCWRC does not have specific land preservation targets.

5.3.2 Recommended Focus Areas

Since existing natural heritage data and current local priorities provide no clear basis to focus preservation activities, this plan recommends targeting preservation activities at those portions of the planning area that currently support a high level of ecological function. This includes the portion of the Peachtree drainage above Mission Road and upper Martins Creek (see Figure 5.1). Concentrating preservation in these two areas should help retain existing function here, as well as help to prevent downstream degradation. These areas are also upstream of sites at which the mountain creekshell was found. While preservation of headwaters tracts in other portions of the planning area is also important to prevent further degradation in ecological condition, emphasizing preservation in the areas outlined above is particularly important.

- Upper Peachtree drainage. The benthic macroinvertebrate community has historically received a rating of Excellent at a site near Mission Road. Sub-watersheds upstream of this site include Upper Peachtree (UPT), Moore Branch (MOB), Pipes Branch (PBR) and a portion of Middle Peachtree (MPT). The Peachtree Headwaters sub-watershed (PHW) is also upstream, but lies entirely within the Nantahala National Forest.
- Upper Martins Creek sub-watershed (UMC). This largely undeveloped sub-watershed remains in best condition of all areas outside of the upper Peachtree drainage.

Section 6

Strategies to Address Causes of Existing Degradation

This section discusses recommended management activities to address the major problems that are widespread in the Peachtree-Martins Creek area:

- Channel modification and lack of riparian vegetation (Section 6.1);
- Pollution from sediment, nutrients and fecal coliform bacteria (Section 6.2);

Strategies to address more localized impacts are also recommended, including:

- Stormwater issues in the Peachtree area (Section 6.3);
- Mission Quarry (Section 6.4); and
- Groundwater contamination (Section 6.5)

6.1 Channel Modification and Lack of Riparian Vegetation

Stream channels and riparian vegetation in the Peachtree-Martins Creek area have been widely modified, resulting in major degradation of ecosystem function. These problems are addressed through riparian area enhancement and stream channel restoration projects. The nature of these projects is discussed below. Potential NCEEP project sites are identified.

6.1.1 General Considerations

Riparian area enhancement (RAE) involves the re-establishment of natural woody vegetation on stream banks. RAE projects are generally undertaken where channels lack proper streamside vegetation, but basic channel morphology (form) is sound and channels are relatively stable (not subject to excessive bed or bank erosion). In some cases some bank stabilization or fencing of livestock may be a necessary part of RAE. Woody riparian zones of 30 to 100 feet on each bank are often recommended to promote aspects of watershed function (Wenger, 1999; Jones et al, 2006). NCEEP requires a minimum width of 30 feet on each bank. Projects implemented using other funding sources may utilize other riparian area widths.

Stream channel restoration (SCR) involves the re-establishment of natural stream morphology and channel hydrology by reconstructing channels with proper dimension (width and depth), pattern (sinuosity) and profile (slope). SCR projects are generally undertaken where: morphology has been highly altered by straightening or other modification; channels are incised and no longer have an appropriate connection to their floodplains; or channels are otherwise unstable. Revegetation of riparian areas is generally undertaken in conjunction with channel restoration. In some cases fencing of livestock may also be necessary.

The need for both RAE and SCR is extensive. Over 90 miles of stream have riparian areas with inadequate vegetation on both sides, while about 26 miles of stream have been channelized. NCEEP can address some of these needs, but the agency is limited both by project criteria (which determine which sites it can select) and overall mitigation needs (which determine the number of linear feet of steam improvement the agency can fund). Given these constraints it is likely the NCEEP will be able to undertake only a small portion of the work needed. If additional

progress is to be made, the HRWC or other local organizations and agencies will need to play an active role in promoting landowner participation and securing funding.

6.1.2 Recommended Strategies

Recommendation: Where channel morphology and stability have been compromised, stream channels should be restored to a natural pattern, dimension and profile. Streams identified by the IPSI as channelized (Appendix A Figure A5) provide a good first approximation of the reaches where SCR projects are needed. NCEEP should undertake these projects to the extent feasible. The HRWC should take the lead to initiate projects for stream reaches where NCEEP cannot operate.

Recommendation: Where channel morphology does not need restoration, but riparian vegetation is inadequate, woody vegetation should be replanted. Streams identified by the IPSI as having inadequate riparian revegetation provide a fairly accurate indication of reaches where RAE projects are needed (Appendix A Figure A4). NCEEP should undertake these projects to the extent feasible. The HRWC should take the lead to initiate projects for stream reaches where NCEEP cannot operate.

Recommendation: Where severely eroding stream banks exist outside of areas to be included in RAE and SCR projects, they should be stabilized and revegetated. The HRWC, Cooperative Extension Service or Cherokee County SWCD could take the lead in this work.

6.1.3 Potential NCEEP Project Sites

Sixteen potential NCEEP stream channel and riparian projects were identified and prioritized as discussed below.

Site selection

The process of identifying stream project sites for NCEEP involved three steps.

1. Initial reach identification. This involved a GIS screening using the IPSI data base to identify reaches that met the following criteria, developed to meet NCEEP project needs:

- Stream is classified as intermittent or perennial by the IPSI;
- Riparian vegetation on both banks is classified as inadequate, based on the IPSI screening (adequate is defined as a zone of woody vegetation at least 30 feet wide);
- Stream reach is $\geq 1,900$ linear feet; and
- Stream reach drainage area < 10 square miles.

2. Field reconnaissance. This involved a field evaluation to assess the reliability of the GIS data and to identify important site features that could not be determined from available GIS data. This was a limited evaluation, based on what could be observed from public rights of way. Several sites were eliminated due to feasibility concerns.

3. Scoring and prioritization. Reaches were scored based on several factors pertaining to potential mitigation value and restoration feasibility. The factors used included the following (range of possible scores shown in parenthesis):

- Number of landowners per reach (0 to 3);
- Total length of the identified project reach (0 to 2);
- Livestock access to the reach (0 to 2);

- Percent of reach identified as eroding (0 to 1); and
- Whether the reach is located adjacent to areas identified as potential wetland restoration sites (0 to 1).

Individual criteria scores for each site were summed to obtain a total site score, with possible values ranging from 0 to 9. The scoring of individual attributes is described further in the *Project Atlas*. Sites were then prioritized based on this scoring as follows: ≥ 6 = high priority; 4-5 = medium priority; ≤ 3 = low priority.

While an initial effort was made to differentiate between potential riparian enhancement and channel restoration projects, most sites appear to contain elements of both and are combined here. The site identification process is described in detail in the *Project Atlas* that is a companion document to this management plan.

Recommended sites

Sixteen feasible sites were identified (Table 6.1 and Figure 6.1), representing a total of more than 72,000 feet of potential stream projects. Riparian revegetation is warranted for virtually the entire length of all of these sites. All sites also have significant opportunities for channel restoration, although more detailed on-site evaluations would be required to accurately estimate reach lengths.

