Upper North Toe River Watershed Action Plan

Avery, Mitchell, and Yancey Counties North Carolina

Effective January 1, 2015

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Key to Acronyms and Abbreviations

Acronym	Definition
BMP(s)	Best Management Practice(s)
BRRC&D	Blue Ridge Resource Conservation & Development Council, Inc.
CCAP	Community Conservation Assistance Program
CWMTF	Clean Water Management Trust Fund
CWP	Center for Watershed Protection
D.O.	Dissolved oxygen
HQW	High Quality Waters
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
IPSI	Integrated Pollutant Source Identification
NCCGIA	North Carolina Center for Geographic Information and Analysis
NCACSP	North Carolina Agricultural Cost Share Program
NCDA&CS	North Carolina Department of Agriculture and Consumer Services
NCDEMLR	North Carolina Division of Energy, Mineral, and Land Resources
NCDOT	North Carolina Department of Transportation
NCDWQ	North Carolina Division of Water Quality (Pre-2013)
NCDWR	North Carolina Division of Water Resources (2013 to present)
NCEEP	North Carolina Ecosystem Enhancement Program
NCFS	North Carolina Forest Service
NCNHP	North Carolina Natural Heritage Program
NCP&R	North Carolina Division of Parks and Recreation
NCSU	North Carolina State University
NCWRC	North Carolina Wildlife Resources Commission
NLCD	National Land Cover Database
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Unit
PQL	Practical Quantitation Limits
PUV	Present Use Value
QAPP	Quality Assurance Project Plan
RSC	Regenerative Stormwater Conveyance
RUSLE	Revised Universal Soil Loss Equation
SAHC	Southern Appalachian Highlands Conservancy
SCM(s)	Stormwater Control Measure(s); formerly Stormwater Best Management Practices – BMPs
STEPL	Spreadsheet Tool for the Estimation of Pollutant Load
SWCD	Soil and Water Conservation District
TAC	Technical Advisory Committee
TLW	Targeted Local Watershed
TMDL	Total Maximum Daily Load
Tr	Trout Waters
TRVW	Toe River Valley Watch
TRVWP	Toe River Valley Watershed Partnership
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
UT(s)	Unnamed Tributary/Tributaries
VWIN	Volunteer Water Information Network
WAP	Watershed Action Plan (this document)
WS	Water Supply

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Executive Summary

Background

Despite the fact that it is use to supply both drinking water and industrial water, portions of the upper North Toe River watershed have been on North Carolina's 303(d) list of impaired waters since 2006; in 2014 a portion of Grassy Creek was added to the list. The mainstem North Toe River was listed because turbidity levels exceed the State's standard for waters assigned the Trout Waters (Tr) supplemental classification; Grassy Creek is listed because of a degraded fish community. The primary sources of sediment include urban and residential development; agricultural, silvicultural, and horticultural activities; poorly vegetated riparian zones; stream channel alterations; and stormwater runoff. In Grassy Creek, aquatic habitat conditions have been impacted from stormwater runoff from commercial and residential developments. While copper was previously identified as a reason for the impaired waters listing of the mainstem North Toe River, its impacts on the biological community and it source were unknown. The 2014 303(d) list does not include these waters as being impaired by copper.

To avoid having the North Carolina Division of Water Resources (NCDWR) mandate actions to reduce turbidity in the upper North Toe River watershed, the Blue Ridge Resource Conservation & Development Council (BRRC&D) submitted a proposal in 2012 to guide efforts to implement watershed improvement projects that would lead to reduced turbidity levels. The proposal for funding from the NCDWR 319 Grant Program (319 Grant) included a plan to conduct watershed assessments that identify specific sediment sources and for those data to be used to develop a Watershed Action Plan (WAP; this document). The purpose of the WAP is to provide the BRRC&D and its partners a road map for implementing watershed improvement projects that will result in decreased turbidity levels and improved biological integrity of streams in the upper North Toe River watershed. The WAP also includes a strong outreach and education component that will be used to increase public awareness about the watershed. Implementation of the WAP will give the BRRC&D access to additional 319 program funding and will serve as a supporting document for grant funding from other sources.

As part of the initiative to develop the WAP, a group called the Toe River Valley Watershed Partnership (TRVWP) is being established. It is to be a coalition of public and private organizations that will collaborate to address water quality issues in the upper North Toe River watershed. They care deeply about the North Toe River and the environmental, economic, and social benefits it provides. The group will build upon the success of the Toe River Valley Watch (TRVW), BRRC&D, the Avery and Mitchell county Soil and Water Conservation Districts, and other conservation organizations. They all have been active in implementing land protections and on-the-ground projects leading not only to reduced erosion but also lower nutrient levels and improved aquatic habitat. Also, they have been actively involved in education and outreach through the local school systems and faith communities.

Based on the overwhelming support of stakeholders to establish a partnership aimed at improving the upper North Toe River drainage, the following goals were established:

Short-Term Goals
- Develop a WAP for the upper North Toe River.
- Garner public support through a well-developed and thoughtful outreach plan
- Collect additional water quality data.
- Implement on-the-ground watershed restoration projects that will improve water quality and in-stream aquatic habitat.

Long-Term Goals
- Improve water quality and restore uses to impaired waters in the upper North Toe River watershed.
- Protect water quality for downstream landowner uses and aquatic resources.
- Support efforts to enhance fish and aquatic species communities.
- Reduce water quality impacts to the upper North Toe River watershed, which will lead to economic benefits.

Watershed Action Plan Organization and Content

The following summarizes the organization and content of the Upper North Toe River WAP.

<u>Section</u>

1. *Introduction* – Provides insight into the history of the watershed, an explanation as to why streams in the Upper North Toe River watershed are impaired, and a synopsis of the cause and sources of the primary stressor -- sediment. It describes why people should care about the watershed; development of the TRVWP; and the watershed planning process, including goals of the planning team.

2. *Watershed Characterization* – Describes the geographic, population, general land use, and natural resources characteristics of the upper North Toe River watershed. Details are provided on industrial land uses as well as a brief description of the ordinances and regulations of Avery and Mitchell counties and the Towns of Newland and Spruce Pine that affect the water quality of the North Toe River and its tributaries.

3. *Watershed Conditions* – Provides a comprehensive review of existing water quality and biological data as well as a review of a recent baseline benthic macroinvertebrate survey. It describes the results of assessments conducted in association with the development of the WAP that were used to identify potential watershed improvement projects. Those assessments were targeted at identifying potential sediment sources and addressed the following issues: turbidity, stream channel conditions, riparian vegetation conditions, unpaved roads, nonnative invasive plants, and horticultural operations.

4. *Management Measures* – Describes the major types of measures that can be used to improve watershed conditions and reduce sedimentation. Descriptions are presented for four categories of projects: stream channel restoration/enhancement, upland management, stormwater controls, and agricultural Best Management Practices (BMPs). It also includes estimates of the pollutant load reductions to be achieved with those projects. A detailed description of the proposed education and outreach plan as well as recommended future watershed assessments, a plan for monitoring watershed

conditions, and the role the TRVWP can play in facilitating watershed improvement projects is presented.

5. *Implementation Strategies* – Provides the road map and accomplishments tracking mechanism for implementation of the WAP. Tables listing how much of each type of project and over what time span are presented. Corresponding implementation schedule tables showing when each action will be implemented are also provided.

6. *References* – Documents the source materials used in the preparation of the WAP, including web links (where available).

7. *Appendices* – Provides details of the methods used to analyze data associated with the assessments. Also includes a list of funding sources and programs.

Watershed History and Characteristics

Water quality of the upper North Toe River has suffered considerable abuses and achieved notable improvement over the last 100 years. Mining and logging were two industries that devastated the watershed landscape in the early 1900s. Clear-cutting and mining methods were harsh on the environment. Sediment runoff from mountainsides and discharges from mine processing often caused the North Toe River to run white with sediments. These conditions often choked out aquatic life. Since the Clean Water Act was passed in 1972, new requirements for erosion control, wastewater treatment, and stormwater permitting have led to improved water quality. Over time, mountain vegetation has recovered and mining methods have improved, resulting in cleaner water and healthier streams. Despite the improvement in water quality, work still needs to be done.

The North Toe River upstream of its confluence with the South Toe River is the focus of the WAP. The watershed is 183 mi^2 in area and lies within Avery, Mitchell, and eastern Yancey counties. The river generally flows east to west, originating at the base of Sugar Mountain in Avery County. Elevations within the watershed range from 6,160 feet along the Roan massif at the head of Roaring Creek to 2,333 feet at the confluence of the North and South Toe Rivers near the Mitchell/Avery county line. Eighty-five percent of the watershed is undeveloped; 8% is in agriculture. Hard-rock surface mining within the “Spruce Pine Mining District” is an important industry, providing high quality quartz for the manufacture of virtually all of the world’s microchips. Thirteen miles of rail line, much of it paralleling the North Toe River, also transects the watershed. Approximately 23,000 acres of land are in public ownership or otherwise managed for conservation purposes. The watershed is home to four plant and eleven animal at-risk species associated with streams and riparian areas. The most notable of them is the Appalachian elktoe (*Alasmidonta raveneliana*), an endangered freshwater mussel; the eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*), a salamander; and the Virginia spiraea (*Spiraea virginiana*), a plant known to thrive along stream banks. Fourteen populations of brook trout (*Salvelinus fontinalis*), North Carolina’s only native trout species, have been documented in headwater streams.

Most streams within Avery County and upstream of the Spruce Pine water intake are assigned some level of “water supply” (WS) classification by the NCDWR. Each level of classification (I, II, III, IV, or V) carries with it varying restrictions on development and permitted discharges. Because of their high water quality and unique habitat conditions, some streams within the watershed carry the NCDWR High Quality Waters (HQW) supplemental classification. Downstream of the Spruce Pine water intake, the North Toe River and most tributaries are assigned a “C” water quality classification. The supplemental Tr classification applies to most streams throughout the entire planning area.

According to 10 years of NCDWR ambient water chemistry data from two monitoring sites, water quality conditions in the upper North Toe River watershed are good. Of 23 parameters evaluated, only turbidity was found to exceed the State’s standards. At those sites and eight additional sites associated with mining operations stormwater discharge permits, 11-25% of samples have exceeded the 10 Nephelometric Turbidity Unit (NTU) standard. Those data were the basis for adding portions of the North Toe River to the 303(d) impaired waters list. Historic and recent benthic macroinvertebrate community monitoring from 33 sites located throughout the watershed revealed that most sites have been rated Good-Fair or better. Only one site downstream of a mine operation discharge point was rated as Poor. Seventeen of these monitoring sites will be used to assess benthic communities before and after BMPs are implemented by the mining companies and for long-term trends. With the exception of Grassy Creek, fish communities at seven sites were rated as Good-Fair, Good, or Excellent. Grassy Creek was rated Fair due to the abundance of pollutant-tolerant fish species. For this reason, it was added to the 303(d) list in 2014.

Aquatic habitat assessments at 27 sites revealed that stream conditions are generally very good. Four streams were considered to have slightly degraded habitats. Stormwater discharges from urban areas and a mining operation were attributed to conditions on three of those streams. Aquatic habitat scores at mainstem North Toe River sites generally declined from upstream to downstream. Riffle embeddedness scores, an indicator of sediment bed loads, were good at almost all sites; however, the percentage of silt+sand was higher at sites on the North Toe River in Mitchell County.

Watershed Planning History

Since 2000, the North Toe River watershed has been the subject of several significant watershed planning studies. While some of the content of those reports is outdated, much of it is still relevant today and was integrated into the WAP. Those studies of most significance include:

- *North Toe River Riparian Corridor Conservation Design for Five Major Drainages off the Roan Highlands* (SAHC 2000)
- *North Carolina Wildlife Action Plan* (NCWRC 2005)
- *French Broad River Basin Restoration Priorities* (NCEEP 2009)
- *French Broad River Basinwide Water Quality Plan* (NCDWQ 2011)
- *Strategic Plan for the Partners for Fish and Wildlife Program 2012 - 2016, Southeast Region* (USFWS 2011)

Pertinent information from these reports, combined with existing water quality and biological data and input from the Technical Advisory Committee (TAC) was used in developing the WAP.

Watershed Assessments and Findings

As part of the current planning process, supplemental watershed assessments were conducted. These efforts were comprised of either field assessments, desktop GIS analyses, or a combination of both. All assessments were targeted at identifying sources of sediment that could be addressed by the implementation of watershed improvement projects or outreach efforts that will result in decreased sediment inputs into streams. Data from these assessments were used to characterize current conditions of the watershed, identify watershed improvement project types and needs, determine data gaps and additional watershed assessment needs, develop a monitoring plan, and organize a comprehensive outreach and education program. The end result of this process was the development of action plans and implementation schedules that will be achieved over the 10-year planning period.

<u>Water Quality Assessments</u> – Water samples taken at varying flows from 16 locations (11 sites on tributaries and 5 on the mainstem North Toe River) were assessed for turbidity. Grab samples taken at low and normal flows did not exceed the 10 NTU standard for the Tr waters classification. At moderate and high flows, turbidity for 7 of 16 and 5 of 16 samples did not exceed the 10 NTU standard, respectively. The highest turbidities were measured from the two sites located farthest downstream on the mainstem North Toe River (70 and 80 NTU at moderate flows), whereas Squirrel Creek (70 NTU) and Threemile Creek (50 NTU) had the highest turbidities at high flows. Single-stage samplers, designed to collect water samples on rising flows following rainfall events, were installed at six locations, five of which were in the vicinity of the grab sample sites. Although water samples were not obtained from all sites for a given rainfall event, all but one of the 41 samples obtained exceeded 10 NTU. The highest readings were recorded from Threemile Creek (250-900 NTU) and Rose Creek (70-500 NTU). Less-developed watersheds generally had lower turbidities.

<u>Windshield Surveys</u> – The 11 most developed subwatersheds were surveyed by vehicle to identify significant sediment sources from stream banks, riparian areas, and upland disturbances. Observations were made from public roads at stream crossings and from upland areas where the stream channel was visible. Eighty-two observations were made. Unpaved roads/driveways, residential yards, and hay fields/pastures were the most frequently observed disturbances. Almost 30,000 feet of stream channel were considered to be in Fair or Poor condition. The Threemile Creek (38%) and North Toe River headwaters (18%) subwatersheds accounted for over half of the most impacted stream channels. Sixty-nine potential project sites were identified.

Forty-seven upland disturbances, not adjacent to streams, were observed. Of those, 31 were 1 acre in size or less; only 5 significantly disturbed sites were seen. All of the large disturbances were associated with agricultural or horticultural operations. Most lands being prepared for other uses lacked basic erosion control measures.

<u>Streamwalks</u> – Portions of the North Toe River, Grassy Creek, and Beaver Creek were walked or surveyed from boats to determine stream channel and riparian area conditions. Twenty miles of the mainstem North Toe River were found to be generally stable and well-vegetated. Seven significant streambank disturbances were observed outside of the Spruce Pine area. In the vicinity of Spruce Pine, impacted buffers were more common due to urban development and an active rail line. Multiflora rose (*Rosa multiflora*) and Japanese knotweed (*Polygonum cuspidatum*), nonnative invasive plants, were common. Numerous outfalls were observed, some of which had elevated conductivities but none of which were turbid.

The 2.25 miles of Grassy Creek paralleling NC 226 were found to be significantly degraded. It is impacted by commercial development. Eleven stormwater outfalls were documented and appear to be the cause of streambank scour. Seven sections of buffer were found to be severely impacted, having moderate to severe erosion. Although seven power line/sewer line crossings were documented, none of them were shown to be causing stream degradation; however, they will be a factor in areas where stream restoration or enhancement is necessary. Fourteen stream crossings were observed; erosion was noted at seven bridges and poor channel alignment was noted as a problem at two bridges.

Beaver Creek was found to be highly impacted by urban development and fill for highway roadbeds. The stream is deeply entrenched and has virtually no floodplain. Most of the stream bank is stable, having been armored when the floodplain was filled. Eleven outfalls and 9 utility lines were identified. Two of the outfalls had elevated conductivities. Multiflora rose and Japanese knotweed infestations are extensive.

<u>Stormwater Assessments</u> – An analysis of land cover was conducted for 55 catchments in the upper North Toe River using GIS and 2011 land cover data. From the selected land cover categories, all pixels with impervious values greater than 20% were retained and then mosaicked together. The purpose of this analysis was to identify catchments where stormwater runoff may be a concern. Seven catchments that encompass the Towns of Spruce Pine and Newland and commercial corridors along US 19 and NC 194 had 36-49% of their area made up of land cover that exceeded 20% imperviousness. Pine Branch, one of the smaller catchments and the only one dominated by mining operations, has about 47% of its area with surfaces contributing to stormwater runoff. Seventeen catchments had 20-30% of their area with surfaces less than fully pervious. These areas contain a mix of agricultural, residential, and mining activities that contribute to these conditions.

A second part of the stormwater assessment included a retrofit survey to identify potential sites where Stormwater Control Measures (SCMs) could be installed. Using a combination of GIS, aerial photo analysis, and field observations, the urban areas of the towns of Spruce Pine and Newland as well as the developed areas along highway corridors leading to those towns were assessed. Input was also obtained from the TAC. Eleven sites with the potential for the installation of 19 SCMs were identified. These features have the potential for treating 56 acres of impervious surfaces.

<u>Nonnative Invasive Plant Assessments</u> – Because nonnative plants, particularly Japanese knotweed (and multiflora rose, are suspected of being contributors to the turbidity problems in the Upper North Toe River Watershed, their presence was noted during other field data collection activities. Japanese knotweed was found to be the most extensively distributed of the nonnative plant species observed. Significant monocultures of knotweed were found in Beaver Creek, Roaring Creek, mainstem North Toe River from Horse Creek to Plumtree Creek, and Plumtree Creek. Mixed patches of knotweed and multiflora rose were seen in the extreme headwaters of the North Toe River, Grassy Creek, Big Crabtree Creek, and the lower portion of Threemile Creek. Japanese honeysuckle (*Lonicera japonica*), privet (*Ligustrum* spp.), and kudzu (*Pueraria lobata*) were also observed in widely scattered patches. Recently, reed canary grass (*Phalaris arundinacea*) was reported in the upper reaches of Roaring Creek. At the very least, these species are affecting the ecology of the Upper North Toe River Watershed. Should they be proven to destabilize stream banks, they would be a cause for chronically increased turbidities, which would be reason for controlling them.

Unwooded Riparian Areas – Riparian areas less than 30 feet in width and woody plants were commonly encountered during the windshield surveys and observed to have little effect in filtering sediment from upland runoff. To determine the extent of this problem, a GIS analysis of riparian buffers was conducted in the four subwatersheds where such conditions were most frequently encountered – headwaters of the North Toe River, Whiteoak Creek, Plumtree Creek, and Threemile Creek. Over 1,600 segments of insufficiently wooded buffer were identified, of which approximately 66% were less than 1,000 in length; only 49 segments greater than 2,000 feet in length were identified. Generally, when riparian vegetation was less than desired, it occurred on both banks. Only 2-4% of the streams were unwooded on one bank, whereas 27-39% of streams were poorly wooded on both banks. A progressive outreach program to educate landowners about the benefits of enhancement woody vegetation along streams is recommended.

Unpaved Roads – As with nonnative plants, unpaved private driveways and roads were frequently encountered during the windshield surveys. These roads were numerous; often, only small portions of them could be observed. To determine the extent of unpaved roads, aerial photos of the North Toe River headwaters and the Plumtree Creek, Threemile Creek, and Whiteoak Creek subwatersheds were analyzed in GIS and ground-truthed. Approximately 262 miles of unpaved roads were documented, 120 of which were associated with horticultural operations. While these data provide insight into the extent of the problem, it does not provide any information on the condition of the roads nor the degree to which they are eroding and contributing sediment to nearby waterways. The North Carolina State University (NCSU) Cooperative Extension Service has conducted an outreach effort to address this problem but lacks funding to implement their recommendations.

Horticultural Operations – Horticultural operations, particularly Christmas tree farms, are common in the Upper North Toe River Watershed. In the four watersheds examined, over 3,000 acres were in production, with many of those located on steep slopes that contain highly erodible soils. Sedimentation from land clearing, farm roads, and bare soil resulting from herbicide application to control grasses and weeds is of concern. Streams on some farms lack woody vegetation that aids in filtering sediments originating from farm roads. Further analysis of these sites and outreach to managers of these operations are recommended to address sediment runoff from these operations.

Watershed Management Activities

To facilitate the development of individual watershed improvement projects, a description of management measures (actions) was developed for each of the following six categories of projects – stream restoration and enhancement, upland enhancements, SCMs, agricultural and horticultural BMPs, and education and outreach. Management strategy descriptions for each category also include, where appropriate, lists of potential watershed improvement projects. The type of disturbance is identified for each of the stream restoration/enhancement and upland disturbance projects identified and can be used in designing plans that will reduce sediment loads.

Quantifying the reduction in pollutant loads, particularly sediment, is a required element of the WAP. Except for SCMs, no individual sediment load reductions were computed. Load reductions for SCMs, stream channel enhancements, and upland disturbances were estimated using existing models.

Streambank erosion is a significant contributor of sediment to waterways in the Upper North Toe River Watershed. Restoration or enhancement of the nearly 56,000 feet of stream bank rated as Fair or Poor could result in an annual decrease of about 1,050 tons of soil. Almost 45% of this could be achieved from projects in the Threemile Creek subwatershed. Significant reductions could also be achieved from North Toe River headwater streams (175 tons) and Plumtree and Grassy Creek subwatersheds (89 tons each).

Potential sediment load reductions for upland disturbed sites are estimated at about 400 tons annually. The largest potential reductions are possible in the Big Crabtree Creek (158 tons) and North Toe River headwaters (122 tons) subwatersheds.

Stormwater control measures at the 11 sites evaluated will reduce sediment loads about 0.5 ton annually. In addition to sediment, stormwater feature retrofits at these sites will also remove about 30 pounds of phosphorus and 25 pounds of nitrogen annually. A more important aspect of these measures is that they will ameliorate erosion downstream by retaining storm flows and releasing them at a rate that mimics natural runoff patterns.

A broad-based outreach and education plan has been developed. The plan includes communications efforts to many audiences, including school children, faith-based communities, local government leaders, streamside landowners, and the general public. Outreach efforts include communications via local newspapers, a regular newsletter, and an established Web site. Educational activities include, but are not limited to, classroom presentations, outdoor classroom events for children and adults, and the distribution of materials at festivals. Presentations from environmental subject experts, such as fisheries biologists, land conservationists, and aquatic habitat specialists, are being planned.

Watershed Action Plan Implementation

As watershed improvement projects are implemented, it will be critical to monitor water quality and biological communities. Such monitoring data will provide insights into how watershed conditions are improving over time. It is recommended that monitoring include continuation of water quality monitoring at the State's two ambient water quality monitoring sites. Biological monitoring should include routine benthic insect, fish, and freshwater mussel community sampling by state and federal agencies at the established sites. To supplement those data, volunteer water quality and benthic insect monitoring sites should be established for long-term trend analysis and to evaluate individual projects.

Implementation of the WAP depends on a significant amount of coordination among partner agencies. An important role that the TRVWP can play is to provide stable funding for a Watershed Coordinator position. Providing support for this position would allow the Watershed Coordinator to focus on obtaining funding to get projects on the ground and to implement the outreach and education strategies.

While the BRRC&D has facilitated a significant number of watershed improvement projects to date, there is a significant amount of work yet to be done to reduce turbidity and improve water quality in the watershed. To accomplish this work in an orderly manner, action plans and implementation schedules for each of the project categories were developed. The action plans describe what type of action is to be taken, a target of how much is to be implemented, who will be primarily responsible for implementing the action, over what time frame the work can be done, what financial resources are needed, where funding may be obtained, and how the accomplishments can be qualitatively measured. The implementation schedule for each category of projects shows, on a year-by-year basis, how much of a given action is planned. This schedule will serve to track watershed improvement project accomplishments over the 10-year life of the WAP.

The process of improving water quality and aquatic habitat conditions in the upper North Toe River will take many years and require the collaboration of partners across agencies, organizations, and jurisdictions. The TRVWP can provide the pivotal leadership role in implementing the management recommendations described in the WAP (Table ES-1). Using the WAP as intended will improve the ecological health and function of streams in the Upper North Toe River Watershed and achieve the goal of having all impaired streams removed from the State's 303(d) impaired waters list.

Table ES-1 Proposed Management Strategies to Address Sediment in the Upper North Toe River Watershed

Stressors	Sources	Functional Impacts	Recommendations (plan section links)
Excess Sediment Inputs	Streambank erosion, unpaved roads, disturbed upland areas and landslides, poorly managed pastures and fields, livestock access to streams	Habitat degradation--filling of pools, embedded riffles; increased turbidity	-Stabilize eroding stream banks (stream and buffer restoration) (4.2.1, 4.2.2, 4.2.3) Upland disturbances (4.3) -Implement agricultural BMPs (4.5) -Perform unpaved roads assessment (4.10.1) -Work with horticultural operations to reduce runoff from access roads (4.10.1)
Lack of Woody Riparian Vegetation	Removal of vegetation	Streambank instability; poor shading; increased temperature; habitat degradation--insufficient woody and leaf material in streams; limited pollutant removal	-Plant native woody vegetation in riparian areas (4.2.1, 4.2.2, 4.2.3) -Implement key buffer restoration projects (4.2.1, 4.2.2, 4.2.3) -Implement agricultural BMPs (4.5) -Control nonnative invasive plant infestations; restore native plant riparian communities (4.2.2, 4.2.3) -Develop or use existing educational programs to encourage native plant riparian communities (4.9.2)
Channel Modification	Channel straightening, dredging, and berming	Stream channel and bank instability; habitat degradation--loss of riffle and pool habitat	-Implement stream restoration projects (4.2.1) -Realign channels with stream crossings (4.2.3)
Stormwater Runoff	Impervious developed areas, NPDES holders	Channel erosion and degradation of in-stream habitats due to increased stormwater discharge; aquatic life impacts from nutrients, toxic pollutants, and high flows	-Implement SCM retrofits (4.4.1, 4.4.2) -Encourage Low Impact Development and alternative runoff controls (4.4.3) -Partner with mine operators, industrial corporations, and CSX railroad to implement additional SCMs (4.9.2) -Develop educational programs to control stormwater and reduce other pollutants (4.9.2)

Acknowledgments

This project would not have been possible without the support of the many stakeholders who attended the input meetings held in association with this project. Over 50 local landowners, business owners, and others interested in improving water quality and aquatic habitat conditions within the North Toe River basin participated in those meetings. Their input has laid the foundation for implementing projects that will lead to the continued improvement in water quality in the Upper North Toe River Watershed and to the removal of the North Toe River from North Carolina's 303(d) impaired waters list.

Preparation of the Upper North Toe River WAP was a collaborative effort of many contributing agencies, organizations, and individuals. Funding for this WAP was provided under a U.S. Environmental Protection Agency (USEPA) Section 319 Grant administered by the North Carolina Division of Water Resources.

Guidance for the development of the WAP was provided by a core Technical Advisory Committee composed of Jonathan Hartsell (Watershed Coordinator and Executive Director, BRRC&D); Starli McDowell (President, TRVW); Andrea Leslie (Ecologist, North Carolina Natural Heritage Program [NCNHP], now with the North Carolina Wildlife Resources Commission [NCWRC]; Ed Williams (Environmental Specialist, NCDWR); Anita Goetz (Habitat Restoration Coordinator, U.S. Fish and Wildlife Service [USFWS]); Mark Endries (GIS Analyst, USFWS); and Gary Peeples (Outreach and Education Specialist, USFWS). They provided input into the design of the field activities, collected field data, led the development of the outreach and education program, conducted GIS analyses, and reviewed and provided comments on the WAP. Kathy Jimison (Chemistry Technician, NCDWR Asheville Laboratory) analyzed the water samples for turbidity and total suspended solids (TSS).

Unimin Corporation was a major business partner in the project. They contributed a cash match of over $450,000 to the project by implementing mining BMPs that went above permit requirements, including 1,000 feet of streambank restoration along the North Toe River at its Schoolhouse Plant. Doug Myers, plant manager for Unimin, is a key member of the NTRWP and pledges Unimin's continued commitment to environmental stewardship. Scott Fortner and Steve Wilson, Environmental Specialists with the Unimin Corporation, deserve special mention for their liaison roles in implementing these projects and facilitating the collection of water quality samples on Brushy Creek as well as giving tours of mining sites and improvement projects being implemented.

Steve Fraley with the NCWRC provided data on the status of existing aquatic resources.

Joey Hester with the N.C. Department of Agriculture and Consumer Services (NCDA&CS) provided GIS data for Avery and Mitchell counties on installed agricultural cost share project locations.

Special acknowledgment is given to Nancy Cole of the USFWS for proofreading the WAP. Her attention to detail and suggested edits greatly improved the document.

North Carolina 9-Element Plan Checklist

Watershed	Upper North Toe River (portion upstream of confluence with South Toe River)
Applicant Name	Equinox Environmental Consultation & Design, Inc. on behalf on the Blue Ridge Resource Conservation & Development Council, Inc.
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Date of Submittal	Draft November 6, 2014; approved December 15, 2014; final December 30, 2014

What plans will you be using to document the 9 Elements required for 319 funding? Please provide a full reference.	Name of Plan(s)	Author/Developer	Year	Link/Location
	North Toe River Watershed Assessment – NPS Control Initiative Quality Assurance Project Plan	Blue Ridge Resource Conservation & Development Council, Inc.; Equinox	2013	On file with NCDWR 319 program; not posted to the web.
	French Broad Basinwide Water Quality Plan	NCDWQ	2005	http://portal.ncdenr.org/web/wq/ps/bpu/basin/frenchbroad/2005
	Basinwide Assessment Report – French Broad River Basin (physical, geographical, and biological data)	NCDWQ	2008	http://portal.ncdenr.org/web/wq/ess/reports
	French Broad Basinwide Water Quality Plan	NCDWQ	2011	http://portal.ncdenr.org/web/wq/ps/bpu/basin/frenchbroad/2011
	French Broad River Basin Watershed Restoration Plan	NCEEP	2005	http://portal.ncdenr.org/c/document_library/get_file?uuid=314c5caa-d1d3-4008-b5b7-6522f9b4544b&groupId=60329
	French Broad River Basin Restoration Priorities 2009	NCEEP	2009	http://portal.ncdenr.org/c/document_library/get_file?uuid=26da5ccb-f458-49a3-8a11-17970c68b37a&groupId=60329
	No NCEEP local watershed plans have been prepared within the Upper North Toe River Planning Area			

Once completed, please submit your checklist to Kim Nimmer at kimberly.nimmer@ncdenr.gov. DWR will conduct an internal review and notify you when the plan has been determined to meet all of the 9 Elements and is eligible for Section 319 Grant implementation funding. As they are approved they will be listed on DWR's list of 319 watershed plans at htpp://portal.ncdenr.org/wegb/wq/s/nps/319program/nc-watersehd-plans. If you are developing a plan that you are hoping to submit a 319 in the same year, please contact Kim Nimmer by email or by phone at (919)-807-6438. Your plan will need to be submitted for approval at least 45 days prior to the 319 Grant application due date

1. Identification of the Causes and Sources Checklist	Yes	No	Notes	Identify location of information (include link or attach plan and identify section and page number)
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Does this plan identify stressors and sources in the watershed?	X			Section 1.3, Page 5 – Synopsis of Causes and Sources of Stressors Section 3, Page 29 – Watershed Conditions
OPTIONAL (Supplemental and/or supporting information)				
Was a GIS desktop analysis performed?	X		Yes – for the following items: • Stormwater (urban) • Impervious Surfaces (watershed) • Riparian Vegetation Conditions • Unpaved Roads • Horticultural Operations	Section 3.2.4, Page 57 Section 3.2.4, Page 57 Section 3.2.6, Page 64 Section 3.2.7, Page 67 Section 3.2.8, Page 68
Has existing water quality or biological data been reviewed? • Ambient water quality data • USGS data • Other?	X		Data obtained for NCDWR ambient water quality, benthic and fish community monitoring, and aquatic habitat monitoring programs; data also obtained from TVA and for NCDEMLR mining NPDES stormwater permits	Section 3.1.1, Page 29 - Water Quality Conditions Section 3.1.2, Page 35 - Biological Conditions
Does the plan(s) identify any water quality impairments in this watershed (303(d) list)?	X		Water quality sampling conducted within 2 sections of North Toe River and 1 on Grassy Creek (303(d) listed) as well as in 9 additional subwatersheds to document turbidities at different flow levels	Section 3.2.1, Page 43 - Turbidity Assessments
Has a field assessment been conducted? • CWP (Center for Watershed Protection) Method • EEP (Ecosystem Enhancement Program) Manual • Other?	X		Streamwalks conducted on 303(d) listed reaches as well as Beaver Creek using CWP' unified stream assessment methodology. Windshield surveys of selected watersheds conducted using NCEEP methods	Section 3.2.3, Page 52 - Streamwalks Section 3.2.2, Page 46 - Windshield Surveys

1. Identification of the Causes and Sources Checklist	Yes	No	Notes	Identify location of information (include link or attach plan and identify section and page number)
Does the plan indicate if a TMDL has been developed for this watershed?	X		Upon approval of watershed plan, 303(d) listed reaches will be placed under Category 4B listing in lieu of a TMDL study.	Section 1.2, Page 4 - Why is the Upper North Toe River Impaired.
Does the plan(s) include a map that shows where stressors and sources are concentrated?	X		Potential stream and upland project locations shown.	Figures 3.3, 3.4, 3.5, 3.6, 3.7, Pages 49/50, 58, 60, 63, 65/66 -Figures depict land disturbance locations and potential projects.
2. Description of the NPS Management Measures Checklist	**Yes**	No	**Notes**	**Identify location of information (include link or attach plan and identify section and page number)**
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Does the plan(s) identify management measures that address the stressors and sources identified in Element 1? (*note prioritization of projects would be considered to meet this element*)	X		Provides descriptions of management measures for potential projects identified in plan as well as alternative stormwater measures such as green roofs.	Sections 4.2-4.6, Pages 71-106 - Management Measures for Reducing Turbidity and Sedimentation
3. Estimate of the load reductions expected for the management measures	**Yes**	No	Notes	**Identify location of information (include link or attach plan and identify section and page number)**
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Have potential indicators been identified for each management measure to determine success?	X			Section 5.3 Action Plan, Tables 5.3, 5.4, 5.5, 5.6, Pages 133-135
Has it been roughly quantified how much each management measure will reduce one or more parameters identified in Element 1?	X		Calculations made for general categories of management measures where suitable quantitative data were available.	Section 4.6 Pollutant Load Reduction Potential, Pages 104-109 - Streambank Erosion, Upland Disturbances and Stormwater Control Measures.
OPTIONAL (Supplemental and/or supporting information)				
Has a water quality, watershed or lake response model been developed for this watershed?		X		

4. Estimate of the technical and financial assistance needed	Yes	No	Notes	**Identify location of information (include link or attach plan and identify section and page number)**
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Have the potential costs associated with management activities listed in the plan(s) been identified?	X		Where possible, estimated unit cost information is provided	Section 5.3 Action Plan; Tables 5.3, 5.4, 5.5, 5.6, Pages 133-135.
Has the technical assistance that may be required to help with design, construction, implementation and monitoring of management strategies listed in the plan(s) been identified?	X			Section 5.3 Action Plan; Tables 5.3, 5.4, 5.5, 5.6, Pages 133-135).
OPTIONAL (Supplemental and/or supporting information)				
Have potential partners and funding sources to assist with implementation of the watershed plan(s) been identified and/or contacted?	X		Potential funding organizations are identified in action plan tables. Appendix E provides brief descriptions of funding programs within agencies.	Section 5.3 Action Plan; Tables 5.3, 5.4, 5.5, 5.6, Pages 133-135). Appendix E Funding Agencies and Programs (Page 187).
Have potential partners and funding sources to assist in the maintenance and/or monitoring following completion been identified?	X		Sponsoring agencies or BRRC&D to assume stewardship responsibilities as part of project planning process	Section 4.11.3 Stewardship Monitoring, Page 124 Section 5.3 Action Plan, Page 130; Table 5.9 Monitoring Action Plan (Page 140)
5. Information/Education component	Yes	No	Notes	**Identify location of information (include link or attach plan and identify section and page number)**
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Have a range of information and education options been identified in the watershed plan?	X		Includes Education and Outreach activities initiated under current 319 Grant.	Section 4.9 Education and Outreach Plan, Pages 108-120 Section 5.2.1 Education and Outreach Plan, Page 127 Table 5.1 Education and Outreach Activities Initiated under current 319 Grant, Page 128 Table 5.7 Education and Outreach Action Plan, Pages 136-138)
OPTIONAL (Supplemental and/or supporting information)				
Have resource agencies that can be integrated into the watershed planning process been identified and/or contacted?	X		Local, State, and Federal agencies have provided input into the plan and will be continuing partners to facilitate implementation.	Section 1.5 Watershed Partners and the Planning Process, Pages 8-11 Section 5.3 Action Plan, Pages 128-140 Table 5.7 Education and Outreach Action Plan, Pages 136-138)

6. Schedule for implementing management measures	Yes	No	Notes	**Identify location of information (include link or attach plan and identify section and page number)**
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Have the tasks and activities that are related to the implementation and monitoring of management recommendations been identified?	X		Tasks and activities based on assessment results, including target numbers to be accomplished.	Section 5.4 Implementation Schedule and Accomplishments Tracking, Pages 141-146 Tables 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.16, Pages 143-146
Has it been determined if these tasks and activities are short-term, medium, or long-term in nature (*note: prioritization of projects is acceptable for meeting this element)*?	X		Implementation based on target numbers and ability to acquire funding.	Section 5.4 Implementation Schedule and Accomplishments Tracking, Pages 141-146 Tables 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.16, Pages 143-146
7. Description of interim, measurable milestones	Yes	No	Notes	**Identify location of information (include link or attach plan and identify section and page number)**
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Have interim, measurable milestones (things that you can track) that can help determine if management measures (in Element 2) are being implemented been identified?	X		Milestones integrated into action plan tables	Section 5.3 Action Plan, Page 130; Tables 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, Pages 133-140
8. Criteria that can be used to determine if loading reductions are being achieved	Yes	No	Notes	**Identify location of information (include link or attach plan and identify section and page number)**
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Have criteria and/or indicators that can be used to determine if management strategies and activities listed in the plan(s) are being effective been identified?	X			Section 5.3 Action Plan, Page 130; Tables 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, Pages 133-140

9. Monitoring	Yes	No	Notes	Identify location of information (include link or attach plan and identify section and page number)
REQUIRED (This box(es) below must be checked Yes in order to be eligible as a 9 Element plan)				
Has a monitoring plan that includes each of the criteria and/or indicators identified in Element 8 been developed?	X		Monitoring plan includes turbidity/water quality, ecological, and stewardship activities.	Section 4.11 - Watershed Monitoring, Pages 123-125
OPTIONAL (Supplemental and/or supporting information)				
Are there plans for conducting water quality monitoring? • Intensive/On-going • Field kits?	X		NCDWR ambient and NPDES stormwater permit sampling will be ongoing; volunteer sampling being planned for subwatershed monitoring.	Section 4.11.1 - Turbidity and Water Chemistry Monitoring, Page 123
If water quality monitoring is expected to be conducted, have you contacted NCDWR?	X		NCDWR Asheville Regional Office is a partner in the project.	Section 4.11.1 - Turbidity and Water Chemistry Monitoring, Page 123

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1. INTRODUCTION

1.1 Background and History

Water quality of the upper North Toe River has suffered considerable impairments and achieved notable improvements over the last 100 years. The most significant impacts occurred in the *Spruce Pine Mining District* (Figure 1.1), which covers parts of Avery, Mitchell,

and Yancey counties, where high-quality feldspar, mica, and quartz have been extracted for commercial uses. Mining has been documented in the area since at least the mid-1700s, when the Cherokee Indians traded with the English. Industrial-scale ore mining and mineral processing were established around 1910. As a result of early mining activities, the North Toe River ran white with sediments and by-products of the processing methods. White sand from the process covered the riverbed, creating sandbars and deltas and choking out aquatic life.

Since enactment of the Clean Water Act of 1972, improvements in water quality have occurred as more restrictive erosion control, wastewater, and stormwater permitting requirements obligated the mining industry, municipalities, and developments to change many of their waste processing procedures. The mining companies invested heavily in processing and treatment system improvements and continue to do so. Water quality improvements have been dramatic, but the area is still negatively impacted.

During this same time period, the hardwood forests of western North Carolina were discovered and harvested. The indiscriminate clear-cutting of American chestnut (*Castanea dentata)* and oak (*Quercus* spp.) forests led to extensive erosion and silting of all but the most remote streams. To compound the damage, roads, small rail lines, log flumes, and splash dams were constructed in or along almost every stream to transport the logs from the mountainsides to sawmills for processing into lumber. As a consequence of this activity, fish populations in these streams were decimated. In many streams, native brook trout (*Salvelinus fontinalis*)

populations were eliminated. This led to the introduction of nonnative rainbow (*Oncorhynchus mykiss*) and brown (*Salmo trutta*) trout, which persist to this day and support the majority of trout fishing in the area.

Over time, the mountain vegetation recovered and mining methods have improved. As a result, the North Toe River watershed and its tributaries are now healthier. The Tennessee Valley Authority (TVA) further aided this recovery by reclaiming hundreds of acres of abandoned mines and tailings disposal sites that were eroding into streams of the Nolichucky

River basin (Muncy 1985). Of the 590 acres identified as in need of reclamation, approximately 315 acres were in Avery and Mitchell counties. All reclaimed areas were created prior to July 1, 1971, and were not covered under North Carolina's newly implemented Mining Act of 1971 or the Sedimentation Pollution Control Act of 1973.

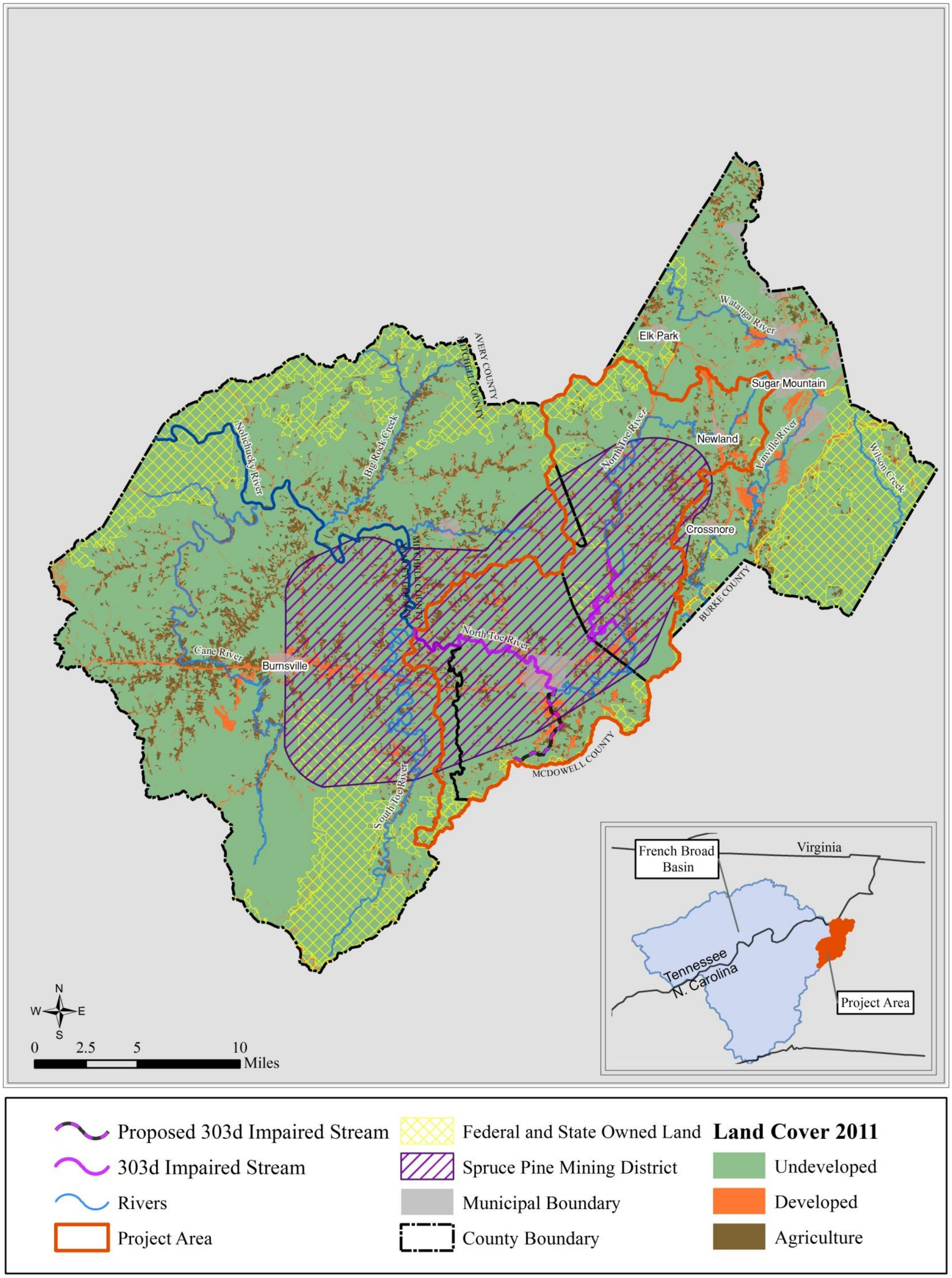
For the most part, streams of the Upper North Toe River Watershed run clearer with much of the finer sediments having been flushed from the system. Streams are once again home to common and rare aquatic species. The Appalachian elktoe (*Alasmidonta raveneliana*), an endangered freshwater mussel, maintains one of its last strongholds here; fishing and boating activities once again abound. While the river has healed itself somewhat, impacts from humans continue to keep it from reaching its full ecological potential. Several previous studies have documented the ecological conditions of the North Toe River. According to the *North Toe River Riparian Corridor Conservation Design document* (SAHC 2000), the *North Carolina Wildlife Action Plan* (NCWRC 2005), the *French Broad Basinwide Water Quality Plan* (NCDWQ 2011), and on-the-ground observations, there are long-term water quality impacts from nonpoint source pollution (NPS) associated with urbanization, sedimentation, and erosion in this watershed.

While the river no longer continuously runs white, over 20 miles of the upper mainstem North Toe River are considered impaired due to turbidity, according to the North Carolina Division of Water Resources (NCDWR; NCDWQ 2012a; NCDWR 2014a). Because of the turbidity, aquatic life is degraded. One only has to observe the river following rainfall events. It runs reddish-brown when stormwater runoff from disturbed areas enters streams, carrying with it sediment and other pollutants. These disturbances include eroded stream banks; stormwater draining off impervious surfaces; residential and commercial construction sites; silviculture, agriculture, and horticulture activities; and to a much lesser degree than in the past, mining activities. Natural stream processes, such as the transport of existing sediment and the erosion of stream banks, also contribute to turbidity levels.

Impervious Surface *– a surface that does not allow rainfall to be absorbed by soil, for example parking lots and buildings.*

Recognizing the importance of the river to their local economy and quality of life, a wide variety of stakeholders have joined together to form the Toe River Valley Watershed Partnership (TRVWP), an independent non-profit watershed organization that recently evolved from the original Toe River Valley Watch. Regardless of its status, this group is committed to continuing to improve the water quality and ecological health of the North Toe River and its tributaries.

Figure 1.1 North Toe River Project Area



This Watershed Action Plan (WAP) is targeted at the portion of the North Toe River watershed upstream of its confluence with the South Toe River. The partners chose to work on this area because it contains two reaches that have been on North Carolina's 303(d) impaired waters list since 2006/2008. These reaches are impacted by urban development and mining activities, both of which can contribute to water quality degradation and fish community impacts (Note: A portion of Grassy Creek was added in 2014 due to an impaired fish community). The partners felt that a locally developed WAP would be the most effective way to address the disturbances that contribute to this problem. The WAP is focused on identifying the causes and sources of sediment and includes management actions that can be taken to realize measurable improvements in water quality and the aquatic communities it supports.

There are three primary objectives of the 319 Grant funded North Toe River Restoration Project:

1. Develop a WAP to guide restoration efforts in the North Toe River watershed.
2. Begin implementing BMPs that lead to restoring uses to the North Toe River watershed.
3. Reduce turbidity to a level that will allow the degraded reaches of the North Toe River to be removed from North Carolina's 303(d) impaired waters list.

1.2 Why the Upper North Toe River is Impaired?

Two sections of the mainstem North Toe River are on North Carolina's 303(d) impaired waters list (Figure 1.1) and include the following (NCDWQ 2012a; NCDWR 2014a):

- From a point 0.2 mile upstream of Pyatt Creek to a point 0.5 mile upstream of U.S. Hwy. 19E near the Avery County airport; 9.4 miles.
- From the mouth of Grassy Creek to the confluence with the South Toe River; 11.3 miles.

__Turbidity__ – cloudiness of water caused by the suspension of fine soil particles in streams; measured in NTU – nephelometric turbidity units.

These portions of the North Toe River are not fully supporting their use due to turbidity levels that exceed the 10 NTU water quality standard for the Trout Waters (Tr) supplemental water quality classifications. Turbidity monitoring at NCDWR's ambient monitoring stations, by National Pollutant Discharge Elimination System (NPDES) permittees, and by volunteer organizations all reveal turbidity levels exceeded 10 NTU in more than 10% of the samples with 90% confidence, thus exceeding North Carolina's evaluation level for turbidity (NCDWR 2014b).

Under the integrated reporting classification, the impaired reaches have been designated as Category 5, meaning that available data indicates at least one use is not being met and that a total maximum daily load (TMDL) must be calculated. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. However, the Blue Ridge Resource Conservation & Development Council, Inc. (BRRC&D) volunteered to sponsor the development of this WAP to implement pollutant control measures that are expected to result in the attainment of the applicable water quality standard in a reasonable period of time. Once this WAP is approved, these river reaches will be designated as Category 4B and a TMDL will not be required. The uppermost headwaters of the Upper North Toe River Watershed are fully supporting. Many of them are in protected areas, such as Pisgah National Forest and Blue Ridge Parkway or are protected by conservation easements or in land trust ownership. If the project focus area can be restored, there is high potential for aquatic organisms that are intolerant of sediment to repopulate the impaired segments and have them fully supporting all uses.

1.3 Synopsis of Cause and Source of the Primary Stressor – Sediment

As stated in Section 1.1, previous studies (SAHC 2000, NCWRC 2005. NCDWQ 2011) have documented the ecological conditions of the North Toe River and found there are long-term water quality impacts from the primary nonpoint source of pollution -- sediment. Sediment in the upper North Toe River has generally been associated with the following activities:

- Urban and residential development.
- Agricultural, silvicultural, and horticultural activities.
- Industrial processes.
- Poorly vegetated riparian zones.
- Channelization and alteration of the natural stream courses.
- Stormwater runoff that increases stream volume and velocities, causing streambank erosion and increased water temperatures.

The physical impacts of sediment on the North Toe River watershed include degradation of the watershed's aesthetic and recreational qualities, degradation of habitat for both rare and common aquatic organisms, erosion of valuable agricultural and commercial land, and increased treatment costs for water users. The mining companies also use river water for their mineral processing, and the Town of Spruce Pine relies on the North Toe River for a portion of its water supply.

1.3.1 Other Stressors

Additional stressor identification has been achieved by NCDWR staff working in the watershed. The collected physical, biological, and chemical water quality data and recorded field observations. The North Toe River WAP developed in this project will provide greater detail on subwatershed needs.

The 2008 integrated 303(d) waters report (NCDWQ 2010a) listed copper as exceeding evaluation levels in the upstream impaired reach on the North Toe River; however, the NCDWR suspects it is from natural sources. Lacking evidence supporting this suspicion, the U.S. Environmental Protection Agency (USEPA) has resisted the NCDWR's attempts to remove copper as a pollutant of concern from this reach. As a result, the reach remains on the 303(d) impaired waters list. The USEPA and NCDWR are working to resolve the issue. Field data does not indicate that copper is having an impact on the biological community.

The draft 2014 North Carolina 303(d) (NCDWR 2014a) list now includes 5.9 miles of Grassy Creek (from its source to the North Toe River) as impaired. This section is considered impaired due to a Fair biological rating of the fish community; however, the source of the degradation is not known.

1.4 Why Care?

Why should citizens living, working, or recreating in the Upper North Toe River Watershed concern themselves with the conditions of the river and its tributaries? There are a number of environmental, economic, and social factors that relate stream health to community health.

1.4.1 Environmental Factors

Streams are valuable resources that provide a variety of ecosystem services. Ecosystem services are natural processes that benefit the environment and, in turn, benefit people. A hydrologically functioning stream provides flood control, which reduces property loss and damage during flood events. A healthy stream provides habitat for a variety of plants, fish, amphibians, and insects that prey on pests such as mosquitoes, black flies, and midges. A functioning aquatic ecosystem also provides surface water filtration, purification, and pollutant processing.

How the land we live on is utilized directly influences the health of streams. As it stands, while much of the land adjacent to the North Toe River and its tributaries is forested, some stream banks along the flatter areas have been cleared of woody vegetation. This has led to eroding stream banks that threaten to damage adjacent property, and the lost soil has degraded stream habitats. As a result, the diversity of plants and animals living in the North Toe River is not as healthy as it could be. The ability of the North Toe River to provide ecosystem services has been diminished.

***Fact** - Turbidity makes it more expensive for communities to treat water for drinking.*

The North Toe River watershed provides important habitat for rare and endangered aquatic species, such as the eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*), a large salamander of special concern, and the Appalachian elktoe,, an endangered freshwater mussel. The U.S. Fish and Wildlife Service (USFWS) has designated 69.4 miles of stream in the Nolichucky River Basin as critical habitat for the Appalachian elktoe. This designation includes not only the 3.7 - mile section of the North Toe River from the mouth of Big Crabtree Creek to its confluence with the South Toe River (Mitchell and Yancey counties) but also 14.1 miles of the South Toe River (Yancey County), 21.6 miles of the Toe River (Mitchell and Yancey counties), 16.5 miles of the Cane River (Yancey County), and 13.5 miles of the Nolichucky River (Mitchell and Yancey counties in North Carolina and Unicoi County in Tennessee; USFWS 2002). This is a USFWS focus area for the Appalachian elktoe's recovery and restoration (USFWS 1996).

1.4.2 Economic Factors

The North Toe River watershed has significant economic implications for Avery, Mitchell, and Yancey counties and the Towns of Newland and Spruce Pine. Outdoor recreation (OIA 2011/2012) and trout fishing (NCWRC 2009) are becoming ever more important to state and local economies to help offset and replace lost manufacturing jobs and wages. Outdoor recreation in North Carolina, exclusive of fishing, hunting, and wildlife viewing, is estimated to generate $19.2 billion in consumer spending

(OIA 2011/2012). Mountain trout fishing in North Carolina alone had an estimated economic output of $174 million in 2008, much of it occurring in Avery, Mitchell, and Yancey counties (NCWRC 2009). The North Toe River's streams and uplands provide aesthetic value and high-quality water for recreation, drinking, agriculture, and industry. Streams in the watershed support healthy populations of trout and smallmouth bass (*Micropterus dolomieu*), which attract thousands of visitors each year. The Towns of Spruce Pine and Newland have been designated "Mountain Heritage Trout Water" cities by the NCWRC. That recognition is designed to promote tourism and trout fishing in those communities.

Financial resources are required to mitigate the effects of poor water quality. Polluted water costs more to treat in order for it to be used for drinking. Additional costs are associated with repairing property, bridges, utilities, and other infrastructure due to flood damage and streambank erosion. In most instances, it requires less of a financial investment to protect natural resources and prevent damage to streams than it costs to restore impacted streams or treat polluted waters.

Enhanced stream corridors also can be an attractive asset within a community. Greenways and parks along streams provide recreational opportunities and attract visitors who spend time and money in the area. Furthermore, implementing BMPs to improve watershed health employs local businesses, such as engineers, land graders, landscapers, and nurseries, to name a few.

Mining continues to be an important economic engine for the area. Most of the high-quality quartz used in electronic microchip industry comes from the Spruce Pine mining district. The local mining companies, Unimin Corporation and The Quartz Corp, recognize the importance of lessening their impact on the environment as a way to improve the quality of life for their employees and local residents. Unimin is committed to working with the BRRC&D, local county and municipal governments, NCDWR, and other partners to invest in BMPs that result in improved water quality. These investments include reducing sediment discharges to a level that goes beyond what is required in their current NPDES permits for turbidity. They are also taking steps to restore stream banks along the North Toe River and participate in public education regarding their efforts to improve the environment.

1.4.3 Social Factors

Healthy streams provide recreational opportunities such as fishing, boating, swimming, or just getting your feet wet. Attractive stream corridors consist of clean -flowing water and lush vegetation that contribute to the livability and aesthetic benefits of a community. Walking paths and greenways along streams provide hiking, biking, and nature-watching opportunities as well as provide health benefits. When a stream is impaired, however, it cannot fulfill these uses because the water may appear dirty and, therefore, deter public use. A healthy environment results in a healthy, thriving community, and investing in the environment is an investment in the community.

1.5 Watershed Partners and the Planning Process

Over the last 10 years the North Toe River watershed has been the subject of several planning projects that have recognized the watershed has many high-quality natural resources and the need for projects that will improve water quality. The most significant of these include:

- *North Carolina Wildlife Action Plan* (NCWRC 2005) - Recognizes the entire Toe River watershed as a priority for conservation efforts that will benefit rare and endemic freshwater aquatic species.
- Aquatic Natural Areas – The NCNHP has designated 24 miles of the North Toe River as an aquatic natural area based on the presence of rare aquatic species. There also are numerous other upland natural areas and protected lands in the Upper North Toe River Watershed (NCNHP 2014).
- *North Toe River Riparian Corridor Conservation Design for Five Major Drainages off the Roan Highlands* (SAHC 2000) - This Southern Appalachian Highlands Conservancy (SAHC) plan identified sediment and the need for enhancing vegetation in riparian areas of the upper North Toe River.
- *French Broad River Basinwide Water Quality Plan* (NCDWQ 2011) – The North Carolina Division of Water Quality (NCDWQ) recognized the need for a watershed organization that will implement watershed improvement projects. The North Toe River is also identified as priority watershed needing BMP projects that will reduce turbidity.
- *French Broad River Basin Restoration Priorities* (NCEEP 2009) - The North Toe River watershed upstream of Grassy Creek also has been identified by the North Carolina Ecosystem Enhancement Program (NCEEP) as a watershed that has significant stream and wetland restoration needs.
- *Strategic Plan for the Partners for Fish and Wildlife Program 2012 - 2016, Southeast Region* (USFWS 2011) – The upper Nolichucky River subbasin, which includes the North Toe River watershed, is a designated focus area for the USFWS for riparian and in-stream habitat restoration and improvements to benefit federally listed and rare aquatic species.

These plans provide a firm foundation for preparation of a WAP that will address the causes of turbidity. Data from them will be used in identifying necessary management actions and implementation schedules that will lead to water quality improvements.

Public support for the North Toe River restoration project is critical. A goal of this project is to motivate landowners, local businesses, and the general public to take ownership of the problems facing the watershed and commit to the mission of improving water quality. Building public support through personal contacts and public meetings will be emphasized. Public events, such as river cleanup days and festivals, will be held at Spruce Pine's Riverside Park to inspire a love for the river, which is essential to the long-term success of this project.

Based on attendance and feedback from the April 7, 2011, stakeholder meeting, the project has already gained support from key local leaders and some landowners. Over 50 people attended that meeting. The climate of the community is ripe for an initiative such as this as the economic and ecological benefits of a healthy watershed are being recognized by these communities. County leaders recognize the importance of a healthy watershed, desire a common vision and shared responsibility for the watershed, and favor the idea of a watershed partnership to increase education, protection and restoration opportunities, and collaboration among various watershed users. Attendees of the meeting agreed that the formation of a broad-based watershed group would be a good way to maintain and improve the water quality of the area.

A key element to engage the public in support of the WAP was the creation of a Watershed Coordinator position whose main objective is to work closely with project partners to develop and implement an outreach plan. The outreach plan would include: (1) the identification of key audiences who have the greatest ability/opportunity to improve the streams, both in the short- and long-term; (2) an investigation of the outreach tools most effective for reaching those audiences; (3) the development and distribution of selected printed, electronic, and other informational materials that could include such things as brochures, a Web site, and a newsletter; and (4) the development and sponsorship of special events that would include film festivals, river festivals, educator workshops, community meetings, and field visits. All of these activities would focus on watershed awareness and water quality improvements.

Agencies, organizations, and landowners have already taken action to improve water quality within the Upper North Toe River Watershed as is shown by the following activities:

- The USFWS has been instrumental in supporting and providing funding for water quality, education, and habitat improvement projects; including, the removal of the North Toe River dam near Spruce Pine, which opened up more than 40 miles of riverine habitat for aquatic species and recreational boaters. This project was performed in cooperation with the Toe River Valley Watch (TRVW), BRRC&D, NCDWR, and local contractors. They also routinely monitor the status of the Appalachian elktoe population.

- The BRRC&D has leveraged over $1 million from federal, state, and private resources in the last 3 years for stream restoration, agriculture BMPs, dam removal, and other conservation projects.

- The TRVW implemented a monitoring program of the watershed through the Volunteer Water Information Network (VWIN) program; sponsors the annual Toe River Festival, where all the 5th-graders in Yancey and Mitchell counties sample for macroinvertebrates in the river and learn about watershed protection; and is establishing the North Toe River canoe trail and access points. The TRVW also has leveraged state, federal, and private dollars to complete stream restoration and educational and outreach projects in the North Toe River watershed.

- The TRVW acquired funds totaling $420,000 to restore approximately 2,000 feet of Grassy Creek along the NC 226 commercial corridor south of Spruce Pine.

- The SAHC and the Blue Ridge Conservancy together have protected over 10,000 acres of land in the North Toe River headwaters and continue their land conservation efforts.

- The Yancey, Mitchell, and Avery county SWCDs have helped over 30 farmers during the last 10+ years to prevent erosion, restore stream banks, and exclude cattle from direct access to rivers and streams through the North Carolina Agricultural Cost Share Program (NCACSP).

- The NCNHP has performed an inventory of aquatic and terrestrial species in Yancey and Avery counties and began inventory work in Mitchell County during 2011. They were also instrumental in facilitating the formation of a watershed organization for the North Toe River watershed.

- The NCWRC routinely monitors game and nongame aquatic species, including the Appalachian elktoe mussel and the hellbender salamander. They are also responsible for the management of game species such as trout and smallmouth bass.

- The NCDWR performs chemical, physical, and biological monitoring assessments on the North Toe River, and they support and document restoration efforts through the NCDWR's Use Restoration Watershed Program and the Asheville Regional Office watershed initiative.

- The BMP implementation efforts of this project will expand the existing partnership to include The Quartz Corp and Unimin Corporation mining companies and local and county governments. This collaboration among nonprofits; industry; local, county, state, and federal governments; and local citizens should demonstrate potential successes for watershed improvement when a cross-section of vested stakeholders cooperates to achieve common goals. It also provides the local support, stakeholder buy-in, and financial resources necessary to improve and protect this degraded watershed.

Based on the overwhelming support to establish a partnership aimed at improving the Upper North Toe River Watershed, the following goals have been established as part of the current project:

Short-Term Goals

- Develop a WAP for the upper North Toe River.
- Garner public support through a well-developed and thoughtful outreach plan
- Collect additional water quality data.
- Implement on-the-ground watershed restoration projects that will improve water quality and in-stream aquatic habitat.

Long-Term Goals

- Improve water quality and restore uses to impaired waters in the Upper North Toe River Watershed.
- Protect water quality for downstream landowner uses and aquatic resources.
- Support efforts to enhance fish and aquatic species communities.
- Reduce water quality impacts to the Upper North Toe River Watershed, which will lead to economic benefits.

The North Toe River Restoration Project will improve a degraded watershed through the development of a WAP and implementation of BMPs that address watershed problems. The TRVWP will work to implement recommendations found in the French Broad Basinwide Plan (NCDWQ 2011) and the SAHC's North Toe River Riparian Corridor Conservation Design (SAHC 2000). A comprehensive monitoring program will be necessary to supplement current monitoring programs to identify stressor origins for WAP development as well as demonstrate measurable results of the installed BMP components. A well-developed outreach program will educate others about the importance of the watershed, existing challenges, and the value of restoration and protection efforts to improving water quality and quality of life. The results of this project will be disseminated through a written report, publications in newspapers, magazines, peer-reviewed journals, presentations at symposiums, and sharing of experiences with other watershed organizations and local governments.

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2. WATERSHED CHARACTERIZATION

2.1 Geographic Location and Attributes

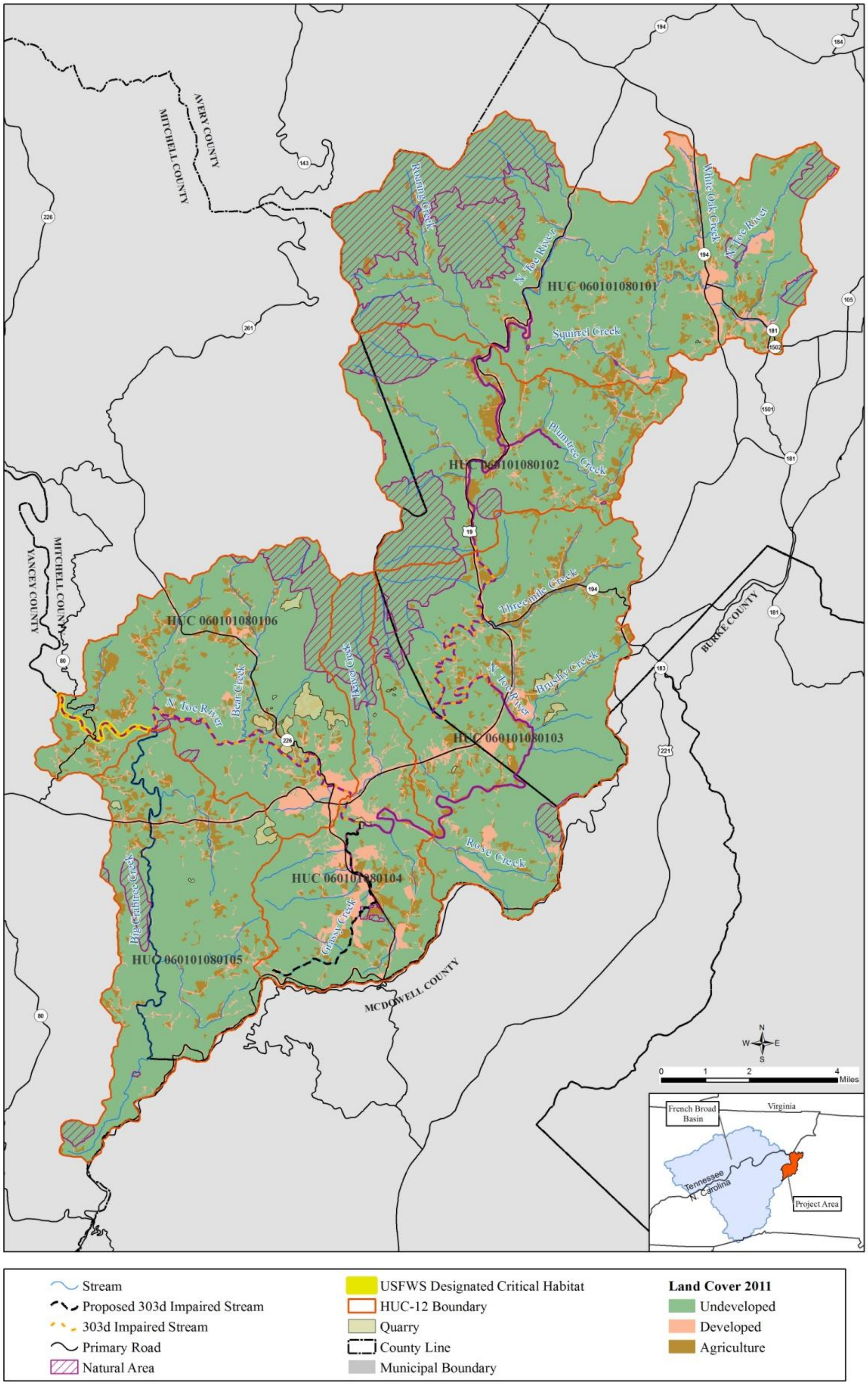
The North Toe River watershed upstream of its confluence with the South Toe River is a 183 mi^2 mostly rural subwatershed that lies within Avery and Mitchell counties and a small portion of eastern Yancey County in western North Carolina (Figure 2.1). It makes up the headwaters of the Nolichucky River watershed that is formed where the North Toe River joins the Cane River in Yancey County, which then flows into Tennessee where it joins the French Broad River.

The upper North Toe River project area is located in the Blue Ridge Physiographic Province (NCGS 2004) and the Blue Ridge Mountains Level III Ecoregion (Griffeth et al. 2002). The watershed is encompassed within six 12-digit hydrologic unit codes (HUC, Figure 2.1). The landscape consists of mostly steep mountain terrain with narrow valleys, except along the main river, where floodplains widen and are nearly level or gently sloping. Elevations within the project area range from 6,160 feet on Grassy Ridge Bald, at the head of Roaring Creek, to 2,333 feet at the confluence of the North and South Toe Rivers.

The average winter air temperature in Avery and Mitchell counties is about 45°F, whereas summer air temperatures are about 77°F (NRCS 2004, 2005). Temperatures in Avery County are slightly lower than those of Mitchell County. Average annual precipitation in the two counties is 50-55 inches.

The majority of the study area is contained within the Spruce Pine Mining District (Brobst 1962). The underlying bedrock of the area is primarily comprised of metamorphic and igneous rocks such as gneisses, schists, and granites. Economically important minerals mined in the area include quartz, feldspar, mica, kaolin, and olivine (NRCS 2003, 2004, 2005). In addition, gemstones, such as emeralds and aquamarines, are found in the area.

Figure 2.1 Upper North Toe River Watershed Characteristics



2.2 Population and Land Use Characteristics

2.2.1 Population

Avery and Mitchell counties, which encompass most of the upper North Toe River project area are sparsely populated and have shown little growth since 2000 (Table 2.1). The 2012 estimated population of the two counties combined was slightly over 33,000 people (USCB 2014). About 24,000 of those people lived within the census tracts most closely aligned with the project area.

Table 2.1 Population by County and Census Tracts

County/Census Tracts[1]	Year	
	2000	2012 Estimate
County[2]		
Avery	17,167	17,815
Mitchell	15,687	15,539
Totals	32,854	33,354
Census Tracts[3]		
Avery	14,400	14,596
Mitchell	9,218	9,180
Totals	23,618	23,776

[1]Source U.S. Census Bureau Census Explorer (USCB 2014).

[2]Includes portions of county outside of Upper North Toe River Watershed.

[3]Includes census tracts most aligned with Upper North Toe River Watershed project boundary.

2.2.2 General Land Use Characteristics

The project area is predominantly rural and undeveloped (Figure 2.1, Table 2.2), with approximately 85% of the project area being forested or otherwise relatively undisturbed. Much of this land is managed by the U.S. Forest Service (USFS), and the National Park Service – Blue Ridge Parkway. Approximately 7% of the watershed is in urban land use. Most of the developed area is in the Towns of Spruce Pine and Newland and along major transportation corridors leading into and out of these communities. In particular, the NC 226 corridor along Grassy Creek, a major tributary to the North Toe, and the downtown areas of the two towns are heavily developed with commercial businesses. The associated parking lots and rooftops create large areas of impervious surface. With the completion of the US 19E highway-widening project from Madison County to Mitchell County, development is expected to continue. Only about 8% of the watershed is in agricultural use. For the most part, agricultural use consists of livestock grazing, cropland, and small horse farms. In a few of the subwatersheds, horticultural activities, composed primarily of Christmas tree farming, cover significant portions of land.

Land Use in Upper N. Toe River
Forested – 85%
Agricultural – 8%
Urban – 7%

The 15% of unforested lands is considered less pervious than forested lands and, as a consequence, runoff from these areas is greater. The increased volume and timing of this runoff can cause greater streambank erosion and transport of sediment from the upland disturbed areas.

Table 2.2 Land Use within the Upper North Toe River Watershed

Land Use[1]	Total	
	Acres	Percent of Watershed
Developed	**9,241**	**7%**
Low Density	873	1%
Medium Density	354	<1%
High Density	98	<1%
Open Space	7,916	7%
Agriculture	**9,780**	**8%**
Pasture/Hay	9,714	8%
Cropland	66	<1%
Undeveloped	**97,816**	**85%**
Deciduous Forest	88,550	76%
Evergreen Forest	3,175	3%
Mixed Forest	2,041	2%
Shrub/Scrub	2,077	2%
Herbaceous	1,973	2%
Other	**354**	**<1%**
Open Water	29	<1%
Barren Land	235	<1%
Woody Wetlands	90	<1%
Total	117,188	100%

[1]Source – 2011 National Land Use Cover Dataset.

2.2.3 Industrial Land Uses

Based on North Carolina Division of Energy, Mineral, and Land Resources data (NCDEMLR), stormwater from nine industrial sources in the Upper North Toe River Watershed is regulated under general NPDES permits (Table 2.3, NCDEMLR 2014). Those permits include requirements to control runoff from these operations and require the companies to monitor the discharges for specific pollutants, including TSS and turbidity. The U.S. Department of Transportation's Federal Railroad Administration regulates the CSX railroad; the State of North Carolina has no regulatory authority to manage stormwater for that corporation (Laura Herbert, North Carolina Division of Energy, Mineral, and Land Resources [NCDEMLR], personal communication).

Table 2.3 Industries Managed Under NPDES Stormwater General Permits

Industry	General Permit Number	Number of Permits[1]
Mining	NCG020000	10
Metal Fabrication	NCG030000	1
Transit and Transportation	NCG080000	1
Treatment Works	NCG110000	1
Landfills	NCG120000	1
Airports	NCG150000	1
Asphalt Paving Mixtures, Blocks	NCG160000	1
Textile Mills	NCG170000	1
Timber Products	NCG210000	2

[1]Permits active as of January 1, 2014.

Based on aerial photos, mines and the CSX railroad impact the largest land area in the Upper North Toe River Watershed. Because these disturbances have the highest chance of being a source of sediment to streams, a summary of their activities is provided.

Mining – Hard-rock surface mining or open-pit mining for minerals and aggregate is big business in the Upper North Toe River Watershed. Aggregate mining is important to the construction business, while mineral mining is important not only to the local economy but also worldwide. Much of the feldspar, mica, and quartz produced are shipped overseas.

Currently, there are two aggregate mines operating within the Upper North Toe River Watershed. One is owned by Vulcan Materials, a publicly traded company, whereas the other is privately held. The Vulcan mine is located in the upper Bear Creek subwatershed north of Spruce Pine, while the other is on the Yancey County side of the Big Crabtree Creek subwatershed, just north of US 19 E. The aggregate mines produce stone and gravel for the construction and road-building industries.

Two companies, Unimin Corporation and The Quartz Corp, operate four mineral processing plants in the Spruce Pine area. Ores from these mines consist of about 60%

feldspar, 30% quartz, and 10% mica. Feldspar is used to make glass and ceramics; quartz is used in the semiconductor industry; and mica has a variety of industrial uses, including drywall joint compound, electrical components, well-drilling operations, rolled roofing, and as a paint additive. Most notable is the fact that quartz from the Spruce Pine mining district is used in the manufacture of virtually all the microchips produced throughout the world.

While hard-rock surface mining or open-pit mining for minerals and aggregates is important to the local economy, by its very nature it causes significant land disturbances. Impervious surfaces are created when the overburden is removed, haul roads are built, and processing facilities are constructed. The runoff from these surfaces creates conditions to erode materials from stock piles, handling losses at loading/unloading areas, and along haul roads. In the past, much of this runoff was allowed to flow directly into streams, carrying sediment and suspended solids with it.

Today, these facilities operate under air and water quality permits that require these facilities to control process discharges and stormwater runoff in order to reduce the amount of dust and sediment that leaves these sites. Most notable are settling ponds that capture stormwater runoff at every facet of the mining process – removal from the ground, hauling, processing, and spoil piles (S. Wilson, Unimin Corporation, personal communication). These settling basins are engineered to capture runoff from most rainfall events and to prevent all but the finest sediments from reaching nearby streams. Other sediment control methods include crowning haul roads to direct runoff to settling ponds, installing and maintaining check dams on haul roads, and berming areas around processing facilities to capture runoff and sediment dropped during the material transfers. According to the general permit, the stormwater control structures must be designed to meet the benchmark values. For all streams in the Upper North Toe River Watershed, this means the discharge cannot increase the turbidity of the receiving waters to exceed 10 NTU. Where the receiving stream exceeds these level due to natural background conditions, the existing turbidity level cannot be increased (NCDEMLR 2014).

Efforts to control sediment have improved the water quality of the North Toe River over what it was 50 years ago. Past stories of the North Toe River running white are but small memories for many residents. A recent internet search could not find any significant stories of these occurrences. While the North Toe River no longer runs turbid all the time, it is still subject to receiving bursts of sediment and suspended solids from these facilities. Intense rainstorms that overwhelm the capacity of settling basins and other stormwater control structures are not uncommon.

Railroads – The CSX Corporation operates approximately 13.5 miles of rail line in the Upper North Toe River Watershed. The rail line parallels the North Toe River most of the way from its confluence with the South Toe River to Rose Creek. It then follows Rose and Little Rose creeks before entering a tunnel under the Blue Ridge Parkway and crossing into the Catawba River drainage.

At a width averaging 100 feet, the right-of-way in the study area is estimated to cover approximately 164 acres. The right-of-way is made up of three zones – the rail bed at the center of the right-of-way, an unvegetated buffer zone on either side of the rail bed, and an outside vegetated zone.

The rail bed is composed of a gravel base and coarse ballast rock into which the wooden ties are embedded and onto which the rails are attached. The bed from toe to toe is estimated to average 20 feet in width, covers about 33 acres, and is considered to be a pervious surface. It is kept free of vegetation.

The unvegetated buffer zone averages about 10 feet in width on both sides of the rail bed and covers an estimated 33 acres. It is kept clear of vegetation to prevent fouling the ballast material, improve site distances at crossing, aid drainage, and reduce the potential for fires. Vegetation is controlled through a variety of mechanical and chemical treatments. The resulting exposed bare soil is subject to erosion and likely is a source of sediment.

The vegetated zone consists of the remaining 30 feet of the right-of-way outside of the unvegetated buffer zone. It is generally allowed to be vegetated; maintenance is limited to keeping tree limbs cut back or removing of high-hazard trees. About 66 of the 164 acres of right-of-way are in this zone. Because it is allowed to remain vegetated, it does not pose much of a risk of being a source of sediment.

Rail lines are regulated by the U.S. Department of Transportation Federal Railroad Administration with most of their focus on rail safety. The best option for determining the extent of erosion and sedimentation originating from the rail right-of-way would be to engage CSX Corporation as a member or supporter of the TRVWP. Under that scenario problem areas could be identified and addressed in a collaborative process.

2.3 Natural Resource Characteristics

The Upper North Toe River Watershed is home to many unique and well-known features of biological and ecological significance. Areas containing populations of rare species, their habitats, and outstanding aquatic and terrestrial natural communities have been identified as State Natural Areas (SNAs) by the NCNHP. The NCNHP also tracks other lands managed to conserve biological diversity and ecological function (NCNHP 2014).

Within the Upper North Toe River Watershed, the NCNHP has identified 23 SNAs covering over 28,000 acres (Figure 2.1). These areas include some or all of such well-known features as the Roan Mountain Massif, Big Yellow Mountain, and Big Crabtree Bog and Forests (Table 2.4).

Table 2.4 Natural Heritage Program Natural Areas

Natural Area Name	Acres
Big Crabtree Creek Bog and Forests	483
Big Yellow Mountain	1,991
Bluerock Knob/Sevenmile Ridge	30
Cane Creek Mountain Connector	15
Crabtree Creek Falls Natural Area	9
Grassy Creek Forests	56
High Haven Natural Area	113
Hughes Marsh	3
Little Buck Hill Forests and Seep	194
Little Tablerock Mountain	251
Little Yellow Mountain and Hawk Mountain	1,634
Lutherock Natural Area	364
Upper North Toe River Aquatic Habitat[1]	1,200
Pyatt Bog	3
Rabbit Hop/Toe River Slope	77
Roan Mountain Massif	4,594
Sevenmile Ridge Swamp Forest-Bog Complex	188
Squirrel Creek Meadow/Shrub Bog	3
Sugar Mountain Natural Area	202
The Peak Mafic Site	52
Yellow Mountain/Raven Cliffs	6,176
Total Acres	17,638

[1]North Toe River upstream of confluence with the South Toe River (45 miles) An additional 65.5 miles of aquatic natural area includes South Toe River and North Toe River/Nolichucky River downstream of South Toe River to the Tennessee state line.

Some of the SNAs are partially or wholly encompassed within lands owned in fee simple, on which conservation easements exist, or that are otherwise managed to some degree for conservation of biological and ecological purposes (Figure 2.1, Table 2.5). Some of these lands are in public ownership and are used for recreation as well as for providing products such as timber, plants, and stone. Furthermore, some properties are not managed for conservation purposes, but are still of conservation interest because of the natural resources contained within them.

Table 2.5 Other Managed Lands

Landowners	Acres
Avery County	244
Blue Ridge Conservancy	514
Conservation Trust of North Carolina	1,122
Mitchell County	540
Clean Water Management Trust Fund (State of North Carolina)	1,118
North Carolina Division of Parks and Recreation (State)	2,656
North Carolina Ecosystem Enhancement Program (State)	26
National Park Service Blue Ridge Parkway (Federal)	1,071
North Carolina Wildlife Resources Commission (State)	1,063
North American Land Trust	74
Private Individual	113
Southern Appalachian Highlands Conservancy	1,603
The Nature Conservancy	395
U.S. Forest Service (Federal)	7,472
Yancey County	124
130 of Chatham, LLC (Private)	4,792
Total Acres Managed	22,926

The Upper North Toe River Watershed is home to 4 plant and 11 animal species that are associated with streams and adjacent riparian areas and are considered at risk of being eliminated due to the current condition of their habitats (Table 2.6). One species of freshwater mussel, the Appalachian elktoe, is on both federal and state endangered species lists (NCNHP 2012). The portion of the North Toe River downstream of its confluence with Big Crabtree Creek was designated as Critical Habitat by the USFWS in 2002 (USFWS 2002).

Six fish and four salamander species considered federal and state species of concern, State threatened, or significantly rare also are known to occur in the project area. The most notable of these are the sharphead darter and eastern hellbender. Four vascular plant species known to occur within riparian areas are also found within the project area. The Virginia spiraea is listed as both federally and state threatened. Populations of brook trout, North Carolina’s only native trout, have also been greatly reduced and are now found mainly on existing protected lands (EBTJV Undated). Since 1990, only 14 populations are known to exist within the study area (NCWRC unpublished data).

Table 2.6 At-Risk Animal and Plant Species

Taxonomic Group Common Name	Scientific Name	North Carolina Status	Federal Status
Freshwater Bivalves			
Appalachian Elktoe	*Alasmidonta raveneliana*	E	E
Wavy-Rayed Lampmussel	*Lampsilis fasciola*	SC	
Fish			
Highland Shiner	*Notropis micropteryx*	SR	
Mimic Shiner	*Notropis volucellus*	SR	
Olive Darter	*Percina squamata*	SC	FSC
Quillback	*Carpiodes cyprinus*	SR	
Sharphead Darter	*Etheostoma acuticeps*	T	FSC
Southern Blotched Chub	*Erimystax insignis eristigma*	SR	FSC
Amphibians			
Northern Pygmy Salamander	*Desmognathus organi*	SR	FSC
Weller's Salamander	*Plethodon welleri*	SC	
Eastern Hellbender	*Cryptobranchus alleganiensis alleganiensis*	SC	FSC
Vascular Plants			
Mountain Bittercress	*Cardamine clematitis*	SR-T	FSC
Bent Avens	*Geum geniculatum*	SC-V	FSC
Trailing Wolfsbane	*Aconitum reclinatum*	SR-T	
Virginia Spiraea	*Spiraea virginiana*	T	T

2.4 Existing Plans and Programs

The rural character of the towns and counties encompassed within the project area did not necessitate significant local environmental regulation until the 1990s, when development booms across western North Carolina occurred. Those areas most affected implemented local controls. Where local ordinances have not been implemented, the State regulates and enforces environmental rules.

2.4.1 Town

Newland – Newland currently does not have any ordinances specific to sedimentation and erosion control or development, but may be considering such regulations in the near future.

Spruce Pine – A zoning ordinance is in place to control development within the town's boundaries.

2.4.2 County

Mitchell – A voluntary agricultural district and floodplain ordinance have been established to control development activities in these locations.

Avery – The county established a sedimentation and erosion control ordinance in 1995 and updated it in 2006. The Avery County Department of Planning and Inspections is responsible for the enforcement of this ordinance. Other regulations in effect to protect natural resources in developing areas include watershed protection, subdivision, and voluntary agricultural district ordinances.

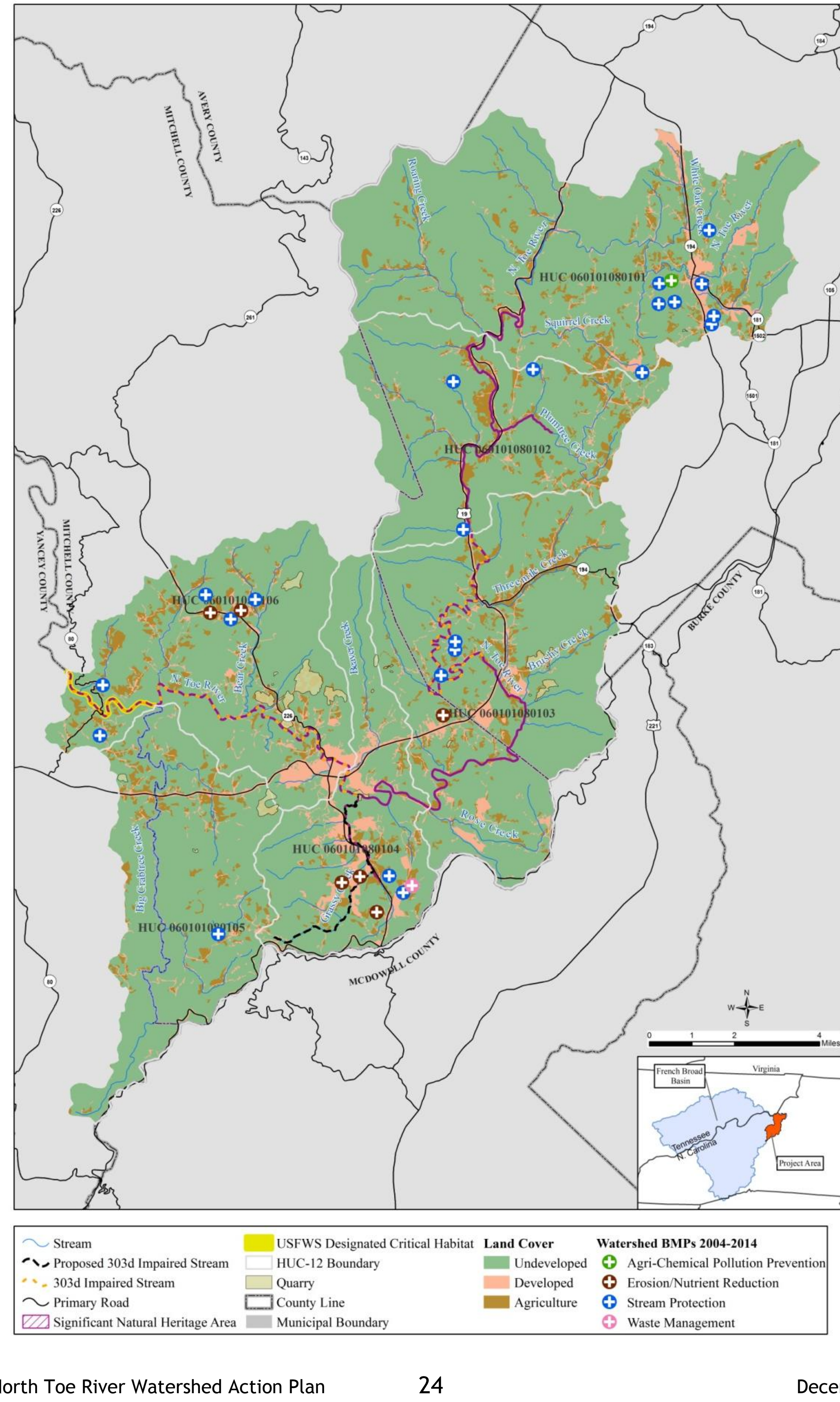
Avery/Mitchell SWCDs – In cooperation with the Natural Resources Conservation Service, the counties' SWCDs manage numerous funding programs that address pollutant reduction on both agricultural and nonagricultural lands for initiatives within developed communities.

Between 2004 and 2014, over 29+ projects have been implemented by the county SWCD (Figure 2.2; J. Hester, North Carolina Department of Agriculture and Consumer Services [NCDA&CS], personal communication). These projects were funded by the NCACSP and the Community Conservation Assistance Program (CCAP). The agricultural BMPs installed at each site were customized to address four main pollutant problems -- agrichemicals, sediment, nutrients, and fecal coliform bacteria.

North Carolina Cooperative Extension Service – In cooperation North Carolina State University, the counties have local offices of the Cooperative Extension Service. Specialists in these offices have provided advice and guidance to farmers and the commercial horticulture industry on ways to reduce their impact on the environment. They can address farm practices issues, such as farm road improvements, the use of agrichemicals, and integrated pest management, all of which can have an impact on water quality.

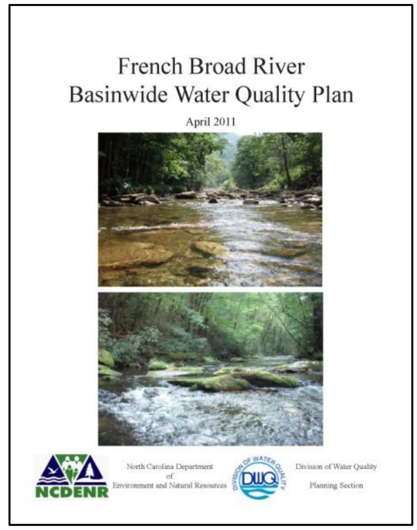
North Carolina Forest Service (NCFS) – In cooperation with the county government, the NCFS assists private landowners on ways to protect, manage, and develop their forest resources. They assist landowners and loggers in the application of forestry BMPs to protect water quality. Layout and design of logging roads, construction of stream crossings, the maintenance of streamside buffer zones, and post-logging site revegetation are a few of the BMPs that they use to minimize erosion of logging sites and protect stream water quality.

Figure 2.2 Installed Agricultural Cost Share Projects, 2004-2014



2.4.3 State

French Broad River Basinwide Water Quality Plan (NCDWQ 2011) – The purpose of this basinwide plan was to provide watershed stakeholders, planners, and regulators with a summary of the stressors and their sources that affect water quality within the French Broad River basin. It is intended to aid in restoring full use of impaired waters, identifying and protecting high-value resource waters, and protecting unimpaired waters while allowing reasonable economic growth. This document has been updated on a 5-year cycle.



French Broad River Basin Restoration Priorities 2009 (NCEEP 2009) - The purpose of this plan was to identify Targeted Local Watersheds (TLWs) for stream, wetland, and riparian buffer restoration and protection. It builds on information contained in NCDWQ's basinwide water quality plan to meet NCEEP's planning needs for wetland and stream mitigation (NCDWQ 2005). Two of the 27 TLWs identified in the report, North Toe River headwaters and Upper North Toe / Plumtree Creek, are within the current watershed planning area. The North Toe River / Grassy Creek / Bear Creek TLW was listed in the 2005 priority plan (NCEEP 2005), but was delisted in 2009 following a reevaluation of local subwatershed conditions. These three TLWs encompass the entire current study area. No local watershed plans have been prepared for these TLWs although the NCEEP has implemented three mitigation projects. Two of the projects are for the preservation of high quality streams, totaling 24,491 feet of stream channel, whereas the third is comprised of stream restoration (6,057 feet), stream enhancement (1,493 feet), riparian wetlands (4.8 acres), and stream preservation (6,421 feet).

North Toe River Riparian Corridor Conservation Design for the Five Major Drainages of the Roan Highlands (SAHC 2000) – The purpose of this study was to assess riparian zone conditions of five catchments draining the majority of the Roan Highlands area in North Carolina. These five catchments -- Henson, Powdermill, Roaring, Birchfield, and Horse creeks -- are all part of the Upper North Toe Watershed. The purpose of the project was to identify riparian buffers that were inadequate in protecting water quality from nonpoint pollutant sources. The study concluded that, for the most part, nonpoint source pollutant problems, particularly sediment, are most prevalent in the downstream reaches where land disturbances are the highest. Sediment from these five streams flushes out quickly due to their high gradient only to impact the lower gradient streambeds of the North Toe River. Coarser sediments settle in the streambed, whereas finer sediments contribute to turbidity problems in the mainstem North Toe River. Logging and livestock, although dispersed throughout these catchments, were identified as the primary cause of sediment runoff. The report recommends addressing the livestock problem by fencing them out of creeks and enhancing the vegetation in areas where it is sparse or lacking. They also recommended implementing an education strategy addressing NPS pollution, pursuing land preservation priorities, and monitoring land disturbing activities planned on USFS lands.

Avery County Heritage Development Plan (BRNHAP 2005) – The following quote is taken directly from the plan and describes its purpose:

> "The Avery County Blue Ridge Heritage Development Plan (BRNHAP 2005) is an integrated approach to developing [the] historic, natural/recreational, infrastructure, music, craft/arts, and agriculture [of Avery County]. The plan identifies specific projects that improve natural greenways and trails, the restoration and preservation of historical buildings and homes, support of infrastructure projects, coordination of agritourism events, and arts/craft and music initiatives. The overarching objective of the Avery County Heritage Plan is to improve the quality of life for residents of the several communities in the county by preserving the history, culture and natural resources that make this county a special place to live, while enhancing the economic development of the area through the thoughtful development of heritage tourism.

2.5 Organizations in the Watershed

Toe River Valley Watch – The TRVW is a nonprofit group that was founded in 2006 (TRVW 2014). It strives to bring the community together to preserve the unique rural heritage of Mitchell and Yancey counties. Their goal is to create solutions that will help the local economy grow without compromising one of our most important assets -- our natural resources. The TRVW works with elected officials, schools, and all residents to help develop community-based planning and projects that will enhance the rural future of Mitchell and Yancey counties. The principles they use to guide their activities are as follows:

- To preserve and protect the rural character of the Toe River Valley.
- To assure a continued, healthy, and abundant supply of clean water in the Toe River and protect the rivers and streams that feed into the Toe River.
- To protect the native flora and fauna of the Southern Appalachian Mountains that are found in the Toe River Valley.
- To develop partnerships with the residents of the Toe River Valley in order to preserve the unique but threatened heritage of their rural environment.
- To protect and promote the clean and healthy environment of the Toe River Valley, the Appalachian Trail, and all other parts of Mitchell and Yancey counties as designated by the Blue Ridge National Heritage Area.
- To foster the economic well-being of the residents of the Toe River Valley for present and future generations by preserving the rich cultural and natural heritage of the area.
- To inform the public about how natural occurrences and human activities impact their environment and to motivate the public to have a positive impact.

Toe River Valley Watershed Partnership - Local nonprofit BRRC&D brought together a diverse group of people interested in the well-being of streams in the Upper North Toe River Watershed to form a new working organization called the "**Toe River Valley Watershed Partnership**". This will include groups, including private companies, local governments, and state and federal agencies as well as corporations that were members of the original TRVW. As an organization created from the TRVW, it will be guided by the BRRC&D to build upon the TRVW recent success in securing funding to ensure that those streams have clean water, are safe to play in, have better fish communities and fishing, and make the area known as an outdoor mecca for travelers and residents alike.

Dealing with erosion and sedimentation problems will be a key focus of the TRVWP as it implements watershed improvement projects that improve stream channels and reduce the impacts of stormwater runoff from agricultural, residential, and commercial areas. The Partnership also will work to expand opportunities for people to enjoy and learn about the rivers by implementing a strong education and outreach program. This program will include supporting the popular "Toes in the Toe" watershed festival held each year for 5th-grade students and reaching out to area teachers to learn how best to serve them.

The TRVWP plans to tackle a host of projects that will provide opportunities for community involvement and things everyone can do to help improve stream health:

- Harvest rainwater for use on lawns and gardens.
- Plant trees and other woody plants along stream banks for stability and shading.
- Reduce the use of lawn and garden chemicals.
- Become a volunteer water quality monitor.
- Get involved with local organizations supporting river stewardship.
- Fish, paddle, and play in streams.

By improving stream health, the TRVWP will improve opportunities to use the river as an economic engine. The stream improvements occurring over the past 40 years are reflected in how people interact with these waters today. Fishing opportunities have improved and now two communities in the valley – Newland and Spruce Pine – have been designated as Mountain Heritage Trout Cities by the NCWRC. Commercial and recreational paddling opportunities have increased, and the valley is now home to a paddling trail. The beautiful streams of the North Toe River Valley should be a draw for tourists and a boost to other sectors of the local economy.

Charter members of the TRVWP include the following:

- Mitchell County
- Spruce Pine
- Downtown Spruce Pine
- Unimin Corporation
- High Country Council of Governments
- North Carolina Cooperative Extension
- North Carolina Division of Water Resources
- North Carolina Wildlife Resources Commission
- North Carolina Natural Heritage Program
- U.S. Fish & Wildlife Service

In addition to those organizations and agencies that attended the 2011 stakeholder meeting (see list below), all others with an interest in protecting and improving conditions within the Upper North Toe River Watershed will be encouraged to join in this effort.

- Avery County Economic Development
- Bark House
- Blue Ridge Conservancy
- Carolina High Peaks Trail Association
- Carolina Mountain Realty
- Freeman Environmental Consulting
- High County Council of Governments
- LandCraft Engineering
- Loafer's Glory Rafting
- Mayland Community College
- Mitchell County Economic Development Commission
- Mitchell County Chamber of Commerce
- Mitchell County Cooperative Extension Office
- Mountain Heritage High School
- N.C. Survey, P.C.
- River's Edge Outfitters
- Southern Appalachian Highlands Conservancy
- Spruce Pine Main Street
- The Nature Conservancy
- Trout Unlimited
- Vulcan Materials
- Yancey County

3. WATERSHED CONDITIONS

3.1 What We Know from Existing Data

As described in Section 2.3, a lot of work has been done to protect the existing high-quality natural resources of the Upper North Toe River Watershed. Many of these efforts have been concentrated on uplands at the highest elevations and primarily encompass headwater streams (Figure 1.1). Consequently, land at lower elevations is generally more disturbed, and streams flowing through these areas have been affected by development. While increased environmental awareness and regulations have resulted in improved water quality, stream habitat and aquatic communities of some streams have not fully recovered from past abuses as can be seen by looking at existing data.

3.1.1 Water Quality Conditions

The project area contains an estimated 1,498 miles of stream. The North Toe River and almost all tributaries upstream of the Spruce Pine intake, located just upstream of the US 19E bridge in Avery County, are classified as water supply (WS) sources (WS-I through WS-V) by the NCDWR. Furthermore, the supplemental Tr classification applies to most of those waters. The North Toe River and most tributaries downstream of the water supply intake have a "C" primary classification and the Tr supplemental classification. The headwaters of Beaver Creek and Graveyard Creek, both of which serve as drinking water sources for Spruce Pine are classified to protect their high quality. Both have WS-I and High Quality Waters (HQW) classifications, the most protective classification the State applies. These classifications (NCDWR 2013a) are intended to protect water quality by requiring limits on wastewater discharges and development activities as well as mandating the use of erosion and sediment controls and agricultural, forestry, and transportation BMPs (Table 3.1).