Four potential sites, totaling about 20,000 linear feet are located in the Middle Martins Creek focus area (see Section 5). Two of these had site scores placing them in the high priority category. The lower Slow Creek focus area also had four potential sites, totaling 17,000 linear feet. Two of these had site scores placing them in the high priority category. See the *Project Atlas* for additional details on the scoring and prioritization process, features of each site and detailed site maps.

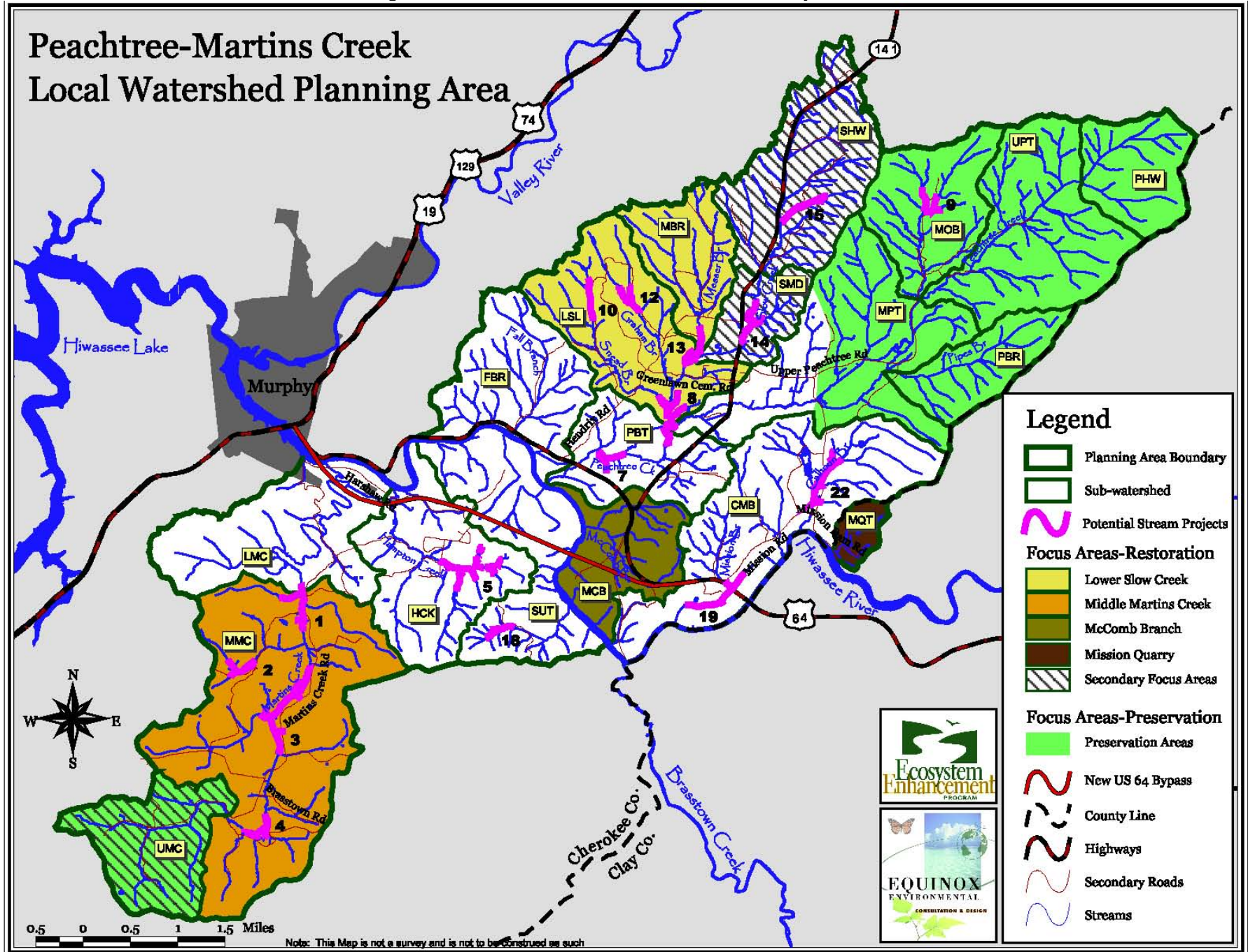
Table 6.1 Summary Information for Potential NCEEP Stream Projects

Reach ID ¹	Stream Name	Sub-WS ²	No. of Landowners	Reach Length (ft)	Total Score ³	Site Priority ⁴	Focus Area
5	Hampton Ck	HCK	1	7,450	6	High	
3	Martins Ck	MMC	9	9,434	6	High	Primary
1	Martins Ck	MMC LMC	4	4,558	6	High	Primary
15	Ut Slow Ck	SHW	2	3,465	6	High	Secondary
13	Slow Ck	LSL MBR SMD	4	4,170	6	High	Primary
8	Slow Ck	LSL MPT PBT	5	7,287	6	High	Primary
4	Martins Ck	MMC	5	3,286	5	Med	Primary
2	George Ck	MMC	3	3,133	5	Med	Primary
14	Slow Ck	SMD	5	3,966	5	Med	Secondary
9	Fate Puett Cove Ck	MOB	5	3,134	5	Med	
7	Peachtree Ck	PBT	2	2,865	4	Med	
12	Graham Br	LSL	4	2,930	4	Med	Primary
19	Mission Br	CMB	2	5,901	4	Med	
10	Snead Br	LSL	3	2,623	3	Low	Primary
22	Calhoun Br	CMB	6	5,617	2	Low	
18	Ut Hiwassee	SUT	5	2,309	1	Low	

Notes:

1. See Figure 6.1.
2. If site falls into more than one sub-watershed, the primary sub-watershed is shown in bold type.
3. Scores range from 0 to 9. See *Project Atlas* for details.
4. High priority=6, medium priority=4-5, low priority=1-3.

Figure 6.1 Location of Potential NCEEP Stream Project Sites



6.2 Measures to Address Sources of Sediment, Nutrients and Fecal Coliform Bacteria

6.2.1 General Considerations

The most likely sources of bacterial contamination in the project area are livestock and inadequate human waste disposal. Sources of sediment, nitrogen and phosphorus are quite varied, with developed areas and agricultural activities both important contributors. Management activities will have to address a variety of issues in order to reduce nutrient and sediment loads. There is considerable overlap between strategies recommended to address these pollutants.

Pollution from land surfaces reaches streams via a variety of pathways, with numerous factors involved. Practices implemented to reduce *transport* can be effective in reducing loading to streams. However, the actual effectiveness of transport interception is highly variable, depending on the particular management activity and its location. Eliminating or *reducing specific pollution sources* is a more reliable and effective approach. Many strategies (e.g. BMPs to reduce sediment inputs from crop land), use elements of both approaches, depending upon the specific practice implemented.