Table 3.1 Freshwater Water Quality Classifications

Classification	Description
Water Supply: WS-1, WS-II, WS-III, WS-IV, and WS-V	Waters used for drinking, culinary, or food processing purposes; amount of protection varies between subclasses.
Class C	Waters protected for secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival, and maintenance of biological integrity, agriculture and other suitable uses. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized or incidental manner.
Trout Waters (Tr)	Supplemental classification intended to protect freshwaters for natural trout propagation and survival of stocked trout on a year around basis.
High Quality Waters (HQW)	Supplemental classification intended to protect waters that are rated excellent based on biological and physical/chemical characteristics. By definition WS-I and WS-II waters are also HQW.

Water quality conditions in the North Toe River project focus area are generally good as shown by 12 years of data from two NCDWR ambient monitoring sites (Figure 3.1, Tables 3.2 and 3.3). Of the 23 parameters monitored monthly by the NCDWR over 12 years, only turbidity was found to exceed the evaluation level (>10% of samples exceeded 10 NTU with 90% confidence; NCDWR 2014b). Turbidity data from eight additional sites (four each upstream and downstream of the discharge points) associated with commercial mine NPDES permits on the North Toe River support the NCDWR data (Figure 3.1, Table 3.4). Those data, covering recent 5- to 7-year periods, show that 11-25% of samples were found to exceed the 10 NTU evaluation standard and were the basis for listing portions of the North Toe River on North Carolina's 303(d) impaired waters list in 2006 and 2008.

The sample sites encompass a significant portion of the mainstem North Toe River on the 303(d) list. Their continued sampling will aid in revealing trends in water quality, particularly turbidity, as watershed improvement projects are implemented. Data from these sites will compliment monitoring associated with individual watershed projects and will strengthen the monitoring strategy of the WAP. Furthermore, the continued monitoring will provide a way to document changes in turbidity over the life of the WAP.

Figure 3.1 Existing Sample Site Locations

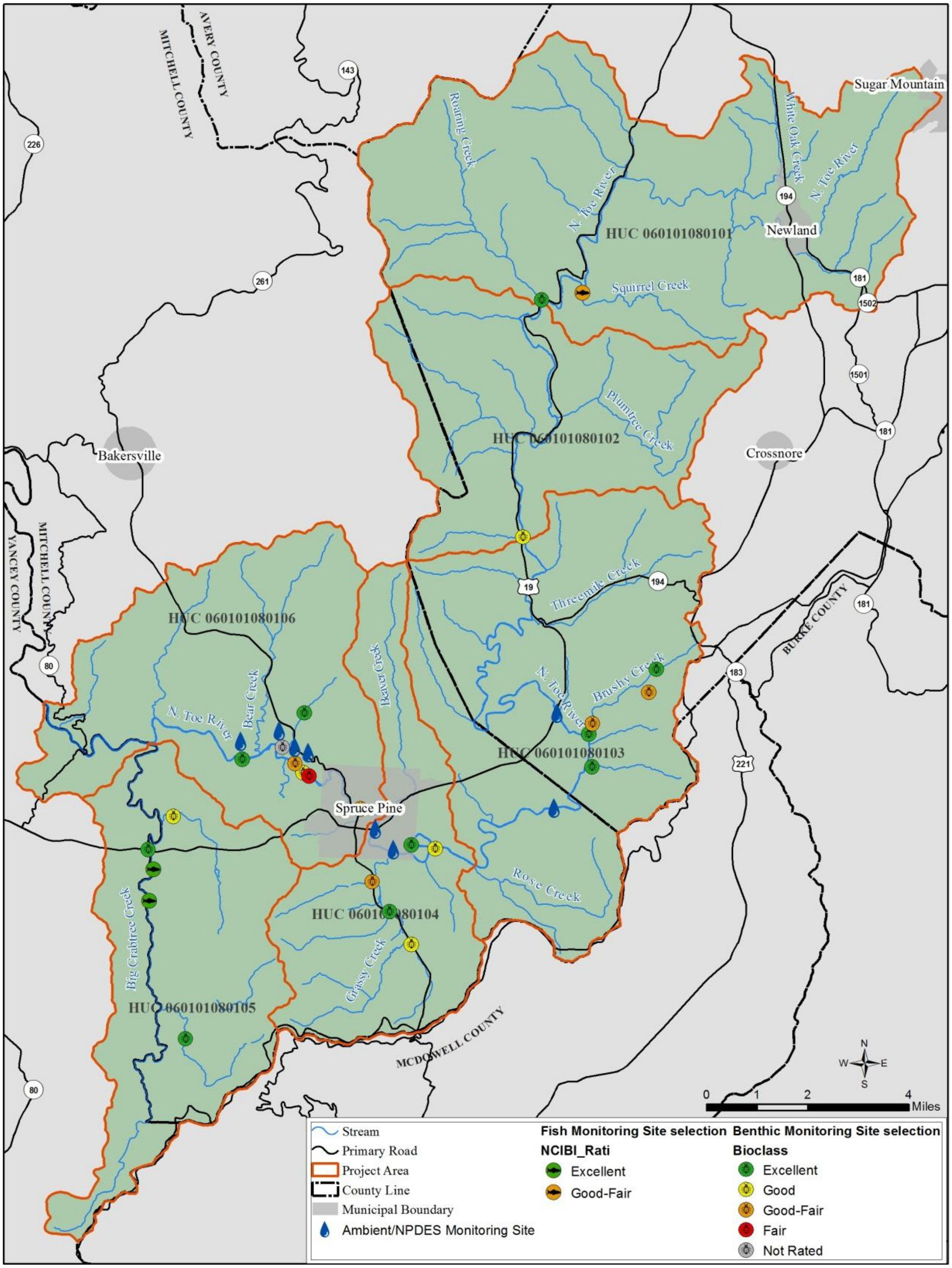


Table 3.2 Water Quality Characteristics at the Ingalls Ambient Monitoring Station, 2000-2011

Sample Characteristics					Results not meeting Evaluation Level		Percentiles						
Character and Parameter	**Number of Samples**	**Number of ND**	**Evaluation Level - Class (C)[1]**	**Evaluation Level - Class (Tr)[1]**	**Number**	**Percent**	**Minimum**	**10th**	**25th**	**50th**	**75th**	**90th**	**Maximum**
Field Measures													
D.O.> (mg/L)	123	N/A	Not <5.0	Not<6.0	0	0	7.5	8.4	9	10.8	12.3	13.2	15.5
pH (SU)	122	N/A	6-9		0	0	5.6	6.5	6.8	7.2	7.6	7.8	8.5
Conductivity (μS/cm)	123	N/A	N/A	N/A			25	42	45	50	55.5	61.8	163
Water Temp (C)	125	N/A	>29		0	0	0.2	3.9	7.4	12.9	19	21	23.2
Other													
Hardness (mg/L)	15	0	N/A				9	9.4	10.5	14	15.5	18.8	21
TSS (mg/L)	50	17	N/A	10 HQW			1	3	3.9	8	13	19.6	480
Turbidity (NTU)	127	3	50	10	26	20	1	1.7	2.3	3.9	8	16.8	240
Nutrients (mg/L)													
NH3 as N	15	9	N/A				0.01	0.02	0.02	0.03	0.04	0.05	0.06
NO2 + NO3 as N	15	0	N/A				0.2	0.4	0.4	0.4	0.6	0.7	0.8
TKN as N	13	1	N/A				0.1	0.2	0.2	0.2	0.3	0.3	0.3
Total Phosphorous	16	5	N/A				0.01	0.01	0.01	0.02	0.03	0.03	0.04
Metals (ug/L)													
Aluminum	30	0	N/A				56	71.5	132.5	190	357.5	661	16000 (11/29/2005)
Arsenic	30	30	50		0	0							
Cadmium	31	31	2	0.4	0	0							
Chloride (mg/L)	54	0	230		0	0	2	3.8	4.6	5.4	6.4	7.3	39 (12/17/2010)
Copper	31	23	7		2	6.5	2	2	2.2	2.4	5.7	18	25 (11/29/2005)
Flouride (mg/L)	118	107		1.8	0	0	0.1	0.1	0.4	0.5	0.8	0.9	1.3
Iron (mg/L)	30	0	1.0		2	6.7	0.1	0.1	0.2	0.3	0.5	0.8	22 (11/29/2005)
Lead	31	29	25		0	0	14	14	14	14	14	14	14
Mercury	29	29	0.012										
Nickel	31	30	88		0	0	17						17
Zinc	31	28	50		1	3.2	11	12.8	15.5	20	51	69.6	82

Fecal Coliform Screening (Number of Colony Forming Units/100mL; CFUs/100 mL)

		Evaluation Level	Geometric Mean	Number of Samples >400 CFUs/100 mL	Percent of Samples >400 CFUs/100 mL
	148	Geometric Mean >200 CFUs/100 mL >20% of samples exceed 400 CFUs/100 mL	41.7	21	14

[1]Evaluation level is the level at which further assessments are warranted to determine necessary actions; C and Tr are water quality classifications that have stricter standards.

Table 3.3 Water Quality Characteristics at the Penland Ambient Monitoring Station, 2000-2011

Sample Characteristics					Results not meeting Evaluation Level		Percentiles						
Character and Parameter	**Number of Samples**	**Number of ND**	**Evaluation Level - Class (C)**	**Evaluation Level - Class (Tr)**	**Number**	**Percent**	**Minimum**	**10th**	**25th**	**50th**	**75th**	**90th**	**Maximum**
Field Measures													
D.O.> (mg/L)	122	N/A	Not <5.0	Not<6.0	0	0	7.6	8.2	9.1	10.5	12.3	13.5	15.2
pH (SU)	122	N/A	6-9		1	0.8	5.6	6.6	6.9	7.2	7.5	7.9	8.7
Conductivity (μS/cm)	123	N/A	N/A	N/A			41	57.2	69.5	89	115.5	147.6	227
Water Temp (C)	125	N/A	>29		0	0	0	3.8	8	13.4	20.9	23	26.4
Other													
Hardness (mg/L)	15	0	N/A				15	16	22.5	26	32.5	48.8	80
TSS (mg/L)	53	10	N/A	10 HQW			1	3.1	4.6	9.8	25.5	76.4	550 (11/29/2005)
Turbidity (NTU)	128	1	50	10	42	33	1.3	2.1	3.1	4.9	12	35	340 (11/29/2005)
Nutrients (mg/L)													
NH3 as N	18	5	N/A				0.01	0.02	0.02	0.05	0.06	0.078	0.28
NO2 + NO3 as N	18	0	N/A				0.19	0.28	0.35	0.43	0.53	0.63	0.85
TKN as N	16	3	N/A				0.1	0.12	0.2	0.2	0.3	0.3	0.4
Total Phosphorous	19	4	N/A				0.01	0.01	0.01	0.01	0.03	0.05	0.06
Metals (ug/L)													
Aluminum	31	0	N/A				110	150	205	300	785	1800	24000 (11/29/2005)
Arsenic	0	31	50		0	0							
Cadmium	0	32	2	0.4	0	0							
Chloride (mg/L)	51	1	230		0	0	3	4.9	6.3	7.5	8.8	12	16
Copper	32	18	7		1	3	2.1	2.1	2.4	3.0	3.7	6.6	33 (11/29/2005)
Flouride (mg/L)	119	35		1.8	7	8.4	0.4	0.5	0.6	0.8	1.2	1.8	3
Iron (mg/L)	31	0	1.0		6	19	0.2	0.25	0.3	0.45	0.84	1.9	28 (11/29/2005)
Lead	32	31	25		1	3.1							20 (11/29/2005)
Mercury	30	30	0.012		0	0							
Nickel	32	31	88		0	0							20 (11/29/2005)
Zinc	32	17	50		1	3.1	10	11.4	12.5	15	19.5	21.2	89 (11/29/2005)

Fecal Coliform Screening (Number of Colony Forming Units/100mL; CFUs/100 mL)

		Evaluation Level	Geometric Mean	Number of Samples >400 CFUs/100 mL	Percent of Samples >400 CFUs/100 mL
	128	Geometric Mean >200 CFUs/100 mL >20% of samples exceed 400 CFUs/100 mL	55.3	23	18

[1]Evaluation level is the level at which further assessments are warranted to determine necessary actions; C and Tr are water quality classifications.

Table 3.4 Water Quality Data Associated with Commercial Mining NPDES Permits[1]

Sample Characteristics			Results not meeting Evaluation Level				Percentiles						
Site Location and Parameter	Number of Samples	Number of ND	Evaluation Level - Class (C)	Evaluation Level - Class (Tr)[2]	Number	Percent	Minimum	10th	25th	50th	75th	90th	Maximum
Unimin Schoolhouse Plant													
Upstream													
pH (SU)													
TSS (mg/L)													
Turbidity (NTU)	476			10	52	10.9	1.2	2	2.4	3.6	6.4	11.4	179
Downstream													
pH (SU)													
TSS (mg/L)													
Turbidity (NTU)	476			10	58	12.1	1.2	2	2.4	3.6	6.4	12.2	176
The Quartz Corp Feldspar Plant at Altapass Highway													
Upstream													
Turbidity (NTU)	473			10	109	22.7	1.3	2.4	3.4	5.2	9.3	23.5	263.0
Downstream													
Turbidity (NTU)	473			10	105	23.5	1.3	2.8	3.7	5.4	9.8	22.1	249.0
The Quartz Corp KT Feldspar Plant													
Upstream													
Turbidity (NTU)	367			10	73	19.9	0.6	2.2	2.9	4.6	8	18.9	765.0
Downstream													
Turbidity (NTU)	367			10	80	21.8	1.3	2.4	3.2	5	9	20	755.0
Unimin MinPro Plant													
Upstream													
pH (SU)	911		6-9		0	0	6.1	6.9	7.1	7.3	7.4	7.6	8.8
TSS (mg/L)	911	264					0	0	0	3.7	8	18	263.0
Turbidity (NTU)	911			10	225	25	1.1	2.4	3.7	5.5	9.9	20.5	518.0
Downstream													
pH (SU)	911		6-9		0	0	6.3	7	7.2	7.3	7.5	7.6	8.7
TSS (mg/L)	911	305					0	0	0	3.1	7	14.5	127.0
Turbidity (NTU)	911			10	207	23	0.9	2.5	3.3	5	9.1	18	445.0

[1]Data years: Unimin Schoolhouse Plant - 2009-2012, The Quartz Corp Feldspar Plant at Altapass Highway - 2009-2012, The Quartz Corp KT Feldspar Plant - 2009-2012, Unimin Minpro Plant - 2007-2012. Samples generally taken three times per week at the discretion of the permittee.

[2]Evaluation level is the level at which further assessments are warranted to determine necessary actions; C and Tr are water quality classifications.

3.1.2 Biological Conditions

> ***Benthic Macroinvertebrates*** *– Stream dwelling insects in various life stages and visible without a microscope.*

Benthic Macroinvertebrate Monitoring – Benthic monitoring in the Upper North Toe River Watershed has been conducted by the NCDWR at various times and places since the early 1980s (Figure 3.1, Table 3.5). While most sampling has been associated with basinwide assessments (NCDWQ 2008, 2011), additional samples associated with a fuel spill and mining operations were taken in 2009 and 2010 (NCDWQ 2009). In 2010, a special study was requested to identify streams with the best and worst biological conditions within the project area (NCDWQ 2010b). The purpose of the study was to identify subwatersheds in need of remediation or whose current condition warrants conservation. The results of that study were used to justify the need for the development of a WAP (NCDWR 2013b).

An examination of all the recent benthic data reveals that almost without exception most benthic communities have been rated as Good-Fair or better throughout the watershed, including the mainstem North Toe River impaired reaches. The only site not consistent with those ratings was located on Little Bear Creek downstream of the Unimin Corporation's MinPro processing plant discharge. Because of its small size, it was "Not Rated" based on the large stream assessment criteria under which it would have been rated Fair or Poor (Table 3.5). Other catchments showing some signs of degradation (Good-Fair ratings) include Brushy Creek, Grassy Creek, and the North Toe River downstream of The Quartz Corp K-T Feldspar processing plant. Beaver Creek, which drains much of downtown Spruce Pine, received a Fair rating. Stormwater runoff from impervious surfaces in that subwatershed likely is having an effect on the benthic community. Increased stormwater volumes and associated stream velocities as well as sediment and pollutants from impervious surfaces are likely potential causes of the lower benthic ratings at this site.

The benthic community monitoring performed on Brushy Creek, Little Bear Creek, and the North Toe River was specifically designed to target areas where the mining companies will be implementing BMPs. That data will be used to assess conditions before and after implementation. As the WAP is implemented, additional benthic monitoring sites may be added to assess conditions associated with watershed restoration projects within specific catchments.

Table 3.5 Benthic Invertebrate Community Ratings by Site (Sheet 1 of 2)

Waterbody[1]	Location	Location Detail	Years Sampled	Ratings[2]	2012 Special Study
North Toe River Tributaries					
Kentucky Creek	NC 181	Off NC 181	2012	G	Yes
Horse Creek	US 19E	At US 19E crossing	2012	G	Yes
Roaring Creek	US 19E	At US 19 nr mouth	2002, 2012	E, E	Yes
Plumtree Creek	US 19E	At US 19E crossing	2012	G	Yes
Jones Creek	SR 1100	Pyatt Creek?	1985	G	
Threemile Creek	US 19E	At US 19E crossing	2012	E	Yes
Brushy Creek	Unimin Schoolhouse Plant	Near mouth downstream of quarry	2010	E	
Brushy Creek	Near Hobbs Lane	End of road	1989	G-F	
Brushy Creek	SR 1101	Upstream of quarry	2010	E	
Brushy Creek	SR 1189	Upstream of quarry access road	1989	G-F	
Harris Creek	Quarry access road	Remote location	2010	E	
Rose Creek	SR 1121	Off SR 1121	2012	G	Yes
Grassy Creek	NC 226	Off NC 226	2012	G-F	Yes
E. Fork Grassy Creek	NC 226	Upstream of car dealership	2012	G	Yes
Graveyard Creek	NC 226	Near confluence w/Grassy Creek	2012	G-F	Yes
Rockhouse Creek	NC 226	Near confluence w/Grassy Creek	2012	E	Yes
Beaver Creek	SR 1121	SR 1121 crossing	2012	F	Yes
Little Bear Creek	NC 226	Downstream of quarry and NC 226	1985, 2010	P, NR	
Little Bear Creek	NC 226	Upstream of quarry and NC 226	1985, 2011	F, E	
Bear Creek	SR 1162	Off SR 1162	2012	G	Yes
Big Crabtree Creek	US 19 E	At US 19E	1997, 2002, 2004, 2007, 2012	E, G, E, E, G	
Brushy Creek	SR 1160	Tributary of Big Crabtree Creek	2009	G	
East Fork Big Crabtree Creek	SR 1002	At impoundments	1992	G	

[1]Samples are listed in upstream to downstream order.
[2]Benthic community ratings (NCDWQ 2012b; NCDWR 2014b): E = Excellent, G = Good, G-F = Good-Fair, F = Fair, P = Poor, NR = Not Rated (streams <3 meters in width that would be rated Fair or Poor using the large streams bioclassification criteria).

Table 3.5 Benthic Invertebrate Community Ratings by Site (Sheet 2 of 2)

Waterbody[1]	Location	Location Detail	Years Sampled	Ratings[2]	2012 Special Study
Mainstem North Toe River					
North Toe River	SR 1347	Off SR 1347	2012	E	Yes
North Toe River	SR 1117	At bridge	2012	E	Yes
North Toe River	US 19E	Near Jones Creek	1984, 1985, 1987, 1988, 1989(2), 1992, 1997, 2002, 2007, 2009, 2012	G, G, G, G, G, G, G, E, G, G, G, E	Yes
North Toe River	SR 1121	Altapass Highway bridge	1985	G	
North Toe River	Carpenter Island Road	At bridge	2009	E	Yes
North Toe River	SR 1151	Upstream of The Quartz Corp at Altapass	1985, 1985	F, F	
North Toe River	NC 226	Business NC 226, Highland Ave.	1985	G-F	
North Toe River	Upstream of K-T Feldspar discharge		2009	G	
North Toe River	Downstream of K-T Feldspar discharge		2009	G-F	
North Toe River	SR 1162	Penland Road	1984, 1985, 1986, 1987, 1988, 1989, 1989, 1992, 1997, 2002, 2006, 2009, 2012	G-F, F, F, F, P, G, G-F, G-F, G, F, E, G	Yes

[1]Samples are listed in upstream to downstream order.
[2]Benthic community ratings: E = Excellent, G = Good, G-F = Good-Fair, F = Fair, P = Poor.

Aquatic Resources – As with benthic communities, NCDWR biologists have developed an indicator to rate the health of fish communities (NCDWR 2013c) relative to what is expected to be found in pristine streams. Rating categories from worst to best are Poor, Fair, Good-Fair, Good, and Excellent. Of the seven sites that have been sampled in the Upper North Toe River Watershed, four of those have been on the mainstem North Toe River; two were on Big Crabtree Creek, and one was on Grassy Creek (Figure 3.1, Table 3.6). All sites except the 2012 sample on Grassy Creek were rated Good-Fair or better. The Grassy Creek site, located downstream of the NC 226 commercial corridor south of Spruce Pine, was rated Fair (NCDWR 2013b) due mainly to an abundance of pollutant-tolerant fish species. Habitat at this site was noted as being degraded; the stream channel was entrenched, bank scour or bank riprapping was common, and riparian vegetation was not well developed. Much of this impact was attributed to stormwater runoff from impervious surfaces.

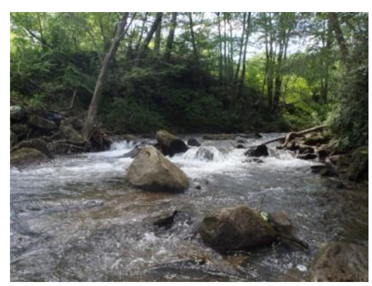
Table 3.6 Fish Community IBI Ratings[1]

Waterbody	Location	Location Detail	Years Sampled	Ratings	Source
North Toe River	SR 1121 SR 1138	Upstream of confluence with Squirrel Creek	1997, 2007, 2012	G-F, G-F, G-F	NCDWQ
Grassy Creek	SR 1117	Lower Carters Ridge Road bridge	2012	F	NCDWQ
Big Crabtree Creek	SR 2002	Bridge at Murphy Road	1997	E	NCDWQ
Big Crabtree Creek	SR 2002	At third bridge crossing	1998, 1999, 2004, 2007, 2012	E, E, E, E	NCDWQ
North Toe River	US 19E	Bridge at Unimin Schoolhouse Plant	1999, 2004	G, G	TVA
North Toe River	SR 1162	Penland Road bridge	1992	F-G	TVA
North Toe River	NC 80	At bridge crossing	1993	G	NCDWQ

[1]Samples are listed in upstream to downstream order.

Freshwater mussel populations of the upper North Toe River are monitored at 5±-year intervals. Sampling by the NCWRC in 2008 and 2013 revealed that the existing mussel populations are stable (S. Fraley, NCWRC, personal communication). Although the species prefers substrates composed of a mix of sand, gravel, and cobble, the abundance of sand in the upper North Toe River may be a limiting factor for this population. The high sand load of the river is likely both a relic of past mining operations and erosion due to current day land disturbances. Improvement of bottom substrates that favor enhancement of the mussel populations is likely to be a slow process.

Aquatic Habitats - In addition to benthic and fish community conditions, the NCDWR also routinely rates aquatic habitat quality on a 0-100 scale at many sampling sites (NCDWR 2013b). According to the NCDWR, fish communities generally show signs of stress (more pollutant-tolerant fish species) when habitat scores are below 70 (B. Tracy, NCDWR, personal communication).



Nineteen such assessments have been made on tributaries within the Upper North Toe River Watershed (Table 3.7) within the last four years; eight additional sites have been evaluated on the mainstem North Toe River. Of the tributary streams, only Grassy Creek and Little Bear Creek had scores <70. Grassy Creek was noted as being impacted by stormwater runoff from a commercial area upstream, whereas the Little Bear Creek site was located downstream of the Unimin Corporation's settling pond discharge. Beaver Creek and Graveyard Creek, whose habitat both scored 70, are also impacted by stormwater. The lower portion of Beaver Creek receives stormwater from downtown Spruce Pine, whereas Graveyard Creek flows through a golf course, where the stream is impounded. These conditions interrupt the normal stream flows that maintain sediment transport, which affects the habitat scores.

Total habitat scores on the mainstem North Toe River generally declined from upstream to downstream. Scores upstream of the upper impaired reach (upstream of Pyatt Creek) were >80, whereas within and downstream of that reach scores fell from the mid-70s to the mid-60s. Scores at the Penland Bridge site (the most downstream location sampled) rebounded to the mid-70s. Riffle embeddedness scores, an indicator of sediment load, were ≥14 out 16 at all 17 sites; however, percent silt+sand was ≥35% downstream from a point at the US 19E bridge near the Unimin Schoolhouse plant, whereas above that location sand+silt was ≤30%

In general, those tributaries and portions of the mainstem North Toe River with the most development or agricultural activity have the lowest total habitat scores; however, all but one of the 21 sites evaluated had high riffle habitat scores (≥14 out of 16). While the headwater tributaries of Kentucky Creek and Plumtree Creek have lower total scores than do others in the area, their impact on the upper mainstem does not appear to be significant. Total habitat scores for the three mainstem sites in the uppermost reaches of the North Toe River were higher than those of Kentucky Creek and Plumtree Creek. The main difference in the total scores can be attributed to lower bank stability and lower light penetration (a measure of shading from canopy cover) metric scores.

The percent of bottom substrate covered by sand+silt as an indicator of habitat quality (higher percentage indicates poor quality) was ≥40% at the three mainstem North Toe River sites in the lower portion of the watershed. This may be due to the fact that the upper mainstem has a higher gradient, causing sediment to be flushed downstream rather than settling on the streambed. As a result, bottom substrates of the headwater portion of the North Toe River are composed of a greater proportion of coarse materials.

Table 3.7 Aquatic Habitat Ratings

Water Body	Location	Location Detail	Years Sampled	Total Habitat Score (Maximum 100)	Riffle Habitat Score (Maximum 16)	Percent Sand+Silt
North Toe River Tributaries						
Kentucky Creek	NC 181	Off NC 181	2012	73	16	15
Horse Creek	US 19E	At US 19E crossing	2012	83	16	0
Roaring Creek	US 19E	At US 19 nr mouth	2012	84	16	0
Plumtree Creek	US 19E	At US 19E crossing	2012	73	16	15
Threemile Creek	US 19E	At US 19E crossing	2012	79	15	30
Brushy Creek	Unimin Schoolhouse Plant	Near mouth downstream of quarry	2010	81	14	50
Brushy Creek	SR 1101	Upstream of quarry	2010	82	16	40
Harris Creek	Quarry access road	Remote location	2010	94	16	20
Rose Creek	SR 1121	Off SR 1121	2012	78	10	30
Grassy Creek	NC 226	Off NC 226	2012	61	15	50
East Fork Grassy Creek	NC 226	Upstream of car dealership	2012	74	16	20
Graveyard Creek	NC 226	Near confluence with Grassy Creek	2012	70	16	25
Rockhouse Creek	NC 226	Near confluence with Grassy Creek	2012	77	16	10
Beaver Creek	SR 1121	SR 1121 crossing	2012	70	15	30
Little Bear Creek	NC 226	Downstream of quarry and NC 226	2010	67	14	35
Little Bear Creek	NC 226	Upstream of quarry and NC 226	2010	81	16	35
Bear Creek	SR 1162	Off SR 1162	2012	74	10	50
Big Crabtree Creek	US 19 E	At US 19E	2012	88	14	20
Brushy Creek	SR 1160	Tributary of Big Crabtree Creek	2009	82	15	0
Mainstem North Toe River						
North Toe River	SR 1347	off SR 1347	2012	88	16	10
North Toe River	SR 1117	At bridge	2012	82	15	30
North Toe River	US 19E	Near Jones Creek	2012	81	15	20
North Toe River	US 19E	bridge at Unimin Schoolhouse plant		73	14	45
North Toe River	Carpenter Island Road	At bridge	2009	77	14	55
North Toe River	Upstream of K-T Feldspar discharge		2009	67	14	35
North Toe River	Downstream of K-T Feldspar discharge		2009	66	14	
North Toe River	SR 1162	Penland Road	2012 (2)	74, 75	14, 14	45, 30

3.2 What We've Learned about Current Watershed Conditions and Sediment Sources

As part of the current project, field assessments were conducted for subwatersheds considered to be the primary source of sediments (Figure 3.2, Table 3.8). Field assessments included turbidity analyses from water quality grab and stage samplers, windshield surveys, and streamwalks. See Appendix A for field assessment methodologies.

Based on the initial windshield survey data, it was evident that there were additional land disturbances that were potential sources of sediment; those data were not being captured. The most significant land disturbances being observed included the extent of wooded vegetation within riparian areas (≤30 feet of streams), unpaved roads, and horticultural operations. In consultation with the core Technical Advisory Committee (TAC) members, the following subwatersheds were chosen for the additional analysis: headwaters of the North Toe River, Whiteoak Creek, Plumtree Creek, and Threemile Creek (Table 3.8). With the exception of Roaring Creek, these assessments were designed to complement the windshield survey data being collected in these same subwatersheds. To evaluate these attributes, desktop analyses of aerial photographs using GIS software (Appendix B) were conducted. Site-specific disturbances were field verified; as a consequence, parcel ownership was not researched and no potential project lists were identified. The results will be used as a basis for determining additional field assessments and landowner outreach efforts necessary to address these issues. A summary of the individual assessments is presented in the following sections.

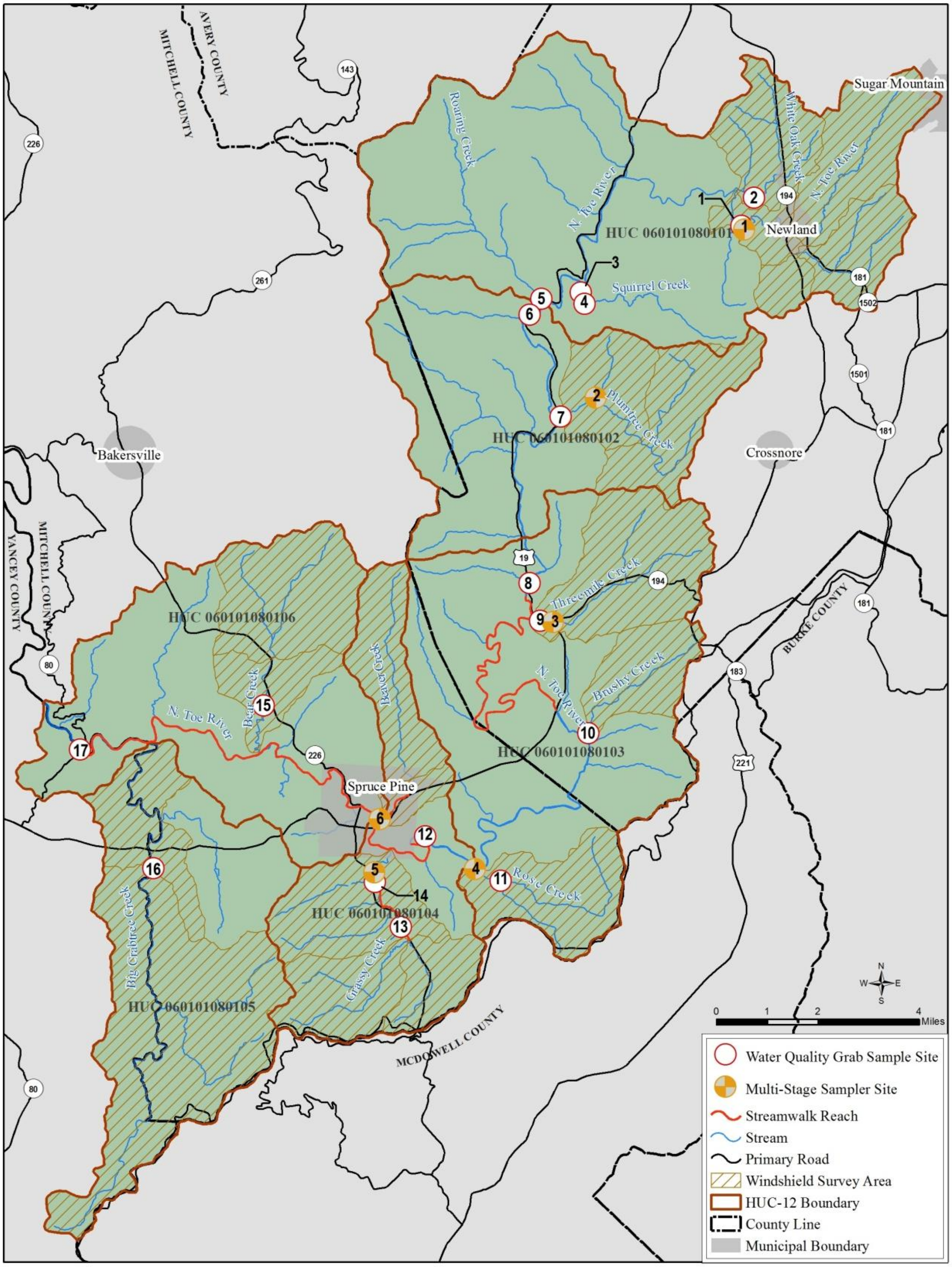
Table 3.8 Subwatershed Field and Desktop Assessment Plan

Subwatershed	Assessment Type					
	Field[1]			Desktop		
	Water Quality Grab Samples[1]	Stage Samples	Windshield Survey	Unpaved Roads	Unwooded Riparian Buffers	Christmas Tree Farms
Headwaters North Toe River	X	X	X	X	X	X
Whiteoak Creek	X		X	X	X	X
Squirrel Creek	X					
Roaring Creek	X			Partial		
Plumtree Creek	X	X	X	X	X	X
Threemile Creek	X	X	X	X	X	X
Brushy Creek	X		X			
Rose Creek	X	X	X			X
Grassy Creek	X	X	X			X
Beaver Creek	X	X	X			
Minor UTs to North Toe River at Spruce Pine			X			
Big Crabtree Creek	X		X			
Bear Creek	X		X			

[1]See Appendix A for details on sample collection equipment and methods.

[2]Additional grab samples were taken from the mainstem North Toe River; see section 3.2.1 for details.

Figure 3.2 Study Assessment Sites and Targeted Subwatersheds



Streamwalks were conducted on the following stream sections:

- North Toe River from US 19E at SR 1108 (Avery County) to US 19E bridge upstream of the Unimin Schoolhouse processing plant; 1 reach.
- North Toe River from the Carpenter Island Road bridge to the NC 80 bridge (Mitchell County); 3 reaches.
- Grassy Creek from the confluence with East Fork Grassy Creek to the lower SR 1117 bridge (Mitchell County); 1 reach.
- Beaver Creek from the culvert under US 19E to its confluence with the North Toe River (Mitchell County); 1 reach.

3.2.1 Turbidity Assessments

Grab Samples – Water quality grab samples were taken at 16 locations; 5 sites were located on the mainstem North Toe River, whereas the remaining 11 sites were located on selected tributaries (Figure 3.2, Table 3.9). During low and normal flows, turbidity did not exceed the 10 NTU evaluation level established by the NCDWR for waters classified as Tr. The highest reading at those flows was 7.3 NTU in Squirrel Creek.

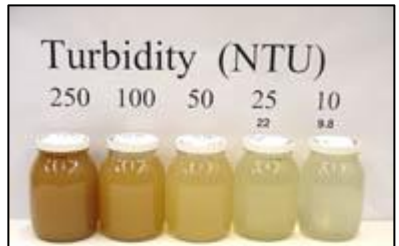


Photo Source: N.C. State University Watershedss web site; http://www.water.ncsu.edu/watershedss/info/turbid.html

At moderate flows, turbidity on the mainstem North Toe River increased from upstream to downstream. The two lower sites were downstream of NPDES-permitted stormwater discharges and had the highest turbidities, 70 and 80 NTU. Turbidity at eight sites was 10-28 NTU, while at the other seven sites turbidity was ≤10 NTU. No other discernable pattern of turbidity was detected among the sites at moderate flows.

At high flows, the pattern of increasing turbidity with increased flow was inconsistent. Turbidity at seven sites was below or just slightly above the 10 NTU evaluation level; two of those were on the mainstem North Toe River. At eight sites, turbidity was approximately equal to or lower than that found at moderate flows. The Squirrel Creek and Threemile Creek subwatersheds exhibited the highest turbidities, but they were not as high as that found on the two lowermost North Toe River sites at moderate flows.

Based on grab sample turbidity data from the 11 subwatersheds and excluding permitted discharges, Whiteoak Creek, Squirrel Creek, and Plumtree Creek appear to be the most significant contributors of sediment to the mainstem Upper North Toe River Watershed. Land disturbances associated with urban development, unpaved access roads, and livestock with access to streams may be significant sources of sediment flowing out of these subwatersheds.

Table 3.9 Grab Sample Turbidity Assessment Results

Site Number	Site Name	Turbidity (NTU) - Relative Flow Levels			
		Low 9/11/2013	Normal 6/6/2013	Moderate 7/2/2013	High 5/7/2013
1	North Toe River at SR 1117	3.4	2.2	12.0	40.0
2	White Oak Creek at SR 1117	1.8	3.0	6.8	45.0
3	North Toe River at SR 1121	1.9	5.2	15.0	-[1]
4	Squirrel Creek at SR 1121	3.8	7.3	10.0	70.0
5	Roaring Creek at US 19	2.2	6.3	7.3	11.0
6	North Toe River at US 19/SR 1130	1.8	5.9	15.0	3.8
7	Plumtree Creek at US 19	2.7	6.1	11.0	13.0
8	Threemile Creek at US 19	2.4	2.6	9.6	50.0
9	Brushy Creek near mouth	3.8	3.6	28.0	28.0
10	Rose Creek on SR 1121	3.3	6.1	9.0	20.0
11	North Toe River at SR 1121	2.0	5.3	70.0	6.9
12	Grassy Creek at NC 226	3.8	4.2	9.1	19.0
13	Grassy Creek at SR 1117	2.7	4.1	8.6	5.8
14	Bear Creek on SR 1162	2.5	3.4	11.0	6.7
15	Big Crabtree Creek on SR 1002	1.3	2.8	11.0	7.5
16	North Toe River at NC80	1.7	2.2	80.0	35.0

[1]No sample taken.

Stage Samplers – Stage samplers are designed to collect water samples as stream stage rises following rainfall events, not at baseflow (Appendix A). Samples taken in this manner reflect turbidities with the "first flush" following a rainfall event. During that period of flow, sediment levels are often higher than those obtained during stable flows, regardless of stage. Sample bottles were mounted at three levels (bottom, mid, and top) on posts installed in the streambed at six locations (Figure 3.2, Table 3.10), five of which were near grab sample locations.

Water samples were obtained following five rainfall events. Due to the dispersion of the sample sites and the scattered nature of rainfall in the mountains of North Carolina, samples were not obtained from all sites on a given date. In addition, within a given rain event, streams may not have risen the same amount so bottles at the same stage level might not have all filled among the sample sites.

All but one of the 41 stage samples taken exceeded the 10 NTU evaluation standard for the Tr classification (Table 3.10). That sample (3 NTU) was obtained from Beaver Creek, whose headwaters are protected as a water supply and also drains portions of downtown Spruce Pine. Turbidities of "bottom" samples were 2-20 times higher than the highest turbidities of any of the grab samples (Tables 3.9 and 3.10). Generally, turbidities of the "middle" samples were equal to or greater than the bottom samples. There were mixed results for changes in turbidities between the middle and top samples, both within and among sample locations. Samples with decreased turbidity at high flow may reflect the dilution effect of water flowing from forested headwaters, where sediment loads are lower, as well as the fact that loose sediments have already been flushed from the adjacent areas. This characteristic cannot be attributed to any specific factor. Given the limited data and variability associated with stage samplers, no significant conclusions can be made from these results.

On a subwatershed basis, stage sample turbidities were highest in Threemile Creek (250-900 NTU) and Rose Creek (70-500 NTU). This compares to turbidities of 50 and 20 NTU for grab samples taken at the highest flows. The Grassy Creek subwatershed also exhibited high turbidities at all sample levels (60-250 NTU), although the results were much less variable than that found in other subwatersheds.

Table 3.10 Stage Sampler Turbidity Assessment Results

Site Number	Site Name Sample Bottle Depth	Sample Date				
		6/5/2013	**6/12/2013**	**6/26/2013**	**7/12/2013**	**7/24/2013**
1	North Toe River below Newland					
	Bottom	85	85	80		260
	Middle	150		130		210
	Top					
2	Plumtree Creek					
	Bottom		210			
	Mid					
	Top					
3	Threemile Creek					
	Bottom		250		340	
	Middle		280		900	
	Top				500	
4	Rose Creek					
	Bottom	70	70	400	220	65
	Middle		140	370	270	190
	Top				500	34
5	Grassy Creek					
	Bottom	40	75	60	75	50
	Middle	75	60	220	130	55
	Top			24	250	190
6	Beaver Creek					
	Bottom			3	27	
	Middle			170	21	
	Top					

Synopsis of Turbidity Assessment – Based on water sample analyses, turbidity within the Upper North Toe River Watershed is a problem associated with high rainfall events. It appears that the most disturbed subwatersheds, notably the headwaters of the North Toe River, Threemile Creek, Rose Creek, and Grassy Creek, are the primary NPS of the sediments causing the increased turbidities downstream. Land disturbances within those watersheds vary widely as to type and distribution. In many cases land disturbances extend from riparian zones into upland areas, which only exacerbate the sediment runoff problem. While general permits limit mining stormwater, dewatering wastewater, and process wastewater from causing a receiving stream's turbidity to exceed 10 NTU, discharges after high rainfall events are known to carry a high sediment load that is deposited in streams. These fine sediments are resuspended even at moderately higher flows and result in increased turbidity levels. The combination of the nonpoint and point sources of sediment are likely to be the reason that portions of the North Toe River are on North Carolina's 303(d) impaired waters list. The subwatersheds identified above should be given priority for the implementation of watershed improvement projects aimed at reducing sediment loads to the North Toe River. Potential projects in those subwatersheds are described in Section 4. In addition, mine managers should be engaged as members of the TRVWP and encouraged to take steps to reduce the amount of fine sediments in their discharges.

3.2.2 Windshield Surveys

Windshield surveys of 11 selected subwatersheds (Figure 3.2, Table 3.8) were focused on identifying significant sediment sources from riparian and adjacent upland areas (Appendix A). These subwatersheds were chosen based on current land use, existing water quality data, and biological assessment of the fish and benthic communities. Upstream and downstream channel conditions were documented at public road stream crossings (both bridges and culverts), where sediment was suspected of entering the watercourse. Stream-channel and upland disturbances outside the 30 - foot riparian area and between crossings were recorded where degraded conditions could be observed from public roadways. The mountainous terrain and extensive forests limited the amount of stream corridor visible, particularly among headwater streams where less than 50% of the stream corridor could be observed. This limitation was not so significant in the more developed areas, where 75% or more of the stream channel corridor was visible from public roadways. Potential project locations were ranked based on site characteristics related to severity of disturbance, bank stability, and the presence of active erosion.

Stream Observations - A total of 82 stream observations were made within 11 targeted subwatersheds (Figure 3.3); 53 were at bridge or culvert crossings, whereas 29 were observed from upland areas adjacent to streams. Most of the observed project distances were 200-800 feet in length. Roads/driveways (17), residential yards (23), and hay fields/pastures (33) were the most frequently observed disturbances. Approximately 70% of the sites had more than one type of disturbance; where riparian disturbances occurred they were always within 10 feet of the stream bank.

Characteristics of the disturbances within the riparian area included the following:

- Roads/driveways – most of these features paralleled the stream channel, with runoff flowing directly into the stream channel. Driveways were mostly unpaved; while many were graveled, those that were not often showed evidence of significant erosion. Public roads were generally paved, and those that were not had graveled surfaces. Surface and ditch erosion occurred in association with maintenance activities. In some cases, straw wattles were placed in ditches as check dams.

- Riparian areas of stream running through residential yards were generally kept clear of vegetation. Scouring often was observed at the toe of the bank; rock riprap was often used in places where significant bank failures had occurred. The worst erosion was seen in places where fill material was placed adjacent to streams and within areas that flood during high-flow events, of which there were many during 2013.

- Most hay fields were in excellent condition, with little or no erosion observed; however, some fields were mowed close to the top of the stream bank, limiting the regeneration of trees and shrubs in riparian areas. Stream banks at these locations tended to be undercut, less stable, and much more likely to be eroding as the stream channel tries to reestablish a meander pattern.

- Pastures were most often occupied by horses, not cattle. While some of the pastures were not overgrazed, the grass in most horse pastures was not in good condition, being overgrazed or trampled. At many sites, livestock were not fenced from the stream channels; the condition of the stream banks here was poor.

Overall, the most significant amounts of Fair/Poor stream channel conditions were documented in the Threemile Creek, headwater tributaries of the North Toe River, and Plumtree Creek subwatersheds (Table 3.11).

Table 3.11 Length of Degraded Stream Channel by Subwatershed[1]

Subwatershed	Site Type		Totals (feet)
	Stream Crossings and Uplands (feet)	Adjacent Stream and Uplands (feet)	
Bear Creek	475	330	805
Beaver Creek	550	200	750
Big Crabtree Creek	825	400	1,225
Brushy Creek	210	0	210
Grassy Creek	2,725	0	2,725
Headwaters N. Toe River	2,550	2,800	5,350
Plumtree Creek	2,255	1,800	4,055
Rose Creek	910	1,250	2,160
Threemile Creek	1,525	9,725	11,250
Minor UTs to North Toe River at Spruce Pine	0	0	0
Whiteoak	725	0	725
Totals	12,750	16,505	29,255

[1]Stream channels with Fair or Poor severity rating.

Of the 11 subwatersheds surveyed, Threemile Creek contains the single-most significant degradation site. Of the 11,250 feet of stream channel and adjacent upland areas within the Threemile Creek subwatershed found to be degraded, an estimated 8,500 feet are in the Fork Creek catchment, the largest tributary of Threemile Creek. The degradation of Fork Creek was observed to be caused by inadequate land-management practices, primarily associated with agriculture, livestock management, farm structures, and single-family home sites.

Of 53 stream crossings with Fair or Poor stability ratings, 20 were located in the Grassy Creek, headwaters of the North Toe River, and Plumtree Creek subwatersheds (Table 3.12). Of 29 degraded sites not at crossings, 21 were located in the Threemile Creek, Plumtree Creek, and headwaters of the North Toe River subwatersheds. While only seven upland sites had severe disturbance ratings, four of those were found in the same three subwatersheds. Based on this analysis, the Grassy Creek, headwaters of the North Toe River, Plumtree Creek, and Threemile Creek subwatersheds need to be of high priority for watershed improvement projects.

Figure 3.3 Windshield Survey Data Collection Site Locations (Sheet 1 of 2)

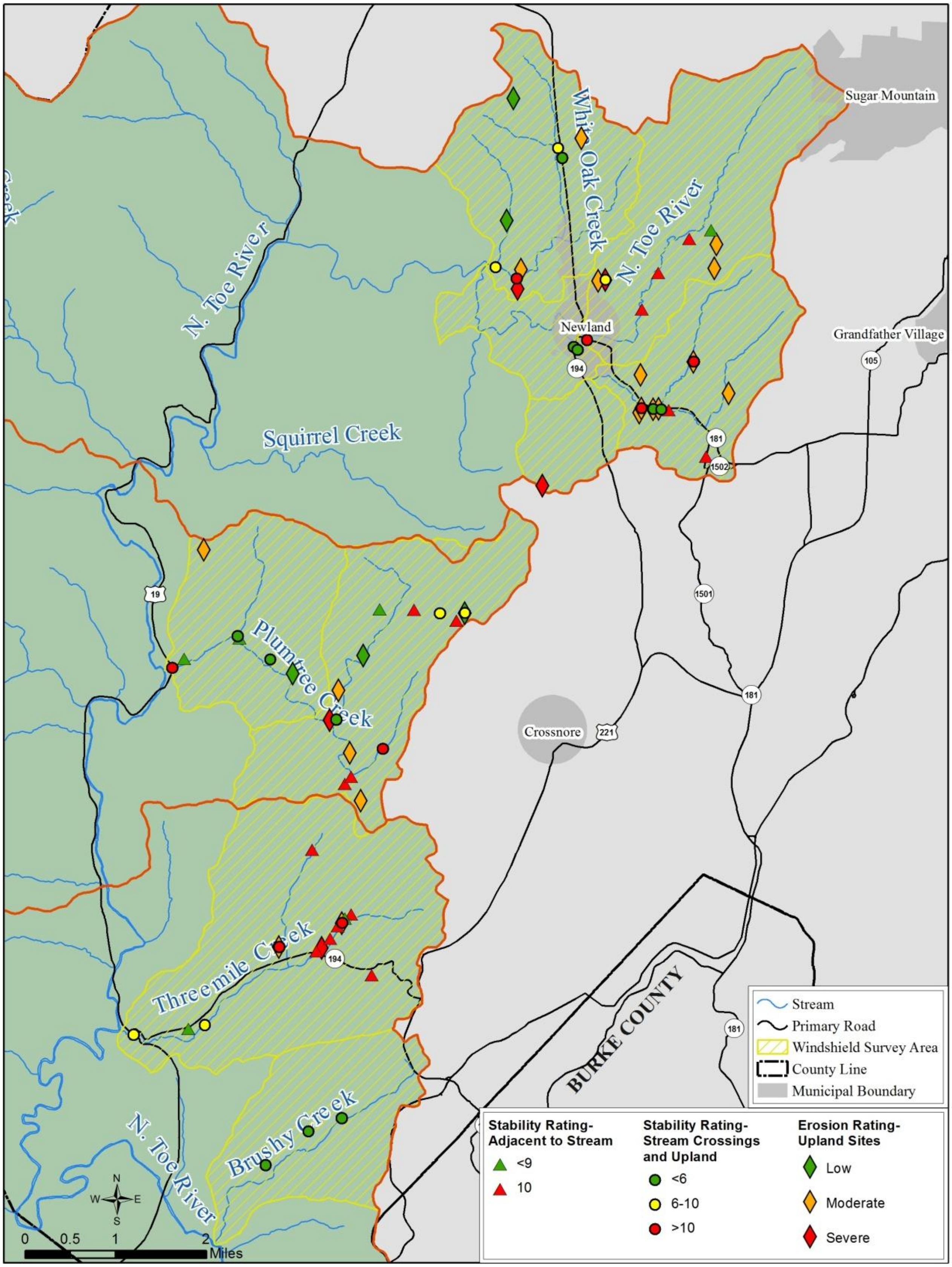


Figure 3.3 Windshield Survey Data Collection Sites (Sheet 2 of 2)

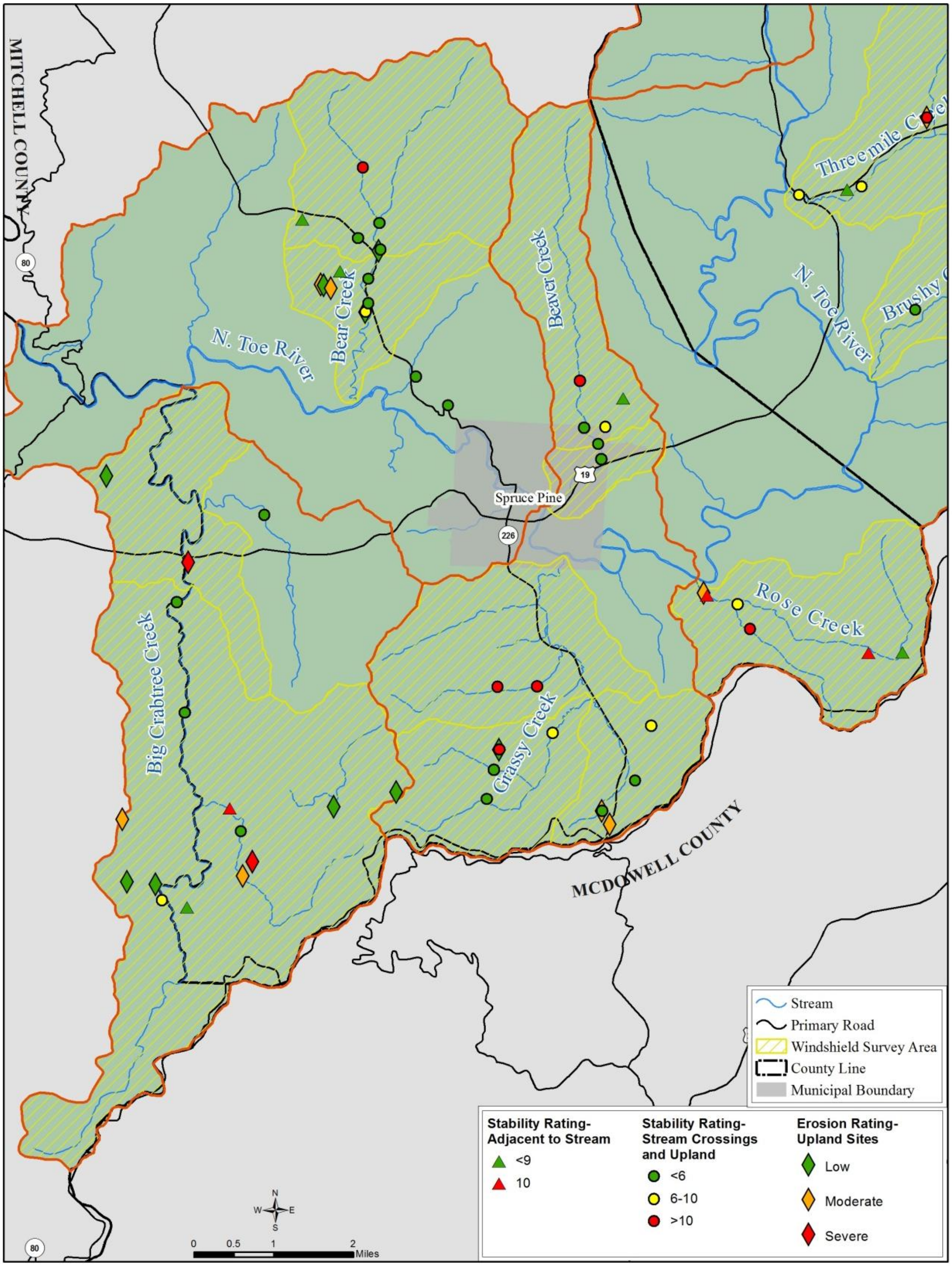


Table 3.12 Windshield Survey Assessments by Subwatershed, Observation Type, and Stability or Disturbance Rating

Subwatershed	Stream Crossing and Upland				Adjacent to Stream[2]	Upland Only			
	N	Stability Rating[1]			N	N	Disturbance Rating		
		≤6 Good	6-8 Fair	≥10 Poor			Low	Moderate	Severe
Bear Creek	6	4		2	2	5	3	2	
Beaver Creek	4	1	1	2	1	0			
Big Crabtree Creek	5	2	2	1	2	9	5	2	2
Brushy Creek	3	1	2			0			
Grassy Creek	9	2	4	3		3	1	2	
Headwaters North Toe River	7		3	4	6	13	1	10	2
Plumtree Creek	7	1	2	4	7	8	3	4	1
Rose Creek	2		1	1	3	1		1	
Threemile Creek	4		1	3	8	3		2	1
Minor UT to North Toe River	2	2				0			
Whiteoak Creek	4		3	1		5	2	2	1
Totals	53	13	19	21	29	47	15	25	7

[1]See Appendix A for scoring and rating methods.

[2]By definition, all observations from adjacent areas were significantly disturbed; therefore, no stability ratings were established.

Upland Observations – A total of 47 upland observations not associated with streams were made during the windshield surveys (Figure 3.3, Table 3.12). Only five large disturbance sites (10+ acres) were observed; two are in the headwaters of the North Toe River and one each is in the Plumtree Creek, Threemile Creek, and Big Crabtree Creek subwatersheds. These sites were associated with either horticultural or agricultural activities. Thirty-one of the remaining sites were 1 acre or less in size. Many of these disturbances were related to dirt roads/driveways, agricultural lands, residential sites, nursery/tree farms, borrow/fill sites, and lands being prepared for other uses. Most land being prepared for other uses had little or no erosion control measures in place nor had actions been taken to establish a ground cover. Not all sites were actively eroding, but had the potential to do so; many were likely to become revegetated by natural regeneration within one or two growing seasons.

Windshield Survey Synopsis – With few exceptions, stream disturbances were widely distributed among the subwatersheds surveyed; however, where they did occur, those activities causing the disturbances were always within 10 feet of the stream. While a significant number of stream channel disturbances were observed, they tended to be moderate in their severity and length. The only openly disturbed areas that could not be evaluated by the windshield survey were Christmas tree farms, many of which also are located in the headwaters of the Threemile Creek, Plumtree Creek, and the North Toe River south of Newland. A desktop analysis of these areas was conducted; the results are presented in Section 3.2.7.

3.2.3 Streamwalks

"Streamwalks" were conducted to obtain data on stream channels that were suspected of having more severely degraded conditions or were not observable using windshield survey techniques or for which more detailed information about other pollutant sources was desired. The "walks" were conducted on the North Toe River in remote areas, using kayaks and canoes; portions of Grassy Creek and Beaver Creek also were surveyed on foot (Figure 3.2). Data for six different categories of impacts were collected (Table 3.13). In addition, conductivities of observed outfalls were measured to determine the potential for other pollutants to be present in the effluent. Generally, conductivities in forested mountain streams are <25 μS/cm, whereas small streams in developed subwatersheds have conductivities generally <140 μS/cm (Traylor and Patch 2011).

North Toe River – Approximately 20 miles of the North Toe River were surveyed. With the exception of the 2.7-mile portion of river between the Carpenters Island Road and NC 226 bypass bridges, the North Toe River channel is generally well vegetated or forested and very stable.

Outside of the Spruce Pine area, only seven instances of degraded buffer were documented. A lack of adequate vegetation was noted for all seven sites; two of those were associated with agricultural activities, and others were associated with residential home sites.

Within the Spruce Pine portion, impacted buffers were more common due to the urban nature of the area. Urban development, an active rail line, and mineral processing plants encroach upon the riparian area over much of the reach. Undeveloped open areas along stream banks were dominated by nonnative invasive plants, primarily multiflora rose and Japanese knotweed. Despite this occurrence, unstable banks generally occurred only where streambank vegetation was kept short or in grasses.

Numerous outfalls associated with The Quartz Corp's mine processing facility were observed; one had a conductivity of 660 µS/cm and a diesel fuel-like odor. None of the discharges were turbid. The conductivity of Beaver Creek at its mouth was also elevated (173 uS/cm) and an odor resembling sewer gas was detected. Two other instances of conductivity above 100 µS/cm were measured. All of these occurrences warrant further assessment.

Grassy Creek – Streamwalks were conducted on 2.25 miles of Grassy Creek, from its confluence with East Fork Grassy Creek to the lower Carters Ridge Road (SR 1117) bridge. This portion of stream is heavily impacted by commercial development that has occurred within the last 25 years. In many places the stream channel has been straightened, armored with rock or both in order to accommodate the development of commercial properties. Constraints from this development will be a challenge to remediating the impacts from these conditions.

Thirty-three outfalls, consisting of both piped and open channels, were documented; eleven were identified as sources of stormwater runoff. Stormwater from these outfalls appears to be contributing to the bank scour identified at most of the seven sections of stream considered to have impacted buffers. All of the impacted buffers were noted as having moderate to severe erosion. Nine instances of conductivity between 100 and 300 µS/cm were measured. The cause of the increased conductivity is unknown and warrants further assessment.

Although seven power line or sewer line crossings were documented, no significant concerns were associated with them. The impact of power lines is limited to vegetation control in the rights-of-way under the lines, but none of them was shown to be eroding. While there was some limited erosion around sewer line crossings, that impact was attributed to debris collecting on supporting piers located in the stream channel and deflecting storm flows toward the adjacent stream banks.

Fourteen stream crossings were documented; nine are bridges, one is a culvert, three are utility lines, and one is a ford. Erosion was noted as being a concern with seven of the bridges. Poor alignment of the stream channel and bridge abutments was identified as a problem with two of the bridges.

Beaver Creek – The 0.83-mile portion of Beaver Creek from its confluence with the North Toe River to where it crosses under US 19E was surveyed. This reach of stream is highly impacted from historic development. It is deeply entrenched and constrained by US 19E on one side and industrial and commercial development associated with downtown Spruce Pine on the other. In most places the banks are stable, having been armored when fill material associated with development and highway construction was placed in the floodplain many years ago.

Impacts from 11 outfalls, 6 stream crossings, and 9 occurrences of utilities were documented within the stream corridor. The extensive infestations of multiflora rose and Japanese knotweed observed in the upstream portion of the watershed during the windshield survey extends through the streamwalk section. One area of kudzu was also observed.

Most of the observed outfalls are pipes, regardless of whether their origin is a stream or a stormwater drain. Conductivity was measured at six locations; two of the outfalls had conductivities over 300 μS/cm whereas three were in the range of 26-56 μS/cm. The high conductivities are an indicator of high dissolved solids. Since no cause for the higher conductivities was noted, they warrant further assessment. One perched highway storm drain was identified as having a severe erosion problem.

Nine instances of utilities were observed on lower Beaver Creek; seven were elevated electric lines and two were sewer lines. One of the lines, broken by debris accumulations, suspected as being a source of raw sewerage has been repaired. There were no concerns with any of the other utilities.

Streamwalk Synopsis – Grassy Creek has the most unstable stream banks observed during streamwalks and should be the area targeted for stream restoration and stormwater control projects. The banks are being scoured by increased volume and velocities of stormwater draining from adjacent commercial properties. While portions of the stream channel are constrained by development on both sides of the channel, there are places where stream channel improvements can be implemented. Such stream work, combined with the installation of stormwater control measures (SCM) would lead to decreased erosion and a reduction in sediment flowing to the North Toe River. Beaver Creek does not offer significant opportunities for reducing sediment. The stream channel is deeply entrenched, highly armored, and has commercial and industrial buildings encroaching on the riparian area, leaving little room for the installation of SCMs. Finally, there are opportunities to reduce erosion on the North Toe River; however, those degraded areas are widely dispersed and small relative to the amount of high-quality, stable stream bank that exists in the reaches surveyed.

Table 3.13 Streamwalk Observations by Reach and Category

Stream Reach Number	Reach Length (miles)	Observation Category					
		Erosion	Impacted Buffer	Outfalls	Stream Crossings	Utilities	Miscellaneous
North Toe River							
1	0.42		1	1			
2	1.80		1	3	1		
3	6.10		3				
4	0.40		7	4	2		
5	2.50		5	12	3	2	1
6	1.90		2	8	1		2
7	2.20			4			1
8	4.80			5	2		
Subtotals:	20.12		19	37	9	2	3
Grassy Creek							
1	1.50	1	6	17	11		
2	0.18		1	2	3		
3	0.43			12		5	
4	0.14			2		2	
Subtotals:	2.25	1	7	33	14	7	
Beaver Creek							
1	0.09			1	3	3	1
2	0.06					1	
3	0.19			5	1		
4	0.25			1	2	4	1
5	0.24			4		1	
Subtotals:	0.83			11	6	9	2
Totals:	23.2	1	26	81	29	18	6

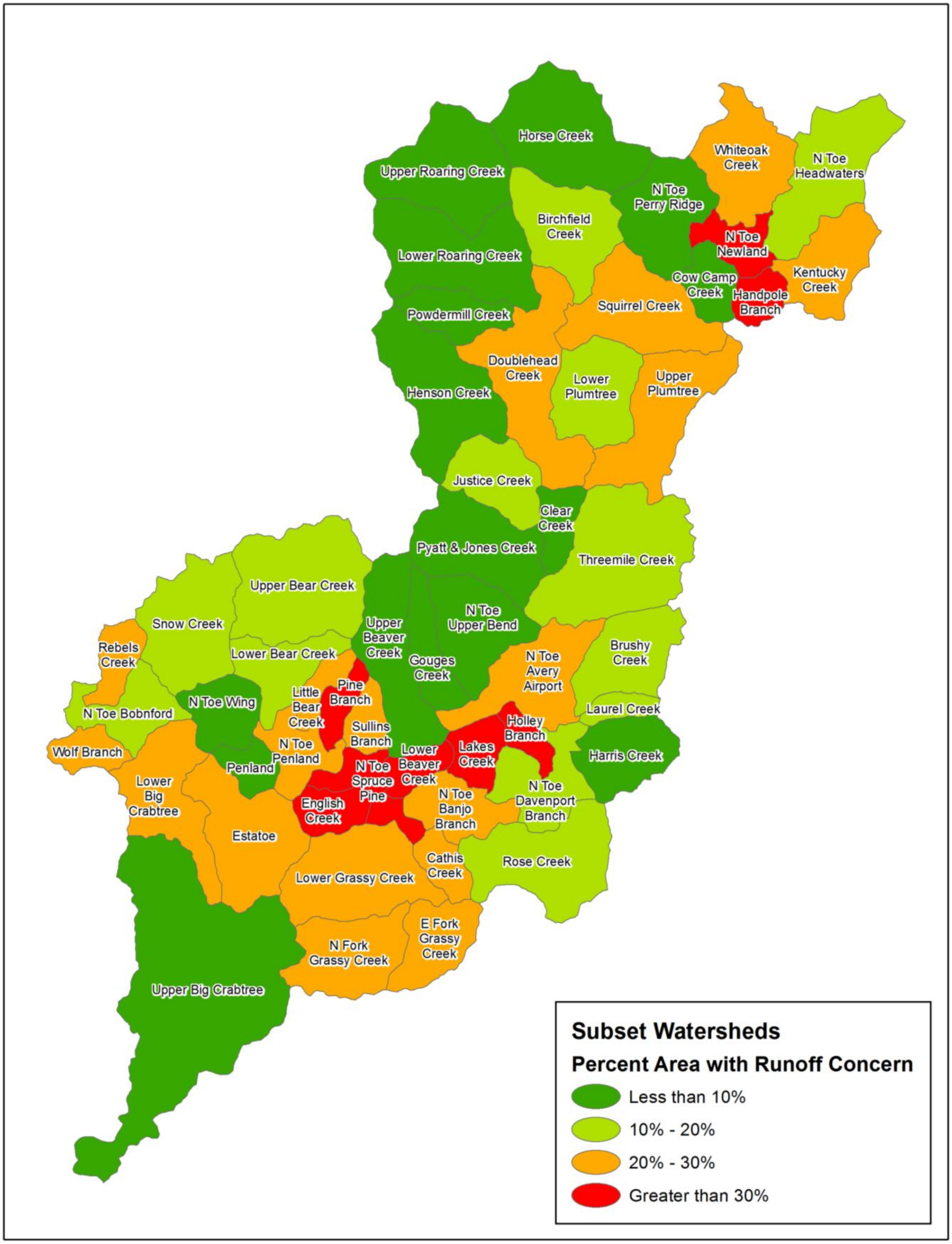
3.2.4 Stormwater

Impervious Surface Analysis – The volume and timing of stormwater runoff within a watershed is known to change as land cover changes occur. In the rural subwatersheds of the upper North Toe River, these changes can be difficult to see because much of the alterations in land cover are well dispersed. Most people realize that roads, buildings, and parking lots result in increased stormwater runoff; however, many do not realize that pastures, lawns, cropland, and exposed bedrock also contribute to increased runoff because they are less pervious than undisturbed lands. Just because land cover is composed of "natural" vegetation does not mean it has the same ability to absorb rainfall as does undisturbed land. The changes in volume and timing of the stormwater runoff impact stream stability by increasing streambank erosion as well as increasing damage to property.

***Impervious Surface** – Land surface that does not let rainwater filter into the soil, such as roof tops, parking lots, open fields, and unpaved roads*

To identify areas where stormwater runoff may be of concern in the Upper North Toe River Watershed, an analysis of the 2011 National Land Cover Database (NLCD) was carried out (Appendix C) for 55 catchments. The analysis included active mining areas identified from aerial photos. Not surprisingly, the seven catchments containing the towns of Spruce Pine, Newland, and the commercial corridors along US 19 E and NC 194 had the highest percentage of land with runoff concerns (Figure 3.4; see Appendix C-1 for details). Between 36% and 49% of these catchments had land cover exceeding 20% imperviousness. The only other catchment with a similarly high level of imperviousness is Pine Branch. It is one the smaller catchments evaluated (630 acres) and was estimated to have runoff concerns from approximately 47% of its area. Coincidentally, this catchment also contained the highest percentage of active mining operations (27%) of which stormwater runoff is regulated by NPDES permits. Another 18 catchments had runoff concerns from 20-30% of their area. In two of the smaller catchments, Sullins Branch (695 acres) and Little Bear Creek (642 acres), mining operations accounted for approximately 11% and 18% of the area of concern.

Figure 3.4 Catchment Imperviousness Classification



Stormwater Management Retrofit Survey - Stormwater management in the Upper North Toe River Watershed, like most stormwater systems in the region, is designed to remove water from a site as quickly as possible through a network of underground pipes. Stormwater runoff is received through storm drains located in roads and parking lots and then routed through the pipes to an outfall that usually empties directly into a stream channel. Such a system not only increases the temperature of the runoff but also does not treat or remove pollutants that reside on the impervious surfaces they drain. Furthermore, concentrating the flow of runoff increases the volume and velocity of stormwater into the stream, which often leads to streambank erosion and increased turbidity of the receiving waterways.

The urban portions of the Towns of Spruce Pine and Newland, as well as the developed areas along the major highway corridors leading into these towns (NC 226, US 19E, NC 194, and NC181), were analyzed to determine potential locations for the installation of SCMs (Appendix C-2). Local members of the core TAC also provided input about potential sites that were not identified during the preliminary GIS analysis.

Seven sites with the potential for constructing SCMs were identified using aerial photo GIS analysis (Figure 3.5, Table 3.14). Four additional sites were identified, two from stakeholder input and two during field assessments. All sites were visited to identify constraints that would make the installation of stormwater control features infeasible. Types of SCMs considered appropriate for installation include bioretention structures, extended detention ponds, and vegetated swales. The stormwater features have the potential for treating a drainage area totaling 56 acres. As a relative measure of the benefit from these features, this comprises about 12% of the estimated 465 acres of developed area within the Towns of Spruce Pine and Newland combined. Construction of these features would lead to an estimated annual reduction of 1,000 pounds of total suspended solids (TSS). Also, an estimated 28 pounds of phosphorus and 23 pounds of nitrogen would be removed. Details of the potential projects are presented in Section 4.4.

Figure 3.5 Potential Stormwater Control Measure Locations

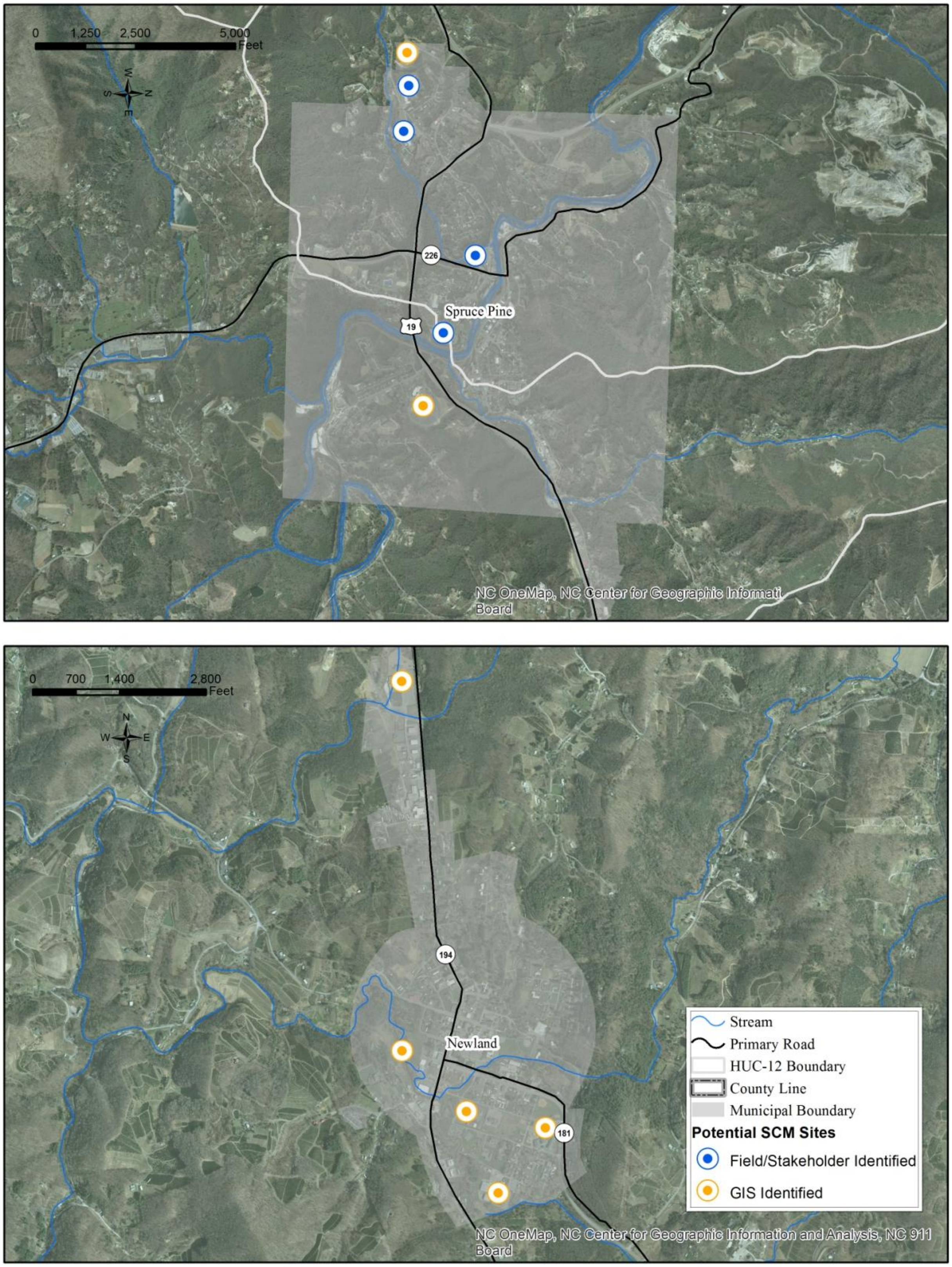


Table 3.14 Preliminary List of Potential Stormwater Control Projects

Site Name	Subwatershed	Drainage Area (acres)	Public Land	Land Use
Blue Ridge Regional Hospital	North Toe River at Spruce Pine and Lower Beaver Creek	26.03	No	Institutional
Marine Propulsion Lab	English Creek	9.57	No	Industrial
Deyton Elementary School	English Creek	2.2	Yes	Institutional
Harris Middle School	English Creek	2.39	Yes	Institutional
Ingles (Newland)	Whiteoak Creek	3.04	No	Commercial
Newland Grade School	North Toe River Headwaters	1.49	Yes	Institutional
U.S. Textile Corp.	North Toe River at Newland	1.27	No	Industrial
Lowes Food/Family Dollar	North Toe River at Newland	1.72	No	Commercial
Ingles (Spruce Pine)	North Toe River at Spruce Pine and English Creek	2.12	No	Commercial
Avery High School	Handpole Branch and Kentucky Creek	1.88	Yes	Institutional
The Bridge/Tri-County Christian School	North Toe River at Spruce Pine	6.8	No	Institutional/Ex-Industrial

3.2.5 Nonnative Invasive Plants

The concern regarding nonnative invasive plants, particularly Japanese knotweed (*Polygonum cuspidatum*) and multiflora rose (*Rosa multiflora*), contributing to turbidity problems in the Upper North Toe River Watershed was taken into account in the field survey designs. Japanese knotweed is suspected of contributing to streambank erosion because its root structure is shallow and not strong enough to hold soil in place (Talmage and Kiviat 2004). Given that it dies back in the winter also exposes the stream banks to the erosive power of spring flood events. To obtain a general idea of the distribution of these and other nonnative plants, they were identified and their location information recorded during water quality sampling, windshield surveys, streamwalks, and incidental observations made while traveling through the project area. The data from all sources were mapped in GIS (Figure 3.6); however, the data does not represent a complete inventory. Some of the data is from cursory observations; only stream reaches observable from public roads and where positive plant identifications could be made were included. Some subwatersheds were not surveyed.

Japanese knotweed was by far the most extensively distributed of the nonnative invasive plant species observed (Figure 3.6). While the actual extent of knotweed was not determined, it is likely present throughout all subwatersheds of the upper North Toe River. In some cases, the densest stands are in the lower portions of the subwatersheds, but it is likely only a matter of time before it spreads to all suitable habitat. Stream reaches that are most heavily forested tended to have the fewest or least-dense concentrations of nonnative species of all types.

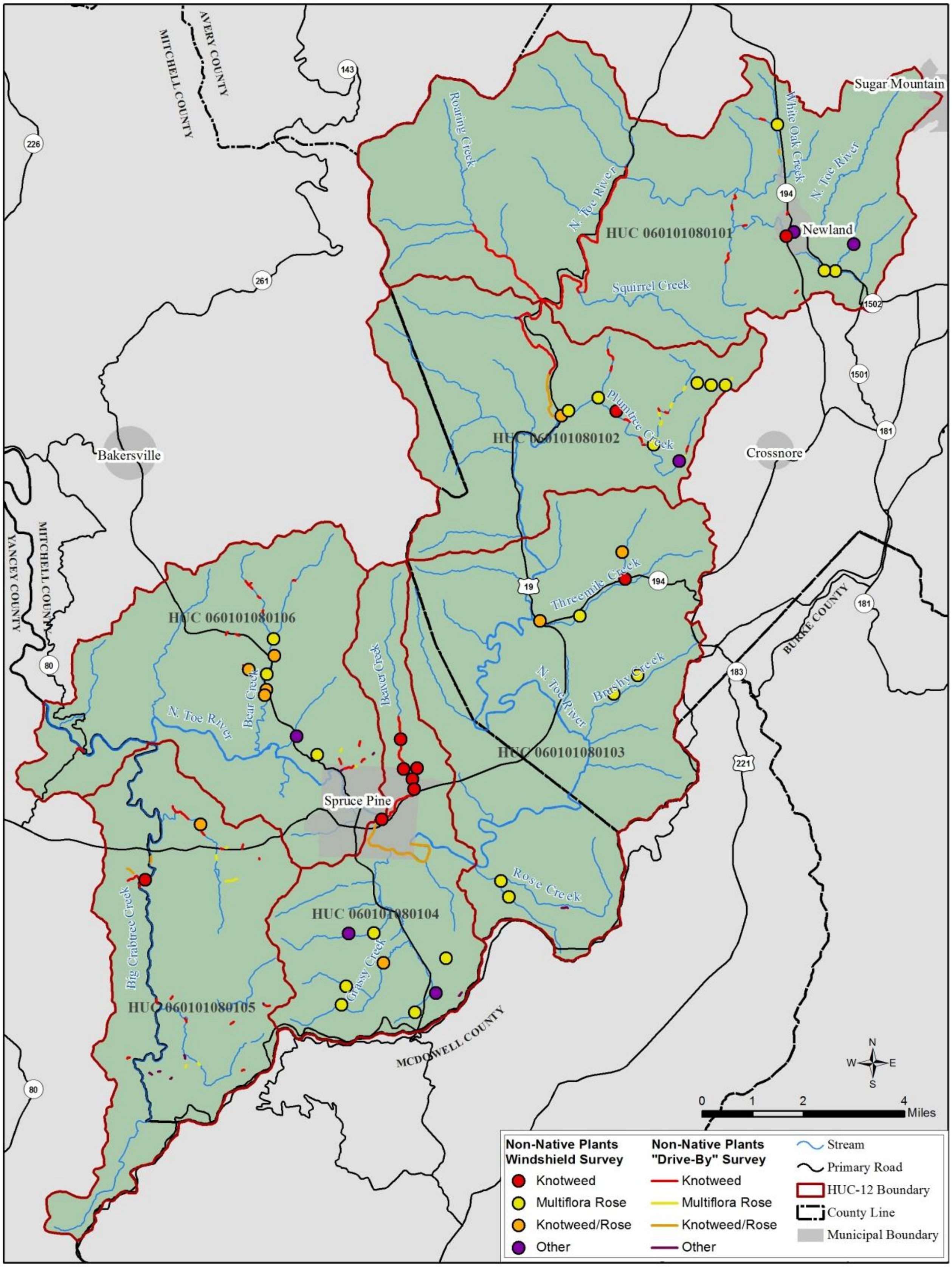
Significant monoculture stands of knotweed were documented as follows:

- Beaver Creek – dense almost contiguous stand from the end of SR 1143 to its confluence with the North Toe River.
- Roaring Creek – dense stands from Jerry Creek to its confluence with the North Toe River.
- North Toe River – dense patchy stands from the mouth of Horse Creek to its confluence with Plumtree Creek.
- Plumtree Creek - moderate densities of knotweed throughout the subwatershed.
- Mixed patches of Japanese knotweed and multiflora rose:
    - North Toe River headwaters.
    - Grassy Creek.
    - Big Crabtree Creek.
    - Threemile Creek – lower portion.
- Low densities of multiflora rose:
    - Whiteoak Creek.
    - Brushy Creek.
    - Rose Creek subwatersheds.

Other nonnative invasive plant species were encountered but they were not extensive. Japanese honeysuckle (*Lonicera japonica*) was commonly found at stream crossings in the following areas -- Bear Creek, lower Plumtree Creek, Rose Creek, lower Big Crabtree Creek, and one minor North Toe River tributary at Spruce Pine. Privet (*Ligustrum* spp.) was observed primarily in North Toe River tributaries upstream of Newland. Finally, one large patch of kudzu (*Pueraria lobata*) was observed in the headwaters of the Big Crabtree Creek subwatershed. More recently, reed canary grass (*Phalaris arundinacea*), a species not native to the Southeast, was observed in the upper reaches of the Roaring Creek subwatershed. It has growth and rooting characteristics similar to those of Japanese knotweed and, while used for erosion control, may be subject to undercutting that leads to bank destabilization.

Based on the data, it is evident that Japanese knotweed is impacting the riparian area plant communities and ecology of the Upper North Toe River Watershed. If knotweed is proven to destabilize stream banks, it would be a significant source of sediment and cause for chronically increased turbidities during high-flow events.

Figure 3.6 Distribution of Nonnative Invasive Plants



3.2.6 Unwooded Riparian Areas

During the windshield survey it was apparent that riparian areas lacking trees and shrubs (i.e., unwooded) within 30 feet of the stream bank were more extensive than was being captured in the survey and are potential significant sources of sediment. Within the subwatersheds evaluated, 60-70% of streams were found to be wooded on both sides (Table 3.15); in most instances where one bank was unwooded, both banks were unwooded. Unwooded riparian areas were generally most prevalent along road corridors of the more developed portions of the subwatersheds. Headwaters in all subwatersheds were generally wooded, except in some areas where horticultural fields extend far enough down the mountain slopes to abut perennial streams. This analysis did not determine the degree to which any reach lacked woody vegetation (measured as percentage covered or average width of vegetation) or type of land disturbing activity on any specific parcel.

Unwooded Riparian Area *– Land adjacent to streams that lack a mixture of trees and shrubs sufficient to filter sediment from the stormwater runoff of upland areas.*

Table 3.15 Percentage of Unwooded Riparian Area by Subwatershed

Subwatershed	Stream Miles	Percent		
		Unwooded One Bank	Unwooded Both Banks	Wooded Both Banks
Headwaters North Toe River	89	4	27	69
Whiteoak Creek	66	2	29	67
Plumtree Creek	66	2	28	70
Threemile Creek	32	4	39	57

Of the 1,618 segments of unwooded riparian area identified, approximately 66% were less than 1,000 feet in length, whereas only 3% (49) of the segments were greater than 2,000 feet in length (Table 3.16). While it is likely that some of these segments contain adequately vegetated riparian areas, it is apparent that there are many opportunities to reduce sedimentation from degraded stream banks. A progressive outreach program to inform landowners about opportunities to enhance riparian areas on their properties may achieve significant results.

Figure 3.7 Distributions of Unwooded Riparian Areas, Unpaved Roads, and Horticultural Fields (Sheet 1 of 2)

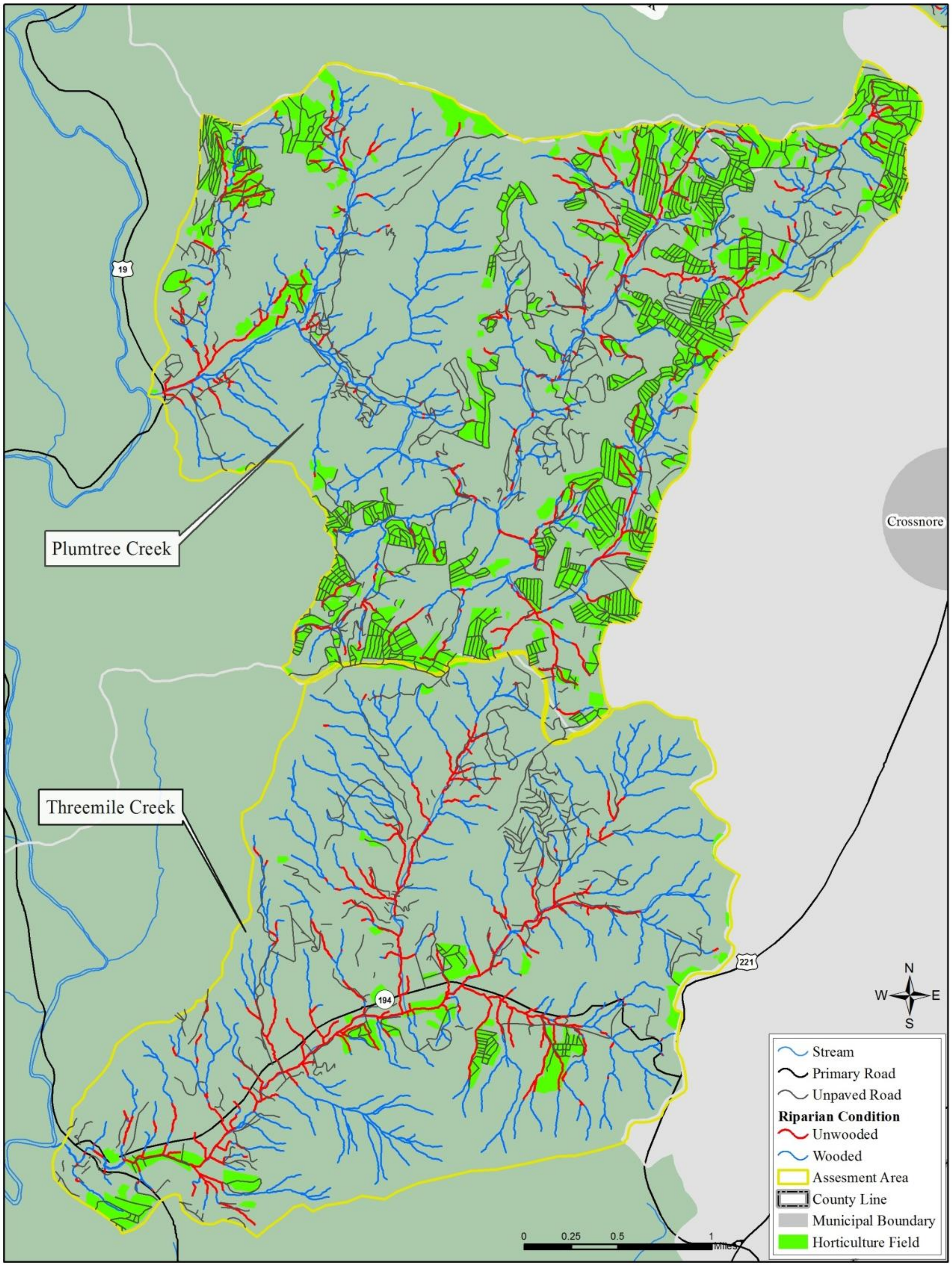


Figure 3.7 Distributions of Unwooded Riparian Areas, Unpaved Roads, and, Horticultural Fields (Sheet 2 of 2)

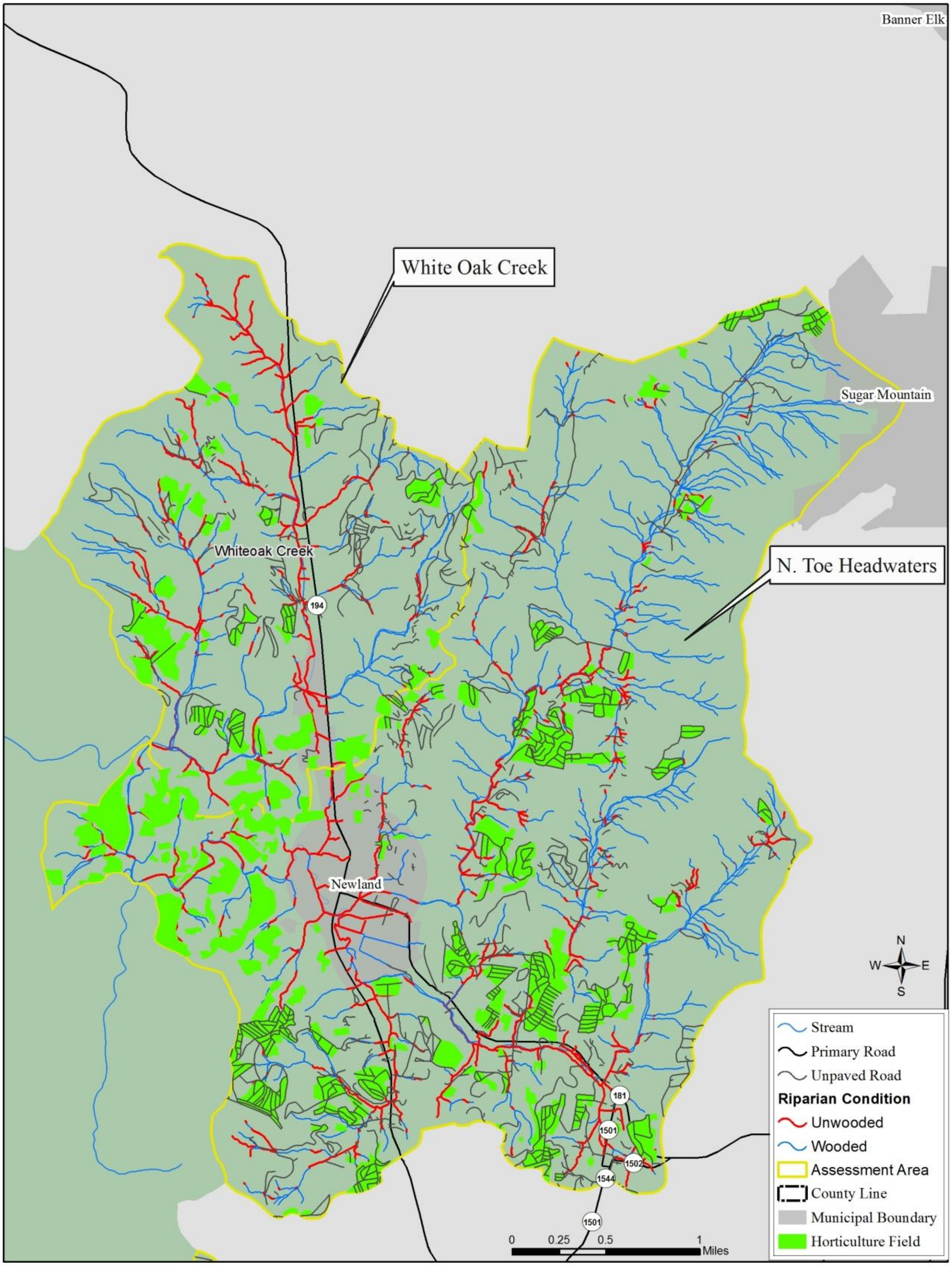


Table 3.16 Length-Frequency of Unwooded Riparian Areas by Segment Length Category and Subwatershed[1]

Wooded Extent and Subwatershed	Segment Length Category (feet)			
	<500	500-1,000	1,000-2,000	>2,000
One Bank Unwooded				
Headwaters North Toe River	103	15	2	
Whiteoak Creek	29	5	2	
Plumtree Creek	57	5		
Threemile Creek	29	7	2	
Subtotals	218	32	6	
Both Banks Unwooded				
Headwaters North Toe River	229	103	66	13
Whiteoak Creek	76	51	43	5
Plumtree Creek	133	66	63	16
Threemile Creek	105	69	53	15
Subtotals	543	289	225	49
Totals	761	321	231	49

[1]See Appendix B for a more detailed length-frequency graph of these data.

3.2.7 Unpaved Roads

Unpaved private driveways and roads were frequently encountered throughout the Upper North Toe River Watershed during the windshield surveys. These roads were numerous and most often only a small portion of them could be observed, the remainder being hidden from view by trees or the topography. This was particularly true in the Plumtree Creek and Headwaters North Toe River subwatersheds where about 125 miles of unpaved roads were identified in the GIS analysis, 74 miles of which were associated with horticultural operations (Table 3.17). Supporting concerns regarding unpaved roads, North Carolina State University (NCSU) Cooperative Extension Service researchers have evidence that sediment from these operations has an impact on aquatic communities (Sidebottom 2003). While these data provide insight into the extent of unpaved roads, it does not quantify the degree to which they are eroding and contributing to the turbidity problem of the North Toe River. It does, however, provide a basis for further investigation and outreach to the horticultural operations community as a partner to reduce erosion to the degree practical. Additional field investigations will be necessary to identify specific problem locations and priority areas.

Table 3.17 Miles and Density of Unpaved Roads by Subwatershed

Subwatershed	Subwatershed Area (square miles)	Miles of Unpaved Road	Density of Unpaved Roads (mi./sq. mi.)	Miles of Unpaved Roads in Horticultural Fields[1]	Percent of Unpaved Roads in Horticultural Fields
North Toe River Headwaters	10.53	77.8	7.4	34.5	44%
Plumtree Creek	8.32	124.1	14.9	75.1	60%
Threemile Creek	7.16	36.7	5.1	6.2	17%
Whiteoak Creek	4.08	23.9	5.9	5.1	21%

[1]Most unpaved roads in horticultural fields are associated with Christmas tree operations.

3.2.8 Horticultural Operations

Horticultural Operation *– Shrubs and trees farmed for use in residential landscaping and in-home holiday decoration.*

This is a type of agriculture that focuses on the cultivation of plants used for landscaping. In the Upper North Toe River Watershed this includes not only specimen plants for garden landscapes but, more importantly, is almost entirely dominated by the Christmas tree industry. In the four subwatersheds examined, over 3,000 acres of horticultural operations were identified (Table 3.18). Of particular concern is the fact that much of the land in Christmas tree production is located on steep slopes with highly erodible soils and often involves the use of pesticides (Sidebottom 2003). Sedimentation from land clearing and site preparation, farm roads, or soil left without vegetation due to herbicide use is still a concern although the industry has been successful in recent years in reducing erosion by implementing better groundcover management techniques.

Horticultural activities, primarily Christmas tree farms, were generally located in the headwaters of the four subwatersheds assessed. Almost 50% of the Plumtree Creek subwatershed and 35% of the headwaters of the North Toe River are in Christmas tree production (Figure 3.18). Based on observations during the windshield surveys, there are still some operations where riparian areas lack woody vegetation and access roads are eroding. As was described in the previous subsection, the degree of disturbance and severity of erosion is unknown and warrants further investigations. To address this problem, NCSU has started a landowner outreach program. Landowners are signing up for assistance and are waiting for a funding source to be identified.

Table 3.18 Horticultural Activity by Subwatershed

Subwatershed	Subwatershed Area (acres)	Area in Horticulture (acres)	Percent of Watershed in Horticulture (acres)
North Toe River Headwaters	3,144	1,099	35%
Whiteoak Creek	2,612	336	13%
Plumtree Creek	3,049	1,402	46%
Threemile Creek	4,584	296	6%
Totals	13,389	3,133	23%

3.3 Synopsis of What We Know

Based on over 10 years of ambient monitoring data and with the exception of turbidity, water quality in the Upper North Toe River Watershed is good. Based on the field and desktop analyses, sediment appears to be originating from widely distributed sources within the more-developed subwatersheds. Runoff from agricultural and horticultural operations, as well as from mining operations and other regulated discharges, appears to be the source most associated with sediment reaching waterways. While high turbidities were measured during this study, no consistent relationship between turbidity and flows is obvious. It is likely that the scattered nature of rainfall events combined with the variation in land disturbances among subwatersheds is the reason for the variability in turbidities. With few exceptions, stream reaches identified as potential projects are short. Few significant upland areas were identified as major contributors of sediment. The four largest areas accounted for 96 of the 137 acres of disturbed uplands; all of those were associated with agricultural or horticultural operations. Many of the remaining sites were small and had weak or no erosion control devices in place; most of them are likely to become revegetated naturally within a few years. While discharges from mining operation settling basins still appear to be a significant point source of fine sediment, particularly following heavy rainfall events, the mining companies are continually working to reduce the amount of sediment leaving their sites. The Unimin Corporation is an active member of the TRVWP and it is hoped The Quartz Corp will join the partnership in the near future.

Windshield surveys and streamwalk observations of stream channel conditions revealed that the Grassy Creek, Threemile Creek, headwaters of the North Toe River, and Plumtree Creek subwatersheds have the most significant degradation and potential for stream improvement projects that will reduce sedimentation. Upland site disturbances are generally not large, and most will not be chronic sources of sediment. Many of the sites would have benefited simply from the installation of erosion control measures.

Only a small portion of the streams in the Upper North Toe River Watershed are impacted by stormwater originating from urban stormwater sources. However, physical constraints, such as topography or existing structures, limit the potential for the installation of SCMs. The 11 sites identified will benefit several small catchments in the Spruce Pine and Newland areas. Reductions in volume and velocities of stormwater flows will reduce channel erosion that contributes to increased turbidities of the North Toe River.

Other factors evaluated and suspected of contributing sediment to streams in the project area include unwooded riparian areas, unpaved roads, horticultural operations, and dense infestations of Japanese knotweed along many miles of stream banks. Based on the assessment, the potential for these activities to be chronic sources of sediment are significant. However, the assessments conducted for this study were limited to GIS desktop analyses and incidental field data collections. It will require the collection of site-specific field data to determine the extent and magnitude that these factors are a source of sediment.

4. MANAGEMENT MEASURES FOR REDUCING TURBIDITY AND SEDIMENTATION

4.1 Watershed Management Goals

The ultimate goal of this WAP is to reduce erosion and sedimentation in the Upper North Toe River Watershed leading to reduced turbidity levels. This will allow its aquatic communities to thrive and permit the river to fully support its designated uses. In achieving this goal, 20.3 miles of river can be removed from the state's 303(d) list of impaired waters.

In the process of developing this WAP, the BRRC&D and TRVWP identified the following additional goals as part of their implementation efforts:

- Develop additional partnerships to facilitate better land stewardship among the state, county, city, business community, and private citizens.
- Engage the community in water quality awareness and education.
- Implement projects that support water quality improvement needs and objectives as described in the following planning documents:
    - *French Broad River Basinwide Water Quality Plan* (NCDWQ 2011).
    - *French Broad River Basin Restoration Priorities 2009* (NCEEP 2009).
    - *North Toe River Riparian Corridor Conservation Design for the Five Major Drainages of the Roan Highlands* (SAHC 2000).
    - *Avery County Heritage Development Plan* (BRNHAP 2005).
- Stimulate economic opportunities in the community and create jobs by using local businesses when management measures are implemented.

The windshield surveys, streamwalks, and aerial photo assessments conducted in the targeted subwatersheds within the project study area (Figure 3.2) revealed the extent of stream channel and upland disturbances within them as significant sources of sediment. This is not to imply that other subwatersheds do not contribute to the turbidity problem of the North Toe River, but their level of development is lower. While those subwatersheds were not assessed, many of the management measures presented in this section can be applied to disturbances identified by the TRVWP as the WAP is implemented.

The following sections describe in detail the steps or management measures that will allow the TRVWP to achieve these goals and to begin the process of improving the water quality of the upper North Toe River. A brief discussion of why these steps are important is included. How these measures are to be implemented are discussed in Section 5.