6.2.2 Strategies for Agricultural Sources

Recommendation: Sediment and nutrients from crop land should be addressed using standard BMPs for controlling erosion, sediment and nutrients on cultivated land. These include conservation tillage, filter strips, field borders, the development of nutrient management plans and other practices. These practices are eligible for cost share from both the Natural Resources Conservation Service (NRCS) and the NC Agricultural Cost Share Program (NCACSP). These practices should be targeted at areas currently using low residue practices (Appendix A Figure A9) and other areas identified by agricultural agency staff as having a high potential for impacts. NRCS and the Cherokee Soil and Water Conservation District (SWCD) should prioritize these areas for appropriate practices.

Recommendation: Sediment, nutrients and bacterial contamination from livestock operations should be addressed using standard BMPs for controlling these pollutants on pasture land. These include limiting livestock access to streams, the establishment of buffer areas between pastures and stream channels, heavy use area protection, rotational grazing and other practices. These practices are eligible for cost share from both the NRCS and the NCACSP. These practices should be targeted at areas with documented livestock stream access (Appendix A Figure A8), pasture land that is in the poorest condition (Appendix A Figure A9) and other areas identified by agricultural agency staff as having a high potential for impacts. NRCS and the Cherokee SWCD should prioritize these areas for appropriate practices.

Discussion. Agricultural activities, including row crops and pasture, are estimated to account for about 21% of the TSS load, 33% of the TP load and 26% of the TN load in the planning area. Crop land contributes more pollution on a per acre basis than does pasture, but the amount of pasture is more extensive. The potential for pollutant inputs from crop land and pasture varies with current land condition and management. According to the IPSI a large proportion of the crop land loading (40% for sediment) comes from fields with low residue. Pasture classified by the IPSI as overgrazed accounts for 55% to 57% of the load from all pasture land, depending on

the pollutant. While ground-truthing by NRCS indicates that much of the land in this category may not be technically overgrazed, these locations do generally represent the pasture land in the planning area that is in the poorest condition.

6.2.3 Strategies for Existing Developed Areas

Recommendation. Education efforts should target property owners to inform them of the importance of a variety of activities aimed at reducing pollution sources. These include: maintaining vegetative cover; using proper erosion and sediment control methods when land disturbance is necessary; conservative use of fertilizer and other lawn and garden products; septic system maintenance; and road design and maintenance. The HRWC, Cooperative Extension Service or a county-developed watershed education program could all be appropriate entities to carry out this work.

Recommendation. Sources of fecal coliform bacteria contamination should be identified and eliminated, including contamination from both domestic waste and livestock. NCDWQ, the Wastewater Discharge Elimination (WaDE) program of the NC Division of Environmental Health and local resource agencies should work together towards this goal. This work should focus on waters where violations of water quality standards were documented by NCDWQ during the summer of 2007, although additional priority areas may be identified by further investigation. The WaDE program should conduct a field survey to determine the extent of straight piping and malfunctioning septic systems in the planning area and identify sites in need of remediation.

Recommendation. An effort should be made to identify specific developed areas which are significant and ongoing sources of sediment. Features in these areas which are major sediment contributors should be stabilized and vegetated. The HRWC, Cooperative Extension Service or Cherokee County SWCD could take the lead in securing funding for these tasks.

Discussion. Developed areas have been identified by the IPSI as a major source of sediment and nutrients, although little information is available on the specific activities within residential areas that are most responsible for generating this load. In general, sediment from established residential areas can originate from a variety of sources, including cut slopes that were never properly stabilized, eroding driveways and associated ditches, landscaping and building additions, and other sources. Nutrient inputs during storms could come from turf fertilization, eroding areas, septic system inputs, or other sources. Additionally, inputs during nonstorm periods, such as nutrients from straight pipes or septic systems may also occur but have not been quantified. Without information on which source activities are most important, it is not clear which specific source control practices should be emphasized.

The WaDE program has some resources available to assist homeowners in addressing domestic waste problems identified during field surveys. Beyond the WaDE survey, additional field assessment would be required to identify which specific areas most merit attention. In practice, effective control is difficult because important sources are dispersed, sometimes difficult to identify, and are located on private property. Unlike agriculture, there are no ongoing programs to provide financial incentives or cost-share assistance to property owners.

6.2.4 Strategies for New Construction and Disturbed Areas

Recommendation: Cherokee County should consider establishing a local Erosion and Sediment Control Program to improve enforcement of regulations and promote the use of more

effective practices. Efforts to reduce construction-related sediment will be most effective if they include not only regulatory requirements, but also non-regulatory efforts to educate contractors and property owners regarding the importance of limiting disturbance and utilizing appropriate control practices. This recommendation is discussed further in Section 8.

Discussion. Areas under construction are a significant source of sediment in the planning area. Many local residents and officials believe that existing state erosion and sediment control requirements are poorly enforced by the state, and that construction site practices are in need of dramatic improvement. Mission Quarry is also a significant source of sediment. Recommendations to address this source are discussed in Section 6.4.

6.2.5 Strategies for Roads

Recommendation: High priority areas of roadway and bank/ditch erosion should be identified and stabilized to the extent practicable. The HRWC, Cooperative Extension Service or Cherokee County SWCD could take the lead in securing funding for these tasks.

Discussion. Sediment from eroding unpaved road surfaces and eroding road banks and ditches is believed to account for about 10% of the sediment load in 2005. The vast majority of the unpaved roads and eroding banks recorded in the IPSI (Appendix A Figure 7) are on private land and maintenance is not the responsibility of the NCDOT. These roads vary greatly in the likelihood of erosion based upon the road surface (gravel, dirt or grass), the gradient, and the existence of drainage problems. Additional field assessment would be required to identify those unpaved roads that most merit attention. Additionally, rates of road surface erosion can be affected by a variety of drainage issues, such as improper ditching. Without information on specific activities associated with these sources, those source control practices that would be most useful cannot be reliably specified.

While road-related sediment sources can be dealt with in theory, control is difficult in practice. There are no ongoing programs to provide financial incentives or cost-share assistance to property owners for road repair and maintenance. Some roads will likely be found to be on slopes too steep to allow for effective erosion and runoff control. Other roads may have severe space constraints that limit remediation options. Additionally, unpaved roads require ongoing maintenance to insure proper erosion control and hydrologic condition. Even if active erosion areas are remediated, problems may return in the future if property owners do not engage in proper maintenance practices.

A variety of resources are available on road maintenance and design. NRCS has developed a guide for the southern mountains (Tew et al, 1985), and the Choctawhatchee, Pea and Yellow Rivers Watershed Management Authority (Alabama) has compiled useful documentation (CPYWMA, 2000). The Penn State University Center for Dirt and Gravel Road Studies (<http://www.dirtandgravelroads.org/>) has developed a series of information bulletins on various aspects of road maintenance.

6.2.6 Other Recommendations

Recommendation: BMPs to protect water quality should be used during harvesting and other silvicultural operations, as outlined in the North Carolina Forestry Best Management Practices Manual to Protect Water Quality (NCDNR, 2006). Particular attention should be paid to recommended practices regarding streamside management zones, stream crossings and roads.

Recommendation: Landowners should be educated regarding the importance of proper maintenance and revegetation practices to limit erosion from recreational and other activities on forest land.

Discussion. Forested areas are generally not significant sources of sediment, but can become source areas in the absence of proper management. Proper silvicultural practices are important, particularly during road construction and timber harvest. Other activities, such as the intensive use of off road vehicles, can also result in erosion if these activities are not properly managed and damage is not repaired. A recent survey by the NC Division of Forest Resources (NCDFR) found that, across all sites surveyed in the NC mountains, only 69% of the appropriate BMPs were implemented, the worst record of any region of the state (NCDFR, 2005).

The repair of eroding stream banks and replanting of riparian areas, carried out to address channel modification and the lack of streamside vegetation (Section 6.1) will also serve to reduce pollutant inputs to streams.

6.3 Stormwater Issues in the Peachtree Area

Recommendation: Potential stormwater retrofit sites should be identified in the Tri-County Community College / Murphy Medical Center area, and an effort undertaken to secure funding to implement these projects. Retrofit projects would be useful even if they do not treat large areas and serve primarily educational purposes.

Recommendation: NCDWQ should continue its investigation into the nature of water quality degradation in McComb Branch and its tributaries, and the role of stormwater impacts in that degradation. NCDWQ should make recommendations to improve water quality in these streams. Recommended actions should include the identification and elimination of any illicit discharges in the Tri-County Community College / Murphy Medical Center area.

Discussion: Existing stormwater impacts in the Peachtree area can be remediated through the practice of stormwater retrofitting - installing stormwater control structures such as detention ponds, stormwater wetlands and bioretention areas in existing developed areas. An exhaustive effort was not made to identify stormwater retrofit opportunities. However, a preliminary search was made of the Tri-County Community College (TCCC) and Murphy Medical Center properties and surrounding parcels. The goal was to identify potential sites suitable for retrofits. A number of areas exist that may be suitable, though these are generally on land owned by other parties that may be subject to development in the future. Two areas on the TCCC property may be suitable for a small facility such as a bioretention area (Figure 6.2). Both sites receive runoff from College buildings and parking lots, though the area draining to each site is difficult to determine since the contributing areas to individual storm outflows are not clear.

- Site No.1 is turf area of approximately one acre between the tennis courts and the NC Division of Forest Resources office;
- Site No. 2 is a somewhat larger field (2.7 acres) located behind the Cochran Funeral Home.

Without better design and stormwater control practices, further stormwater impacts in the vicinity of US64/ NC141 are likely as additional commercial developments occurs. Implementation of these practices is critical to prevent further deterioration in the McComb

Branch sub-watershed, which has already seen substantial impacts. Recommendations regarding stormwater management are discussed further in Section 8.

Tributaries to McComb Branch flow under both the TCCC campus and facilities adjacent to the Murphy Medical Center. The nature of connections to these underground segments (from both stormwater and other sources) is unknown. The potential for illicit discharges is a particular concern in the TCCC area due to high baseflow metals concentrations and unusual stream discharge conditions observed by NCDWQ.

6.4 Impacts from Mission Quarry

Recommendation: In order to reduce sediment impacts to the stream below the quarry and to the Hiwassee River, the NCDWQ and NCDLR should continue their effort to bring the Mission Quarry operation into compliance with all operating permits. Steps should be taken to ensure that ongoing enforcement is sufficient to induce continued compliance and that additional impacts do not occur.

Recommendation: NCDWQ should continue its efforts to identify the source of high conductivity in the stream below the quarry, as well as high nutrient levels. The agency should make recommendations for water quality improvement upon completion of the investigation.

6.5 Groundwater Contamination

Recommendation: The NC Division of Waste Management (NCDWM) should conduct follow up sampling of private drinking wells in the Peachtree area to determine if a health risk exists from groundwater contamination at the Tri-County Community College or Moog sites. Sampling should be conducted in consultation with the Cherokee County Health Department.

Recommendation: NCDWM should continue to monitor compliance with remediation activities at the two sites to insure that reductions in contaminant concentrations continue and that required monitoring occurs.

No threat to drinking water or to aquatic life has been documented from the contaminated groundwater. However, additional investigation of drinking water wells is warranted.

Figure 6.2 Location of Potential Stormwater Retrofit Sites on the Tri-County Community College Campus



Section 7

Preservation Strategies and Priorities

While the preceding recommendations in this plan have discussed measures to address existing degradation, this section focuses on measures to preserve watershed function. This is important both to protect existing high quality resources, but also because protection of key areas can help prevent further loss of function in downstream areas. The preservation strategies discussed below include:

- Preservation of forested areas through conservation easements; and
- Practices for the sustainable use of forest land.

Potential preservation projects to meet NCEEP criteria are presented.

7.1 Background

Data are currently lacking to identify areas for preservation based upon specific ecologically-based criteria. As discussed in Section 5.3, few natural heritage data are available for the planning area and local organizations have not yet developed conservation priorities. The emphasis in developing potential preservation targets for the Peachtree-Martins Creek Local Watershed Plan was therefore on the identification of relatively large forested tracts. Preservation of forested area is critical to maintenance of stream function. It will also preserve terrestrial habitat, although the natural heritage value of this habitat cannot be readily ascertained.

Preservation tools include the purchase of land and the use of conservation easements. Conservation easements are a permanent, legally binding agreement between a private landowner and a qualified land conservation organization that protect important ecological values of a property while allowing continued ownership and use of the land by the landowner. Entering into a conservation easement is completely voluntary. Non-profit private land trusts typically hold conservation easements but federal, state, and local government entities may also perform this function.

7.2 Preservation Recommendations

Recommendation: Governmental agencies and private organizations should work with local landowners to protect exiting forested tracts in the planning area using conservation easements or other means. NCEEP can undertake these projects in situations where this is feasible. The HRWC, the Land Trust for the Little Tennessee and other local groups should work with property owners to initiate projects where NCEEP cannot operate.

Discussion: Two sets of forested tracts were identified for potential preservation - a limited set of parcels meeting specific criteria for NCEEP projects, and a larger set that may be of broader conservation interest. These tracts are discussed in Sections 7.4 and 7.3 respectively.

7.3 General Preservation Priorities

7.3.1 Tract Identification

Parcels containing a minimum of 50 acres of forest were identified using the IPSI land use/land cover data base and Cherokee County parcel information. Several parcels were dropped because forested areas in the tract were fragmented. Parcels which are part of the Nantahala National Forest were also dropped. Finally several parcels along the US 64 bypass near Harshaw Road (sites number 3 and 5) were dropped because plans for development are in place for these parcels and preservation seems unlikely.