4.2 Stream Channel and Riparian Area Enhancement

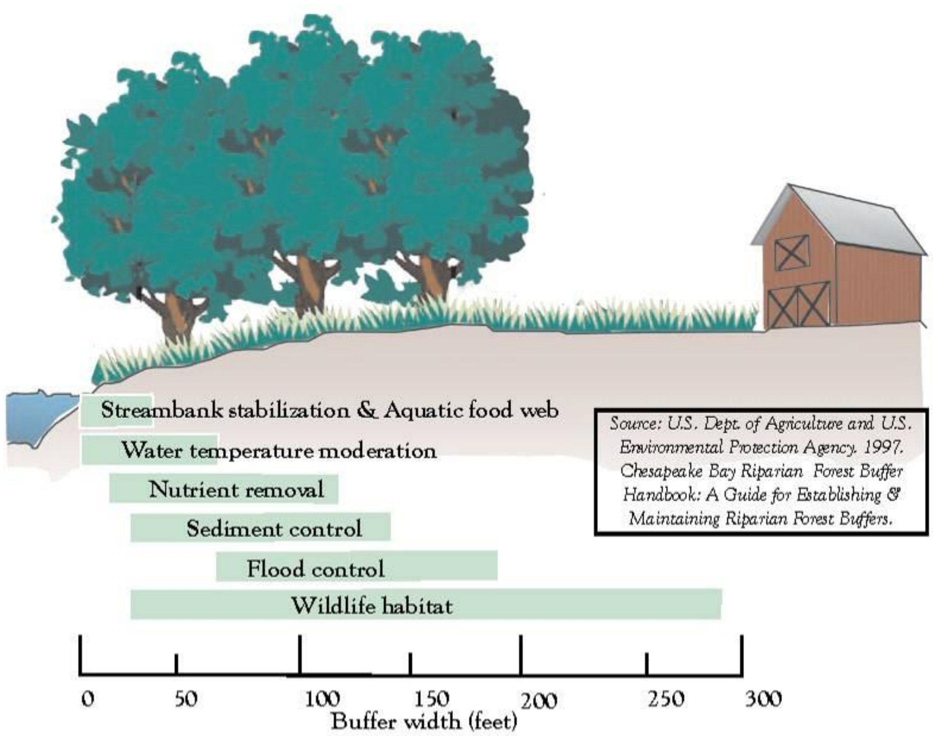
Based on our field observations, most stream channels in the subwatersheds of the upper North Toe River are moderately incised; less steep portions of channel were historically straightened and a large proportion of those reaches have wooded riparian areas that are less than 30 feet in width. In almost all cases where woody vegetation is lacking, upland disturbances extend into the riparian area and contribute to bank instability. These conditions have resulted in erosion, sedimentation, degraded aquatic habitat, and, in some cases, significant property loss as streams attempt to reestablish meander patterns. Incised and historically straightened streams are particularly vulnerable to erosion as they are detached from their adjacent floodplains. This reduces or eliminates the ability of the floodplain to mitigate storm-flow velocities and results in the streams being subjected to constant erosion.

4.2.1 Stream Channel Restoration and Enhancement

To best rectify stream instability problems, it will be necessary to apply stream restoration techniques that reestablish the proper dimension, pattern, and profile to the stream channel wherever possible. Some degraded stream reaches may have constraints (e.g., roads, structures, and utilities) that will not allow for full restoration or that only need bank reshaping to restore stability. Restoration or enhancement of degraded reaches will lead to reduced erosion, improved sediment transport, and better in-stream habitat conditions.

Revegetation of the riparian area adjacent to the restored stream channel with native shrubs, trees, and herbaceous plants should be conducted in concert with stream restoration or enhancement to restore ecological function and to reestablish a riparian area's ability to filter sediment and other pollutants originating from upland areas (Figure 4.1).

Figure 4.1 Functions of Woody Riparian Vegetation



Based on observations taken during windshield surveys and streamwalk assessments, 99 potential stream restoration/enhancement projects were identified in the upper North Toe River (Table 4.1). The project sites of the windshield survey were ranked based on their stability score (Appendix B). The scores are not prioritizations as no detailed measures of individual site conditions were made. Separate project lists were created for the windshield survey and streamwalk assessment data.

<u>Windshield Survey</u> - Windshield survey assessments of streams were of two types, those taken at bridges and culverts and those taken from roads adjacent to streams. Because the data for each type of observation was slightly different and often the streambank conditions could not be evaluated for observations not at crossings, separate potential project lists were developed for each type of observation. Observation types were defined as follows:

- Stream Channel Conditions at Crossings – observations were made upstream and downstream of public road crossings of both bridges and culverts. Observations were made almost exclusively from public roads. Upland disturbances outside of the riparian area were recorded as to type and degree of severity.
- Stream Channel Conditions Not at Crossings – Observations of degraded conditions from public roads that were adjacent to the stream course. Data were recorded as if the observer were standing at the lower end of the assessed reach. Upland disturbances outside of the riparian area (>30 feet from the stream bank) were recorded as to disturbance type and degree of severity.

Stream stability ratings at 39 stream crossings were determined to be Poor (Figure 3.2, Tables 4.1 and 4.2); 17 of the locations occur in the headwaters of the North Toe (Newland vicinity) and Plumtree Creek subwatersheds. The remaining 22 sites were scattered among the other nine targeted subwatersheds. Landownership at the individual sites was not determined although most sites are assumed to be in private ownership. As part of the implementation process, landowners must voluntarily agree to a project. Each site must be assessed to determine whether the improvements are feasible based upon physical constraints and landowner willingness to participate in the program.

<u>Streamwalk Assessment</u> – Observations during streamwalks revealed 17 potential stream restoration/enhancement areas having moderate to severe erosion problems, an indicator of bank instability (Figure 3.2, Table 4.3). Because of the limited number of observations the sites were not ranked. Thirteen of the sites also were noted as having a lack of vegetation and would benefit from plantings suitable for stabilizing the soil.

Table 4.1 Potential Stream Restoration/Enhancement Projects at Stream Crossings Identified from Windshield Surveys Data (Sheet 1 of 2)

Subwatershed Code	Site ID	Stream	Stability Score[1]	Project Length	Disturbance Type								
					Roads	Commercial	Other	Yards	House	Hay/Pasture	Cultivated	Nursery	within 10 ft
Bear	8	Little Bear	14	325	X			X		X			X
Bear	4	Stewarts Branch	10	150	X	X	X		X				X
Bear	9	Bear Creek	4	150	X			X					X
Bear	10	Bear Creek	4	175	X			X					X
Bear	12	Bear Creek	4	250	X			X	X				X
Bear	13	Bear Creek	4	300	X			X					X
Beaver	1	Beaver Creek	12	200				X					X
Beaver	4	Hanging Rock Br.	10	200	X			X					X
Beaver	5	Beaver Creek	6	150	X			X					X
Beaver	2	Beaver Creek	2	200	X			X	X				X
BigCrabtree	12	Big Crabtree Creek	10	400	X			X					X
BigCrabtree	1	Brushy Creek	6	300	X		X	X					X
BigCrabtree	7	Big Crabtree Creek	6	125	X								X
BigCrabtree	2	Big Crabtree Creek	4	300	X			X					X
BigCrabtree	5	Big Crabtree Creek	4	185			X			X			X
Brushy	2	UT2	6	150			X			X			X
Brushy	3	UT1	6	60									X
Brushy	1	UT3	4	130						X			X
Grassy	9	UT10	16	500				X		X			X
Grassy	11	UT to Rockhouse Creek	12	600	X					X		X	X
Grassy	12	Rockhouse Creek	12	325				X		X			X
Grassy	1	UT3	8	300				X		X			X
Grassy	6	Grassy Creek	8	500	X		X			X		X	X
Grassy	2	Reddick Branch	6	300			X	X	X				X
Grassy	5	East Fork Grassy Creek	6	200			X	X	X				X
Grassy	7	Grassy Creek	4	135	X		X			X			
Grassy	8	North Fork Grassy Creek	2	150				X		X			X
HW-NToeR	22	North Toe River at NC 181 Bridge	14	350	X	X	X						X
HW-NToeR	8	Kentucky Creek	12	750		X	X			X			X
HW-NToeR	9	Loggy Creek	12	600						X			X
HW-NToeR	20	UT to Hickory Nut Branch.	10	300	X		X						X
HW-NToeR	23	North Toe River at NC 194 Br	6	350		X	X						X
HW-NToeR	24	Loggy Creek	6	100	X		X			X			X
HW-NToeR	26	Kentucky Creek	6	100			X						

[1]Maximum score is 20 and indicates the worst conditions; stability scores ≥XX were considered poor.

Table 4.1 Potential Stream Restoration/Enhancement Projects at Stream Crossings Identified from Windshield Surveys Data (Sheet 2 of 2)

Subwatershed Code	Site ID	Stream	Stability Score[1]	Project Length	Disturbance Type								
					Roads	Commercial	Other	Yards	House	Hay/Pasture	Cultivated	Nursery	within 10 ft
MUTtoNTR	2	Minor UT1 to North Toe River	4	70	X								X
MUTtoNTR	1	Little Bear Creek #2	2	50									X
PlumtreeCrk	16	Little Plumtree Creek	20	900			X			X			X
PlumtreeCrk	1	Plumtree Creek	16	230				X				X	X
PlumtreeCrk	13	Trim Branch	10	425				X	X				X
PlumtreeCrk	15	Trim Branch	10	300			X						X
PlumtreeCrk	4	Isaac Branch	6	200	X			X					X
PlumtreeCrk	21	Plumtree Creek	6	200	X		X	X					X
PlumtreeCrk	6	Fall Branch	4	225									X
Rose	6	Little Rose Creek	12	260	X		X						X
Rose	3	Rose Creek	8	650				X		X			X
Threemile	4	Threemile Creek	20	200						X			X
Threemile	10	Fork Creek	20	725		X				X	X	X	X
Threemile	13	Threemile Creek	10	300	X			X					X
Threemile	12	Threemile Creek	8	300						X			X
Whiteoak	7	Whiteoak Creek	12	160				X					X
Whiteoak	4	Whiteoak Creek	8	425		X	X	X					X
Whiteoak	6	Whiteoak Creek	8	80	X					X			X
Whiteoak	2	UT	6	60	X		X	X					X

[1]Maximum score is 20 and indicates the worst conditions; stability scores >10 were considered Poor.

Table 4.2 Potential Restoration/Enhancement Projects Identified from Observations Adjacent to Streams Made During Windshield Surveys

Subwatershed Code	Site ID	Stream	Stability Score[1]	Project Length	Disturbance Type								
					Roads	Commercial	Other	Yards	House	Hay/Pasture	Cultivated	Nursery	Within 10 ft
Bear	7	UT to UT3	6	300						X		X	X
Bear	5	UT2	6	30	X								X
Beaver	3	Hanging Rock Branch	2	200	X		X						X
BigCrabtree	6	Big Crabtree Creek	10	200			X						X
BigCrabtree	11	UT to E. Fork Big Crabtree	8	200	X					X			X
HW-NToeR	13	North Toe River	10	600		X				X			X
HW-NToeR	17	Kentucky Creek	10	600				X					X
HW-NToeR	14	North Toe River	10	400			X			X			X
HW-NToeR	5	Kentucky Creek	10	300						X			X
HW-NToeR	12	North Toe River	10	300						X			X
HW-NToeR	11	North Toe River	6	600						X			X
PlumtreeCrk	12	Trim Branch	10	900						X			X
PlumtreeCrk	18	Little Plumtree	10	300						X			X
PlumtreeCrk	14	Trim Branch	10	200			X						X
PlumtreeCrk	19	UT6	10	200						X			X
PlumtreeCrk	11		5	200				X					X
PlumtreeCrk	2		0[2]	0						X			X
PlumtreeCrk	5		0[2]	0							X		X
Rose	5	Rose Creek	10	650			X			X			X
Rose	2	Rose Creek	10	300			X						X
Rose	4	Rose Creek	6	300				X					X
Threemile	11	Fork Creek	10	8500				X		X			X
Threemile	1	UT3	10	375				X	X	X			X
Threemile	2	UT2	10	300						X			X
Threemile	8		10	300						X			X
Threemile	5		10	200			X						X
Threemile	7		10	50						X			X
Threemile	3		0[2]	0			X			X			X
Threemile	14		0[2]	0						X	X		X

[1]Maximum score is 10, indicating the worst site conditions.
[2]Site was evaluated for reasons other than bank stability; agricultural- or horticultural-/nursery-related activities.

Table 4.3 Potential Restoration/Enhancement Projects Derived from Streamwalk Assessment Data

Subwater-shed Code	Reach	ID	Latitude Upstream	Longitude Upstream	Latitude Downstream	Longitude Downstream	Bank	Left Bank Width	Left Bank Length	Right Bank Width	Right Bank Length	Impacts[1]	Erosion	Impact Severity	Notes
NTOE	AP-2	IB-3	35.91417228	-82.06652974	35.91435442	-82.06712066	RT			50	20	LV,TN,OT	N	Moderate	Railroad right-of-way encroachment
NTOE	AP-1	IB-4	35.90614351	-82.05491619	35.90628709	-82.05437933	LT	100	30			LV,OT	Y	Moderate	Multiflora rose and knotweed present; recent erosion
NTOE	AP-1	IB-5	35.90617443	-82.05236600	35.90594477	-82.05033246	LT	400	20			LV,ST,AG,OT	Y	Moderate	Bird houses; bird farm; strong odor
NTOE	AP-1	IB-6	35.90357177	-82.05472986	35.90372155	-82.05548801	LT	100	25			LV	Y	Severe	Moderate to severe erosion
NTOE	AP-1	IB-8	35.90336792	-82.05937888	35.90335979	-82.05937218	LT	85	10	85	10	LV	Y	Severe	Moderate to severe erosion
NTOE	AP-1	IB-9	35.90458900	-82.06186714	35.90451188	-82.06228481	LT	150	30			LV,OT	Y	Moderate	Low to moderate erosion; photo 21 of slide on right bank looking downstream, The Quartz Corp property
NTOE	AP-2	IB-12	35.91129712	-82.06732350	35.91278	-82066651	LT	125	12			LV,ST,PV,OT	Y	Moderate	Riverside Park; multiflora rose, honeysuckle
NTOE	NT-1	IB-20	35.97751960	-82.01729955	35.97302833	-82.01501163	RT					LV, AG, OT	Y	Severe	Recent fencing; j-hooks; possible NRCS project; approximately 300 feet had cattle access
NTOE	NT-2	IB-21	35.95916558	-82.02904847	35.95778491	-82.03079903	LT					LV	Y	Moderate	Steep eroding bank; opposite bank with bedrock
GRASSY	GC-1	IB-13	35.881897	-82.057172	35.882036	-82.057487	RT			50	15	ST	Y	Moderate	Boulder wall on bank
GRASSY	GC-1	IB-14	35.882124	-82.057358	35.882272	-82.057449	LT	45	10			OT	Y	Severe	Steep eroding bank being addressed by TRVWP project
GRASSY	GC-1	IB-15	35.883056	-82.056865	35.884757	-82.057742	BO					OT	Y	Moderate	Moderate to severe erosion; channel constricts in bend; left bank downstream armored with concrete
GRASSY	GC-1	IB-16	35.885924	-82.058595	35.886346	-82.058863	BO	100	15	150	15	LV	Y	Moderate	Wood waste recycling center above right bank looking downstream
GRASSY	GC-1	IB-17	35.886817	-82.059696	35.887151	-82.060415	BO	50	3			LV	Y	Moderate	Grassed banks; toe undercut and eroding
GRASSY	GC-1	IB-18	35.887869	-82.062513	35.887999	-82.062686	LT	30	5			LV	Y	Severe	Eroding bank; undercut
GRASSY	GC-2	IB-19	35.887869	-82.062513	35.888209	-82.0645	BO	See waypoint	5	See waypoint	5	LV, TN, ST	Y	Severe	
GRASSY	GC-1	ER-1	35.88275	-82.0572	35.882896	-82.057059									

[1]Impact codes: LV – lack of vegetation, TN – vegetated area too narrow, ST = structure, AG = agriculture, OT = other.

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4.2.2 Riparian Area Vegetation Enhancement

Wooded buffers along streams act as filters to reduce sediment inputs associated with adjacent land use practices. Additionally, riparian vegetation can reduce streambank

scour during storm events by holding the soil in place (Figure 4.1). However, as shown in Figure 3.6 and Table 3.13, 57-70% of the riparian areas in the headwaters of the North Toe River, Whiteoak Creek, Plumtree Creek, and Threemile Creek subwatersheds have wooded riparian areas that are less than 30 feet in width. These areas present ample opportunity to reduce sedimentation while reestablishing native trees, shrubs, and herbaceous plants. The objective of this management measure should be to establish functioning riparian areas of at least 30 feet in width. Where nonnative invasive exotic plant species dominate, their control should also be carried out in conjunction with vegetation enhancement. The most common invasive exotic plants in the North Toe River watershed, Japanese knotweed and multiflora rose, create monocultures that exclude the establishment of native plant species and do not have the root structure necessary to hold stream banks in place or to filter pollution.

Riparian vegetation enhancement should also be considered for stream restoration sites where physical constraints preclude a full restoration project, require only minor restoration, or have somewhat stable stream banks where the riparian area has no or little woody vegetation (Tables 4.1-4.3). Although these conditions often occur primarily in developed areas where utilities must be maintained, in the case of the upper North Toe River they occur primarily on agricultural lands and low-density developments. Riparian areas in such condition are not effective at capturing sediment or other pollutants originating from upland areas. In those cases, the enhancement of woody riparian vegetation and expansion of the riparian area width are all that is needed or possible.

Recommended Native Plant Species for Use in Stream Restoration and Riparian Enhancement

Trees	*River Birch, Bitternut Hickory, Shagbark Hickory, Sugarberry, Persimmon, Green Ash, Blackgum, Sycamore, Black Cherry, Swamp Chestnut Oak, Water Oak, Shumard Oak, Black Willow, White Basswood*
Small Trees & Shrubs	*Southern Sugar Maple, Painted Buckeye, Tag Alder, Serviceberry, Red Chokeberry, Common Paw Paw, Sweet Shrub, Ironwood, Buttonbush, Alternate Leaf Dogwood, Silky Dogwood, Hazelnut, Deciduous Holly, Winterberry, Virginia Willow*
Herbs	*Jack-in-the-Pulpit, Swamp Milkweed, Fringed Saxifrage, Bladder Sedge, Hop Sedge, Lurid Sedge, Broom Sedge, Tussock Sedge, Fox Sedge, Turtlehead, Umbrella Sedge, Bottlebrush Grass, Joe Pye Weed, Boneset, Jewel Weed, Soft Rush, Rice Cutgrass*

Developed by the North Carolina Stream Restoration Institute at North Carolina State University.
Note: this list is not exhaustive and is intended as a guide. Plants listed in the table may not be appropriate and revegetation plans should be developed for site specific conditions.

4.2.3 Channel Realignment

Only three stream crossings were found to be misaligned to the stream channel during the streamwalk assessment (Table 4.4). Two of those sites are located within the commercialized reach of Grassy Creek, while the other is associated with the high railroad bridge crossing the North Toe River just downstream of Carpenter Island Road. All three of them were considered to have low levels of erosion and limited opportunity to remediate the sites due to constraints. While alignment was not specifically targeted during the windshield surveys, a review of all site photographs found little evidence that nonalignment of stream channels and bridge or culvert crossings is a significant source of sediment. Erosion problems associated with crossings are captured in the streambank assessment windshield survey data. Most of the larger streams are spanned with bridges or concrete box culverts that are aligned or are armored sufficiently to resist erosion. Many of the culverts are on high-gradient streams that have channels with little or no meanders or are in areas where channels have been straightened to align with existing culverts.

Table 4.4 Potential Channel Alignment Project Opportunities

Latitude	Longitude	Description
35.90544228	-82.04869824	High railroad bridge with concrete piers
35.882036	-82.057487	Access bridge at Parkway Fire and Rescue
35.887034	-82.060259	Private bridge on Grassy Creek Drive

4.3 Upland Management Practices

During the windshield surveys, disturbances occurring outside of the 30-foot riparian area and considered significant enough to be a potential source of sediment were recorded (Table 4.5).

The largest number and sizes of disturbances were found to be associated with agricultural and horticultural activities, including pastures, access roads, and cropland. Many of the horticultural disturbances were located on steep slopes. Smaller disturbances were generally associated with private residences and included driveways/parking areas, sites being prepared for development, and garden plots. Natural revegetation of some of these sites may have occurred by the time this WAP is implemented so the sites will require revisiting to assess the need for stabilization. Projects were ranked according to the size of the disturbance and erosion-severity rating. The list of disturbed areas is not exhaustive. Only those sites observable from public roadways were documented; a thorough analysis of recent aerial photos may reveal additional disturbed sites of concern.

The type of management measure applied at a specific site must be tailored to the type of disturbance. In most cases common erosion control measures, such as reestablishing vegetation on bare ground, graveling roadways, rotating livestock among pastures, or fencing them out of streams, may be all that is necessary.

Table 4.5 Potential Upland Disturbance Project Opportunities (Sheet 1 of 3)

Subwatershed Code	Site ID	Stream	Severity	Area (acres)	Area Estimated from GIS	Disturbance Type									
						Mining	Roads/Drives	Commercial	Construction	Other	Residential	Agriculture	Pasture/Hay	Cultivated	Horticulture
Bear	3	Stewarts Branch	Moderate	0.041							X				
Bear	1	Stewarts Branch	Moderate	0.023							X				
Bear	4	Stewarts Branch	Low	Unknown							X				
Bear	2	Stewarts Branch	Low	0.034						X					
Bear	11	Bear Creek	Low	0.015						X					
BigCrabtree	3	Big Crabtree Creek	Severe	2						X					
BigCrabtree	10	Burnett Branch	Severe	1.5	X	X	X								
BigCrabtree	13	UT to Big Crabtree	Moderate	1					X						
BigCrabtree	16	Big Crabtree Creek	Moderate	0.5						X					
BigCrabtree	4	UT1 to Big Crabtree Creek	Low	10											X
BigCrabtree	15	UT to Big Crabtree Creek	Low	2											X
BigCrabtree	9	Burnett Branch	Low	1.5								X	X		
BigCrabtree	14	UT to Big Crabtree Creek	Low	0.75						X					
BigCrabtree	8	UT to Long Branch	Low	0.25						X					
Grassy	5	East Fork Grassy Creek	Moderate	0.2			X								
Grassy	3	Grassy Creek	Moderate	0.11		X									
Grassy	9	UT10	Low	Unknown							X	X	X		

Table 4.5 Potential Upland Disturbance Project Opportunities (Sheet 2 of 3)

Subwatershed Code	Site ID	Stream	Severity	Area (acres)	Area Estimated from GIS	Disturbance Type									
						Mining	Roads/Drives	Commercial	Construction	Other	Residential	Agriculture	Pasture/Hay	Cultivated	Horticulture
HW-NToeR	20	UT to Hickory Nut Branch	Severe	1			X	X							
HW-NToeR	25	Handpole Branch	Severe	0.25			X								
HW-NToeR	10	UT to North Toe River	Moderate	16	X		X								X
HW-NToeR	9	Loggy Creek	Moderate	10								X	X		
HW-NToeR	7	North Toe River	Moderate	2		X									
HW-NToeR	15	North Toe River	Moderate	2											X
HW-NToeR	6	Kentucky Creek	Moderate	1	X		X					X		X	X
HW-NToeR	18	Loggy Creek	Moderate	1		X									
HW-NToeR	8	Kentucky Creek	Moderate	0.75						X					
HW-NToeR	16	Kentucky Creek	Moderate	0.5						X					
HW-NToeR	3	Kentucky Creek	Moderate	0.05			X								
HW-NToeR	21	UT1 to North Toe River	Moderate	0.01			X								
HW-NToeR	1	Kentucky Creek	Low	0.25			X			X					
PlumtreeCrk	8	Plumtree Creek	Severe	0.09			X								
PlumtreeCrk	3	Plumtree Creek	Moderate	60	X		X								X
PlumtreeCrk	9	Plumtree Creek	Moderate	1						X					
PlumtreeCrk	17	UT6	Moderate	1											X

Table 4.5 Potential Upland Disturbance Project Opportunities (Sheet 3 of 3)

Subwatershed Code	Site ID	Stream	Severity	Area (acres)	Area Estimated from GIS	Disturbance Type									
						Mining	Roads/Drives	Commercial	Construction	Other	Residential	Agriculture	Pasture/Hay	Cultivated	Horticulture
PlumtreeCrk	20	Little Plumtree Creek	Moderate	0.014			X								
PlumtreeCrk	15	Trim Branch	Low	1						X					
PlumtreeCrk	10	Plumtree Creek	Low	0.06						X					
PlumtreeCrk	7	Plumtree Creek	Low	0.02			X								
Rose	1	Rose Creek	Moderate	0.1		X	X								
Threemile	9	Threemile Creek	Severe	2						X					
Threemile	10	Fork Creek	Moderate	10								X	X	X	
Threemile	4	Threemile Creek	Moderate	1			X								
Whiteoak	9	Whiteoak Creek	Severe	2						X					
Whiteoak	8	Whiteoak Creek	Moderate	3								X	X		
Whiteoak	1	UT	Moderate	0.01			X								
Whiteoak	3	Whiteoak Creek	Low	1								X	X		
Whiteoak	5	Whiteoak Creek	Low	0.005		X									

4.4 Stormwater Control Measures (SCMs; formerly BMPs)

In the Upper North Toe River Watershed, impervious surfaces (primarily parking lots, roads, and building rooftops) are concentrated in the developed portions of the Towns of Newland and Spruce Pine, transportation corridors leading to these municipalities, and nearby industrial and institutional facilities. During a rain event, stormwater flows across these impervious surfaces, builds volume, and carries sediment and other pollutants with it into streams. The increased volume of runoff results in increased stream velocities that scour stream banks. These factors combine to cause increased turbidities. The use of SCMs offsets the impacts of impervious cover by capturing runoff and storing water on-site, which allows sediment and other pollutants to be reduced. The on-site detention and infiltration of stormwater runoff protects adjacent streams from the erosive effects of increased water volumes and velocities by slowly releasing stormwater, reducing peak discharges of large events to match natural stream-flow characteristics. Some stormwater structures are effective in not only removing sediment but also in reducing the levels of nitrogen, heavy metals, and phosphates in the runoff. In addition to reducing the potential for streambank erosion, SCMs also can provide improved wildlife habitat by enhancing open space, reducing elevated stream temperatures caused by heat-absorbing pavement, and beautifying the landscape with the addition of water features and vegetation. Stormwater control measures are typically categorized into three types: simple, structural, and nonstructural or natural.

4.4.1 Simple Stormwater Control Measures

Runoff Volume

One inch of precipitation falling on 1,200 square feet of roof produces approximately 750 gallons of runoff.

Simple SCMs include small, low cost measures that cumulatively add up to make a big impact. Homeowners and small businesses can easily implement simple SCMs on their properties. When done properly these simple practices will beautify a property, protect basements and foundations from water seepage, and reduce water consumption and money that property owners spend on water utilities. Each property is unique. Prior to implementing any of these solutions, property owners should assess their site to ensure that their runoff will not cause or worsen storm runoff problems for neighbors or create or add to erosion and flooding conditions on their properties. Even though we refer to these solutions in this plan as ‘simple’, professional assistance with design and construction may be needed.

Downspout Rerouting - Downspouts from rooftop gutter systems can be rerouted from driveways, parking lots, and streams to lawns and wooded areas in order to reduce runoff volume and stream velocity. People interested in helping streams through these practices should expect minimal investment in time and money. A homeowner with just a few downspouts will not incur as much cost as those who manage a large commercial facility. The site to which the downspout is rerouted should be assessed for its infiltration and erosion potential. Rerouting downspouts to steep slopes or clay soil areas may cause erosion or flooding. When these site conditions are unavoidable, the use of stone, erosion control fabric, and vegetation can help control erosion and promote the infiltration of stormwater into the ground. The more complicated a site, the more likely that assistance from a design professional would be helpful. Many homeowners will find this solution easy and inexpensive to implement and can likely undertake such a project on their own.

Rain Barrels and Cisterns - Rain barrels and cisterns (Figure 4.2) provide a storage device to capture rooftop drainage for later use on the site. Many people capture and reuse this water for their gardens and landscape plantings. Rain barrels come in a variety of sizes, shapes, and colors. It has become fairly commonplace to find 50- to 75-gallon barrels that make attractive additions to the landscape. A simple, 50-gallon plastic rain barrel will typically cost around $100 or less to install. Users of this practice will need to make sure that they have screens over openings to keep mosquitoes from using the reservoir as a breeding ground. They will also need to direct the overflow to a suitable location to keep it from seeping into foundations and basements.

Figure 4.2 Rain Barrel and Cistern Setup

A rain barrel is attached to a downspout and collects rain water.

An above ground cistern located at the City of Morganton Parks and Recreation maintenance building catches runoff from the roof. The water is used to clean equipment.

Dry Creek Beds - Dry creek beds (Figure 4.3) can be an attractive landscape amenity that can serve the function of re-routing storm runoff from impervious rooftops, driveways, and parking lots into a yard area where infiltration can occur.

Figure 4.3 Dry Creek Beds in a Residential Setting

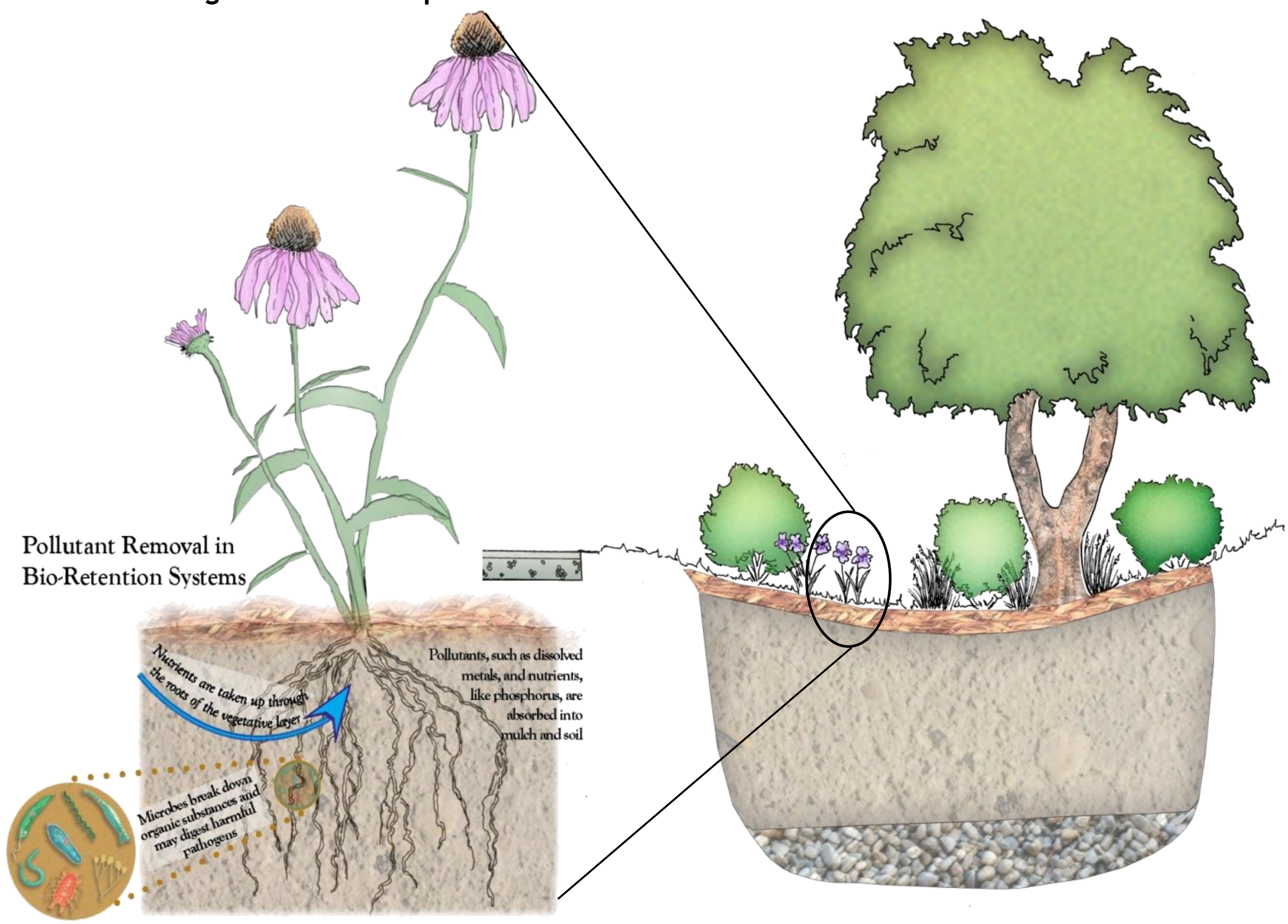
The rough edges of the stones and the open spaces in between the rocks slow down runoff and allow it to be absorbed into the ground. Landscape plantings within and surrounding the dry creek bed also slow the water and promote infiltration. The stones and plants can also work together to create natural habitat for birds and small mammals.

4.4.2 Engineered Stormwater Control Measures

Engineered structures are ones that are intended to treat larger areas of imperviousness. They vary greatly in size, complexity, and function and typically incorporate plant material, soil mixes, and diversions that filter pollutants by natural processes. Common examples of engineered SCMs include rain gardens, constructed wetlands (also known as stormwater wetlands), wet detention ponds, and bioswales. Less common and more expensive alternatives include permeable paving, permeable weirs, and green roofs.

As shown in Figure 4.4, stormwater flows into an engineered SCM where pollutants are absorbed into the soil. Sediment either settles to the bottom or is filtered out; nutrients are taken up by plants while microbes break down organic substances. They typically occur as vegetated depressions that capture runoff and allow plants to take up excess nutrients and water while filtering runoff through a soil medium.

Figure 4.4 Plant Uptake and Pollutant Removal Processes



<u>Bioretention</u> - Bioretention features are shallow landscape depressions that use soils and plants to treat stormwater runoff, using many of the water storage and pollutant-removal mechanisms that operate in healthy forests. During storms, water temporarily ponds on the surface of a sand/soil bed that then infiltrates through the bed into an underdrain system. Bioretention areas can be designed to infiltrate water

directly into native soils if the soils are sufficiently permeable. Bioretention can be used in a variety of topographic conditions although individual retention areas are usually small and can generally treat runoff from areas of 1 acre or less.

More simplified versions of bioretention features are known as rain gardens and are often utilized in residential applications (Figure 4.5). Rain gardens function like bioretention features by utilizing landscape depressions but do not normally include the infrastructure and soil mediums typical of bioretention cells. Because they lack drainage structures, soils in rain gardens need to be highly permeable in order to function correctly. Both methods are intended to "draw down" or empty within 48 hours following a rain event, alleviating stagnant water and mosquito-breeding concerns.

Figure 4.5 Bioretention Features in Residential and Commercial Applications

The median construction cost for bioretention areas is approximately $25,400 per impervious acre treated (CWP 2007). Development of designs for SCMs will increase this cost by about 33%. The advantage of bioretention is that it offers a cost-effective compliment to parking lot and streetscape improvements where improved landscape aesthetics are also a goal. Rain gardens can also fit nicely in a backyard or as part of the stormwater management system of a residential development. Routine maintenance similar to landscape maintenance will be required, including replacement of the top-most mulch every few years, removal of invasive exotic weeds, occasional plant pruning, and some tilling or aeration of the soil if fine sediments accumulate on the surface.

Regenerative Stormwater Conveyances (RSC) - A new and more descriptive term for what have been known as swales, RSCs are essentially drainage ditches, but they do more than simply convey water from one point to another. They are designed to slow down water flow and allow infiltration. This innovative system utilizes open-channel, sand-seepage filtering systems that incorporate a series of shallow aquatic pools, riffle weir grade controls, native vegetation, and an underlying carbon-rich sand channel to treat and safely detain and convey storm flow (Figure 4.6, Brown et al. 2010). In the process, stormwater is converted to groundwater through infiltration. An RSC system combines the features and treatment benefits of swales, water infiltration, pollutant filtering, and wetland practices. Simple grass-lined swales have limited pollutant removal benefits, but are often utilized in conjunction with other SCMs.

The cost for grass swales in the North Carolina mountain region averages $1.24 per square foot (Hathaway and Hunt 2007). Swales on steep slopes may need turf reinforcement matting or other support, which can add an additional $0.50 per square foot to the cost. Costs for more sophisticated RSCs would depend on site conditions (terrain, soils, volume, etc.)

Figure 4.6 Examples of Regenerative Stormwater Conveyances

At Construction

After One Growing Season

After Construction

Three Years After Installation

Constructed Wetlands (also known as stormwater wetlands) - Constructed wetlands are shallow depressional wetlands constructed to mimic the functions of natural wetlands (Figure 4.7). They temporarily store stormwater in shallow pools that contain diverse wetland vegetation. The wetland uses physical, chemical, and biological processes to filter pollutants. They can also be designed to provide stormwater volume control.

A forebay is an important design feature that is placed near the inlet to the wetland. This feature allows coarser sediment particles that often accompany runoff to settle into a basin rather than enter the wetland and reduce the wetland's treatment capacity. The forebay also protects the physical integrity of the wetland by dissipating the energy of the incoming stormwater.

In contrast to rain gardens, wetlands can be used to treat runoff from a larger area. Because they are shallow, stormwater wetlands require more surface area than similar wet detention ponds to treat the same amount of runoff.

Costs for retrofitted constructed wetlands, as reported by the Center for Watershed Protection (CWP), can be upwards of $38,400 per impervious acre treated. Design costs of an SCM will increase this cost by about 33%. Sediments that accumulate in the forebay of a constructed wetland need to be dug out every 5 years or when the depth of the forebay diminishes by 50%. Wetlands should also be monitored for the invasion of exotic plant species and removed promptly when found. Other maintenance requirements include the periodic inspection of the flow delivery mechanisms upstream of the wetland to ensure that stormwater is able to get to the wetland as designed. Otherwise, the wetland plant species may die. Trash and other debris removal may also be needed periodically.

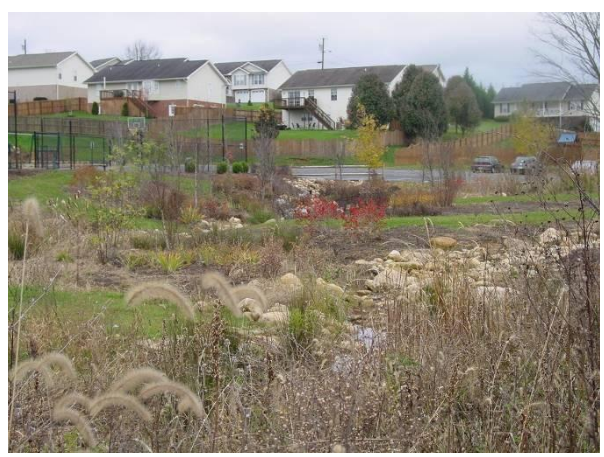
Figure 4.7 Examples of Constructed Wetlands

A constructed wetland at a city park captures stormwater runoff from a residential development and a parking lot. It also serves as a water feature in the park and provides wildlife habitat.

A bio-retention area effectively captures runoff, preventing large volumes of polluted runoff from entering a stream.

A small curb cut allows stormwater from a parking lot to enter into a bio-retention area bordering the parking lot.

Following a rain event, stormwater enters the bio-retention area where it is absorbed by mulch and soil and is taken up by plants.



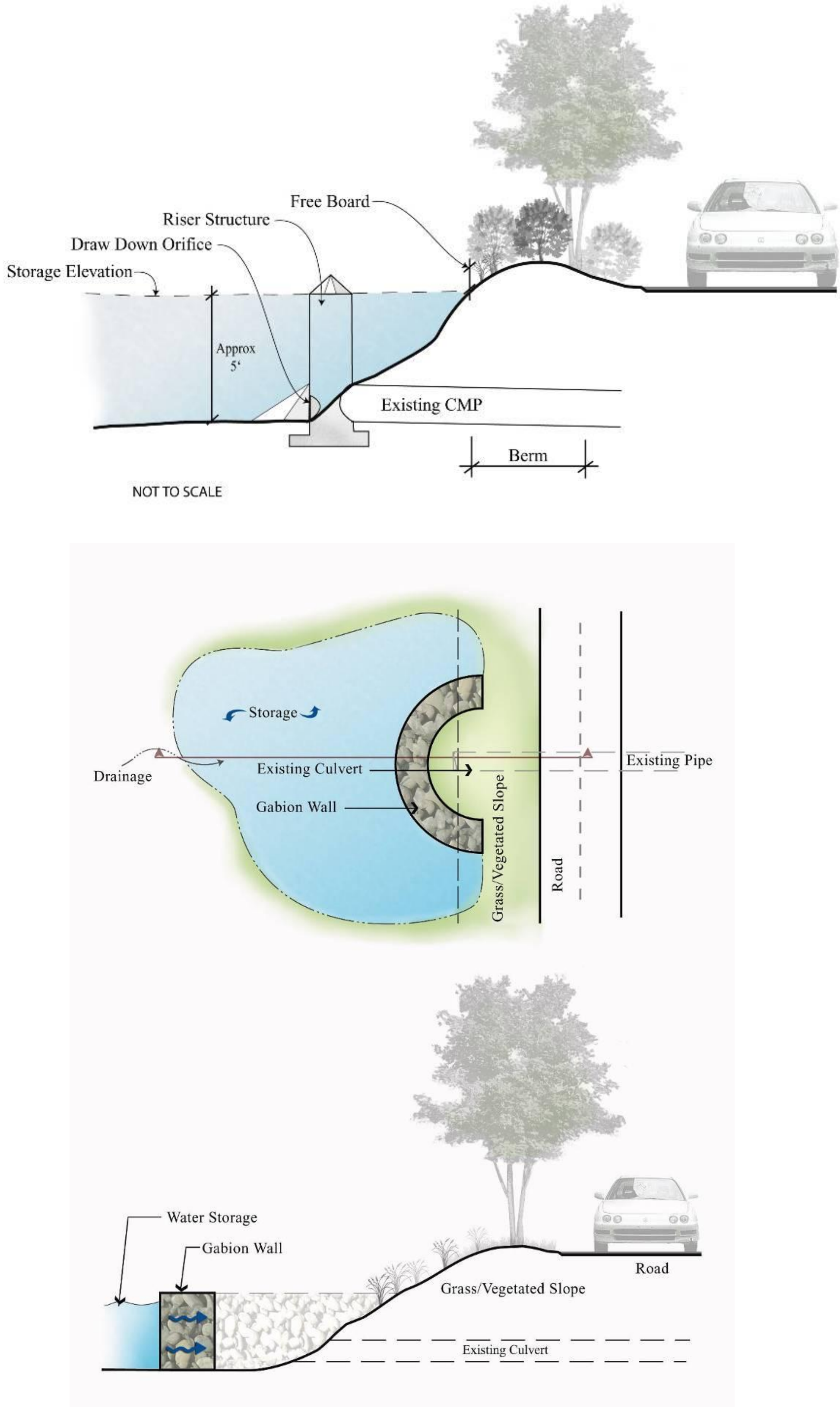
Examples of constructed wetlands.

Detention and Retention Ponds - Wet detention ponds act in a similar manner as stormwater wetlands, storing stormwater for 12-24 hours (Figure 4.8). During this time, sediment and other pollutants settle out or are absorbed on the lake bottom. Like wetlands, detention basins can handle runoff from large areas. In contrast, wet detention basins are usually deeper, are armored with concrete embankments, and do not utilize vegetation in the pollution treatment. While they may not require as much space to install as a wetland, they lack some of the aesthetic and functional qualities that are provided by wetlands. Because of the safety issues posed by the pond depth, fencing is often required around the perimeter. Since water temperature is a concern for trout streams in the North Toe River watershed, wet-pond use should be avoided. The lack of shading results in increased water temperatures that can affect stream life as water is released to receiving streams. Constructions costs for wet-pond retrofits can be upwards of $57,500 per impervious acre of treatment. Routine maintenance can be expected to cost about 3 to 5% of the construction cost.

Figure 4.8 Examples of Wet Detention Ponds

Extended detention is designed to capture stormwater and temporarily store it for 12-24 hours, allowing sediment and other pollutants to settle out before it slowly continues to follow its drainage pattern (Figure 4.9). While extended detention structures can be installed wherever water flows through a culvert, they must be sized to accommodate the upstream drainage area. A structure, such as a riser or gabion wall, is installed upstream of the culvert and causes the water to back up. Over the course of it designed extension time, the water slowly releases through the existing culverts or corrugated metal pipes. Since there is no long-term storage of the water, extended detention facilities do not have the same negative effects of increased water temperature as wet ponds. Furthermore, innovative use of these facilities can also provide open space and provide for recreational use of the surrounding area

Figure 4.9 Examples of Extended Detention Pond Designs



4.4.3 Green Infrastructure Alternatives

Although no assessments for the application of green infrastructure alternatives to reduce stormwater impacts were made as part of this project, the NTRWP wanted to include the following options as part of their action plan. The following green infrastructure alternatives are applicable should opportunities to use them arise.

Green Roofs – A green roof is a roof that has plants on it (Figure 4.10). While still a relatively novel concept in the southeastern United States, this engineered construction practice has been time tested throughout Europe and is beginning to show up in North America (Chicago's City Hall has a green roof). This practice is a great way to manage rooftop stormwater when space is limited for BMPs on the ground surrounding the building. Green-roof technology is not only a good way to manage stormwater runoff; these types of roofs provide greater insulation from heat and cold, soundproofing, and last up to two times longer than conventional roofing. Green roofs can also help moderate the "heat island" effect of urban areas.

Green-roof technology is applicable in residential, commercial, and institutional applications. Installation costs of green roofs can range from $8.75 to $31.80 per square foot (CNT Undated), depending upon design and plant materials utilized. This is higher than conventional roofing costs, but owners can expect reduced maintenance and energy costs over the long term. Structural engineering analysis is a prerequisite before construction. Figure 4.11 shows the layers required for a functioning green roof. Figure 4.12 shows the amount of runoff captured by a green roof compared to a conventional roof.

Figure 4.10 Examples of Green Roofs

Photos Courtesy of Weston, Inc.

Figure 4.11 A Green Roof Cross-Sectional Diagram

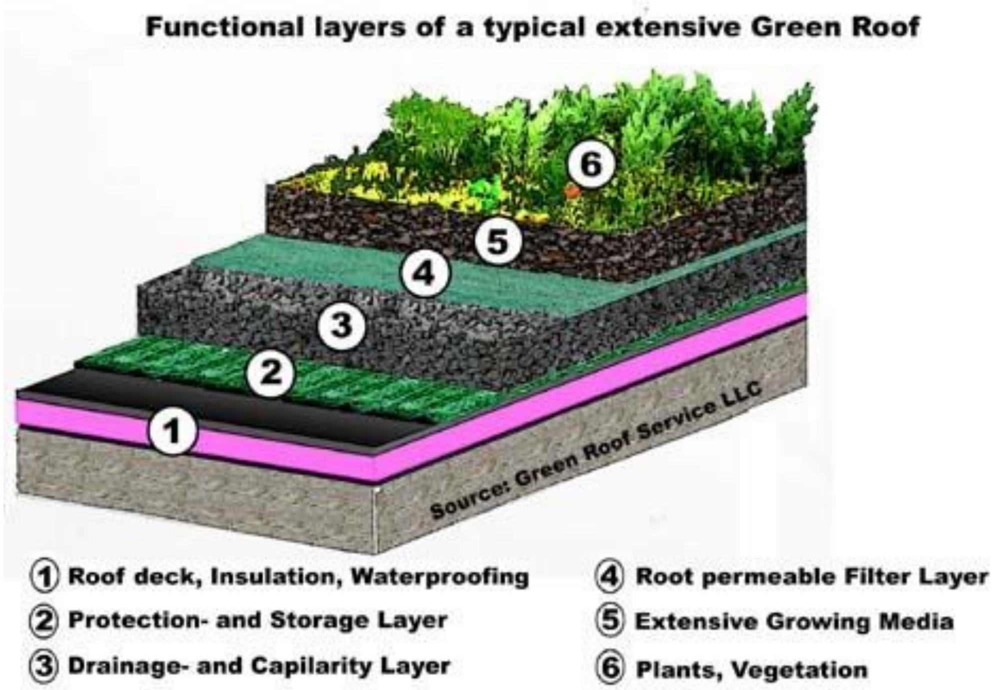
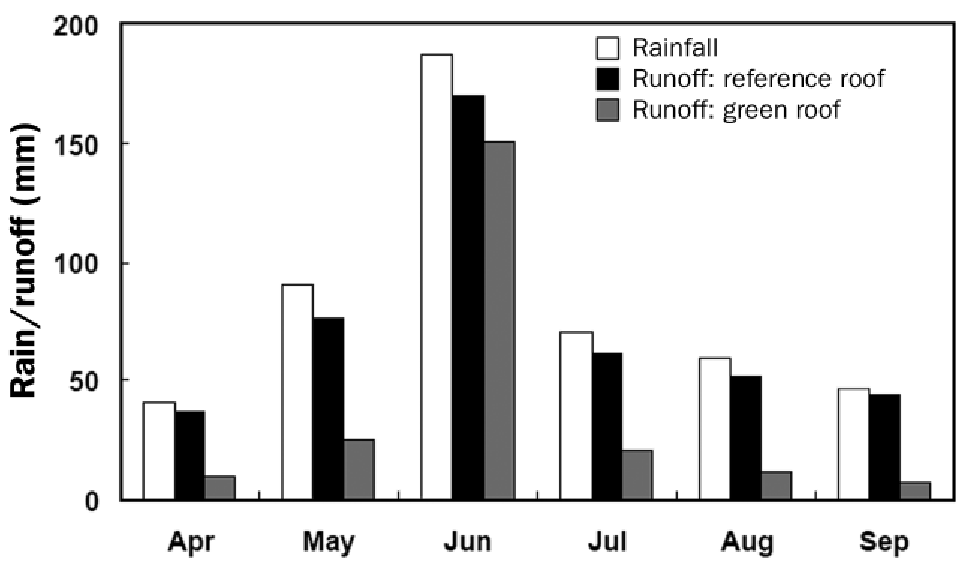


Figure 4.12 Comparing Green and Traditional Roofs for Controlling Runoff



Source: BioScience, November 2007

Impervious Surface Removal (Recovering Open Space) – As economic changes take place within urban areas, opportunities to address constraints to implementing SCMs and enhance the beauty of town centers can arise. Two of the best opportunities for this to occur include the rehabilitation of unused parking areas and the purchase and removal of vacant/surplus buildings that have outlived their useful life or are no longer suitable for rehabilitation. Once the pavement or building is removed, the open space can be designed not only to provide a park-like setting, but also can serve as an area into which stormwater control features can be incorporated. Such open spaces become an amenity that will attract visitors to downtown areas, resulting in increased business for existing merchants and attracting new ones as well.