The resulting group of tracts (Figure 7.1) includes 31 parcels with at least 50 acres of forest. These parcels range in size from 52 to 401 acres. About 20 of these have been identified by the Local Advisory Committee (LAC) as having substantial potential for development over the next 10 years, due either to their location or a belief that the owner is interested in developing the property. One of the tracts (number 33 in Figure 7.1) is in US Forest Service (USFS) ownership, but is likely to be sold to a private party or traded by the USFS for a tract elsewhere that is contiguous to other Forest Service lands.

Whether the owners of these 31 parcels are potentially interested in land conservation options was not explored in any detail during the development of this plan. There are several parcels for which the LAC feels the owner may be interested in preservation, though this information should not be considered conclusive and LAC members were not familiar with all property owners. This information is included in Table A2 in Appendix A, along with parcel and property owner information for these tracts.

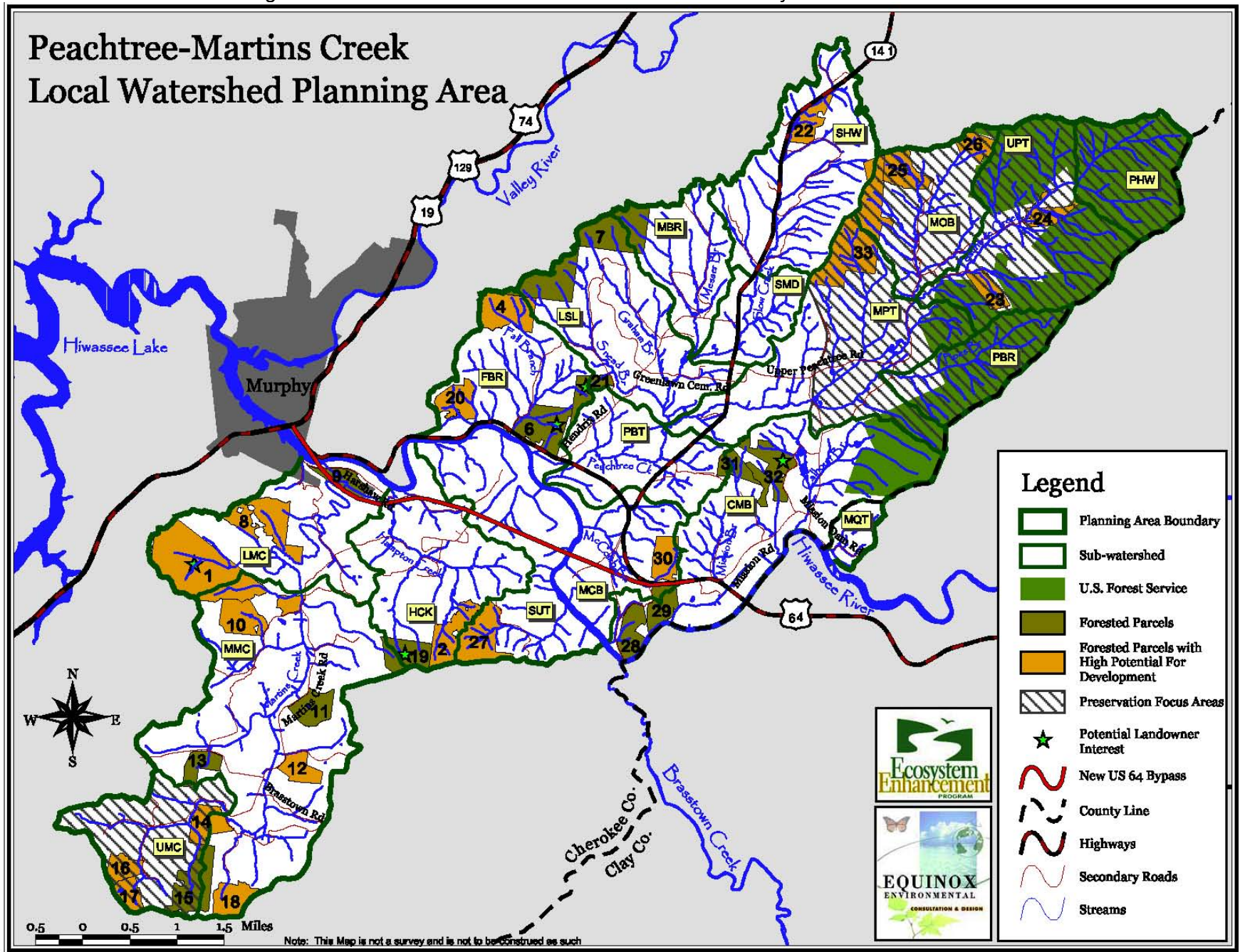
7.3.2 Priority Tracts for Preservation

Other than the Nantahala National Forest, few large parcels of forested land remain in the planning area. Of the 31 parcels described above only 4 exceed 300 acres, located primarily on the western margin of the area. Only 6 other parcels exceed 100 acres. Preserving large areas of forest in the Peachtree-Martins Creek area will thus be a challenge and will likely require working with multiple landowners to preserve even a modest amount of forested land.

All of the parcels identified in Figure 7.1 should be considered for potential preservation. As discussed in Section 5, the upper Peachtree drainage and the Upper Martins Creek (UMC) sub-watershed have been identified as focus areas for preservation. These are the only portions of the planning area that currently support a high level of ecological function. In order to help retain existing function in these areas, preservation of forested tracts here should be a priority. These areas are also upstream of sites at which the mountain creekshell was found. There are five parcels in the UMC sub-watershed with more than 50 acres of forest, and five such parcels in the upper portion of the Peachtree drainage (Upper Peachtree and Moore Branch sub-watersheds).

Preservation of headwaters tracts in other areas is also important to prevent further degradation in ecological condition and is recommended.

Figure 7.1 Potential Preservation Tracts with at Least Fifty Acres of Forest Cover



7.4 Potential NCEEP Project Sites

A site search was conducted to identify potential preservation parcels for NCEEP to meet compensatory mitigation needs. Sites were identified as potential NCEEP preservation sites based upon parcel size, stream reach length and riparian area classification criteria developed in consultation with NCEEP.

Primarily forested reaches were identified as potential NCEEP preservation reaches using a three-stage process similar to the one used to select restoration and enhancement sites.

1. Initial reach identification using the IPSI data base;
2. Limited field reconnaissance;
3. Scoring and prioritization. Reaches were scored based on several factors and sites were then prioritized based on this scoring.

Methods are discussed in detail in the *Project Atlas* that accompanies this Watershed Management Plan.

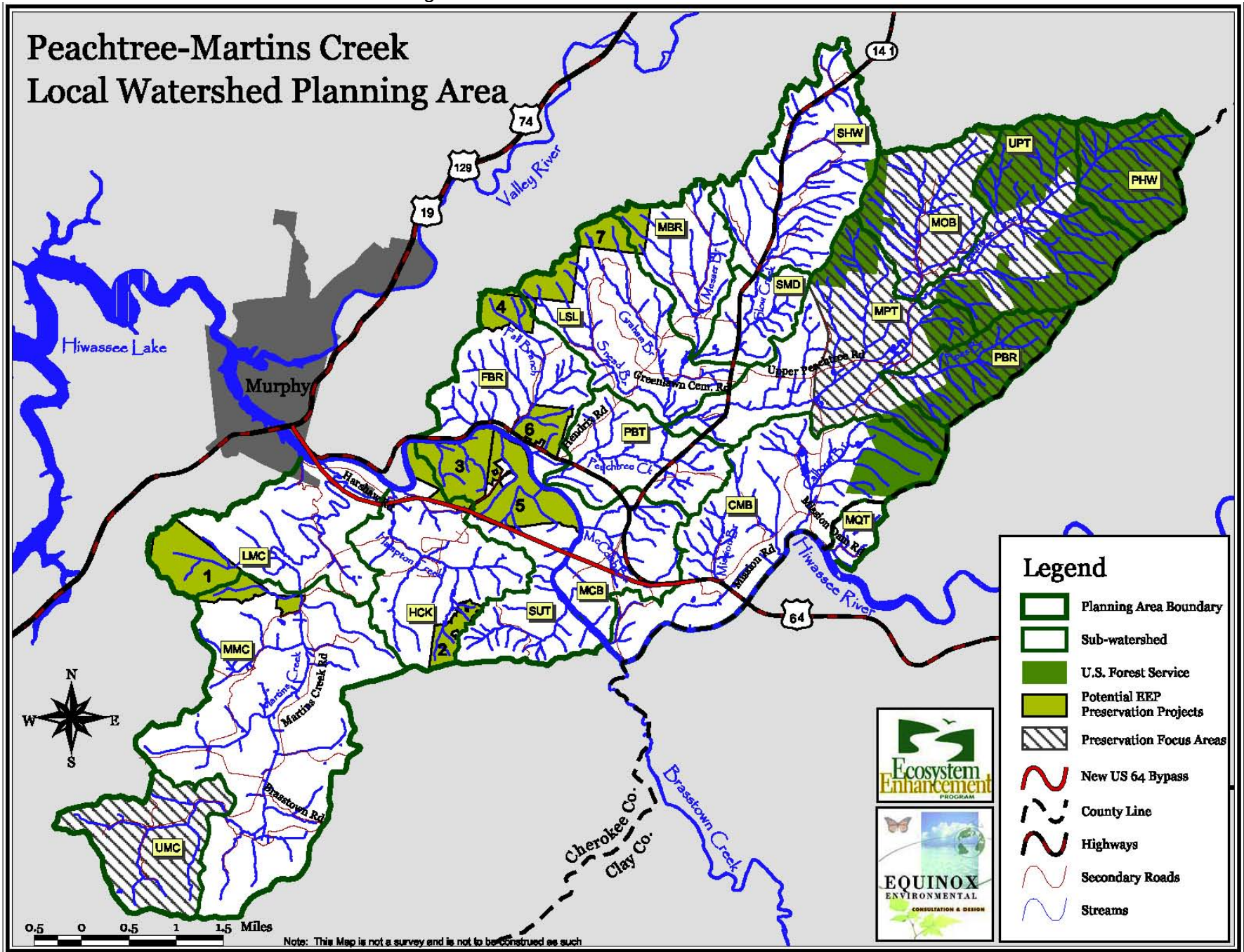
Seven sites in the planning area were identified (Table 7.1 and Figure 7.2), though many have either recently been impacted by the 64 bypass project or are likely to be infeasible because of impending development or other issues. Two sites are not affected by these concerns. These are also the two sites with the highest ecological condition scores. These are Sites 1 and 6, which are recommended to NCEEP as priority preservation sites. Additional information on the seven sites is included in the *Project Atlas*.

Table 7.1 Potential NCEEP Preservation Sites

Reach ID	Sub-Watershed*	Stream Name	Total Score**	Priority Level**	Feasibility Concerns
1	LMC/MMC	Right Prong Martins Ck	7	High	No
6	FBR	Fall Br	6	Medium	No
2	HCK	Hampton Ck	5	Medium	Yes
4	FBR/LSL	Fall Br	5	Medium	Yes
3	SUT	UT Hiwassee River	4	Low	Yes
5	SUT	UT Hiwassee River	4	Low	Yes
7	LSL/FBR/MSB	Snead Br/Graham Br	4	Low	Yes

*Where portions of a parcel lie in several sub-watersheds, the primary sub-watershed is shown in bold type.

Figure 7.2 Potential NCEEP Preservation Sites



7.5 Management of Forested Lands

Recommendation: Owners of private woodlands in the planning area are encouraged to practice sustainable forest management, protecting habitat and water quality while making productive use of their land.

Discussion: Several resources are available to private landowners who want to more actively manage their forest lands while still meeting some conservation objectives. Appalachian Voices in Boone, NC has produced a sustainable forestry guidebook, well-respected by a variety of forestry professionals, entitled *Managing Your Woodlands, A Guide for Southern Appalachian Landowners* (Goslee, 2004). Additional copies of this handbook can be obtained free of charge from Appalachian Voices.

The NC Division of Forest Resources (NCDFR) provides free on-site forestry planning and consultation to forest land owners. The NCDFR administers the non-binding Forest Stewardship Program to provide landowners with cost-effective resource management planning. Participants in this program are eligible for cost-share assistance from NCDFR that can help with reforestation and timber stand improvements. Participants also receive recognition with a sign to post on their land. NCDFR also maintains a list of consulting foresters who can help woodland landowners with forest management plans and road and access designs to minimize impact on streams and riparian areas (<http://www.dfr.state.nc.us/contacts/cf/cfyancey.pdf>.) The private consulting foresters charge for their services.

Regardless of whom landowners select to perform these services, good forest management plans, at minimum, should specify the following stream and riparian protective measures:

- Retaining a streamside management zone to filter sediment, shade streams, and maintain a wildlife corridor;
- Minimizing the number of stream crossings;
- Installing properly temporary stream crossings that are required;
- Constructing logging access roads at less severe angles to streams;
- Installing erosion control measures where necessary to reduce overland erosion and sedimentation into streams;
- Seeding immediately road beds constructed for access; and
- Leaving trees that have wildlife benefit.

Approximately 14% of the project area, located primarily in the upper half of the Peachtree Creek drainage, lies within the Tusquitee Ranger District of the Nantahala National Forest. Under current management plans, national forest lands within the project area are included under Management Area 3B. These lands are managed for sustainable timber harvest, habitat for wild turkey and other compatible species (which may involve specific timber cuts or the maintenance of cleared areas), and recreational activities such as hiking and hunting (USDA National Forest Service, no date). Motorized vehicle access is limited.