*A **stormwater retrofit** is a best management practice installed after construction where little or no stormwater controls exist.*

4.4.4 Stormwater Control Measure Assessment

As part of the Upper North Toe River Watershed assessment, an SCM retrofit inventory was conducted to identify opportunities to improve stormwater management at developed sites. Although stormwater management could be improved in the town centers of Newland and Spruce Pine, and other areas developed for commercial/industrial/institutional use, the steep terrain and other constraints make retrofitting impractical or financially infeasible for those areas. Therefore, assessment areas and sites were selected according to the following criteria:

1. Assessments were conducted in portions of subwatersheds with more impervious area to minimize the cumulative impact of the increased volume of stormwater runoff on the receiving streams.
2. For sites that appeared to have no constraints to construction, utility and other limitations will be considered in the design of the individual SCMs.
3. No priority was given to pollutant type due to the limited number of feasible sites; sites were evaluated for potential reductions in phosphorus, nitrogen, and TSS.

Based on these criteria, 19 individual SCM retrofit opportunities at 11 different sites in the vicinity of Spruce Pine and Newland (Figure 3.4, Table 4.6) were identified. The sites were not prioritized. Recommended SCM types primarily include nonstructural SCMs (such as bio-retention features, constructed wetlands, and RSCs), but also include a few structural SCMs (such as extended detention and filtration chambers). The types of SCMs selected were based upon the type of desired treatment and the available space. Site constraints (such as buildings, utilities, and slope) also largely determined the type of SCM recommended.

Site descriptions, rationales for prioritization, proposed management options, and supporting graphics are provided for two of the high-priority sites in Section 4.4.5 to provide examples of different treatment opportunities. Although descriptions provided are site-specific, similar SCM concepts may be applied at other sites throughout the watershed. Refer to Appendix C-1 for more details on SCM prioritization methods.

Table 4.6 Potential Stormwater Control Measure Project Site Characteristics (Sheet 1 of 2)

Site	SCM ID	Property Name	Type of SCM	Subwatershed	Was The Site Accessed	Public Land	Land Use	Field Notes
1	a	Blue Ridge Regional Hospital	Bioretention	North Toe River at Spruce Pine & Lower Beaver Creek	Yes	No	Institutional / transitional construction	Unshaded parking areas, some existing stormwater management evident
1	b	Blue Ridge Regional Hospital	Bioretention	North Toe River at Spruce Pine & Lower Beaver Creek	Yes	No	Institutional / transitional construction	
1	c	Blue Ridge Regional Hospital	Bioretention	North Toe River at Spruce Pine & Lower Beaver Creek	Yes	No	Institutional / transitional construction	
1	d	Blue Ridge Regional Hospital	Extended Detention	North Toe River at Spruce Pine & Lower Beaver Creek	Yes	No	Institutional / transitional construction	
2	a	Marine Propulsion Lab	Wet Pond to Dry Pond Conversion	English Creek	No	No	Industrial	Nonfunctioning wet pond (possible dredging operation), storm drain goes directly into drainage. Conversion to a dry pond as opposed to reverting back to a wet pond which increases water temperatures
2	b	Marine Propulsion Lab	Bioretention	English Creek	No	No	Industrial	Nonfunctioning wet pond, storm drain goes directly into stream
3	a	Deyton Elementary School	Vegetated Swale	English Creek	Yes	Yes	Institutional	
3	b	Deyton Elementary School	Bioretention	English Creek	Yes	Yes	Institutional	Sheet drain parking lot into bioretention
4	a	Harris Middle School	Vegetated Swale	English Creek	Yes	Yes	Institutional	
4	b	Harris Middle School	Bioretention	English Creek	Yes	Yes	Institutional	Paving in bus parking in need of repair, good time to install SCMs

Table 4.6 Potential Stormwater Control Measure Project Characteristics (Sheet 2 of 2)

Site	SCM ID	Property Name	Type of SCM	Subwatershed	Was The Site Accessed	Public Land	Land Use	Field Notes
5	a	Ingles (Newland)	Bioretention	Whiteoak Creek	Yes	No	Commercial	Little buffer between parking lot and stream
5	b	Ingles (Newland)	Bioretention	Whiteoak Creek	Yes	No	Commercial	Little buffer between parking lot and White Oak Creek
6	a	Newland Grade School	Bioretention	North Toe River Headwaters	Yes	Yes	Institutional	Potential bioretention in upper parking lot, storm water piped offsite currently
7	a	U.S. Textile Corp.	Extended detention	North Toe River at Newland	No	No	Industrial	All of outdoor parking lots are gravel
8	a	Lowes Food / Family Dollar	Bioretention and trees	North Toe River at Newland	Yes	No	Commercial	Wetland borders edge of parking lot
9	a	Ingles (Spruce Pine)	Extended detention	North Toe River at Spruce Pine and English Creek	Yes	No	Commercial	Stormwater from parking drains directly into North Toe River
9	b	Ingles (Spruce Pine)	Bioretention	North Toe River at Spruce Pine and English Creek	Yes	No	Commercial	Stormwater from parking drains directly into North Toe River
10	a	Avery High School	Bioretention	Handpole Branch and Kentucky Creek	Yes	Yes	Institutional	Bioretention in bus/staff parking area
11	a	The Bridge / Tri-County Christian School	Bioretention	North Toe River at Spruce Pine	Yes	No	Institutional / ex-industrial	

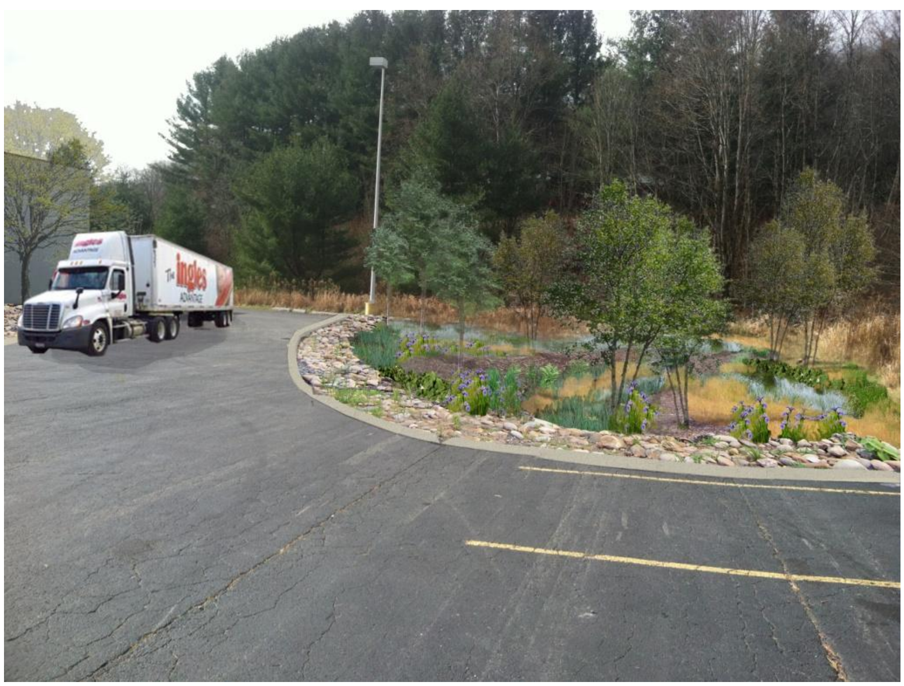
4.4.5 Site Exhibits

The following two exhibits are mock-ups that show how the proposed SCMs may look when installed. These mock-ups are for illustrative purposes only and should not be construed as preliminary design plans. Full design plans will depend on a thorough analysis of the site, which may reveal unknown constraints (such as utility lines) that were not discovered during the preliminary analysis.

Site 5 – The parking area of Site 5 (Figure 4.13) is illustrated due to its proximity to Whiteoak Creek and the opportunity to reclaim a seemingly excessive asphalt area beside the store. Evidence of "rack lines" deposited from ponding reveals signs of inadequate storm drainage. As the mock-up exhibits, delivery truck access can still be accommodated after the stormwater treatment is retrofitted. Bioretention is the preferred treatment method so as to minimize the land necessary to achieve NCDWR design standards. However, doing so may be problematic due to the likely seasonably high water table due to its proximity to Whiteoak Creek. Therefore, a constructed wetland may be preferred. It would enhance habitat, remove pollutants from the parking area as well as restore the riparian zone, which also would serve to reduce water temperatures.

Figure 4.13 Mock-up of Stormwater Control Measures at Site 5

Existing Conditions



Conceptual Design of the Stormwater Control Measure

<u>Site 11</u> - Figure 4.14 is designed to show improper drainage over a fill slope (below the photo). Runoff down the fill slope risks long-term stability. The use of bioretention features would reduce the amount of impervious surface for the area, provide shade on the asphalt, and should incorporate appropriate infrastructure to properly route the stormwater to the toe of the slope.

Figure 4.14 Mock-up of Stormwater Control Measures at Site 11

Existing Conditions

Conceptual Design of the Stormwater Control Measures

4.5 Agricultural Best Management Practices (BMPs)

Although agriculture is not a major industry in the Upper North Toe River Watershed, there are some concentrations of agricultural activities as well as many “hobby” farms distributed throughout the project area. Most of the hobby farms have horses for recreation rather than livestock for generating income from meat or dairy production. In addition to farms with livestock, a considerable amount of land was observed to be managed for the production of hay; a lesser amount was being used to grow corn or other livestock feed crops. Outside of small residential gardens, few commercial vegetable operations were observed during the windshield surveys conducted for this project. Regardless of the activity, many of these farms could benefit from the installation of agricultural BMPs that would reduce the amount of sediment entering streams of the Upper North Toe River Watershed. The following is a description of those management measures most applicable to degradation observed during windshield surveys. Technical assistance for these BMPs can be obtained from local SWCD or County Cooperative Extension offices.

Livestock Exclusion Fencing – Where livestock have access to stream channels, they typically destroy streamside vegetation and trample stream banks, which lead to increased erosion and direct pollution in the form of animal waste. The preferred option is to permanently exclude livestock from streams, including the riparian area. Alternative water sources will need to be provided if livestock are dependent on a stream for drinking water.

Revegetating Riparian Areas – Riparian area vegetation serves as a buffer between upland areas and streams. Fully functioning riparian areas include a mixture of grasses, forbs, sedges, shrubs, and trees. They function to filter sediment; stabilize stream banks; absorb nutrients; regulate stream temperatures by providing shade; and provide food, nutrients, and habitat for aquatic organisms. The key to establishing a well-functioning riparian area is to match the plant species to the soil, to its location on the stream bank, and to local climate conditions. Native species are preferred and best suited to local conditions.

Streambank and Channel Restoration – In some cases stream channels and banks are so unstable that they need to be rebuilt to restore floodplain function and improve sediment transport and improve aquatic habitat. The primary benefit of stream stabilization is to reduce erosion; however, when combined with improving riparian vegetation, reductions in nutrients and sediment can also be achieved. Stream restoration should be accomplished using natural approaches that address the cause of the channel instability and whose solution includes a combination of engineering techniques and revegetation appropriate for the site.

Increase Wooded Riparian Area Widths – In some cases the riparian area closest to the stream is intact, but due to its narrow width it is not fully functional. This was often seen in conjunction with fields managed for crops or in residential areas. In these cases all that may be necessary is to not mow or plow as closely to the stream bank and let natural revegetation occur. To reestablish woody shrubs and trees more quickly, it may be desirable to install livestakes and plant containerized stock composed of native species.

Grassed Waterways – Particularly useful in controlling erosion on fields with steeper slopes, grassed waterways are vegetated channels through fields where runoff is concentrated. These features not only reduce erosion but also can trap sediment moving from upland areas, reduce peak discharge, and absorb pesticides. The design of grassed waterways must be tailored to site-specific conditions that include slope, soil type, and agricultural activity.

Pasture Rotation Plans – In the few instances where intensive livestock grazing was found to occur, the use of rotational grazing plans would reduce the amount of bare ground exposed and disturbed. As a consequence, sediment runoff as well as the nutrients and fecal coliform bacteria contained in animal wastes that reaches streams would be reduced. Overall, this would lead to improved water quality and, more particularly, turbidity.

4.6 Pollutant Load Reduction Potential

Field data and generalized predictive models were used to determine the potential pollutant load reductions from stream banks, disturbed upland areas, and SCMs (Appendix D). While sediment reduction loads were estimated for all three categories of projects, nutrients were estimated only for SCMs.

4.6.1 Streambank Erosion

Sediment loading estimates for streambank erosion were calculated using the USEPA's Spreadsheet Tool for Estimation of Pollutant Load (STEPL) model (Appendix D). Because of differences in how streambank stability scores were calculated, sediment loadings were calculated separately for data collected at stream crossings versus data collected from observation points adjacent to streams.

Almost 56,000 feet of stream banks rated as Fair or Poor were documented during field assessments (Table 4.7). Based on those data, we estimate that sediment load reductions of approximately 1,050 tons per year could be achieved by implementing stream restoration or enhancement projects at those locations. The greatest reduction in annual sediment loads could be achieved by implementing watershed improvement projects in the Threemile Creek (472 tons), North Toe River headwaters (175 tons), Plumtree Creek (89 tons), and Grassy Creek (89 tons) subwatersheds.

Table 4.7 Potential Sediment Load Reduction from Streambank Stabilization

Subwatershed	Stream Crossing and Uplands				Adjacent Stream and Uplands				Total Potential Load Reduction (tons)
	Bank Length (ft)	Unstabilized Bank Annual Load (tons)	Stabilized Bank Annual Load (tons)	Annual Load Reduction (tons)	Bank Length (ft)	Unstabilized Bank Annual Load (tons)	Stabilized Bank Annual Load (tons)	Annual Load Reduction (tons)	
Bear	950	59.9	12.0	47.9	660	13.5	2.7	10.8	58.7
Beaver	1,100	22.5	4.5	18.0	400	8.2	1.6	6.6	24.6
Big Crabtree	1,650	33.8	6.8	27.0	800	16.4	3.3	13.1	40.1
Brushy	420	8.6	1.7	6.9	5,600	114.7	22.9		6.9
Grassy	5,450	111.6	22.3	89.3	3,600	73.7	14.7		89.3
North Toe River headwaters	5,100	104.4	20.9	83.5	2,500	51.2	10.2	91.7	175.2
Plumtree	1,820	37.3	7.5	29.8	19,450	398.2	79.6	59	88.8
Rose	1,820	37.3	7.5	29.8	660	13.5	2.7	41	70.8
Threemile	3,050	192.2	38.4	153.7	400	8.2	1.6	318.6	472.3
Whiteoak	1,450	29.7	5.9	23.8					
Total	**22,810**	**637.1**	**127.4**	**509.7**	**33,010**	**675.9**	**135.2**	**540.8**	**1,050.5**

4.6.2 Upland Disturbances

Sediment loads from upland disturbances were based on the TVA's Integrated Pollutant Source Identification (IPSI) model (Holcombe and Malone, Undated, Appendix D). The disturbed areas were visually estimated; no actual site measurements were taken. Although some of these sites may revegetate through natural processes, it is reasonable to assume that the amount of disturbed areas within these watersheds will be relatively constant. Upland disturbed areas were greatest in the North Toe River headwaters, Big Crabtree Creek, and Whiteoak Creek subwatersheds (Table 4.8). As a consequence, the stabilization of land disturbances in those areas using the management measures recommended in this WAP would achieve a 75% reduction in the estimated annual sediment load (331 tons out of a total of 406 tons).

Table 4.8 IPSI Model Outputs and Associated Load Reductions for Upland Disturbed Sites[1]

Subwatershed	Area (acres)	Estimated Soil Loss (tons per year)		Annual Load Reduction (tons)
		Disturbed	Stabilized	
Bear Creek	0.99	9.21	0.06	9.15
Big Crabtree Creek	17.00	158.95	0.95	158.00
Grassy Creek	0.76	7.11	0.04	7.06
North Toe River headwaters	13.15	122.95	0.74	122.21
Plumtree Creek	2.15	20.10	0.12	19.98
Rose Creek	0.10	0.94	0.01	0.93
Threemile Creek	4.00	37.40	0.22	37.18
Whiteoak Creek	5.53	51.71	0.31	51.40
Total	**43.68**	**408.36**	**2.45**	**405.91**

[1]See Appendix D for details of the model inputs used to obtain these estimates.

4.6.3 Stormwater Control Measures

The 19 individual SCM retrofit opportunities at 11 different sites will be tailored to site conditions (Table 4.9). Cumulatively, the 19 SCM features have the potential to reduce runoff volume and velocity from approximately 57 acres of existing impervious surfaces. While most SCM types are very efficient at removing suspended solids, they also reduce nitrogen, phosphorus, and fecal coliform bacteria levels of stormwater (Appendix Table D.4). Based on the conceptual designs and pollutant removal efficiencies, it is estimated the proposed SCMs will result in an annual reduction of about 0.5 ton of suspended sediment, 30 pounds of phosphorus, and 25 pounds of nitrogen.

While the potential pollutant reductions from SCM retrofits appear to be slight, the cumulative benefits and value of reducing impervious surface area; reducing stormwater volume and velocity, which contributes to streambank erosion; improving wildlife habitat; and beautifying the landscape are significant. Also, the proposed SCM projects will be valuable demonstration tools in informing the public about stormwater runoff and the ability of SCMs to remove sediment and nutrients.

Furthermore, SCMs can achieve additional goals stated in this WAP. Mutual cooperation and collaboration with landowners, local governments, and nonprofit groups are necessary in order to achieve SCM implementation. As private landowners learn about BMPs from demonstration projects on public land, they will want to install SCMs on their property. Finally, SCM installation requires professional services for design, construction, and maintenance, thus employing contractors and stimulating the local economy. The implementation of the SCMs, combined with other management measures, will lead to lowered turbidity and improved ecological function of the Upper North Toe River Watershed.

Table 4.9 Potential Stormwater Control Measure Pollutant Load Reduction Estimates (Page 1 of 2)

Site	SCM ID	Property Name	Type of SCM	Subwatershed	Drainage Area (acres)	Total Phosphorus Annual Load (lb)	Total Phosphorus Annual Removed (lb)	Total Nitrogen Annual Load (lb)	Total Nitrogen Annual Removed (lb)	Total Suspended Solids Annual Load (lb)	Total Suspended Solids Annual Removed (lb)
1	a	Blue Ridge Regional Hospital	Bioretention	North Toe River at Spruce Pine and Lower Beaver Creek	3.0	4.4	2.0	4.4	1.5	77.6	66.0
1	b	Blue Ridge Regional Hospital	Bioretention	North Toe River at Spruce Pine and Lower Beaver Creek	3.27	4.8	2.2	4.8	1.7	84.6	71.9
1	c	Blue Ridge Regional Hospital	Bioretention	North Toe River at Spruce Pine and Lower Beaver Creek	3.16	4.6	2.1	4.6	1.6	81.7	69.5
1	d	Blue Ridge Regional Hospital	Extended Detention	North Toe River at Spruce Pine and Lower Beaver Creek	16.6	24.3	4.9	24.3	6.1	429.3	214.7
2	a	Marine Propulsion Lab	Wet Pond to Dry Pond Conversion	English Creek	6.33	11.8	3.5	11.8	0.6	206.6	62.0
2	b	Marine Propulsion Lab	Bioretention	English Creek	3.24	6.0	2.7	6.0	2.1	105.7	89.9
3	a	Deyton Elementary School	Vegetated Swale	English Creek	0.45	0.7	0.2	0.7	0.4	11.6	9.3
3	b	Deyton Elementary School	Bioretention	English Creek	1.75	2.6	1.2	2.6	0.9	45.3	38.5

Table 4.9 Potential Stormwater Control Pollutant Load Reduction Estimates (Page 2 of 2)

Site	SCM ID	Property Name	Type of SCM	Subwatershed	Drainage Area (acres)	Total Phosphorus Annual Load (lb)	Total Phosphorus Annual Removed (lb)	Total Nitrogen Annual Load (lb)	Total Nitrogen Annual Removed (lb)	Total Suspended Solids Annual Load (lb)	Total Suspended Solids Annual Removed (lb)
4	a	Harris Middle School	Vegetated Swale	English Creek	1.78	2.6	0.7	2.6	1.4	46.0	36.8
4	b	Harris Middle School	Bioretention	English Creek	0.61	0.9	0.4	0.9	0.3	15.8	13.4
5	a	Ingles (Newland)	Bioretention	Whiteoak Creek	1.58	2.2	1.0	2.2	0.8	37.7	32.0
5	b	Ingles (Newland)	Bioretention	Whiteoak Creek	1.46	2.0	0.9	2.0	0.7	34.8	29.6
6	a	Newland Grade School	Bioretention	North Toe River Headwaters	1.49	2.2	1.0	2.2	0.8	38.5	32.8
7	a	U.S. Textile Corp.	Extended detention	North Toe River at Newland	1.27	2.4	0.5	2.4	0.6	41.4	20.7
8	a	Lowes Food / Family Dollar	Bioretention and trees	North Toe River at Newland	1.72	2.3	1.1	2.3	0.8	41.0	34.9
9	a	Ingles (Spruce Pine)	Extended detention	North Toe River at Spruce Pine and English Creek	1.1	1.5	0.3	1.5	0.4	26.2	13.1
9	b	Ingles (Spruce Pine)	Bioretention	North Toe River at Spruce Pine and English Creek	1.02	0.8	0.6	1.4	0.5	24.3	20.7
10	a	Avery High School	Bioretention	Handpole Branch and Kentucky Creek	1.88	2.8	1.2	2.8	1.0	48.6	41.3
11	a	The Bridge / Tri-County Christian School	Bioretention	North Toe River at Spruce Pine	4.65	6.8	3.1	6.8	2.4	120.3	102.2
				Totals	56.6	85.7	29.6	86.3	24.6	1,517.0	999.3

4.7 Government Practices and Programs

As described in Section 2.4, environmental regulation has evolved in the Upper North Toe River Watershed over the last 25 years. The major thrust of that evolution occurred in the 1990s during the development boom. Environmental regulations at the local level, while not perfect, have resulted in more responsible development. However, the effectiveness of these regulations is only as good as ensuring compliance with the rules. Based on field observations, construction sites often were found to lack adequate erosion controls. As a result, the TRVWP is not recommending any additional regulations. The TRVWP will use education and outreach tools to inform local officials, agencies, and the development community about the importance of using on-site erosion control measures to minimize the sedimentation of nearby waterways. In addition, they will serve as a source of information about which local leaders can make decisions about future growth. The NCWRC's Green Growth Toolbox and their guidance for dealing with steep slope development are examples of information the TRVWP can provide.

4.8 Land Conservation

Land conservation of all types is an important element of any watershed plan. Be it the outright protection of intact forests from development; conservation of unique habitats for rare species; ensuring that historic uses, such as farmland, remain; or maintaining open spaces, to name a few. Each has a its own value that needs safeguarding.

Forests at high elevations are generally on the steepest slopes. Their conservation will prevent the disturbance of stream banks and uplands and prevent turbidities in the watershed from increasing. It is hoped that some conserved tracts will provide opportunities for riparian area enhancement that will improve their function in filtering sediment and maintaining the integrity of the stream banks. While the TRVWP will be most active in implementing sediment reducing projects on disturbed lands in the Upper North Toe River Watershed, they will partner with land trusts and conservancies in acquiring land conservation agreements. Because the TRVWP is made up of local residents, many of whom are also active with land conservation organizations (particularly the Southern Appalachian Highlands Conservancy and Blue Ridge Conservancy), they can facilitate contact with landowners. Conservation organizations active in protecting or managing lands within the North Toe River basin and their focus areas include the following:

- Southern Appalachian Highlands Conservancy – Greater Roan Highlands.
- Blue Ridge Conservancy – Headwater tributaries of the North Toe River.
- Conservation Trust of North Carolina – Properties adjacent to the Blue Ridge Parkway.
- The Nature Conservancy – Greater Roan Highlands.

These organizations will work among themselves to effectively and efficiently use their funding sources for the conservation of land. In many instances, the organizations act as intermediaries to purchase lands and then transfer them to the USFS, National Park Service – Blue Ridge Parkway, North Carolina Division of Parks and Recreation (NCDP&R), or the NCWRC for permanent protection.

To a lesser extent, local governments also purchase lands for the benefit of their residents. Their objectives generally include providing parkland and river access. Strategies to conserve lands in the Upper North Toe River Watershed include the following:

- Fee simple purchases.
- Acquisition of conservation easements.
- Transfer of development rights.
- Incentive contracts for agricultural lands.
- Informal landowner agreements.

4.9 Education and Outreach Plan

The purpose of this education and outreach plan is to encourage stream stewardship by reaching out personally to specifically targeted stakeholders who were selected based on their ability to foment positive changes in stream health. In order for the outreach to be as effective as possible, it should be based on the following guiding principles:

- Establish that supporting stream health is both the right thing to do, the expected thing to do, and is already being done in the community.
- Personalize interactions as much as possible.
- Use outreach resources to reward stream stewardship.
- Be as transparent as possible with TRVWP activities.

4.9.1 Partners

The key to ensuring the education and outreach plan is implemented and adheres to the guiding principles is to involve representatives of agencies and organizations involved in land and natural resource management of the Upper North Toe River Watershed. Primary contacts are those involved in the direct implementation of the education and outreach plan; secondary contacts are those representatives that can be called upon to participate in various education and outreach activities (Table 4.10). All the partners are committed to sharing their knowledge with others for the purpose of conserving and improving the North Toe River watershed. They are willing to do so by making presentations, providing educational materials, or contributing funding where possible.

Table 4.10 Education and Outreach Plan Implementation Partners

Name	Organization	Phone	E-mail
Primary Contacts			
Jonathan Hartsell	Blue Ridge RC&D Council	828-284-9818	jhartsell@blueridgercd.org
Starli McDowell	Toe River Valley Watershed Partnership	828-765-3008	Starsledge@aol.com
Ed Williams	N.C. Division of Water Resources	828-296-4500	ed.williams@ncdenr.gov
Gary Peeples	U.S. Fish & Wildlife Service	828-258-3939	gary_peeples@fws.gov
Secondary Contacts			
Name	**Organization**	**Phone**	**E-mail**
Kathy Young	Blue Ridge RC&D Council	828-385-0912	kyoung@blueridgercd.org/ kyoung@mitchell.main.nc.us
Tressa Hartsell	Toe River Valley Watershed Partnership	828-682-4030	tlhartsell@yanceync.net
Anita Goetz	U.S. Fish & Wildlife Service	828-258-3939	anita_goetz@fws.gov
Herb Walters	Sustainable Yancey	828-675-4626	hwalters@yancey.main.nc.us
Jonathan Ward	Sustainable Yancey		Jbward13@gmail.com
Mark Byrd	Mitchell SWCD	828-765-5158	mark.byrd@nc.nacdnet.net
Mark Forbes	Avery SWCD	828-733-2291	mark.forbes@nc.nacdnet.net
Jeff Vance	Mitchell Cooperative Extension Office	828-688-4811	jkvance@ncsu.edu
Jerry Moody	Avery Cooperative Extension Office	828-733-8270	Jerry_moody@ncsu.edu
Alan Huskins	Mitchell - North Carolina Forest Service	828-688-9405	mitchell.ncfs@ncagr.gov
Joe Shoupe	Avery - North Carolina Forest Service	828-766-8043	avery.ncfs@ncagr.gov

4.9.2 Goals and Objectives

Initial Action Items

Goal 1: Assemble basic outreach tools.

Objectives:

- Develop a two-page project fact sheet
- Create a Facebook page
- Explore the possibility of a regular column, "Toe Talk," in the Mitchell County newspaper

Elementary and Secondary Schools Activities

Rivers, river life, and the water cycle make up important parts of the North Carolina standard course of study for grades 5 and 8 and high school biology and environmental studies classes. It's a natural fit for the partners involved in this project to support the schools' study of these topics. Targeted schools include the following:

Mitchell County:

- Deyton Elementary, 5th Grade Teacher
- Harris Middle School, 8th Grade Teacher
- Mitchell High School, Environmental Science Teacher
- Guidance Counselor, Mitchell County
- Principal, Bowman Elementary School

Avery County:

- Avery County High School Teacher
- Avery Middle School Teacher
- Newland Elementary Teacher
- Riverside Elementary Teacher

Messages:

- Streams have diverse biological communities.
- Stream communities are interconnected , both within the water and with terrestrial systems.
- Humans can impact aquatic systems; all disturbances affect downstream landowners.

Goal 1: Open lines of communication with appropriate schools.

Objectives:

- Identify target teachers and county office staff and compile contact information.
- Send a letter to the target teachers, introducing the watershed coordinator, and the project, and discussing possible opportunities that might come to them from the TRVWP.

Goal 2: Maintain and improve student access to field-based learning experiences.

Objectives:

- In collaboration with partners, conduct "Toes in the Toe Watershed Discovery" events annually for Mitchell County 5th-grade students.
- Annually contact 5th-grade, 8th-grade, biology, and environmental science teachers at the identified schools to offer field-based river education programs (e.g., aquatic invertebrate collection and identification, float trips, mussel searches, etc.).
- Annually contact 5th-grade, 8th-grade, biology, and environmental science teachers at the identified schools to identify other opportunities where existing educational efforts can be supported (e.g. science fairs, established field trips, career days, etc.).
- Annually coordinate with partners (including schools) to identify, gauge interest in, and possibly implement new educational opportunities (e.g., art contests, photo and video contests, geotagging, class-based stream monitoring, Tumblr or Instagram online projects focused on streams, etc.).
- Identify other possible education partners in the basin, identify their programs, and look for ways to support existing stream-related educational offerings or partner to expand offerings. Possible partners include the Blue Ridge Parkway, USFS, RiverLink, Mayland Community College, Arthur Morgan School, AMY library system, etc.
- Identify best point of contact and work with Mitchell High School faculty to determine whether an Eco-club is feasible.

Goal 3: Provide student exposure to subject matter experts.

Objectives:

- Annually contact 5th-grade, 8th-grade, biology, and environmental science teachers at the identified schools to offer to speak to area biology and earth environmental studies classes on topics in line with the North Carolina standard course of study (possible topics include hydrologic cycle, aquatic life, humans and aquatic systems, state of the North Toe River). Utilize tools such as the Enviroscope.
- Annually contact 5th-grade, 8th-grade, biology, and environmental science teachers at the identified schools to look for ways existing educational efforts can be supported (e.g., science fairs, established field trips, career days, etc.).
- Identify other possible education partners in the basin, identify their programs, and look for ways to support existing stream-related offerings or partner to expand offerings. Possible partners include the Blue Ridge Parkway, USFS, RiverLink, Mayland Community College, Arthur Morgan School, AMY library system, etc.

Goal 4: Provide teachers the opportunity to gain additional skills and resources

Objectives:

- Annually coordinate at least one educator training event focused on a water-related topic (either teach directly, or bring a partner in to teach).
- Annually coordinate with partners (including schools) to look for ways existing educational efforts can be supported where appropriate.
- Annually coordinate with partners (including schools) to identify and implement new educational opportunities.

Communities of Faith

The upper Nolichucky River basin is home to strong communities of faith, many of which are already addressing issues of conservation and environmental protection. It would be a natural fit for this outreach effort to tap into and support these existing movements. The following is a noninclusive list of institutions to be contacted:

- First Baptist Church of Spruce Pine
- The Western Carolina Church
- Trinity Episcopal Church, Spruce Pine

Messages:

- Caring for Creation.
- Environmental stewardship is part of God's message and is referenced throughout the Bible.
- Environmental stewardship and a thriving economy are not mutually exclusive.

Goal 1: Open lines of communication between the TRVWP and this audience.

Objectives:

- Meet with church representatives to explain the TRVWP, the goals and objectives of the project, and what role churches may play in improving water quality.
- Give a presentation to First Baptist Church of Spruce Pine.
- Gauge success of the first presentation and reach out to other churches.

Goal 2: Get churches and local watersheds to participate in an "adopt your stream" program.

Objectives:

- Invite "test" churches to participate.
- Gauge success of implemented programs.

Goal 3: Recognize church groups that participate in water quality stewardship.

Objectives:

- Develop a watershed stewardship recognition program.
- Recognize successful watershed stewards.

County and Municipal Administrations

Rivers are a source of economic opportunity for local communities. Local governments are best poised to help ensure those economic opportunities are realized. Additionally, they have responsibilities to help ensure that their rivers stay at high quality. This includes ensuring that the terms of their NPDES permits are met (or surpassed) and that the impacts of their obligations, such as local road construction and maintenance, are minimized. Engaging the Mitchell and Avery Boards of County Commissioners as well as the Spruce Pine and Newland Town Councils, Mayors, and City/County Managers will be of paramount importance in gaining support for, and implementation of, the Upper North Toe River WAP.

Messages:

- Clean rivers provide immediate, direct economic opportunity.
- Clean rivers help cut costs in other areas such as public health and drinking-water treatment.
- There are positive, nonregulatory, proactive ways local governments can foster healthy rivers and their use.
- Local governments have a responsibility to ensure that their activities don't jeopardize river health,

Goal 1: Open lines of communication between the TRVWP and this audience.

Objectives:

- Identify all elected county and municipal officials in the watershed as well as town/county managers and planning directors.
- Meet with all elected officials and top staff outside of public meetings (one on one if possible) to explain the TRVWP, solicit ideas on how to use healthy streams for economic gain, and invite future exchanges.

Goal 2: Foster a sense of economic opportunity in healthy rivers.

Objectives:

- Work with the NCWRC to annually support a "Trout-acu-lar" fishing event.
- Provide local governments with maps of the basin, showing habitat for aquatic game species as well as other species of conservation importance.
- Coordinate with the NCDP&R, NCWRC, and local governments regarding opportunities for developing access points along the Toe River paddling trail and expanding the trail upstream.
- Coordinate with basin economic development offices and local outfitters over the possibility of marketing the basin as a fishing and paddling destination
- Prepare and present to the local governments a report on the economic benefits and opportunities of clean rivers, including how the basin's communities are taking advantage of this and ways to improve it.

Goal 3: Foster a sense of civic responsibility toward maintaining and improving stream health.

Objectives:

- Annually organize a float trip for county and municipal officials.
- Provide local governments with maps of the basin that show, where possible, habitat for species of recreational and conservation importance.

Goal 4: Maintain communication between the TRVWP and this audience.

Objectives:

- Include these representatives on the newsletter mailing list.
- Provide them annual updates on watershed improvement work.
- Invite them to watershed-wide stakeholder meetings.

Goal 5: Recognize local government actions that support river health and recreation.

Objectives:

- When possible, use local media outlets (letters to the editor, guest columns, etc.) to praise stewardship actions by local governments.
- When possible, post praise for stewardship actions to the Facebook page.

Streamside Landowners

Perhaps the most important group of people when it comes to ensuring that a community has healthy streams is streamside landowners. Their actions go a long way in determining the health of a stream.

Messages:

- You are the people who are fundamentally responsible for maintaining and improving stream health.
- There are simple things you can do to help ensure stream health.
- There are resources available to help you improve habitat and riparian areas on your property.

Goal 1: Open lines of communication with streamside landowners and introduce them to the project

Objectives:

- Identify streamside landowners (throughout target area, on impaired stretches, on certain streams?)
- Send a personal letter introducing the watershed coordinator, the project, and the opportunities the project brings to landowners and offer to meet for coffee, on the TRVWP.
- Host a BBQ dinner for landowners with members of the BRRC&D and TAC.

Goal 2: Provide streamside landowners with information needed to make land use decisions that will benefit the stream

Objectives:

- Adapt the USFWS "Shade Your Stream" program for landowners in the North Toe River watershed.
- Implement a program to assist landowners with regard to ways they can reduce sediment losses from unpaved roads.
- Develop a brochure modeled after one prepared by the Little Tennessee River Partnership focusing on things agricultural landowners can do, and make it available through local outlets (e.g., Cooperative Extension, SWCD, library, etc.) and/or direct-mailing.
- Develop a brochure modeled after one prepared by the Little Tennessee River Partnership focusing on things residential landowners can do and make available through local outlets (e.g., Cooperative Extension, SWCD, library, etc.) and/or direct mailing.
- Develop a brochure modeled after one prepared by the Little Tennessee River Partnership focusing on things commercial landowners can do and make available through local outlets (e.g., Cooperative Extension, SWCD, etc.) and/or direct mailing.
- Identify ways to provide information through Cooperative Extension's existing programs (master gardeners, etc.).
- Identify other venues for disseminating information to landowners (e.g., real estate agents, feed and seed stores, etc.) and begin making those contacts.
- Where possible, include appropriate information on the TRVWP Facebook page and other mass media products.

Goal 3: Develop a sense of stewardship among streamside landowners.

Objectives:

- Annually organize and implement a public wading/snorkeling/fishing opportunity for people to learn more about the river ecosystem.
- Identify key private landowners and funding for demonstration projects (restoration, riparian plantings, etc.). Implement and publicize demonstration projects accordingly.
- Identify significant sources of sediment and develop a plan for reaching out to those landowners and addressing those issues.

Goal 4: Reward private landowner actions that support river health.

- When possible, use local media outlets (letters to the editor, guest columns, etc.) to praise stewardship actions by private landowners.
- When possible, post praise for their stewardship actions to the TRVWP Facebook page (with photos if possible).
- When appropriate, send a letter of thanks and encouragement for good stewardship that is observed.

NPDES Permit Holders and Railroads

Holders of NPDES permits have a vested interest in maintaining or improving the quality of water in the streams they use. That interest spans the economic, health, and recreational values that healthy streams provide to a community.

Messages:

- NPDES permit holders have a special responsibility to stream health.
- Contact agencies as soon as possible if a problem is detected.

Goal 1: Open lines of communication between the project team and this audience.

Objectives:

- Identify points of contact for NPDES permit holders.
- Identify point of contact for CSX Railroad.
- Send a letter to each identified point of contact introducing the watershed coordinator and the project expressing interest in helping them maintain compliance and offering to meet in person.

Goal 2: Ensure that NPDES permit holders are aware of whom to contact in the event they go outside the parameters of their permit.

Objectives:

- Provide all NPDES permit holders with a list of agency contacts in an easily readable and easily postable format.

Goal 3: Ensure that NPDES permit holders are aware of the natural resources of the river.

Objectives:

- Provide each NPDES permit holder with a map of the basin showing important game fish areas and important areas for species conservation efforts.
- Annually offer to make presentations to NPDES permit holders (in general, and to specific staff identified by the permit holder) about the importance of the streams and the diversity of life in them.
- Provide a small reminder sticker that can go on equipment where operators can see it.
- Where possible, include appropriate information on Facebook or in mass media products.

Goal 4: Identify ways to work with NPDES permit holders to ensure compliance.

Objectives:

- Work with permit holders to identify potential problems that may lead to future noncompliance issues (old equipment, lack of redundancy, decreased staff time, etc.) and help them seek solutions.

Goal 5: Recognize permit holders for actions that support river health.

Objectives:

- When possible, use local media outlets (letters to the editor, guest columns, etc.) to praise stewardship actions by permit holders.
- When possible, post praise for their stewardship actions to the TRVWP Facebook page (with photos if possible).
- When appropriate, send a letter of thanks and encouragement when good stewardship is observed.

Construction and Development Companies

Construction and development companies are responsible for the majority of land-disturbing activities within any watershed. While they do have to comply with sediment and erosion control regulations, they may not be fully aware of the effects that their activities may have on stream health. Engaging them as partners in order to improve water quality in the Upper North Toe River Watershed and to develop and awareness of existing water quality conditions should lead to lessened impacts from their activities.

Messages:

- Sediment is the single greatest water pollutant in North Carolina.
- Developers and their employees and contractors have a role as part of the solution to the erosion and sedimentation issues in the basin.

Goal 1: Open lines of communication between the TRVWP and this audience.

Objectives:

- Identify points of contact for the major earth-moving companies in the basin.
- Send a letter to the point of contact introducing the watershed coordinator and the project; offer to meet them in person and discuss ways they can help improve stream condition.

Goal 2: Provide land-disturbing companies with information about: (a) sediment and erosion control laws and (b) aquatic resources in the basin.

Objectives:

- Provide all land-disturbing companies within the basin with a map showing the aquatic resources.
- Offer a field-based learning experience to staff of land-disturbing companies.
- Offer sediment and erosion control training in the basin.
- Annually offer to make presentations to these companies about the importance of the streams and the diversity of life in them.
- Provide a small reminder sticker that can be placed on equipment where operators can see it.
- Where possible, include appropriate information on Facebook or in mass media products.

Goal 3: Ensure open lines of communication between natural resource agencies and this audience.

Objectives:

- Provide companies with a list of appropriate natural resource agency contacts.

Goal 4: Recognize private landowner actions that support river health

Objectives:

- When possible, use local media outlets (letters to the editor, guest columns, etc.) to praise their stewardship actions.
- When possible, post praise for stewardship actions to the TRVWP Facebook page (with photos if possible).
- When appropriate, send a letter of thanks and encouragement when good stewardship is observed.

Core Stakeholders Loosely Engaged in the Watershed Planning Process

Near the outset of this restoration effort, the team held a meeting that brought together stakeholders from across the Toe/Cane River Valley. Since then, the work focus has narrowed to the North Toe watershed. Including this broader group as an audience is a way to keep them abreast of the TRVWP's activities (including successes), which, in turn, builds a foundation for work elsewhere in the basin.

Goal 1: Keep original group of stakeholders (from First Baptist Church of Spruce Pine meeting) informed about actions of the TRVWP.

Objectives:

- Compile an e-mail list of attendees at that first stakeholder meeting.
- Via e-mail, periodically update this audience on TRVWP's activities.
- Invite to future watershed-wide stakeholder meetings.

4.10 Additional Watershed Assessments

Although sufficient data is available to address many sources of sediment within the targeted subwatersheds of the upper North Toe River, significant data gaps were uncovered during this project. The following sections describe additional assessments that would give the TRVWP a more complete assessment of sediment sources as well as assessments that address pollutants that are not sediment related.

4.10.1 Supplemental Sediment Source Assessments

Less Developed Subwatersheds – It was not possible to thoroughly assess the entire 173 mi^2 project area for the development of this WAP. Using GIS data and personal knowledge of the area, the TAC chose the most-developed subwatersheds to identify the sources of sediment that are contributing to the North Toe River's impairment. As this WAP is implemented, the TRVWP should survey other known disturbance areas but on a smaller scale and level of intensity. Unless conditions warrant, the additional assessments should focus on sites with known development or degradation and not on entire subwatersheds or catchments. Such an approach would be a more efficient use of time as significant portions of those subwatersheds are forested and have little land-disturbing activity.

Horticultural Operations – During the windshield surveys in Avery County it became apparent that horticultural operations, primarily Christmas tree farms, often contained significant amounts of bare soil that is subject to erosion. These sites could not be assessed due to their distance from public roads or the fact that they were otherwise being shielded from view. From what could be observed, it was evident that ungraveled field roads and the use of herbicides to control vegetation among the trees were the primary causes of the bare soil. The potential for erosion at these sites is enhanced by the fact that many of them are on steep slopes. An additional assessment of these operations is needed. Such an assessment could be done in cooperation with the NCSU Cooperative Extension Service. The TRVWP could participate in outreach efforts that encourage operators to implement vegetation management plans that reduce the erosion and sedimentation of headwater streams.

Unpaved Roads – During the windshield surveys numerous unpaved driveways and access roads, other than those on horticultural operations, were observed. Many of them had only dirt surfaces, lacking any stabilizing gravel or rock, and more than a few were moderately to severely eroding. Because only small portions of these roads could be observed, they were not formally assessed. While the extent of unpaved roads in some subwatersheds was quantified using aerial photographs and GIS, there was inadequate funding to assess the condition of the road surfaces. To determine the amount of sediment reaching stream channels, a more detailed study, combining an analysis of aerial photos and field observations, is needed.

4.10.2 Other Water Quality Assessments

Spruce Pine Stormwater Assessment and Plan – During the stormwater assessment conducted for this WAP, opportunities to install SCMs in downtown Spruce Pine were nonexistent due to constraints such as the lack of sufficient open space, utilities, unknown sources and volumes of stormwater, and property ownership. It was recognized that alternative SCMs, such as those described in Section 4.4.3, may be feasible. However, to determine the feasibility of using such alternative measures will require the development of a stormwater plan that inventories the conditions of the existing downtown Spruce Pine area. Such an assessment would need to thoroughly inventory the existing constraints and opportunities to use alternative stormwater measures. The inventory will need to include such items as property ownership, utility locations, land cover, and soil conditions/contamination, among other unknown issues.

Outfalls and Hot Spots – During the streamwalks, numerous outfalls were observed. Although the observations did not show significant amounts of sediment in the effluent, high conductivity measurements in some indicated the presence of other potential pollutants. Several outfalls associated with mineral processing facilities also had a diesel fuel-like odor. Those outfalls suspected of having other types of pollutants should be investigated to determine the source of the effluent and whether they contain pollutants of concern. If so, steps to remediate those pollutants can be implemented.

The urban areas in and around Spruce Pine and Newland have the potential for surface runoff of accumulated pollutants, particularly associated with businesses such as car washes, auto repair facilities, and trucking facilities. Such urban "hot spots" of pollutants were not a target of this assessment, but a few hot spots were observed during the windshield surveys. To determine the number and severity of these hot spots as being sources of pollutants, a more thorough survey of the urban/developed areas of the watershed is needed.

Aquatic Organism Passage – While most stream banks associated with public road crossings were stable and not significant sources of sediment, quite a few culverted crossings (concrete box culverts and corrugated metal pipes) were identified as being potential barriers to the passage of aquatic organisms. The current assessment did not address private road stream crossings, which were often installed without consideration for the passage of aquatic organisms. Conditions preventing the movement of aquatic organisms include perched culvert outfalls, shallow flows, inadequate pool depths, high velocities, and steep gradients. The TRVWP, in cooperation with the USFWS and NCWRC, should implement more detailed assessments of stream crossings in areas where aquatic species populations would benefit from removal of man-made barriers that restrict their movement.

4.11 Watershed Monitoring

To determine the effectiveness of the management measures being implemented, the physical and ecological conditions of the watershed should be monitored over time. As specific management actions are completed, turbidity (the primary water quality indicator), is expected to decline. Corresponding improvements in aquatic habitats and ecological function are expected to follow. Secondary indicators of improved water quality conditions include improvements in the benthic macroinvertebrate, fish, and mollusk communities. A standard suite of water chemistry parameters should also be monitored to ensure that other pollutants are not becoming a problem.

4.11.1 Turbidity and Water Chemistry Monitoring

Turbidity – The monitoring of turbidity is necessary to determine how the watershed is responding to the implementation of management measures. The NCDWR should continue its monthly ambient monitoring sampling at two established stations on the mainstem North Toe River (near Ingalls and Penland; Figure 3.1, Table 4.10). In addition, turbidity data associated with NPDES permits for mining operations also should be monitored. To obtain trend data for individual subwatersheds, a regular volunteer monitoring program (weekly, monthly, or some other routine schedule) should be initiated by the TRVWP. Such a program could be achieved by participating in the VWIN program or conducting in-situ evaluations using USEPA-approved turbidity meters. Site-specific or catchment-level monitoring may be necessary to determine the effectiveness of individual projects in reducing turbidity levels.

Water Chemistry – A suite of other water chemistry parameters is measured at the two NCDWR ambient monitoring stations on the North Toe River (Figure 3.1, Table 4.8). To ensure that other pollutants are not becoming a problem in the Upper North Toe River Watershed, the monthly sampling for these parameters should continue.

4.11.2 Ecological Monitoring

To determine if there are ecological effects from reduced turbidity levels, benthic macroinvertebrates, fish, and mollusk communities as well as aquatic habitats should be monitored.

Benthic Macroinvertebrates – To establish a baseline for this WAP, the NCDWR collected benthic macroinvertebrate samples from 13 sites in 2012 (Figure 3.1, Table 3.4). Sampling should be conducted at least every 4 years at sites located in subwatersheds targeted for improvement projects (Table 4.8). Where concentrations of projects are planned, it may be necessary to establish sites at the catchment level.

Fish Community – The NCDWR sampled fish communities at three sites in 2012 (Figure 3.1, Table 3.5) to establish fish Index of Biotic Integrity (IBI) ratings. Two of those sites had been sampled previously, whereas a site on Grassy Creek was newly established. These sites should be monitored on the same schedule as the benthic macroinvertebrate sampling (Table 4.8).

Mollusks – The NCWRC routinely monitors freshwater mussel populations and distributions. The portion of the North Toe River from its confluence with Big Crabtree Creek to its confluence with the South Toe River is designated as critical habitat for the Appalachian elktoe by the USFWS. The Appalachian elktoe is listed by the Federal and North Carolina governments as an endangered freshwater mussel species. Because of this, monitoring of this population should be conducted on a similar schedule as fish and benthic macroinvertebrates (Table 4.8). This monitoring will provide information on population numbers and distribution.

Aquatic Habitat – As with the biological communities, NCDWR assessed aquatic habitats at eight sites on the mainstem North Toe River and 19 sites within 13 subwatersheds between 2009 and 2012. These assessments provide a baseline on which to rate aquatic habitat conditions that can be used to compare trends in these conditions as watershed improvement projects are implemented. Habitat assessments at these sites should be conducted on the same schedule as recommended for biological communities.