Section 8

Mitigating the Impacts of Future Development

8.1 Introduction

Both residential and commercial development will continue in the Peachtree Martins Creek planning area. Without a focused effort to mitigate the impacts of this activity, further degradation of water quality, hydrologic condition and stream habitat is likely to occur in many area streams. Additionally, efforts to ameliorate current degradation may have little noticeable impact, or those impacts may be short-lived, if future development issues are not dealt with effectively and expeditiously.

The potential water quality and ecological impacts of development can be avoided or reduced through institutional measures taken by local and state governments to guide and shape this activity. These measures can include ordinances, design standards, educational efforts and other actions to assure that development occurs in such a manner that negative environmental impacts are minimized.

Cherokee County currently has few regulations to guide development activity. A limited floodplain ordinance applies to portions of the Valley River drainage, outside of the planning area. A water supply protection program includes part of the McComb Branch and Calhoun-Mission sub-watersheds. Cherokee County does not have a comprehensive plan and has not developed a subdivision ordinance.

This section recommends nine institutional measures for the consideration of local officials in the Peachtree-Martins Creek area:

1. Adoption of a subdivision ordinance that encourages Low Impact Development (LID) approaches and other methods of reducing impacts;
2. Instituting post-construction stormwater management requirements;
3. Developing a local erosion and sediment control program;
4. Ongoing public education regarding watershed and stormwater issues;
5. Evaluation of stormwater control opportunities on government properties;
6. Adoption of hillside development standards;
7. Expansion and revision of the existing water supply and floodplain ordinances;
8. Development of a long-term wastewater management plan; and
9. Development of a comprehensive land use plan.

The task of developing and adopting these measures will be a major undertaking for the County and will take some time to carry out. It is important that the process begin as soon as possible, so that as much future development as possible takes place under a set of standards that will more effectively mitigate environmental impacts. While all nine of the recommended measures are important, the first four are particularly important to pursue as expeditiously as possible.

8.2 Recommendations

Adoption of a subdivision or development ordinance

Recommendation 1: Cherokee County should consider developing and adopting a subdivision ordinance to ensure that adequate planning occurs prior to land development and that design standards and development practices are adequate to address environmental and resource protection needs. The ordinance should encourage Low Impact Development and other measures to minimize water quality impacts from development and should provide developers with incentives to undertake a variety of voluntary conservation efforts.

Discussion: Subdivision and land development ordinances are important tools both to promote orderly growth and facilitate the provision of public services, as well as for ensuring environmental protection. A subdivision ordinance should consider a range of issues related to water quality, including: infrastructure planning, road design, vegetative clearing, building setbacks, drainage design, open space and other concerns. *Better Site Design* (Center for Watershed Protection, 1998), a document developed by the Center for Watershed Protection, is one useful resource in developing such an ordinance. The recommendations developed by participants in the Northeast Georgia Growth Readiness Program (Southeast Watershed Forum, 2007) provide a set of consensus guidelines developed for the southeastern mountains by individuals representing a diverse group of interests. These recommendations encompass planning for roads and related vehicular uses, lot development and conservation of natural areas.

In the design of the ordinance, options should be included to encourage the use of Low Impact Development (LID) techniques. LID is a comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. LID techniques generally include the active promotion of infiltration practices and other approaches to limit stormwater volume in both low density and high density development. LID seeks to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Stormwater management through landscape features located at the lot level is preferred over larger subdivision scale controls. A variety of resource materials on LID are available (see: Prince George's County, 1999; USEPA, 2000; <http://www.epa.gov/nps/lid/>; and <http://www.lowimpactdevelopment.org/>).

While an ordinance must include specific requirements, it will be most effective if it also provides developers with incentives to undertake voluntary land conservation efforts, including preservation of open space and natural areas as well as practices that promote environmental protection. Several of the measures discussed in the recommendations to follow (e.g. post construction stormwater management and hillside development standards) could potentially be addressed as part of a subdivision or development ordinance.

Post-construction stormwater management

Recommendation 2: Cherokee County should consider developing and adopting a comprehensive stormwater management program to reduce the environmental impacts of post-construction stormwater.

Discussion: In order to prevent further stream channel and biological community degradation, it is critical that effective post construction stormwater management be employed throughout the planning area. This need is particularly acute in the US 64/NC141 area and in the vicinity of the

new US 64 Bypass, but stormwater concerns will become more common throughout the area as development continues. There is little likelihood that stormwater management will improve without requirements established by local government. A post-construction stormwater program should seek to reduce the volume of stormwater runoff, as well as velocities and peaks flows, providing water resource benefits as well as helping to prevent flooding. Traditional structures such as wet detention ponds can be used, as well as constructed wetlands, bioretention areas and a variety of other practices, including those associated with LID.

Erosion and sediment control

Recommendation 3: Cherokee County should consider development of a local erosion and sediment control program, with specific provisions to address smaller sites and road and site development on steep slopes. Staffing levels sufficient to support effective enforcement are essential. Efforts to reduce construction-related sediment will be most effective if they include not only a regulatory component, but also non-regulatory efforts to educate contractors and property owners regarding the importance of limiting disturbance and utilizing appropriate control practices. These educational functions could also be performed as part of a broader public education program (see below).

Discussion: The state's Erosion and Sediment Control (E&SC) Program, operated by the Division of Land Resources, covers the planning area out of a regional office located in Asheville. The state program was developed to address sediment issues on a state-wide basis and is not specifically designed to address issues particular to the mountain region, which has steeper slopes and higher rainfall levels than elsewhere in North Carolina. An approved local program would provide the County with the authority to enforce both state and local standards. Some state funding is available to support the start up of local programs. Development of a local program should facilitate both more responsive enforcement of regulations and the development of guidelines that better reflect local needs and concerns, including construction on steep slopes and impacts from smaller development sites which fall below the state's one acre threshold for an erosion control plan.

Public education

Recommendation 4: Cherokee County should develop a robust public education program to increase public knowledge of water quality and watershed issues, including stormwater and other issues of concern.

Discussion: Effective education of local citizens and business is critical to all aspects of watershed management. It is important both to change individual behaviors that result in unnecessary pollution and to build public support for effective solutions to both existing and anticipated problems. Among the issues a program should address are the following:

- Potential impacts of uncontrolled stormwater on stream channels and water quality;
- Role of both voluntary and regulatory measures in watershed management;
- Proper pesticide and fertilizer use;
- Proper riparian zone management, including retaining existing wooded riparian areas on streams and replanting native riparian vegetation where it is absent;
- The importance of avoiding stream channel disturbance; and
- Proper septic system maintenance.

Education is a long-term investment in the future of the Peachtree-Martins Creek area. Though a piecemeal approach can be used to address various educational needs, a more viable approach would be to develop a comprehensive program implemented at the county level.

Evaluation of stormwater control opportunities on government properties

Recommendation 5: Publicly owned facilities - including facilities owned by Cherokee County, NCDOT, TCCC and other government agencies - should be evaluated for their potential to treat/retain stormwater. Stormwater BMPs should be implemented on other public properties as they are developed.