4.11.3 Stewardship Monitoring

> ***Watershed stewardship** ensures that investments in watershed conservation practices are protected and managed for purposes of maintaining water quality, wildlife habitat, and community awareness.*

Stewardship is an important component of this WAP. All watershed improvements, be they physical improvements, SCMs, riparian revegetation, or land conservation, require stewardship to ensure that they are maintained and protected for the long term. This is necessary not only to maintain their effectiveness but to protect the community's investment in improving the watershed. As management measures are implemented throughout the watershed, it is necessary to monitor them on a regular basis. Monitoring in this sense will be to ensure that structures are functioning properly, lands are being managed appropriately, and encroachments into areas under legal protection (e.g., conservation easements) are not occurring. It will be the responsibility of the Watershed Coordinator (Section 4.8) to oversee stewardship activities.

Monitoring activities, frequencies, benchmark levels, and target levels have been developed and are presented in Table 4.11. Benchmarks for fish and benthic macroinvertebrate communities and aquatic habitat are based on metric scoring methods developed by the NCDWR, whereas water quality parameters are measured against NCDWR and USEPA standards.

Table 4.11 Watershed Monitoring Plan

Parameter	Sites	Frequency	Benchmark Levels	Target Levels
Water Chemistry				
Turbidity	North Toe River, ambient monitoring stations	Monthly	Comparison with historic data	10 NTU; <10% of samples exceeding 10 NTU with 90% confidence
Turbidity	NPDES permit monitoring	Twice weekly	Comparison with historic data	10 NTU; <10% of samples exceeding 10 NTU with 90% confidence
Turbidity	Selected subwatersheds	Monthly	To be established	Declining trends; 10 NTU; <10% of samples exceeding 10 NTU with 90% confidence
Ambient monitoring suite	North Toe River • near Ingalls • at Penland bridge	Monthly	Comparison with historic data	State Standards
Biological				
Benthic macroinvertebrate community	Special Study sites	2016, 2020, 2024	Comparison with historic data	Excellent NCDWR ratings
Fish Community	North Toe River at Squirrel Creek; Grassy Creek; Big Crabtree Creek	2016, 2020, 2024	Comparison with historic data	Excellent NCDWR ratings
Mollusk population	North Toe River downstream of Spruce Pine	2016, 2020, 2024	Comparison with historic data	Expanded population and distribution
Physical				
Aquatic habitat	Previously sampled sites	2016, 2020, 2024	Comparison with historic data	All sites with metric scores ≥80
Stewardship				
Project structures and properties	Completed sites	Annually	Post-project conditions	Stream stability, reduced erosion, no encroachments

4.12 Watershed Coordinator - Importance and Need

A responsibility the BRRC&D assumed as part of the 319 Grant allowing this WAP to be developed includes implementing measures to reduce turbidity in the watershed. That responsibility was conveyed to the BRRC&D when the NCDWR designated the Upper North Toe River Watershed as a Category 4B impaired watershed. Under that designation, the requirement to conduct and abide by the results of a TMDL study was waived. Designation as a Category 4B impaired water implies that the cause and sources of impairment, in this case turbidity, can best be addressed and achieved through the implementation of watershed improvement projects under local sponsorship.

Continuous coordination and administration is a necessary component in carrying out any WAP. It is necessary not only to maintain momentum and ensure that progress is made in implementing management measures but also is the only way the BRRC&D can meet their responsibilities and achieve project goals.

In the case of the North Toe River WAP, achievement of the goals set forth in the WAP will best be accomplished by designating a Watershed Coordinator, whether hired independently or assigned from an existing agency or organization. The position should be assigned day-to-day responsibilities for coordinating watershed activities as well as assisting in securing project funding, maintaining project records, ensuring project reporting requirements are met, and documenting project accomplishments. It is also incumbent upon the Watershed Coordinator to facilitate communication among the TRVWP, determine when revisions to the WAP are necessary, and take appropriate actions in getting the WAP revised. To achieve this goal, the BRRC&D will seek to fund a position that will carry out their responsibilities for implementation of the WAP.

5. IMPLEMENTATION STRATEGY

5.1 Overview

This WAP is intended to guide planning and restoration efforts in the Upper North Toe River Watershed for the next 10 years. It serves as a road map to reducing turbidity levels that will lead to continued improvement in the ecological health and function of streams in the watershed, particularly the 20.3 miles of the North Toe River that are on North Carolina's 303(d) list of impaired waters (NCDWQ 2010a, 2012a; NCDWR 2014a). The BRRC&D has committed to implementing this WAP as a local sponsor and to avoiding the regulatory requirements of a formal TMDL study. This local sponsorship will engage local landowners and lead to water quality improvements that will allow the stream reaches to be removed from the impaired waters list and allow them to fully support their designated uses.

Implementation strategies have been developed from input gathered during a public meeting and collaboration with a TAC made up of representatives of local, state, and federal organizations. An outcome of this process includes the formation of the TRVWP that will work with the BRRC&D to ensure the successful implementation of the WAP. It will be important for this group to work together to fulfill their commitment to the NCDWR to reduce turbidity in the North Toe River. While the NCDWR agreement to designate the impaired reaches of the North Toe River as a Category 4B waters, it does not impose mandatory requirements; however, the BRRC&D and TRVWP are expected to carry out the WAP. The State of North Carolina is ultimately responsible for addressing impaired waters and will take appropriate action to achieve that goal if water quality improvements are not being reached within a reasonable time period. Therefore, it is in the BRRC&D's and TRVWP's best interests to take the lead in implementing the management measures outlined in this WAP.

The implementation strategy is composed of three parts: an action plan, an implementation schedule, and a watershed monitoring plan. The action plan identifies specific management measures and activities to be carried out. The implementation schedule reveals the time line over which the planned actions are expected to be achieved. It also includes a mechanism to track how well the management actions are being implemented. The monitoring plan details how changes in turbidities and ecological conditions will be measured.

5.2 Accomplishments to Date

While the WAP has been under development, the TRVWP has already begun work on implementing the education and outreach strategies and some management measures. This section describes their accomplishments to date.

5.2.1 Education and Outreach Plan

Since mid-2012, the Watershed Coordinator and members of the Education and Outreach Committee have begun implementing education and outreach activities to the targeted audiences as described in Section 4.8. Accomplishments to date are listed in Table 5.1

Table 5.1 Education and Outreach Activities as of August 1, 2014

Action Category	Targeted Audience	Activity Completed
General Communications	General Public	Created Project Fact Sheet. Created Facebook page. Established monthly "Toe Talk" column in local media.
Environmental Education	Teachers	Delivered educational materials – maps, map guides, and teaching materials to all schools in watershed.
	Elementary and Middle School students	Presented ten outdoor classroom lessons.
	High School Students	Led two "Creek Walk" programs to Mitchell High School Environmental Science Class.
	College Students	Presented lecture to college environmental class.
	Faith Communities	Provided educational materials to five churches in Spruce Pine community.
	Private Landowners	Revised landowner action guide.
	Government Administrations	Avery County Commissioners Presentation. Mitchell County Commissioners Presentation.
	Resource Agencies	Yancey County Cooperative Extension Office. Avery County SWCD. Mitchell County SWCD. Yancey County SWCD. North Carolina Forest Service.
Public Events	General Public	Toe River Festival (4 days). Earth Day Festival.
Networking/Training Events	BRRC&D and TRVWP staff	Stream Restoration Workshop. Western North Carolina Water Quality Initiative

5.2.2 Recently Completed Projects and Projects in Progress

The TRVWP, in collaboration with the BRRC&D and TRVW, have continued to be successful in securing funding to do on-the-ground projects aimed at reducing sediment and improving the ecological health of the Upper North Toe River Watershed (Table 5.2). This is in addition to the outreach and education activities described in Section 4.9.1.

Table 5.2 Complete and In-Progress Projects as of August 1, 2014

Project Name	Cooperator/Funder	Activity
North Toe River Streambank Stabilization	Unimin Corporation match for current 319 grant	Stabilized approximately 1,000 feet of the North Toe River (completed).
Hawkins Branch Riparian Vegetation Enhancement	Unimin Corporation/USFWS's Partners for Fish and Wildlife Program	2,500 feet of Hawkins Branch planted with 3,200 livestakes and 2,000 bare root plants (completed).
Rockhouse Creek Bank Stabilization	USFWS Partners for Fish and Wildlife Program	Stabilized 1,800 feet of stream bank; installed two rock cross vanes; installed 200 livestakes (completed). 
Grassy Creek Parkway Fire and Rescue Bank Stabilization	BRRC&D	Stabilize 120 feet of Grassy Creek; install one J-hook, plant with livestakes, and native seed mix (spring 2015).
"Shade Your Stream" Workshops	TRVW/USFWS	$5,000 grant obtained; 3 regional workshops focused on using native plants to stabilize stream banks and provide shade (2015).
Grassy Creek Stormwater and Stream Improvement Project	TRVW/CWMTF	Restore and enhance 2,700 feet of stream channel, integrate aquatic habitat structures, design and construct wetlands to treat stormwater from 25 acres of impervious surface (2015).
Grassy Creek Greenway	Unimin Corporation; Private Landowners	In conceptual planning stage.
Landowner Action Guide	TRVW	Modified existing guide for application to Avery, Mitchell, and Yancey counties; posted to Web site.

5.2.3 Agricultural BMPs Projects

The Avery and Mitchell county SWCDs continue to identify projects for funding through the NCACSP and CCAP. Over the past 10 years they have combined to implement a total of about 30 NCACSP and CCAP projects (see Section 2.4.2). Currently, the Mitchell County SWCD has applications for nine NCACSP projects within the Upper North Toe River Watershed. One has been funded for 2014 and three are likely to be funded in 2015. They also have two applications for CCAP funding. Most of the proposed projects are for the purpose of installing pasture improvements that include stream protection/stabilization, sediment/nutrient reduction, and waste management.

5.3 Action Plan

This implementation strategy identifies specific actions necessary to reduce erosion and the transport of sediments to streams in the Upper North Toe River Watershed. Their implementation will lead to reduced turbidity and improvement of the ecological health of the watershed, with the ultimate goal of getting the degraded reaches of the North Toe River removed from North Carolina's 303(d) list of impaired waters. This action plan is designed to cover a 10-year period. It addresses management measures in the following categories:

- Stream restoration and riparian area enhancement.
- Upland management practices.
- SCMs.
- Agricultural and horticultural BMPs.
- Local government practices and programs.
- Education and outreach.
- Additional watershed assessments.

Each management measure consists of a series of recommended actions that, upon completion, will contribute to improving watershed conditions. It should be noted that lag times between implementation and response at a watershed level often occur and that turbidity levels may not improve greatly until existing sediments are flushed from the system. In turn, aquatic communities may be slow to show improvement once restoration efforts are implemented. Based on the results of restoration efforts, it may be necessary to modify management actions during the planning period. At the end of the 10-year life span of this document, the WAP will be updated.

An action plan for each management measure (Tables 5.3-5.9) has been developed that includes the following components:

- *Management Action* - what is to be done.
- *Targets* - how much of each action is planned.
- *Responsible Party* - who will take the lead in getting a specific action completed.
- *Schedule for Implementation* - when will the work be completed: short-term 1-3 years, mid-term 4-6 years, or long-term 7-10 years.
- *Financial Resources* – where possible, estimated costs needed to implement an action.
- *Potential Funding Sources* - specific grant agencies; see Appendix E for a listing of funding programs available within the individual agencies.
- *Technical Resources Needed* - information or professional services needed to implement an action.
- *Qualitative Success Indicators* - criteria that indirectly provide a measure of the water quality improvements that are being achieved.

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Table 5.3 Stream Restoration and Riparian Area Enhancement Action Plan

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Restore/enhance stream channels	2,000 ft/year 20,000 ft total	Watershed Coordinator	Long-term	$250-$300 per stream foot for design, construction and monitoring	NCEEP, NRCS, CWMTF, NCDWR, SWCD	Engineering, landscape architect design, material supplier	Stabilized stream channels, reduced erosion, reduced turbidity
Riparian area vegetation enhancement	20,000 feet (14 acres at 30 ft width)	Watershed Coordinator	Long-term	Up to $14,000 per acre	NCEEP, NRCS, CWMTF, NCDWR, SWCD	Landscape architect design, material supplier	Reduced bank erosion, improved function to filter sediment
Realign stream channel at bridge crossings	4 crossings	NCDOT or bridge owner	As bridges are upgraded or replaced	Varies	NCDOT, NCEEP, NRCS, CWMTF, NCDWR, SWCD	Engineering assistance	Reduced bank erosion

Table 5.4 Upland Management Practices Action Plan

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Revegetate borrow and fill sites	1/year	Landowners	As opportunities arise	Varies	Landowner	Erosion control specialist	Ground cover established
Stabilize unpaved residential drives	0.5 mile/year	Landowner or NCDOT	As opportunities arise	Varies	Landowner, NCDOT	Road specialist	Reduction in erodible surface

Table 5.5 Stormwater Control Measure Action Plan

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Disconnect building downspouts	50 buildings	Avery/Burke County, Spruce Pine, Newland	Mid- to long-term	Minimal	Local and state agencies	Need more assessment of numbers	Reduced runoff volume to streams
Install bioretention SCMs	9 sites, 27.1 acres treated	Blue Ridge Regional Hospital, County Boards of Education, commercial facilities	Mid- to long-term	$25,400 per impervious acre treated[1] (unit cost will decrease with increase in area treated)	NCDWR, CWMTF, SWCD, local govt's, landowner match	Engineering, landscape architect, design, material supplier	Reduced runoff volume, reduced sediment and other pollutant loads
Install extended detention structures	3 detention structures	Blue Ridge Regional Hospital, County Boards of Education, commercial facilities	Mid- to long-term	$3,800 per impervious acre treated[1]	NCDWR, CWMTF, SWCD, local govt's, landowner match	Engineering, landscape architect, design, material supplier	Reduced runoff volume, reduced sediment and other pollutant loads, reduced streambank erosion
Wet pond to dry pond conversion	1	Marine Propulsion Lab	Long-term	TBD	NCDWR, CWMTF, SWCD, local govt's, landowner match	Engineering, landscape architect, design, material supplier	Reduced runoff volume, reduced sediment and other pollutant loads, reduced streambank erosion
Vegetated swales	2	Public schools	Mid-term	Varies, depending on site characteristics	NCDWR, CWMTF, SWCD, local govt's, landowner match	Landscape architect	Established ground cover, reduction in exposed erodible surface

[1]Based on information from CWP (2007) and WERF (2009).

Table 5.6 Agricultural and Horticultural BMPs Action Plan

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Riparian area fencing	500 feet/year	Landowner	Ongoing throughout life of WAP	$10/linear foot	Landowner, SWCD, NRCS	Agricultural specialist	Natural reestablishment of riparian vegetation
Stabilize unpaved roads	0.5 mile/year	Landowner	Ongoing throughout life of WAP	Varies, depending on site characteristics	Landowner	Soil specialist	Reduction in amount of erodible surface, control of surface runoff
Implement ground cover management plans	1 acre/year	Landowner	Ongoing throughout life of WAP	Varies, depending on site characteristics	Landowner	Horticultural specialist	Reduction in amount of erodible surface, amount of ground cover reestablished

Table 5.7 Education and Outreach Action Plan (Sheet 1 of 3)

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Organizational Activities							
Fund Watershed Coordinator position	1 part-time position (20 hours/week	BRRC&D; TRVWP	Continuous	$40,000 per year	NCEEP, CWMTF, NCDWR, SWCD, local gov'ts.	Environmental planner	Key element to successful plan implementation
Open communications and develop relationships with targeted audiences regarding TRVWP activities	Ongoing with all audiences	TRVWP	Ongoing through life of WAP	None	N/A	None	Invitations to participate in events, project participation
Develop a two-page fact sheet about the TRVWP	1 fact sheet	TRVWP	Completed	None	N/A	None	Feedback from audiences, general public
Create and maintain a Facebook page	1; update quarterly	TRVWP	Ongoing through life of WAP	None	N/A	None	Number of "Likes"
Determine feasibility of newspaper column – "Toe Talk"	If feasible; quarterly column	TRVWP	Short-term	None	N/A	None	Feedback from audiences, letters to the editor
Create a formal watershed stewardship recognition program	Annual award; multiple categories	BRRC&D, TRVWP, SWCDs	Short-term; continuing	$200/year	BRRC&D	None	Nominations, feedback from audiences, increased participation in projects and events
Audience: Elementary and Secondary Schools							
Conduct "Toes in the Toe" events	Annually	TRVWP and Mitchell County	Short-term	$2,000	BRRC&D, sponsors	None	Participation, requests for other events
Determine feasibility of establishing an "Eco-Club" at Mitchell High School	Organize one club	TRVWP, Mitchell County Schools	Short-term	None	Mitchell County School support	Faculty advisor	Student participation, project activities
Arrange for subject-matter experts to make presentations to grade and high school classes	5/year	TRVWP; school systems	Continuous	None	N/A	Agency specialists	Requests for presentations
Coordinate educator training events	1/year	TRVWP	Ongoing through life of WAP	$1,000	NCDWR, NCWRC, NCFS, NCP&R, USFWS, USFS	Trainers	Continuing participation

Table 5.7 Education and Outreach Action Plan (Sheet 2 of 3)

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Audience: Communities of Faith							
Facilitate churches to participate in “Adopt-a-Stream” program	Determine interest	TRVWP	Short- and mid-term	None	NCDWR	None	Number of streams adopted
Audience: County and Municipal Administrations; Government Agencies							
Support a local fishing event	1/year	TRVWP, NCWRC	Annually through life of WAP	$2,000/year	BRRC&D, local sponsors, NCWRC	None	Participation
Coordinate development of river access points	2 access points	TRVWP, NCWRC, local government	Mid- to long-term	To be determined	Local government, NCWRC, TVA	Design engineer	Increased river use, increased demand for more access
Develop a marketing plan for fishing and paddling on the North Toe River	Initiate and update as needed	TRVWP, local economic development coordinators, Chambers of Commerce	Mid-term	$10,000	Local Chambers of Commerce; Avery/Mitchell County; N.C. Dept. of Commerce	Marketing specialist	Requests for information by Chambers of Commerce and tourism agencies
Prepare a report on the economics of healthy streams and present to local officials	1; update at 5-year interval	TRVWP	Mid- to long-term	None	N/A	None	Reception by local officials, support of programs
Organize float trips for local officials	1/year	TRVWP	Annually through life of WAP	$1,000/year	Local sponsors	None	Feedback from participants

Table 5.7 Education and Outreach Action Plan (Sheet 3 of 3)

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Audience: Streamside Landowners							
Host “Meet and Greet” BBQ dinners	3 at various locations	TRVWP	Short- and mid-term	$2,000/event	BRRC&D, local sponsors	None	Participation, subsequent interest in project participation
Develop informational brochures for agricultural, residential, and commercial landowners	3 with updates as needed	TRVWP	Short-term	$1,500/brochure (1,000 copies)	BRRC&D, NCDWR, CWMTF	Graphic designer, printing specialist	Number of copies distributed
Organize streamside educational events for adults	1/year held at various locations	TRVWP	Annually through life of WAP	$1,000/year	BRRC&D, local sponsors	None	Participation numbers and feedback from participants
Recruit key private landowners to support restoration and enhancement demonstration projects	10 contacts per year	TRVWP	Annually through life of WAP	None	N/A	None	Implementation of projects
Audience: NPDES Holders							
Offer to make staff presentations about stream life	Upon request	TRVWP	Continuous through life of WAP	None	N/A	None	Number of requests
Collaborate with permit holders on compliance issues	Seek opportunities	TRVWP	Continuous through life of plan	None	N/A	None	Feedback on collaborative efforts; changes in procedures
Audience: Construction and Development Companies							
Offer to make staff presentations about stream life	Upon requests	TRVWP	Continuous through life of WAP	None	N/A	None	Number of requests
Facilitate sediment and erosion control training programs	1/year; rotate between counties	TRVWP	Annually	None	N/A	Sediment and erosion control specialist	Participation, improved application of methods

Table 5.8 Additional Needed Assessments for the Upper North Toe River Watershed

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Unpaved road inventory and field assessment	Most-developed subwater-sheds	TRVWP	Mid- to long-term	$25,000	NCDWR, CWMTF	GIS specialist	Highly eroding roads identified for remediation, reduced erosion
Horticultural operations ground cover inventory and assessment	All operations	TRVWP, NCSU Cooperative Extension Office	Mid- to long-term	$25,000	NCDA&CS, NCSU Cooperative Extension	Horticultural specialist, soil scientist	Improved ground cover management and stabilized access roads
Inventory source and contents of suspect outfalls and hot spots	Conduct in urban and commercial areas	TRVWP	Long-term	$10,000	NCDWR	Certified laboratory	Specific pollutants identified for reduction
Assess barriers to aquatic organism passage in problem areas	Complete assessment in targeted areas	TRVWP	Long-term	To be determined	NCWRC, NCDWR, USFWS	Engineering assistance, fisheries biologist	Improved stream channel and aquatic habitat

Table 5.9 Monitoring Action Plan

Management Actions (what)	Targets (how much)	Responsible Party (who)	Schedule for Implementation (when)	Financial Resources (how much)	Potential Funding Sources	Technical Resources Needed	Qualitative Success Indicators
Turbidity monitoring: Ambient sites NPDES sites Targeted subwatersheds	Monthly Twice weekly To be determined	NCDWR Permit holders, TRVWP	Short-, mid-, long-term	None None TBD	N/A N/A NCDWR	Certified Laboratory	Declining trend in turbidity levels;
Water chemistry monitoring at 2 ambient stations	Monthly	NCDWR	Short-, mid-, long-term	None	N/A	None	No parameters exceed state standards
Biological Monitoring Benthic macroinvertebrates Fish Mollusks	3 samples, 4 years apart at existing sites	NCDWR NCDWR NCWRC, USFWS	Short-, mid-, long-term	None	N/A	Agency specialists	Presence of more tolerant species; improved populations
Aquatic habitat monitoring	3 samples, 4 years apart at existing sites	NCDWR	Short-, mid-, long-term	None	N/A	Agency specialist	Improved stream channel and aquatic habitat
Stewardship monitoring	All project sites	TRVWP, Sponsoring agency	Short-, mid-, long-term	None - incorporated as operations costs	N/A	N/A	TRVWP project investments protected

5.4 Implementation Schedule and Accomplishments Tracking

The implementation schedule for this WAP presents the time line over which each management action will be achieved during the 10-year planning period (Tables 5.10-5.16). Target numbers for each management action are taken from the management action plan tables in Section 5.3 and are distributed across years based on stakeholder and TAC input. The tables are also designed to compare actual versus planned accomplishments for each management action. The planned accomplishments numbers will serve as interim milestones against which progress in implementing the management measures will be evaluated. Significant deviations from the planned accomplishments will serve as an indicator that the action plan may need revision.

The main objective of the WAP is to reduce turbidity levels in the degraded reaches of the North Toe River to a level where they can be removed from North Carolina's 303(d) impaired waters list. During this planning period, detectable declines in turbidity are likely to occur only in subwatersheds where significant numbers of on-the-ground projects are implemented. It is believed that by implementing the projects identified in this WAP and the outreach efforts aimed at motivating individual landowners to reduce erosion from their properties, significant progress will be made in reducing turbidities across the Upper North Toe River Watershed.

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Table 5.10 Implementation Schedule for Stream Restoration and Riparian Area Enhancement

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Restore and enhance stream channels (feet)	Planned		2,000		2,000		2,000		2,000		2,000	10,000 feet
	Actual											
Restore riparian area vegetation (1,500 feet at 30 feet ≈ 1 acre)	Planned	1,500		3,000	1,500	3,000	1,500	3,000	1,500	3,000	2,000	20,000 feet
	Actual											
Realign stream channels at stream crossings	Planned	As bridges or culverts are upgraded or replaced										4 crossings
	Actual											
Watershed Coordinator position established	Planned	Establish position in year 1; maintain funding throughout life of WAP										1 full-time position
	Actual											

Table 5.11 Implementation Schedule for Upland Management Practices

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Revegetate borrow and fill sites	Planned	1	1	1	1	1	1	1	1	1	1	10 sites
	Actual											
Stabilize unpaved residential drives (acres)	Planned	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5 acres
	Actual											

Table 5.12 Implementation Schedule for Stormwater Control Measures

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Disconnect building downspouts	Planned	5	5	5	5	5	5	5	5	5	5	50 buildings or residences
	Actual											
Install bio-retention areas at high-priority sites	Planned				1	1	1	2	2	2		9 sites/27.1 acres treated
	Actual											
Install extended detention structures	Planned				1		1		1			3 structures
	Actual											
Wet pond to dry pond conversion	Planned							1				1 structures
	Actual											
Vegetated swales	Planned				1		1					2 swales
	Actual											

Table 5.13 Implementation Schedule for Agricultural and Horticultural BMPs

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Riparian area fencing (feet)	Planned	500	500	500	500	500	500	500	500	500	500	5,000 feet
	Actual											
Stabilize unpaved roads (miles)	Planned	0.5.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5 miles
	Actual											
Implement ground cover management plans (acres)	Planned	1	1	1	1	1	1	1	1	1	1	10 acres
	Actual											

Table 5.14 Implementation Schedule for Education and Outreach (Sheet 1 of 2)

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Fund Watershed Coordinator position	Planned	Maintain position throughout life of WAP										
	Actual											
Open communications and develop relationships with targeted audiences regarding TRVWP activities	Planned	Ongoing throughout life of WAP										
	Actual											
Develop a two-page fact sheet about the TRVWP	Planned	1										Created; update as needed
	Actual	1										
Create and maintain a Facebook page	Planned	Establish and maintain throughout life of WAP										Track “Likes”
	Actual											
Determine feasibility of newspaper column – “Toe Talk”	Planned											If feasible, write 4 articles per year
	Actual	4	4	4	4	4	4	4	4	4	4	
Create a formal watershed stewardship recognition program	Planned	1	1	1	1	1	1	1	1	1	1	Annual awards, multiple categories
Conduct “Toes in the Toe” events	Planned	1	1	1	1	1	1	1	1	1	1	1 event per year
	Actual											

Table 5.14 Implementation Schedule for Education and Outreach (Sheet 2 of 2)

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Determine feasibility of establishing an "Eco-Club" at Mitchell High School	Planned	If feasible and established, maintain continuing support										Club established
	Actual											
Arrange for subject-matter experts to make presentations to grade and high school classes	Planned	5	5	5	5	5	5	5	5	5	5	50
	Actual											
Coordinate educator training events	Planned	1	1	1	1	1	1	1	1	1	1	10 events
	Actual											
Facilitate churches to participate in "Adopt-a-Stream" program	Planned			1			1			1		3 "adoptions"
	Actual											
Support a local fishing event	Planned		1	1	1	1	1	1	1	1	1	9 events
	Actual											
Coordinate development of river access points	Planned	To be determined										2
	Actual											
Develop a marketing plan for fishing and paddling on the North Toe River	Planned					1						Marketing plan implemented
	Actual											
Prepare a report on the economics of healthy streams and present to local officials (number of presentations)	Planned		Report (5)				Update (5)				Update (5)	Report complete/updated
	Actual											
Organize float trips for local officials	Planned	1	1	1	1	1	1	1	1	1	1	10 trips
	Actual											
Host "Meet and Greet" BBQ dinners	Planned		1		1		1					Host 3 events
	Actual											
Develop informational brochures for agricultural, residential, and commercial landowners	Planned		1	1	1							3 brochures; update as needed
	Actual											
Organize streamside educational events for adults	Planned		1	1	1	1	1	1	1	1	1	9 events
	Actual											
Recruit key private landowners to support restoration and enhancement demonstration projects	Planned	10	10	10	10	10	10	10	10	10	10	Make 100 contacts
	Actual											
Offer to make staff presentations about stream life (NPDES permit holders, construction and development firms)	Planned	Presentation made upon request										2/year
	Actual											
Collaborate with permit holders on compliance issues	Planned	To be determined as relationships are developed										1/year
	Actual											
Facilitate sediment and erosion control training programs	Planned	1	1	1	1	1	1	1	1	1	1	1/year
	Actual											

Table 5.15 Implementation Schedule for Additional Watershed Assessments

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Unpaved road inventory and field assessment	Planned				X	X						Completed
	Actual											
Horticultural operations ground cover inventory and assessment	Planned					X	X	X				Completed
	Actual											
Inventory source and contents of suspect outfalls and hot spots	Planned								X	X	X	Completed
	Actual											
Assess barriers to aquatic organism passage in problem areas	Planned								X	X	X	Completed
	Actual											

Table 5.16 Implementation Schedule for Watershed Monitoring

Management Action	Year	Short-Term			Mid-Term			Long-Term				Target
		1	2	3	4	5	6	7	8	9	10	
Turbidity monitoring	Planned	X	X	X	X	X	X	X	X	X	X	See Table 4.10 for details
	Actual											
Water chemistry monitoring	Planned	X	X	X	X	X	X	X	X	X	X	See Table 4.10 for details; monthly
	Actual											
Biological monitoring	Planned		X				X				X	See Table 4.10 for details
	Actual											
Aquatic habitat monitoring	Planned		X				X				X	See Table 4.10 for details
	Actual											
Stewardship monitoring	As needed	X	X	X	X	X	X	X	X	X	X	Resource investments and improvements protected

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7. APPENDICES

Appendix A Watershed Assessments

A-1 Turbidity and Total Suspended Solids

Introduction

Upstream of its confluence with the South Toe River, the North Toe River watershed comprises 183 mi^2 (117,120 acres) within Avery, Mitchell, and Yancey counties. The NCDWR's Use Restoration Watershed Program has identified the North Toe River as a high-priority site for watershed improvement projects. Two reaches on the North Toe River (totaling 20.3 miles) were listed on the NCDWQ's 2012 303(d) list of impaired waters due to the fact that turbidity exceeded the state standard of 10 NTU in more than 10% of samples previously taken (NCDWQ 2012a, b). Those two reaches are as follows:

- From the confluence of Grassy Creek to its confluence with the South Toe River; 11.3 miles.
- From a point 0.2 mile upstream of Pyatt Creek to a point 0.5 mile upstream of US 19E; 9.4 miles of stream.

Prior to conducting water quality sampling funded as part of this project, a Quality Assurance Project Plan (QAPP, BRRC&D 2013) was prepared and approved by the NCDWQ (now the Division of Water Resources; NCDWR). That document provides details of the sampling plan and methods used in assessing turbidity and TSS in the Upper North Toe River Watershed. That plan was approved by the NCDWR on March 23, 2013.

This appendix provides a synopsis of the sampling methods and a description of the sampling plan. These data were collected primarily for the purpose of assessing existing turbidity conditions. Some data also will serve benchmarks against which trends in turbidity and TSS will be measured as BMPs and restorative actions are implemented. Furthermore, this assessment is intended to aid in determining those subwatersheds that are likely the most significant sources of sediment causing the degraded water quality conditions in the impaired reaches of the North Toe River. The data will be used to target subwatersheds where management actions to reduce erosion should be focused.

Most results of this assessment are included in the body of the WAP. Results peripheral to the goals and objectives of the WAP are included in this appendix.

Methods

Sample Collection – Water samples were collected using two methodologies, grab samples and U-59b single-stage samplers. Grab samples were taken either by wading from the shoreline or with the aid of an extension pole to which the sample bottle was attached. Sample collections were planned so as to obtain measurements at four different flows -- low, normal, moderate, and high. Relative stream flow was determined by measuring the distance from established benchmarks to the water surface at each sample site. Flow levels for the North Toe River site on Altapass Highway was obtained from the National Weather Service Advanced Hydrologic Prediction Service.

Six U-59b single-stage samplers were constructed by NCDWR staff following the design of Lane et al. (2003). They are passive samplers, designed to collect water samples at multiple water levels on rising stream stages following specific rainfall events, and are intended to collect "first flush" runoff. The U-59b units were installed so water samples would be collected when water levels rose approximately 0.5, 1.0, and 1.5 feet above normal flow.

Sample Site Selection – A total of 16 grab sample sites were established (Figure 3.2, Table A.1). The 11 sample sites on the tributary subwatersheds were selected based on the degree of nonforested land, development, and agricultural activities currently taking place. Sites were placed at the lowest practical sampling point within a given subwatershed so as to allow efficient collection of the water samples and expedite delivery to the laboratory for processing.

The five grab sample sites on the mainstem North Toe River were selected to obtain data along the entire study area and to fill gaps among existing mining company and NCDWQ ambient monitoring locations.

Five of the six stage samplers were installed at locations near the grab sample sites and to complement those data (Figure 3.2, Table A.1). One stage sampler was installed near the mouth of Beaver Creek. Samples were obtained for five rainfall events.

Water Sample Processing - Water quality grab samples were collected between May 7, 2013 and September 11, 2013. Samples were collected following the QAPP protocol established for this project (BRRC&D 2013), stored on ice and delivered to the NCDWR Asheville Regional water quality lab the same day they were collected. They were analyzed for turbidity and TSS. Temperature (ºC) and conductivity (µS/cm) were collected at each site during each sampling event.

Stage samples were collected within 24 hours of a known rainfall event. These samples were handled in the same manner as the grab samples.

Methods employed by the NCDWR's Asheville Regional Laboratory in analyzing the water samples for turbidity and TSS complied with the NCDWR's existing ambient monitoring program QAPP (NCDWQ 2012b). Water quality samples were analyzed using the following analytical methods:

- Turbidity – EPA 180.1 Rev. 2 (1993); PQL = 1 NTU.
- Total Suspended Solids (Residue) – APHA SM2540D; PQL = 6.2 mg/L.

Turbidity was measured in NTU, whereas TSS was measured in milligrams/Liter (mg/L). The laboratory Practical Quantitation Limit (PQL) for turbidity was 1 NTU and for TSS it was 6.2 mg/L.

Special Grab Samples – Water samples also were taken at two sites where unusually high turbidities were observed during windshield surveys (Table A.1) that, coincidentally, were conducted following a heavy rainfall event. These sample sites were located on streams receiving discharge from stormwater settling ponds associated with mining operations. The samples were processed in the same manner as the grab sample methods described above.

Table A.1 Water Sampling Locations by Method of Sample Collection

Collection Method Stream Name	Location	Latitude	Longitude
Grab Samples			
North Toe River	Cow Camp Creek Road (SR 1117) bridge, Avery County	36.08623942	-81.94495124
White Oak Creek	Old Toe River Road (SR 1157) bridge at intersection with White Oak Creek Road (SR 1185), Avery County	36.09430407	-81.94069818
North Toe River	Squirrel Creek Road (SR 1121) bridge, Avery County	36.06566814	-82.00084931
Squirrel Creek	Lick Log Road (SR 1121) bridge, Avery County	36.06251277	-81.99941810
Roaring Creek	US 19E culvert at intersection with Roaring Creek Road (SR 1132); Avery County	36.06359060	-82.01476101
North Toe River	US 19E bridge at Powdermill Creek Road (SR 1130), Avery County	36.05891425	-82.01873437
Plumtree Creek	US 19E bridge at Plumtree Post Office	36.03000406	-82.00666510
Threemile Creek	US 19E culvert at intersection with Threemile Highway (NC 194)	35.93953265	-81.99344977
Brushy Creek near mouth	Near mouth on Unimin Schoolhouse Mine property	35.93953265	-81.99344977
Rose Creek	Altapass Highway (SR 1121) bridge at intersection with SR 1128, Mitchell County	35.89645201	-82.02281945
North Toe River	Adjacent to Altapass Highway (SR 1121) at The Quartz Corp truck turnaround	35.90855565	-82.04993793
Grassy Creek	NC 226 culvert at Parkway Fire and Rescue Department	35.88239405	-82.05740780
Grassy Creek at SR 1117	Lower bridge on Carters Ridge Road (SR 1162)	35.89498820	-82.06712821
Bear Creek on SR 1162	Adjacent to 348 Penland Road (SR 1162)	35.94458694	-82.10815988
Big Crabtree Creek	Big Crabtree Creek Road (SR 1002) at intersection with Murphy Road (SR 1264)	35.89694655	-82.14522340
North Toe River	Under NC 80 bridge at Yancey County line	35.93026687	-82.17244682
Special Grab Samples			
UT to Little Bear Creek	NC 226 culvert below Unimin Mine	35.936034	-82.096340
Hawkins Branch	End of Hawkins Branch Road (SR 1150)	35.935626	-82.084415
Stage Samples			
North Toe River	Upstream of the Cow Camp Creek Road (SR 1121) bridge below Newland	36.08512	-81.9438036
Plumtree Creek	Adjacent to Plumtree Creek Road (SR 1114) below Isaac Branch	36.035652	-81.9943752
Threemile Creek	Adjacent to NC 194, approximately 0.4 mile from the intersection with US 19E	35.971057	-82.0070541
Rose Creek	Adjacent to SR 1121 just upstream from mouth	35.899589	-82.0320184
Beaver Creek	Between the railroad tracks and mouth	35.913016	-82.0659949
Grassy Creek	Downstream of the commercial area, near intersection of Fairway Lane Extension and NC 226	35.897666	-82.0672986

Results

Turbidity results and a discussion of the grab and stage sample data are presented in Section 3.2.1. Turbidity measured at low and normal flows did not exceed the NCDWR's 10 NTU evaluation level at any of the 16 sample sites (Table A.2). The highest turbidity measured was 7.3 in Squirrel Creek. At moderate flows nine sites had turbidities exceeding 10 NTU; however, turbidity at six of those sites was 10-15 NTU. Turbidity in Brushy Creek was 28 NTU, the North Toe River just upstream of Spruce Pine was 70, and the North Toe River at the NC 80 bridge (lowermost site) was 80 NTU. At the highest flows, 10 sites had turbidities exceeding 10 NTU. Turbidities at four sites were between 11 and 20 NTU; at five sites turbidities were between 28 and 50 NTU. The highest turbidity during that round of samples, 70 NTU, occurred in Squirrel Creek. Turbidity levels at the SR 1121 and NC 80 sites were much lower than those found at those sites during moderate flows.

The two special grab samples taken in association with stormwater detention ponds on mining operations and following a heavy rainfall event were found to have turbidities of 500 and 1,000+ NTU.

Stage sample results (Section 3.2.1, Table A.3) did not reveal any consistent relationship between water level and turbidity. This was likely due to the scattered nature of rainfall events occurring within and among the subwatersheds.

No anomalies of temperature or conductivity were measured.

The TSS data, which were not used in the development of this WAP, is presented in Table A.2. Those data were intended for use in determining a correlation with turbidity, but too few samples were taken to obtain such results.

Table A.2 Laboratory Analysis of Water Quality Grab Samples in the Upper North Toe River Watershed

Site Number	Site Name	Turbidity (NTU)[1]					TSS (mg/l)[1]			
		Relative Flow Levels and Sample Date					Relative Flow Levels and Sample Dates			
		Low 9/11/2013	Normal 6/6/2013	Moderate 7/2/2013	High 5/7/2013		Low 9/11/2013	Normal 6/6/2013	Moderate 7/2/2013	High 5/7/2013
1	North Toe River @ SR 1117	3.4	2.2	12.0	40.0		6.2	6.2	21.0	65.0
2	White Oak Creek @ SR 1117	1.8	3.0	6.8	45.0		6.2	6.2	13.0	124.0
2A	North Toe River @ SR 1121[2]	1.9	5.2	15.0	-[2]		6.2	11.0	27.0	[2]
3	Squirrel Creek @ SR 1121	3.8	7.3	10.0	70.0		6.3	13.0	16.0	19.0
4	Roaring Creek @ US 19	2.2	6.3	7.3	11.0		6.2	8.0	13.0	14.0
5	North Toe River @ US19/SR 1130	1.8	5.9	15.0	3.8		6.2	11.0	25.0	30.0
6	Plumtree Creek @ US19	2.7	6.1	11.0	13.0		6.2	11.0	16.0	66.0
7	Threemile Creek @ US19	2.4	2.6	9.6	50.0		6.2	6.2	15.0	82.0
8	Brushy Creek nr mouth	3.8	3.6	28.0	28.0		6.2	6.2	17.0	31.0
9	Rose Creek on SR 1121	3.3	6.1	9.0	20.0		6.2	7.8	12.0	15.0
10	North Toe River @ SR 1121	2.0	5.3	70.0	6.9		6.2	8.8	99.0	47.0
11	Grassy Creek @ NC 226	3.8	4.2	9.1	19.0		6.2	6.8	14.0	16.0
12	Grassy Creek @ SR 1117	2.7	4.1	8.6	5.8		6.2	7.0	12.0	20.0
13	Bear Creek on SR 1162	2.5	3.4	11.0	6.7		6.2	6.5	18.0	22.0
14	Big Crabtree Creek on SR 1002	1.3	2.8	11.0	7.5		6.2	6.2	14.0	38.0
15	North Toe River @ NC80	1.7	2.2	80.0	35.0		6.2	11.0	125.0	131.0
Special Grab Samples										
		7/18/2013					7/18/2013			
MUT-1	UT to Little Bear Creek	1,000+[3]					3,790			
MUT-2	Hawkins Branch	500					468			

[1]The laboratory's lowest Practical Quantitation Limit (PQL) for turbidity is 1 NTU and for TSS is 6.2 mg/l.

[2]No sample taken on May 7, 2013.

[3]Turbidity estimated; concentration exceeded upper end of laboratory scale.

Table A.3 Laboratory Analysis of Water Quality U-59b Stage Samples in the Upper North Toe River Watershed

Stream	Collection Date	Turbidity (NTU)			Total Suspended Solids (mg/L)		
		Bottom	Mid	Top	Bottom	Mid	Top
North Toe River	6/5/2013	85	150		155	300	
Plumtree Creek							
Threemile Creek							
Rose Creek		70			108		
Grassy Creek		40	75		59	165	
Beaver Creek							
North Toe River	6/12/2013	85			138		
Plumtree Creek		210			404		
Threemile Creek		250	280		408	576	
Rose Creek		70	140		93	231	
Grassy Creek		75	60		128	111	
Beaver Creek							
North Toe River	6/26/2013	80	130		262	11	
Plumtree Creek							
Threemile Creek							
Rose Creek		400	370		210	304	
Grassy Creek		60	220	24	33	16	204
Beaver Creek		3.1	170		858	700	
North Toe River	7/12/2013						
Plumtree Creek							
Threemile Creek		340	900	500	613	15600	1020
Rose Creek		220	270	500	464	574	1280
Grassy Creek		75	130	250	150	224	442
Beaver Creek		27	21		54	52	
North Toe River	7/24/2013	260	210				
Plumtree Creek							
Threemile Creek							
Rose Creek		65	190	34			
Grassy Creek		50	55	190			
Beaver Creek							

A-2 Windshield Surveys

Introduction

A windshield survey was conducted to provide a general impression of stream channel and watershed conditions and to document significant land disturbances within the riparian area, in upland areas, or both. It was a rapid exercise designed to maximize subwatershed observations of sediment sources originating from select subwatersheds. Based on an evaluation of land use characteristics and input from the core TAC, the following subwatersheds in the Upper North Toe River Watershed were selected (Figure 3.2):

- Upper North Toe River (upstream of Whiteoak Creek)
- Whiteoak Creek
- Plumtree Creek
- Threemile Creek
- Brushy Creek
- Rose Creek
- Grassy Creek
- Big Crabtree Creek
- Bear Creek
- Tributaries to the North Toe River in the mining district north and west of downtown Spruce Pine and including the following:
  - Little Bear Creek at the Unimin Plant on NC 226
  - Hawkins Branch
  - Pine Branch
  - Sullins Branch

Methods

The methodology used for the North Toe River Restoration Project windshield survey was based on the CWP subwatershed and site reconnaissance methodology (CWP 2005a). A one-sheet field data form (Table A.4) was used to collect information: site identification, water quality parameters (temperature, conductivity, and turbidity); riparian zone activities/features (within 30 feet of the stream); hot spot concerns; nonnative plant infestations; streambank stability; channel substrate and sediment sources; in-stream habitat conditions; channel modification; and agricultural BMP project potential. A section was added to capture significant upland (outside of the 30-foot riparian zone) disturbances, whether active erosion was occurring, and the severity of the disturbance. Four site types were delineated –- stream crossings (with and without adjacent upland disturbances), observations adjacent to streams (with and without upland land disturbances), uplands, and observations of stream disturbances not at crossings (adjacent to streams). Data taken from adjacent locations (not at stream crossings) were recorded as if they were being taken from the downstream end of the site being evaluated (i.e., only upstream observations).

Prior to conducting the windshield surveys, reference maps of the subwatersheds were prepared. To identify potential stream crossings, the N.C. Department of Transportation roads GIS layer was overlaid onto the stream network layer. All points where roads and streams intersected were identified as potential stream crossings. Because the road layer identified only bridge crossings, some potential crossings were false positives due to the impreciseness of the digital data. Culverted stream crossings were confirmed during the field reconnaissance trips.

Field data were collected by traversing virtually all public roads within the targeted subwatersheds. Data were collected at most bridges regardless of riparian or upland conditions. Data were generally collected at culverted crossings only where significant erosion concerns were observed, either in the riparian zone, upland area, or both. Data on disturbed upland sites were taken regardless of the proximity of the sites to perennial streams. Practically all these sites were on steep slopes, making the likelihood of sediment being transported to stream channels via overland flow high. Side roads were not driven when they were so short that observations could be made from the main road and for which no disturbances could be seen. A few private roads were driven where no restrictive signs were observed. Urban portions of the North Toe headwaters (Newland) and Grassy Creek (Spruce Pine) subwatersheds were not surveyed. Data on conditions within those areas were evaluated during the stormwater field assessments.

Temperature, conductivity, and turbidity were measured at stream crossings where other data were taken. Temperature and conductivity were measured with a YSI Model EC300 temperature/conductivity meter, whereas turbidity was measured with a Hach Company 2100Q turbidity meter. Both instruments were calibrated and operated according to the QAPP for this project (BRRC&D 2013).

An analysis and summary of the data are presented in Section 3.2.2. Due to the size of the database, it will be provided in digital format suitable for use with GIS and spreadsheet software.

Table A.4 Windshield Survey Field Data Sheet

Watershed Reconnaissance Worksheet - North Toe River Restoration Project

Subwatershed:___________________ **Site ID:**__________ **Site Location**:_____________________________________
Site Type: ☐ Stream (crossing) **Staff:**__________________________ **Date**_____________ **Time**______☐AM ☐PM
☐ Upland (for upland sites fill in tracking information and upland site characteristics (on back page)
☐ Stream (non-crossing; general)

Tracking Information
Waypoint No. ___________ Lat_______________________ Long_______________________ Photo number(s) and description____ ____ ____

Water Quality Field Parameters and Observed Conditions	
Field Parameters: Turbidity___________NTU Specific conductance _______µS/cm Water temperature______^{0}C; Last Rainfall (if known)	*Water Appearance*: ☐ Turbid ☐ Clear ☐ Other (list) _______________________ *Flow Conditions*: ☐ High ☐ Normal ☐ Low ______________

> *Stream Site Characteristics* <

Upstream	Downstream
Riparian Zone Activity Nature of activity (check all that apply, circle major): *Estimated Observation Distance:*________________*ft* *LB RB:* *LB RB::* ☐ ☐ Forested ☐ ☐ Resid. yards ☐ ☐ Roads ☐ ☐ Houses ☐ ☐ Industrial ☐ ☐ Apts. ☐ ☐ Commercial ☐ ☐ Pasture/hay ☐ ☐ Institutional ☐ ☐ Cultivated land ☐ ☐ Construction Site ☐ ☐ Animal Oper. ☐ ☐ Golf Course ☐ ☐ Nursery ☐ ☐ Other _____________________ Check if incidental ☐ Check if within 10 ft ☐	**Within 30 Feet of Stream (For Stream Sites)** Nature of activity (check all that apply, circle major): *Estimated Observation Distance:*________________*ft* *LB RB:* *LB RB::* ☐ ☐ Forested ☐ ☐ Resid. yards ☐ ☐ Roads ☐ ☐ Houses ☐ ☐ Industrial ☐ ☐ Apts. ☐ ☐ Commercial ☐ ☐ Pasture/hay ☐ ☐ Institutional ☐ ☐ Cultivated land ☐ ☐ Construction Site ☐ ☐ Animal Oper. ☐ ☐ Golf Course ☐ ☐ Nursery ☐ ☐ Other _____________________ Check if incidental ☐ Check if within 10 ft ☐
Riparian Hot Spot Concerns *LB RB:* *LB RB:* ☐ ☐ Highly impervious ☐ ☐ Waste Manage. ☐ ☐ Gas station/car wash ☐ ☐ Junk yard ☐ ☐ Materials storage ☐ ☐ Nursery ☐ ☐ Vehicle maint./storage ☐ ☐ Livestock Access ☐ ☐ Other_________________ Check if stream/storm drain inputs likely ☐	**(if Applicable)** *LB RB:* *LB RB:* ☐ ☐ Highly impervious ☐ ☐ Waste Manage. ☐ ☐ Gas station/car wash ☐ ☐ Junk yard ☐ ☐ Materials storage ☐ ☐ Nursery ☐ ☐ Vehicle maint./storage ☐ ☐ Livestock Access ☐ ☐ Other_________________ Check if stream/storm drain inputs likely ☐

Invasive Plants	**(Rate Each Bank)**
Left Bank: *Right Bank:* ☐ Japanese knotweed ☐ Japanese knotweed ☐ Multiflora rose ☐ Multiflora rose ☐ Kudzu ☐ Kudzu ☐ Japanese honeysuckle ☐ Japanese honeysuckle ☐ Oriental bittersweet ☐ Oriental bittersweet ☐ Tree of Heaven ☐ Tree of Heaven ☐ Chinese silvergrass ☐ Chinese silvergrass ☐ Privet ☐ Privet ☐ Japanese spiraea ☐ Japanese spiraea ☐ Other______________ ☐ Other______________ *Severity of Infestation:* ☐ L ☐ M ☐ H ☐ L ☐ M ☐ H	*Left Bank:* *Right Bank:* ☐ Japanese knotweed ☐ Japanese knotweed ☐ Multiflora rose ☐ Multiflora rose ☐ Kudzu ☐ Kudzu ☐ Japanese honeysuckle ☐ Japanese honeysuckle ☐ Oriental bittersweet ☐ Oriental bittersweet ☐ Tree of Heaven ☐ Tree of Heaven ☐ Chinese silvergrass ☐ Chinese silvergrass ☐ Privet ☐ Privet ☐ Japanese spiraea ☐ Japanese spiraea ☐ Other______________ ☐ Other______________ *Severity of Infestation:* ☐ L ☐ M ☐ H ☐ L ☐ M ☐ H
Bank Stability	**(Rate Each Bank)**
Left Bank: *Right Bank:* ☐ Good ☐ Good ☐ Fair ☐ Fair ☐ Poor ☐ Poor ☐ Can't Evaluate ☐ Can't Evaluate	*Left Bank:* *Right Bank:* ☐ Good ☐ Good ☐ Fair ☐ Fair ☐ Poor ☐ Poor ☐ Can't Evaluate ☐ Can't Evaluate
Channel Substrate	**and Sediment Sources**
☐ Good (abundant coarse material, limited embeddedness) ☐ Fair (some coarse material, but excessive sedimentation) ☐ Poor (dominated by sand and silt) Obvious sediment sources (list)________________________	☐ Good (abundant coarse material, limited embeddedness) ☐ Fair (some coarse material, but excessive sedimentation) ☐ Poor (dominated by sand and silt) Obvious sediment sources (list) ________________________
Instream	**Habitat**
Riffle habitat: ☐ Poor ☐ Fair ☐ Good ☐Excellent Pool habitat: ☐ Poor ☐ Fair ☐ Good ☐Excellent Other habitat: ☐ Poor ☐ Fair ☐ Good ☐Excellent (LWD, root mats, etc.)	Riffle habitat: ☐ Poor ☐ Fair ☐ Good ☐Excellent Pool habitat: ☐ Poor ☐ Fair ☐ Good ☐Excellent Other habitat: ☐ Poor ☐ Fair ☐ Good ☐Excellent (LWD, root mats, etc.)
Upstream	**Downstream**
Channel Modification	**and Floodplain Access**
Channel straightened: ☐ No ☐ Recent (<10 years) ☐ Historic Bank hardening: ☐ None ☐ Minor ☐ Major Piped? ☐ Yes ☐ No Potential Fish Barrier ☐ Yes ☐ No ☐ Can't Tell Estimated height:____________________inches Channel at least moderately incised ☐ Yes ☐ No	Channel straightened: ☐ No ☐ Recent (<10 years) ☐ Historic Bank hardening: ☐ None ☐ Minor ☐ Major Piped? ☐ Yes ☐ No Potential Fish Barrier ☐ Yes ☐ No ☐ Can't Tell Estimated height:____________________inches Channel at least moderately incised ☐ Yes ☐ No
BMP	**Potential**
☐ Stormwater (follow up during retrofit survey) ☐ Yes ☐ No ☐ Probably Not ☐ Agricultural ☐exclusion ☐ conserve tillage ☐ Other________	☐ Stormwater (follow up during retrofit survey) ☐ Yes ☐ No ☐ Probably Not ☐ Agricultural ☐exclusion ☐ conserve tillage ☐ Other________
Other Features	**of Interest**
☐ Large tracts of mature forest ☐ Livestock fenced from stream ☐ Conservation tillage ☐ Major bank failure ☐ Active incision ☐ Recent clearcutting ☐ Other____	☐ Large tracts of mature forest ☐ Livestock fenced from stream ☐ Conservation tillage ☐ Major bank failure ☐ Active incision ☐ Recent clearcutting ☐ Other____

Upland Site Characteristics			
Significant Land Disturbances		**(outside of 30 foot buffer)**	
Nature of activity (check all that apply, circle major):		Active Erosion:	Severity of Disturbance:
☐ Mining	☐ Residential. yards	☐ Yes	☐ Mild
☐ Dirt Road/Driveway	☐ Houses	☐ No	☐ Significant
☐ Industrial	☐ Apartments	☐ Cannot evaluate	☐ Severe
☐ Commercial	☐ Pasture/hay		
☐ Institutional	☐ Cultivated land	Size of Impact:	
☐ Construction Site	☐ Animal Operations	Length (ft)___________Width (ft)_____________	
☐ Golf Course	☐ Nursery/Tree Farm	or	
☐ Other _____________________		Estimated:_______________acres	
Notes:			

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A-3 Streamwalk Surveys

Introduction

Many portions of streams within the Upper North Toe River Watershed were suspected of having degraded riparian and channel conditions. Sediment originating from these areas was suspected of being one reason that 20.7 miles of the North Toe River are on North Carolina's 303(d) list of impaired waters. In addition to the main river, the core TAC identified the urbanized portions of Grassy Creek and Beaver Creek as also having a high probability of being significant sources of sediment entering the North Toe River. Data collection methods were based on those developed by the CWP (2005b); a summary of those methods are presented below.

Methods

Most portions of the North Toe River, Grassy Creek, and Beaver Creek could not be assessed from public roadways. To complete the evaluation, the stream reaches of interest were either assessed from boats (North Toe River) or by walking the stream channel (Beaver Creek and Grassy Creek).

The North Toe River was floated from the US 19E bridge at Jones Creek to the US 19E bridge at the Unimin Corporation Schoolhouse processing plant (8.6 miles) and from the Carpenter Island Road bridge to the NC 80 bridge at the Yancey County line (14.2 miles). Grassy Creek was walked from its confluence with East Fork Grassy Creek to the lower Carters Ridge Road (SR 1117) bridge (1.7 miles). Beaver Creek was walked from its mouth to where it emerges from a culvert under US 19E (0.9 mile). Although subreaches were delineated with each section traversed, the conditions within the sections were considered uniform.

Data collection methods were based on the Unified Stream Assessment approach developed by the CWP (2005b). This approach involves making observations on a variety of stream conditions and features that are recorded on a series of forms (Table A.5). For the North Toe River project, data were recorded in the following categories: reach identification, severely eroding banks, impacted buffers, outfalls, stream crossings, and utility impacts. To maximize the information on each feature's level of degradation and relative contribution of sediment, the data sheets for these features were modified. A "miscellaneous" data sheet was adapted to collect information on the severity of nonnative invasive plant species infestations within the riparian areas. Some species, such as Japanese knotweed, have shallow root systems that are vulnerable to being washed away during storm flows, thus exposing soil and making it susceptible to erosion.

Location information was recorded on a recreational grade GPS unit; digital photographs were taken for each data record. The data were uploaded into a digital format for spatial viewing and analysis in GIS.

Results

Five days were necessary to conduct streamwalks on the targeted stream reaches within the Upper North Toe River Watershed. The results and analysis of the data are presented in Section 3.2.3.

Table A.5 Streamwalk Assessment Field Sheets

Reach Level Assessment **RCH**

SURVEY REACH ID:	**LBDS** / **RBDS**	**DATE:** ___/_____/___	**STAFF:**
START TIME:____:____AM/PM **END TIME:**____:____AM/PM			**WP#** ______ **TO** ______

REACH START **CONDUCTIVITY** _________**uS/cm** **TEMPERATURE** __________ ^{0}**C** **TURBIDITY** _____________**NTU**

RAIN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Trace ☐ None

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

WATER CLARITY ☐ Clear ☐Turbid (suspended matter) ☐ Stained (clear, naturally colored) ☐ Opaque (milky) ☐ Other (chemicals, dyes____

ODOR ☐ None ☐Sewage ☐Gas ☐ Detergent ☐Sour ☐Sulfide ☐Petroleum ☐Other___________________________

ADJACENT LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:_______________

DOMINANT RIPARIAN COVER (50 FEET): (Looking Downstream)	Paved	Structures	Bare Ground	Turf/Lawn	Tall Grass	Shrub/Scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐	☐:_________
RT Bank	☐	☐	☐	☐	☐	☐	☐	☐:_________

Channel Dynamics ☐ Unknown ☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition ☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized (recent) ☐ Re-establishing meander

Channel Substrate

Pools: ☐ Gravel, cobble, boulder ☐ Gravel, cobble ☐ Mostly gravel ☐ Sand/silt/clay/detritus ☐ Other_______________

Riffles: ☐ Gravel, cobble, boulder ☐ Gravel, cobble ☐ Mostly gravel ☐ Sand/silt/clay/detritus ☐ Other_______________

	OPTIMAL	**Suboptimal**	**Marginal**	**Poor**
DEGREE OF ENTRENCHMENT	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function

Notes:

Impacted Buffer **IB**

SURVEY REACH ID:	☐ LBDS / ☐ RBDS	**DATE:** ___/_____/___	**STAFF:**
WP #: **TO**	**PHOTO #**		

IMPACTED BANK:	**LEFT BANK:**	**IMPACTS:**	**ACTIVE EROSION:**
(Looking Downstream) ☐ LT ☐ RT ☐ Both	Length (ft): ______ Width (ft): _______ **RT BANK:** Length (ft): ______ Width (ft): _______	☐ Lack of vegetation ☐ Too narrow ☐ Structures ☐ Recently planted ☐ Paved ☐ Utility ROW parallel ☐ Utility ROW crossing ☐ Agriculture ☐ Other:___________________	☐ Yes ☐ No **SEVERITY OF IMPACT:** ☐ Mild ☐ Significant ☐ Severe

Severe Bank Erosion **ER**

SURVEY REACH ID:	☐ LBDS ☐ RBDS	**DATE:** ___/_____/___	**STAFF:**
WP #: **TO**		**PHOTO #**	

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both (*looking downstream*)
LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:______________________

DIMENSIONS:

Bank Ht	LT_______ft	and/or	RT__________ft
Bank Angle	LT________°	and/or	RT________°
Est. Length	LT_______ft	and/or	RT_________ft

PROCESS:	**TYPE:**	**LAND COVER:**
☐ Downcutting	☐ Bank slumping/failure during normal flow	☐ Forest ☐ Field/Ag ☐ Developed
☐ Widening	☐ Bank scour during high flows	☐ Other:________________________
☐ Headcutting	☐ Slope failure	**EXISTING RIPARIAN WIDTH:**
☐ Aggrading	☐ Active channelization	☐ ≤10 ft
☐ Sed. Deposition	☐ Currently unknown	☐ 10 – 25 ft
☐ Bed Scour		☐ 25 - 50 ft
☐ Meander Re-establishment		☐ >50ft
☐ Other_____________________		

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

Stream Crossing **SC**

SURVEY REACH ID:	☐ LBDS ☐ RBDS	**DATE:** ___/_____/___	**STAFF:**
WP #:		**PHOTO #**	

TYPE	**POTENTIAL CONCERNS:**	**ALIGNMENT:**
☐ Road Crossing – Bridge	☐ None	☐ Flow-aligned
☐ Road Crossing – Culvert	☐ Erosion; source: __________________________	☐ Flow- not aligned
☐ Railroad Crossing – Bridge	☐ Improper alignment	☐ Could not determine
☐ Railroad Crossing – Culvert	☐ Downstream scour hole	**SEVERITY OF EROSION:**
☐ Manmade Dam	☐ Potential fish barrier	☐ Mild
☐ Other:_______________	☐ Debris blockage	☐ Significant
DROP HEIGHT:________________	☐ Other:__________________________________	☐ Severe

Cause of Fish Barrier: ☐ DROP TOO HIGH ☐ FLOW TOO SHALLOW ☐ EXCESSIVE GRADIENT ☐ OTHER:______________________

Outfalls & Tributaries **OT**

SURVEY REACH ID:	☐ LBDS ☐ RBDS	DATE: ___ /_____/___	STAFF:
WP #:	**PHOTO ID #:**		**TIME:**___:____AM/PM
SOURCE ☐ Stream ☐ Outfall ☐ Unknown	Bank ☐LT ☐RT ☐ Head		

FLOW:	**TYPE:**	**MATERIAL:**	**DIMENSIONS:**
☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:	☐ Closed pipe	☐ Concrete ☐Metal ☐ PVC/Plastic ☐Brick ☐ Other:___________	Diameter:_____ (in)
	☐ Open channel	☐ Concrete ☐ Earthen ☐ Other:___________	

FLOWING ONLY (Discharge Characteristics)	**Specific Cond.** ________µS/CM	**Color:** ☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:_______________
	Temp________°C	**TURBIDITY:** ________________NTU ☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque ☐ Other:________

ORIGIN OF OUTFALL:	**ODOR:**	**DEPOSITS/STAINS:**	**ACTIVE EROSION/CAUSE:**
☐ Wastewater ☐ Straight Pipe ☐ Industrial Facility List type if known:_____________ ☐ Commercial Facility List type if known:_____________ ☐ Other:____________________ ☐ Stormwater ☐ Gutter ☐ Parking lot ☐ Street/Road Way ☐ Other:___________ ☐ Unknown	☐ None ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Petroleum ☐ Other: ___________:	☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Suds ☐ Colors ☐ Floatables ☐ Algae ☐Other	☐ Yes ☐ Discharge scour ☐ Outfall height excessive ☐ Outfall angle ☐ Other:_____________ ☐No **SEVERITY OF EROSION:** ☐ Mild ☐ Significant ☐ Severe
DEGREE OF CONCERN: ☐ High ☐ Medium ☐ Low ☐ Can't Evaluate If High or Medium, discuss in notes. Follow up recommended ☐ Yes ☐ No			
Notes:			

Utility Impacts **UT**

SURVEY REACH ID:	☐ LBDS ☐ LBDS	**DATE:** ___/_____/___	**STAFF:**
WP #: **TO**		**PHOTO #**	

POTENTIAL CONCERNS:	**TYPE:**	**LOCATION:**	**CONDITION:**
☐ None ☐ Evidence of discharge ☐ Susceptible to stream flow damage ☐ Fish barrier ☐ Causing bed/bank erosion ☐ Other:__________________	☐ Sewer line ☐ Manhole ☐ Electrical ☐ Unknown Pipe ☐ Other:_______	☐ Floodplain ☐ Stream bank ☐ Above stream ☐ Stream bottom ☐ Other:___________________	☐ Good ☐ Joint failure ☐ Pipe corrosion/cracking ☐ Protective covering broken ☐ Manhole cover absent ☐ Other:_____________

EVIDENCE OF DISCHARGE: (OBSERVATIONS ONLY)	**COLOR**	☐ None ☐ Clear ☐ Dark Brown ☐ Lt Brown ☐ Yellowish ☐ Greenish ☐ Other:_________________
	ODOR	☐ None ☐ Sewage ☐ Oily ☐ Sulfide ☐ Chlorine ☐ Other:________
	DEPOSITS	☐ None ☐ Tampons/Toilet Paper ☐ Lime ☐ Surface oils ☐ Stains ☐ Other:_____________________________

Appendix B GIS Analyses

B-1 Riparian Area Assessment

Introduction

An aerial imagery analysis was performed to assess the general condition of the riparian corridor with regard to woody vegetation. Based on data collected during windshield surveys and input from the TAC, the analysis was focused on the following subwatersheds:

- Headwaters North Toe River—upstream of Whiteoak Creek, including Kentucky Creek
- Plumtree Creek
- Threemile Creek
- Whiteoak Creek

This analysis focused on defining areas of "wooded" or "unwooded" on either right or left descending banks within 30 feet of the stream. Of note, this analysis was strictly a desktop exercise and has not been field-verified. Due to the inherent subjectivity associated with the visual analysis of aerial imagery, this data is intended to be used as a coarse estimate of total stream length classified as "wooded" or "unwooded" at a watershed scale and not to identify specific landowners or potential projects.

Reference datasets used in this analysis include:

- USFWS Paved Roads Analysis Dataset - Provided by the USFWS.
- North Toe Subwatersheds - Watershed divisions created for the North Toe River Restoration Project.
- North Carolina 2010 Orthoimagery (NCCGIA 2011).
- North Carolina Streams from North Carolina Stream Mapping Program (NCCGIA Undated).

Methods

Wooded Buffer Identification and Attribution - Wooded buffers were identified using NC OneMap 2010 Orthoimagery (NCCGIA 2011) provided by the State of North Carolina. "Wooded" was defined as areas that were primarily forested within the 30 foot buffer. "Unwooded" was defined as all other possibilities; including, but not limited to, herbaceous, shrub/scrub, and road crossings.

Using the NCDWQ streams data layer, a 30-foot buffer was generated around all streams within the study area. A copy of the NCDWQ streams data was exported into individual datasets for each subwatershed, and fields for left- and right-descending banks were generated. Starting at the downstream end of each subwatershed and moving upstream, aerial images were visually examined, and each stream segment in the exported stream datasets was classified as "wooded" or "unwooded" for left- and right-descending banks. In an attempt to maintain consistency, aerials were initially examined at 1:1000, zooming in if necessary to verify classifications. Left- and right-descending banks were classified and attributed separately. Note: the NC Onemap 2010 orthoimagery in the North Toe Watershed is "leaf-off," in some cases making the identification of forested areas difficult. When necessary, additional imagery was used—primarily ESRI World Imagery—in order to verify the presence of forested areas within the buffer.

Output from the GIS dataset was exported to a Microsoft Excel format for further analysis. Percent "unwooded" and "wooded" bank length was individually calculated for right- and left-descending banks for each subwatershed as well as a combined percentage. Additionally, a length-frequency distribution of segment length for unwooded stream segments was generated for left- and right-descending banks.

QA/QC - Quality control was performed by a second staff member who examined and verified imagery and "wooded" buffer classifications at a 1:3000 scale. Classification errors did not exceed 2 percent—calculated by dividing total stream length classified by the misclassified stream length—for any subwatershed in this study.

Results

Since variation in riparian condition varied less than 1% percentage value between left- and right- descending banks across all subwatersheds, left- and right-descending bank percentages were combined for each subwatershed. Percent of "unwooded" buffer ranged between 25% and 43% across all subwatersheds (Table B.1), with the lowest percentage falling in the North Toe Headwaters subwatershed and the highest in the Whiteoak Creek subwatershed.

"Unwooded" bank segments ranged in length from 10 to 2,373 feet, with the Plumtree Creek watershed having the highest reach length. All four subwatersheds examined had "unwooded" reach lengths greater than 1,700 feet. Bank length frequency distributions indicate that 57% and 58% of "Unwooded" stream lengths on left- and right-descending banks, respectively, are in the 0-300-foot range (Figures B.1 and B.2).

Detailed results and a discussion of the implications of this analysis to the WAP are presented in Section 3.2.6.

Table B.1 Percent Stream Length of "Unwooded" and "Wooded" buffers by Subwatershed, Left- and Right-Descending Banks Percentages Combined

Subwatershed	Unwooded	Wooded	Total
Headwaters North Toe River	25%	75%	100%
Plumtree	32%	68%	100%
Three Mile	30%	70%	100%
Whiteoak	43%	57%	100%
Handpole Branch	43%	57%	100%
North Toe River at Newland	48%	52%	100%

Figure B.1 Left-Descending Bank Length Frequency Distribution of "Unwooded" Buffers by Subwatershed

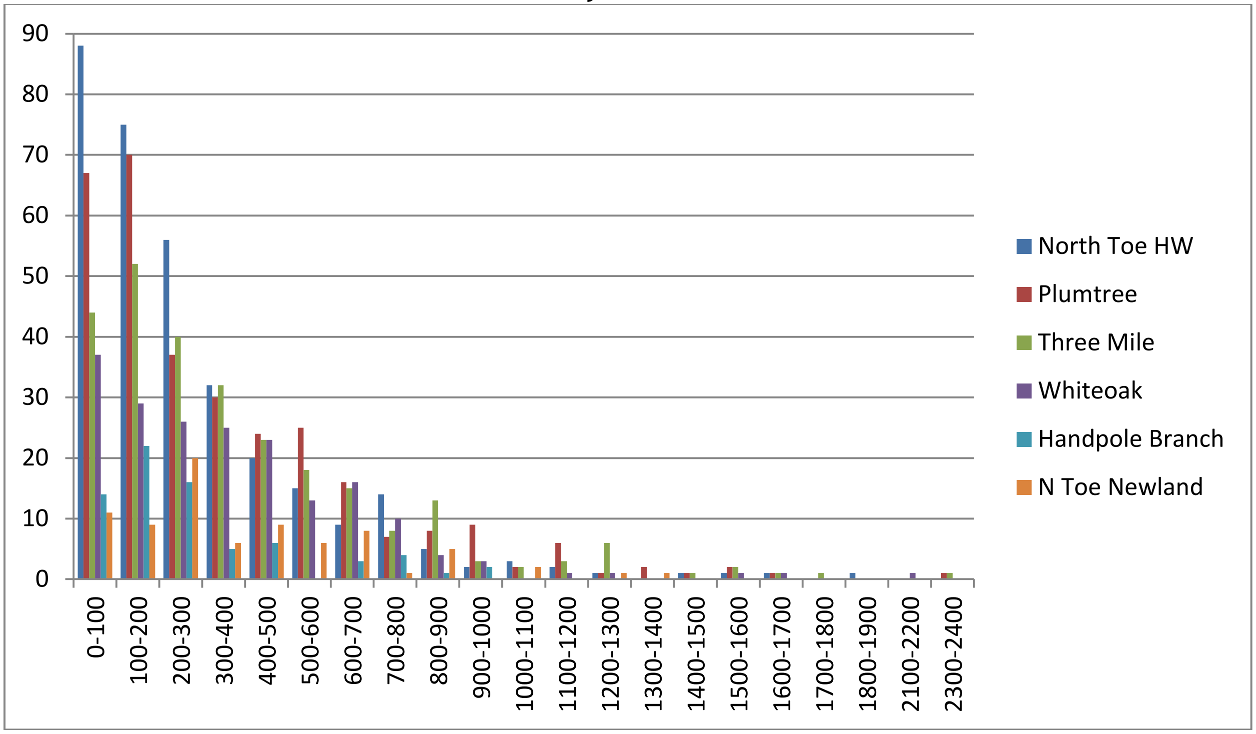
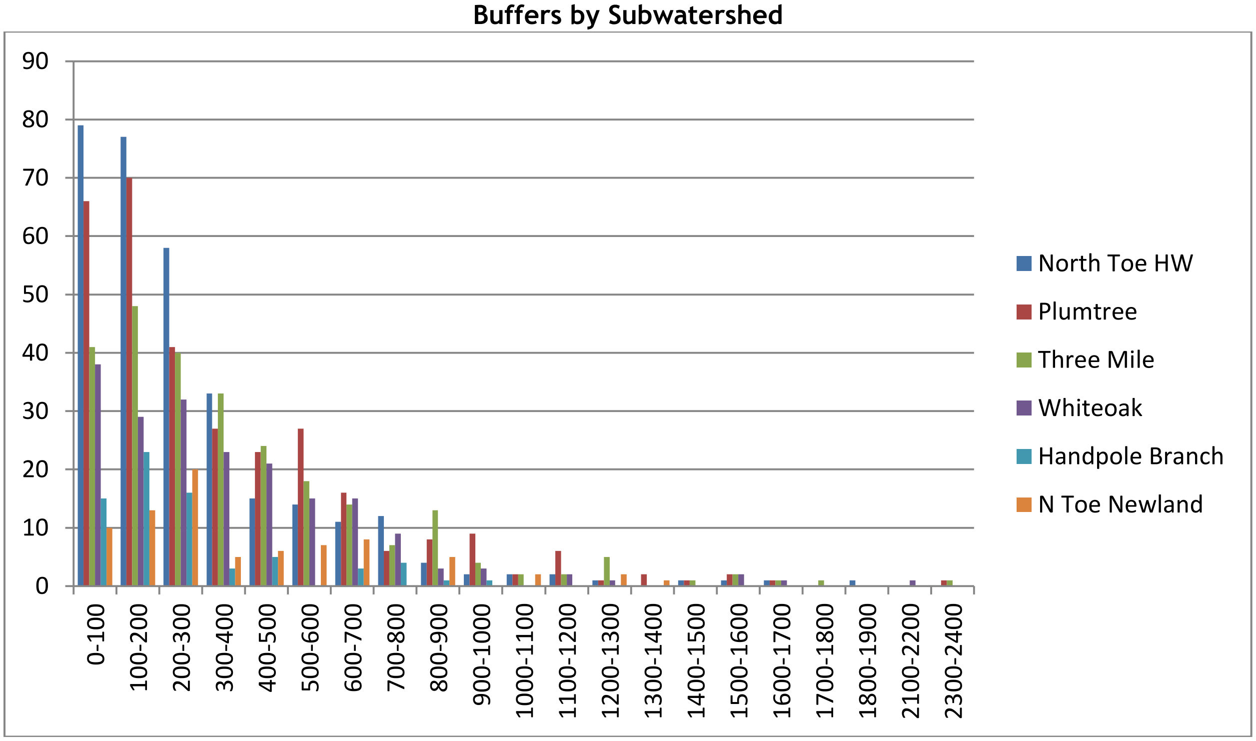


Figure B.2 Right-Descending Bank Length Frequency Distribution of "Unwooded" Buffers by Subwatershed



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B-2 Unpaved Roads Assessment

Introduction

During windshield surveys it became apparent that unpaved roads were likely a significant source of sediment in the watershed. Because most of these roads could not be observed from public highways, it was determined that a GIS analysis of aerial photographs would be necessary to document the extent of unpaved roads within the selected subwatersheds. This analysis was conducted by Mark Endries, GIS Specialist with the USFWS, Asheville Field Office.

Methods

An initial desktop assessment of road surface was performed in GIS by analyzing North Carolina 2010 Orthoimagery and a Navteq® streets dataset of the North Toe River watershed. Using the Navteq® streets dataset as a base, a "paved" attribute field was added to the dataset. Using orthoimagery, typically at a 1:1000 scale, the road surface for each feature in the modified Navteq® dataset was analyzed and determined to be paved or unpaved. The "paved" attribute field was populated with "yes" if a road was paved and "no" if not paved. "NA" values were applied to roads not assessed, typically because they fell outside of the subwatershed focus areas. When a road existed but was not included in the original Navteq® dataset, the road was digitized and added to the modified Navteq® dataset. A new road was defined as any type of landscape feature where it was evident that it was used by vehicles, including private driveways and automobile paths in agricultural and horticultural fields.

Once the road data were created and attributed, the data were field-verified to ensure correct attribution. Field verification was performed by driving on roads and noting the road surface. Roads in private communities could not be field-verified due to access and time constraints. Additionally, some roads were not fully verified. In these instances, if a road was paved within the distance that could be seen from the intersection; i.e., looking down the road, then the remainder of the road not seen was assumed to be paved unless it was obvious from the GIS that this was not the case. When field verification showed incorrect attribution, the value was corrected in the modified Navteq dataset.

Roads associated with horticultural operations were identified as being quite prevalent. Because many of these operations are located on steep slopes, there was concern about sediment originating from them being a cause for elevated turbidity levels. As a result, lands in active horticultural use also were digitized. Statistics of unpaved roads associated with those activities were parsed from the entire dataset.

Once corrected, the miles of unpaved roads and the miles and percent of unpaved roads associated with horticultural fields were calculated (Table B.2)

Results

A total of 261.5 miles of unpaved roads were estimated to be present in the seven subwatersheds assessed (Table B.2). Of those, approximately 120 miles were associated with horticultural operations. An analysis and discussion of the data are presented in Section 3.2.6.

Table B.2 Unpaved Road Analysis Summary

Subwatershed	Total of Unpaved Road Miles in Subwatershed	Sum of Unpaved Roads in Horticultural Fields	Percent of Unpaved Roads in Horticultural Fields
Handpole Branch	18.3	9.1	50%
Kentucky Creek	30.1	14.2	47%
Lower Plumtree	27.3	11.6	43%
North Toe Headwaters	28.4	10.4	37%
Threemile Creek	36.7	6.2	17%
Upper Plumtree	96.8	63.4	66%
Whiteoak Creek	23.9	5.1	21%
Totals	261.5	120.0	45.9

B-3 Horticultural Land Assessment

Introduction

An analysis of horticultural land use was performed to provide location and delineate the approximate land area currently under cultivation. The initial parcel assessment focused on the targeted subwatersheds examined in the windshield survey assessment. The delineation was performed on the following subwatersheds in order to focus the analysis and provide supplemental data to the riparian area and unpaved road assessments:

- Headwaters North Toe River—upstream of Whiteoak Creek, including Kentucky Creek
- Handpole Branch
- Plumtree Creek
- Threemile Creek
- Whiteoak Creek

This analysis focused on identifying parcels within the focus subwatersheds that were currently in horticultural use and then delineating specific areas within those parcels under cultivation. This assessment does not distinguish between farms being actively managed and those that may be abandoned. Additionally, this assessment cannot distinguish the type of stock being grown or the age of the stock.

Reference datasets used in this assessment include:

- USFWS Paved Roads Analysis Dataset - Provided by the USFWS (Appendix B, Section 1).
- North Toe Subwatersheds - Watershed divisions created for the North Toe River Restoration Project.
- North Carolina 2010 Orthoimagery - http://www.nconemap.com/OrthoimageryforNorthCarolina/2010OrthoimageryProject.aspx.
- NCDWQ Streams (NCCGIA Undated)

Methods

Horticultural Farm Delineation and Attribution - The development of this dataset was a three-step process based on data provided by NCDA&CS and aerial imagery analysis by Equinox. Initially, using county tax data, NCDA&CS staff identified parcels being taxed at "Present-Use Value" (PUV). Due to the nature of PUV tax status, this approach may miss some areas that are in Christmas tree or nursery stock but where landowners have not applied for PUV tax status. A shapefile of parcels being taxed at PUV was provided to Equinox. To verify the current use of parcels provided by the NCDA&CS and identify parcels that may have been missed using the PUV approach, Equinox staff used North Carolina 2010 aerial imagery to identify additional parcels in the same windshield survey focus subwatersheds that had signatures of Christmas tree or nursery stock farms.

To complement the data for the riparian area assessment, specific areas within parcels showing signatures of Christmas tree and nursery stock farms were delineated within the North Toe River Headwaters, Plumtree Creek, Threemile Creek, and Whiteoak Creek subwatersheds. These areas were delineated in GIS and maintained in a shapefile for use in other analyses.

Results

A total of 515 parcels were identified as containing Christmas tree or nursery stock farms in the subwatershed focus areas. A total of 288 individual areas were delineated within the Headwaters North Toes River, Plumtree Creek, Threemile Creek, and Whiteoak Creek subwatesheds. These areas ranged in size from 0.05 acre to 100 acres. A total of 1,811 acres of land under Christmas tree or nursery stock cultivation were identified (Table B.3). The importance of this data and the need for further assessment is discussed in Section 3.2.6

Table B.3 Land Area and Percent of Watershed Being Used as Horticulture

Subwatershed	Subwatershed Area	Total Area in Horticulture	Percent Watershed in Horticulture
Handpole Branch	674	157	23%
Kentucky Creek	1,983	321	16%
Lower Plumtree	2,275	284	12%
North Toe Headwaters	3,144	310	10%
North Toe at Newland	937	311	33%
Threemile Creek	4,584	296	6%
Upper Plumtree	3,049	1,118	37%
Whiteoak Creek	2,612	336	13%

Appendix C Stormwater Assessment

C-1 Stormwater Runoff Analysis

The following analysis was conducted by Mark Endries of the USFWS, Asheville Field Office.

Dataset Sources

Using the following datasets, stormwater runoff concerns were assessed for defined catchments in the Upper North Toe River Watershed:

- 2011 National Land Cover Database – Landcover layer; http://www.mrlc.gov/nlcd2011.php.
- 2011 National Land Cover Database - Impervious Surface layer; http://www.mrlc.gov/nlcd2011.php.
- A shapefile of active quarry areas, including mine surfaces, haul roads, processing facilities, storage and waste piles, grassed areas, and other disturbed areas were created by Equinox, using 2010 aerial photographs.

Processing Steps

The data were processed as follows:

1. The shapefile of quarry properties was converted from vector to raster format.
2. Within the NLCD's impervious surfaces dataset, all pixels with impervious values greater than 20% were reclassified and given a value of 1; all others were give the value of "NoData."
3. Within the NLCD's landcover database, the following landcover categories were retained: Barren Land, Cultivated Crops, Developed High Intensity, Developed Medium Intensity, Developed Low Intensity, Developed Open Space, and Hay/Pasture. All other landcover classes were given the value of "NoData."
4. The datasets created in steps 1, 2, and 3 were then mosaicked together into a new dataset that represents areas of concern for water runoff.
5. Catchment delineations were taken from the original project planning documents intended to be used in field assessments.
6. Using the newly created dataset, the following calculations were made:
    a. Total acreage of each catchment.
    b. Total acreage where imperviousness exceeds 20%.
    c. Percent of catchment area where imperviousness exceeds 20%.
    d. Acreage of catchment with active mining operations.
    e. Percent of catchment area with active mining operations.
7. Resulting calculations were summarized in Table C-1.
8. Catchments were categorized into the following groups based on percent of imperviousness:
    a. Less than 10%
    b. 10%-20%
    c. 20%-30%
    d. Greater than 30%
9. Catchments were mapped and impervious surface categories were color-coded.

Table C-1 Catchment Area Impervious Surfaces (Page 1 of 2)

Name	Catchment Area (acres)	Area with >20% Imperviousness (acres)	Percent Area with >20% Imperviousness	Quarry Operations (acres)	Quarry Operations (% of area)
Upper Roaring Creek	3,300	155	5		
Lower Roaring Creek	3,592	256	7		
Powdermill Creek	1,241	46	4		
Henson Creek	3,410	200	6		
Horse Creek	3,664	200	5		
Birchfield Creek	2,575	329	13		
Doublehead Creek	3,656	814	22		
Lower Plumtree Creek	2,275	274	12		
Upper Plumtree Creek	3,049	886	29		
Squirrel Creek	3,038	710	23		
North Toe River - Headwaters	3,144	513	16		
Kentucky Creek	1,983	561	28		
North Toe River - Perry Ridge	2,398	145	6		
Whiteoak Creek	2,612	703	27		
Cow Camp Creek	935	86	9		
Handpole Branch	674	252	37	1.8	0.3
N. Toe River - Newland	937	346	37		
Threemile Creek	4,584	915	20		
Clear Creek	833	70	8		
Justice Creek	1,742	208	12		
Pyatt & Jones Creeks	2,813	208	7		
Upper Big Crabtree	10,045	932	9		
Wolf Branch	773	189	25		
Rebels Creek	874	202	23		
Snow Creek	3,018	593	20		
Upper Bear Creek	4,086	546	13	64.9	1.6
Upper Beaver Creek	2,743	159	6	14.5	0.5
Gouges Creek	1,232	79	6	8.9	0.7
North Toe River - Upper Bend	2,314	201	9		
Brushy Creek	2,135	382	18	115.9	5.4
Laurel Creek	503	56	11	48.3	9.6
Harris Creek	1,831	9	1		
Lower Bear Creek	1,568	177	11	12.9	0.8
Lower Big Crabtree	2,634	544	21	25.6	1.0
Estatoe	3,074	624	20	95.2	3.1
North Fork Grassy Creek	2,351	502	21		
East Fork Grassy Creek	1,600	463	29		

Table C-1 Catchment Area Impervious Surfaces (Page 2 of 2)

Name	Catchment Area (acres)	Area with >20% Imperviousness (acres)	Percent Area with >20% Imperviousness	Quarry Operations (acres)	Quarry Operations (% of area)
Cathis Creek	766	175	23		
Rose Creek	3,232	480	15		
North Toe River - Avery Airport	2,564	709	28	91.0	3.5
Little Bear Creek	642	177	28	115.4	18.0
Lower Beaver Creek	649	249	38		
Lakes Creek	906	353	39	6.89	0.76
Holley Branch	540	254	47		
Lower Grassy Creek	3,284	919	28	3.1	0.1
Pine Branch	631	291	46	172.4	27.3
Sullins Branch	695	188	27	74.5	10.7
English Creek	901	409	45	10.7	1.2
North Toe River - Wing	1,346	135	10		
Penland	695	40	6		
North Toe River - Davenport Branch	1,845	286	16		
North Toe River - Banjo Branch	1,453	298	20		
North Toe River - Penland	1,169	240	21	76.1	6.5
North Toe River - Spruce Pine	1,078	524	49	20.9	1.9
North Toe River - Bobnford	1,549	255	16		

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C-2 Stormwater Control Measures

Inventory

GIS Analysis - To address impacts from potential sources of pollution and to improve the management of stormwater runoff in developed areas of the Upper North Toe River Watershed, opportunities for SCMs were explored. Land use data, aerial photos, and stormwater outfalls and ditches documented during the streamwalk were used to guide and expedite field identification of potential SCM project opportunities. Aerial photos of commercial, institutional, and industrial land uses were examined in closer detail in GIS. Based on aerial photo analysis, areas containing large expanses of impervious surface, poor land use practices, and potential pollutant generating hot spots were flagged for field evaluation to assess potential impacts and opportunities for SCMs. The location of stormwater outfalls and ditches found during streamwalks were also viewed more closely in GIS. Areas draining to outfalls having a specific conductance greater than 200 µS/cm were investigated in the field for potential sources of pollutants and for SCM opportunities. Through GIS analysis, seven potential SCM project sites were identified. Locations for an additional four potential sites were provided by members of the TAC.

Field Assessment - Over the course of 2 nonconsecutive days, all 11 sites were evaluated in the field. During the field assessment, observations were made on the land use draining to the site, existing stormwater management practices, and site constraints to determine whether SCMs are feasible. If a retrofit was determined to be feasible, a datasheet (Table C.2) was completed and photographs taken to document existing conditions. Site sketches were made of the site with the type of retrofit being proposed.

Results - Based on the field evaluations, all 11 potential SCM sites were determined to be feasible (Figure 3.4, Table 4.6). Preliminary assessments indicated the potential for installation of 19 stormwater control features. Priority ranking of the individual sites was based on the potential to cumulatively treat larger impervious areas, the number of observable constraints, sites that occur on public land, and sites with a greater likelihood for feasibility or acceptability by the landowner. Details of the analysis and proposed SCMs for each site are presented in Section 4.4.3.

Table C.2 Stormwater BMP Evaluation Datasheet

Subwatershed: __________ BMP (desktop) ID Type: __________ Staff:_________________
Date___________________ Site Location (Road):____

Tracking Information

Waypoint ___________ Lat______________________ Long______________________
Photo number(s) and description____

Reason for Assessment (check one; describe if further details are deemed appropriate)
☐ Large developed area (e.g. mall, large strip development, industrial complex, large mixed use area)
____

☐ Large area of land clearing or disturbance (note nature if obvious)____
☐ Pollution potential (list if any are observed, e.g. storage tanks, trash receptors, etc.)
____

Nature of Site
Name of Facility/Area (if obvious)____
(Check all that apply)
☐ Commercial ☐ Gov't ☐ Pasture ☐ Land disturbance ☐ Institutional ☐ Transport-related ☐ Row crops ☐ Animal operation ☐ Other____________ ☐ Industrial ☐ Golf course ☐ Nursery ☐ Residential

Site Concerns (check all that apply):
Developed uses:
Vehicle Operations (circle): Fueled Washed Maintained Repaired Stored Sold None No Observation
Uncovered Outdoor Material Storage: ☐Yes ☐No ☐Unknown ☐ No Observation
Describe: ____
Waste Management: ☐Garbage ☐Construction ☐Hazardous ☐None ☐Other__________ ☐ No Observation
Dumpsters: ☐Leaking ☐Near storm drain ☐OK ☐ No Observation
Impervious Surface Condition: ☐Clean ☐Stained ☐Debris/Dirty ☐Breaking Up ☐ No Observation
☐ Other____
Impervious Surface Size: ☐<1 acre ☐1-5 acres ☐5-10 acres ☐>10 acres
Type of impervious surface: ☐ Parking lot ☐ Rooftop ☐ Roadway ☐ Other…
☐ Open space between outfall and property boundary
☐ Area drains directly to storm sewers
☐ Area drains directly to adjacent property
☐ Area in immediate proximity to stream or drainageway (with / with no controls)-circle one

Site Constraints:
Possible conflicts with other site functions (e.g., traffic flow) ☐No ☐Yes (describe)____
Conflicts with existing utilities ☐ None

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Electric
☐	☐	Overhead utilities
☐	☐	Other___________________________________

Access Constraints (construction and maintenance) ☐No ☐Yes (describe-slopes, structures)
Possible Conflicts with Adjacent Land Use ☐No ☐Yes describe)____

ST Potential☐1 ☐2 ☐3 ☐4 ☐ 5 ☐6 ☐7 ☐ 8-specifically ☐ Other-explain on back

Appendix D Sediment Load Reduction

Streambank Erosion

Sediment loads related to streambank erosion were calculated using data collected during windshield surveys and the USEPA's Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) model. The STEPL model is comprised of a spreadsheet that uses simple algorithms to calculate nutrient and sediment loads. For purposes of this WAP, STEPL was used to estimate annual sediment load contributed from streambank erosion, based on bank condition and length of eroding bank, and the potential load reductions if banks were stabilized (Tables D-1 and D-2). Technical information regarding calculations of sediment loading can be found in the STEPL User's Guide (USEPA 2006).

The required STEPL model inputs include length of bank (feet), height of bank (feet), rate of lateral recession, BMPs efficiency, and soil textural class. As outlined in Table 3.11, the model was run separately for each site type — "Stream Crossings and Uplands." and "Adjacent Stream and Uplands." Within each model, the values were partitioned by subwatershed. For each subwatershed, a total length of degraded stream bank was derived by multiplying the length of degraded stream channel (identified during windshield surveys) by two. Since bank height was not recorded in the field, a conservative estimate of 3.5 feet was used for modeling purposes. An average bank stability score for each subwatershed was used to determine the lateral recession rate. The STEPL model categorizes lateral recession into four categories with:

- Slight - Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.
- Moderate - Bank is predominantly bare, with some rills and vegetative overhang.
- Severe - Bank is bare, with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features, such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped.
- Very Severe - Bank is bare, with gullies and severe vegetative overhang. Many fallen trees, drains, and culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross-section is U-shaped and the streamcourse or gully may be meandering.

The bank stability rating was crosswalked into a lateral recession rate based on the site type. Bank stability scores for "Stream Crossings and Uplands" were split into four ranges (0-6, 6-12, 12-18, and >18) in order to crosswalk scores into lateral recession categories. These ranges were based on professional judgment and observations in the field. Reaches with stability scores <6 were excluded from the model since they were not considered "degraded" in the initial listing of degraded stream channels in Table 3.11. Since "Adjacent Stream and Uplands" site types were documented only when there was an obvious disturbance adjacent to the stream but it was not always possible to accurately assess the stability of the bank, these site types were conservatively placed into the "moderate" lateral recession category.

The efficiency of each type of BMP, expressed as percent removal of the targeted pollutants, is required to estimate the total pollutant load reduction to be achieved. In this case, it is the reduction in sediment due to bank stabilization. Some level of background erosion is present in any natural stream system; however, erosion will be significantly less than that of an impacted stream system. For this model, we used a BMPs efficiency (% reduction) of 0.8 to account for some level of background erosion even with a successful project. The last input for the STEPL model is soil textural class, which can greatly affect the amount of soil loss due to differences in cohesion. A review of Natural Resources Conservation Service (NRCS) soil survey data indicated that most of the study area consisted of a mixture of loams and sandy clay loams.

Load and load reduction outputs from the STEPL model are shown in Tables D-1 and D-2 and are presented and discussed in Section 4.6.1.

Table D.1 STEPL Model Outputs for "Stream Crossings and Uplands" Site Types

Subwatershed	Bank Length (ft)	Lateral Recession Category	Lateral Recession Rate (ft/yr)	BMP Efficiency (0-1)	Soil Dry Weight (ton/ft^3)	Unstabilized Bank Annual Load (ton)	Stabilized Bank Annual Load (Ton)	Annual Load Reduction (ton)
Bear	950	Severe	0.4	0.8	0.045	59.9	12.0	47.9
Beaver	1100	Moderate	0.13	0.8	0.045	22.5	4.5	18.0
Big Crabtree	1650	Moderate	0.13	0.8	0.045	33.8	6.8	27.0
Brushy	420	Moderate	0.13	0.8	0.045	8.6	1.7	6.9
Grassy	5450	Moderate	0.13	0.8	0.045	111.6	22.3	89.3
North Toe River headwaters	5100	Moderate	0.13	0.8	0.045	104.4	20.9	83.5
Plumtree	1820	Moderate	0.13	0.8	0.045	37.3	7.5	29.8
Rose	1820	Moderate	0.13	0.8	0.045	37.3	7.5	29.8
Threemile	3050	Severe	0.4	0.8	0.045	192.2	38.4	153.7
Whiteoak	1450	Moderate	0.13	0.8	0.045	29.7	5.9	23.8
Total	**22,810**	-				**637.1**	**127.4**	**509.7**

Table D.2 STEPL Model Outputs for "Adjacent Stream and Uplands" Site Types

Subwatershed	Bank Length (ft)	Lateral Recession Category	Lateral Recession Rate (ft/yr)	BMP Efficiency (0-1)	Soil Dry Weight (ton/ft^3)	Unstabilized Bank Annual Load (ton)	Stabilized Bank Annual Load (Ton)	Load Reduction (ton)
Bear	660	Moderate	0.13	0.8	0.045	13.5	2.7	10.8
Beaver	400	Moderate	0.13	0.8	0.045	8.2	1.6	6.6
Big Crabtree	800	Moderate	0.13	0.8	0.045	16.4	3.3	13.1
North Toe River headwaters	5,600	Moderate	0.13	0.8	0.045	114.7	22.9	91.7
Plumtree	3,600	Moderate	0.13	0.8	0.045	73.7	14.7	59.0
Rose	2,500	Moderate	0.13	0.8	0.045	51.2	10.2	41.0
Threemile	19,450	Moderate	0.13	0.8	0.045	398.2	79.6	318.6
Total	**33,010**	-				**675.9**	**135.2**	**540.7**

Uplands

Sediment loads associated with upland disturbance areas were calculated using the TVA's IPSI spreadsheet model (Holcombe and Malone, Undated). The IPSI model is based on the Revised Universal Soil Loss Equation (RUSLE). Required model inputs include rainfall and runoff factor (R), soil erodibility factor (K), slope factor (LS), crop vegetation and management factor (C), and support practice factor (P). Due to proximity and similarity, IPSI model inputs for the Mills River watershed in Henderson County were used for the North Toe Upland Site Disturbance model. Two land use regimes -- "Disturbed" and "Pasture (Good)" -- were used for load calculations both before and after site stabilization. The logic being that stabilization of a disturbed site would likely result, initially, in the establishment of grass and other herbaceous vegetation. Inputs used for the model are shown in Table D-3. The sediment load reductions are presented and discussed in Section 4.6.2.

Table D.3. RUSLE Inputs for the North Toe River IPSI Model

RUSLE Inputs[1]			
R - 200			
Disturbed Land		*Pasture (Good)*	
K-	0.17	K-	0.17
LS-	0.55	LS-	0.55
C-	0.5	C-	0.003
P-	1	P-	1

[1]Inputs obtained from Mills River IPSI Model (unpublished data).

Stormwater Pollutant Reduction Calculations

An estimate of pollution reduction potential was calculated based on the following:

- pollutant removal efficiencies of the proposed SCM types (Table D.4).
- Annual precipitation in Avery and Mitchell counties.
- Percent of impervious surfaces draining into each SCM.
- Pollutant concentration in runoff based on land use.
- Area of land draining to the SCM using the SIMPLE method (Schueler 1987).

Calculations in this model are based on conceptual designs and provide only rough approximations of the actual pollutant reductions that may be achieved. A more in depth study of each site, including pre- and post-construction water quality analyses would be required to estimate the actual pollutant reductions.

Results of this analysis are presented in Section 4.6.3.

Table D.4 Pollutant Removal Efficiencies of Various Stormwater Control Measures

SCM Type	Ability to Reduce Volume?	Total Suspended Solids	Nitrogen	Phosphorous	Fecal Coliform Removal Ability
Bio-retention	Possible	85%	35%	45%	High
Constructed Wetlands	Yes	85%	40%	40%	High
Bio-swale	no	35%	20%	20%	Low
Extended Detention	Yes	50%	10%	10%	Medium
Filtration	Possible	85%	30%	35%	High
Permeable Pavement	Possible	0%	0%	0%	Low
Riparian Buffers	No	60%	30%	35%	High

Appendix E Funding Agencies and Programs

The following table is intended to provide program funding details for the agencies listed as funding sources in the action plan tables in Section 5.3. The agencies listed are those that have been commonly used to fund watershed improvement projects. The list is by no means exhaustive of potential grant sources. Because grant requirements, allowable uses, matching requirements, and funding cycles often change, up-to-date details should be obtained from the agency before starting the application process. This list does not include loan programs that may be available to local government agencies.

Table E.1 Watershed Improvement Project Funding Agencies and Programs

Funding Source	Programs
Clean Water Management Trust Fund	Legislated funding for stream restoration and land conservation
Conservation Trust of North Carolina	Provides grants to local land trusts to advance land conservation goals
Environmental Protection Agency	Five Star Grants; multiple other
Avery, Mitchell, and Yancey County Soil and Water Conservation Districts	Agricultural Cost Share Program Community Conservation Assistance Program
Local Governments – Newland, Spruce Pine; Avery, Mitchell, and Yancey counties	Utilize funds from these agencies to meet required matches for Federal grants.
Toe River Valley Watershed Partnership	Provides base funding and match for projects
National Fish and Wildlife Foundation	Multiple lists of grant opportunities. See http://www.nfwf.org/whatwedo/programs/Pages/home.aspx#.VBrOUZRdWSp for details.
North Carolina Department of Justice	Environmental Enhancement Grants
North Carolina Department of Transportation	Non-mitigation funding associated with road improvement projects Special projects
North Carolina Division of Parks and Recreation	Adopt-a-Trail Program Parks and Recreation Trust Fund (PARTF)
North Carolina Division of Water Resources	EPA 319(h) nonpoint source pollution watershed management and Implementation Funds EPA 205(j) – Source Water Protection Planning Grants Adopt-a-Stream Program
North Carolina Ecosystem Enhancement Program	Stream and wetland mitigation funding in targeted watersheds
North Carolina Forest Service	Forest Management Plan Program for private landowners (free) Urban and Community Forestry Grants
North Carolina. Wildlife Resources Commission	No formal grant program, but can provide technical assistance some of which may be useable as match.
Trout Unlimited	Embrace-A-Stream Grants to engage local chapters with other partners
USDA Natural Resource Conservation Service	Federal Farm Bill Programs – Environmental Quality Incentives Program (EQIP), Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP)
U.S. Fish and Wildlife Service	Partners for Fish and Wildlife Program; Shade Your Stream Program; Endangered Species Program, Wetlands Conservation Act Program
U.S. Forest Service	Challenge Cost Share Projects (can conduct projects within administrative boundary than can include private lands)
Z. Smith Reynolds Foundation	Provides funding for projects that improve air and water quality and preserve natural landscapes, but not land purchases, greenways, or plant species preservation.