Discussion: Cherokee County and other governmental agencies have the opportunity to use their facilities both to initiate water quality improvement efforts and to educate citizens and business owners regarding stormwater management. Implementing feasible stormwater retrofits and other projects on public properties is one way for local and state agencies to exercise leadership in watershed management.

Adoption of hillside development standards

Recommendation 6: Cherokee County should consider the development of hillside development or mountain protection standards to address potential problems associated with development activity on steep terrain.

Discussion: Local and state governments in North Carolina, Georgia and other portions of the southeastern US have become increasingly aware of the potential hazards associated with development on land characterized by steep slopes and shallow soils. Without appropriate design and construction, development in these areas poses an increased risk of water quality impacts due to sediment and an increased risk to life and property from landslides and slope failure. A variety of approaches have been implemented or discussed by governmental agencies, including measures such as the following: create standards that specify conditions under which a geotechnical analysis is required; require plan approval by an engineer; set limitations on the extent of disturbance (e.g. percentage of site graded based on slope) or road corridor dimensions; require preservation and/or replacement of vegetation; and regulate the nature and extent of fill. Voluntary efforts to avoid development in difficult areas could be encouraged by educating property owners and developers regarding these issues and encouraging better land planning and subdivision design. Asheville, Boone and Jackson County are among the North Carolina jurisdictions that have recently passed hillside development ordinances. Henderson and Buncombe Counties are currently considering draft measures to address hillside development concerns.

Expansion and revision of the existing water supply and floodplain ordinances.

Recommendation 7: Cherokee County should consider expansion of its floodplain ordinance to include relevant portions of the Peachtree-Martins Creek area, and should evaluate both the floodplain and water supply protection ordinances to determine ways in which they may be improved.

Discussion: Floodway and floodplain development can pose dangers to life and property and cause a variety of environmental impacts. Upstream actions, such as the filling of floodplain areas can have a significant impact on downstream properties. Floodplain policies provide guidance to control the alteration of natural floodplains, stream channels, and natural protective barriers involved in the accumulation of flood waters, including filling, grading, dredging, or other development which may increase erosion or flood damage. Such policies can help to minimize public and private losses during floods.

Development of a long term wastewater management plan

Recommendation 8: Cherokee County should develop a long term plan for meeting future wastewater treatment needs.

Discussion: As the county continues to grow, it will become increasingly important to plan for the adequate disposal of domestic wastewater. Maintenance and expansion of the existing sanitary sewer/wastewater treatment system is one key concern. Assuring the integrity of onsite systems, including system maintenance and the proper disposal of pump-out waste, is also important. In order to assure that both environmental and service delivery issues are addressed, a comprehensive plan should be developed that addresses future needs for both of these components.

Development of a comprehensive land use plan

Recommendation 9: Cherokee County should consider the development of a county-wide comprehensive land-use plan.

Discussion: A comprehensive land use plan is a tool to aid local governments and citizens in guiding growth, ensuring adequate infrastructure and services and protecting environmental resources. Development of a plan will help the county to develop a vision for the future and take a proactive approach to attaining that vision. County guidelines or ordinances can then be developed as appropriate to implement the plan.

Section 9

References Cited

Arnold, C.L. and C.J. Gibbons. 1996. Impervious surface coverage: the Emergence of a Key Environmental Indicator. *Journal of the American Planning Association*. 62:2:243-258.

Booth, Derek B., D. Hartley and R. Jackson. 2002. Forest Cover, Impervious Surface Area, and the Mitigation of Stormwater Impacts. *J. of the American Water Resources Association*. 38:3:835-845.

Center for Watershed Protection. 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Center for Watershed Protection. Ellicott City, MD. August.

Center for Watershed Protection. 2003. *Impacts of Impervious Cover on Aquatic Systems*. Watershed Protection Research Monograph NO. 1. Center for Watershed Protection. Ellicott City, MD.

Choctawhatchee, Pea and Yellow Rivers Watershed Management Authority (CPYWMA). 2000. *A Guideline for Maintenance and Service of Unpaved Roads*. February.

Equinox Environmental. 2007. *Peachtree-Martins Creek Local Watershed Plan—Watershed Assessment Report*. Report prepared by Equinox Environmental Consultation and Design, Inc. for the NC Ecosystem Enhancement Program. May 2007.

Equinox Environmental. 2006. *Peachtree-Martins Creek Local Watershed Plan--Preliminary Findings and Recommendations Report*. Report prepared by Equinox Environmental Consultation and Design, Inc. for the NC Ecosystem Enhancement Program. January 2006.

Goslee, Katy. 2004. *Managing Your Woodlands: A Guide for Southern Appalachian Landowners*. Appalachian Voices. Boone, NC.

Jones, Krista L., G.C. Poole, J. L. Meyer, W. Bumback and E. A. Kramer. 2006. Quantifying Expected Ecological Response to Natural Resource Legislation: a Case Study of Riparian Buffers, Aquatic Habitat and Trout Populations. *Ecology and Society*. 11(2)15. Online at <http://www.ecologyandsociety.org/vol11/iss2/art15>.

Prince George's County. 1999. *Low Impact Development Design Strategies: an Integrated Design Approach*. Prince George's County, Maryland, Department of Environmental Resources.

NCDFR. 2005. *Final Report for the NC Forestry BMP Implementation Survey, 2000-2003*. NC Division of Forest Resources. December.

NCDFR. 2006. *North Carolina Forestry Best Management Practices Manual to Protect Water Quality*. NC Division of Forest Resources. Publication Number FM-08-01. September. Online at http://www.dfr.state.nc.us/water_quality/wq_bmpmanual.htm.

- NCWRC. 2005. North Carolina Wildlife Action Plan. NC Wildlife Resources Commission.
- Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques*. 2(1): 233-239.
- Southeast Watershed Forum. 2007. Northeast Georgia Growth Readiness Report, 2007. Online at <http://www.southeastwaterforum.org/news/item.asp?id=421>.
- Tew, Howard C., L.C. Price and L.W. Swift. 1985. *The Layman's Guide to Private Access Road Construction in the Southern Appalachian Mountains*. NRCS Waynesville Area Office. Waynesville, NC. Reprinted 1996.
- Tennessee Valley Authority. 2006. Tusquittee-Peachtree-Martins Creek Nonpoint Source Pollution Inventory. Report Prepared for the NC Wetlands Restoration Program. Knoxville, TN.
- USDA National Forest Service. no date. *Highlights of the Land and Resource Management Plan. Amendment 5. Nantahala and Pisgah National Forests*. Forest Service Southern Region.
- USEPA. 2000. Low Impact Development (LID) - A Literature Review. Report Number. US Environmental Protection Agency Office of Water. 841-B-00-005.
- Wenger, Seth. 1999. *A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation*. Institute of Ecology. University of Georgia. Athens, Georgia.