A WATERSHED ACTION PLAN FOR THE PIGEON RIVER WATERSHED

OPTIONS FOR IMPROVING OUR WATER QUALITY

HAYWOOD COUNTY, NORTH CAROLINA

Created By:

Haywood Waterways Association's
Technical Advisory Committee

The Pigeon River Watershed Action Plan is the coordinated effort of Haywood Waterways Association's Technical Advisory Committee which is composed of agencies, organizations, and individuals with skills and/or interest in nonpoint source water quality issues. The report also reflects perspectives shared by residents of the County.

This Plan was adopted on March 7, 2002 and is a living document. It is updated as additional strategies develop or new information is obtained. The most recent revision was completed in May, 2014.

Additional copies of the Haywood County Watershed Action Plan can be obtained by contacting the Haywood Waterways Association at info@haywoodwaterways.org.

TABLE OF CONTENTS

Page

List of Tables

Page

List of Figures

List of Appendices

Executive Summary

The Pigeon River Watershed Action Plan outlines several approaches to improve surface water quality in the Pigeon River Watershed of Haywood County, North Carolina. This 343,077-acre watershed is completely contained within the county. All nonpoint source pollution in this watershed is the result of actions that Haywood County residents have done or allowed to happen to their watershed. However, unlike many areas, Haywood County can have the water quality it wants because no other jurisdictions can affect its water. At present, the water quality in this watershed is highly variable. The water quality of some streams is among the highest in the State of North Carolina, but in others it is so degraded that it does not meet the State's designated use classifications.

The Plan provides an overview of the natural and land use history of the watershed. The conditions we see today reflect changes in the watershed over almost 200 years of history. These changing conditions also highlight land use trends. They provide a snapshot of where we have been and where we appear to be going today. It tells us where we need to focus the most attention and resources to minimize the adverse consequences of the ongoing land use changes. In this watershed, the emphasis is rapidly moving from agriculture to residential development. For the purpose of this plan and the public participation process, the Pigeon River Watershed was divided into four major subwatersheds: the Upper Pigeon, Lower Pigeon, Richland Creek, and Jonathan Creek watersheds. The plan summarizes information for each subwatershed, ranging from the water and land uses to the relative significance of pollutant sources.

Many agencies have been collecting water quality data for several years. This data provides evidence of the most significant problem areas and identifies data gaps to address in the future. This water quality information helps prioritize areas needing the greatest attention to address current concerns. Sediment is the most significant nonpoint source pollutant in the Pigeon River Watershed.

The Plan includes the results of two Integrated Pollutant Source Identification surveys obtained by Haywood Waterways Association (HWA) in 1999 and 2006. This nonpoint source pollutant modeling software identifies the locations and land uses degrading water quality. This data has been quantified within a geographic information system model, providing an effective watershed analysis tool. The primary sources of sediment in the watershed are eroding stream banks, unpaved roads, pasture in poor condition, and animal access to streams.

The Plan summarizes options for addressing the water quality issues in this watershed. These options range from the public awareness and technical assistance efforts currently underway, to possibilities that would substantially change the way developments are approved and permitted. From this list of options, HWA's Technical Advisory Committee (TAC) has selected 14 strategies to improve water quality.

Each strategy has a series of action plans. The action plans recognize that there are work priorities but the factors driving them vary. For example, removing all streams from the NC list of impaired waterways, reducing sediment in Lake Junaluska, and improving water quality in the Fines Creek and Rush Fork Creek areas would be priorities. However, any work that implements, demonstrates or tests best management practices and improves water quality in the Pigeon River Watershed would be work worth doing. The targets and goals within these action plans are based on priorities as well as the availability of the skills needed to get the work done. Some general assumptions were made as to the interest and willingness of landowners to participate in the various cost-share programs.

This Plan is the coordinated effort of the HWA's TAC which is composed of agencies, organizations, and individuals with skills and/or interest in nonpoint source water quality issues. The report also reflects perspectives shared by participants at public forums, as well as contacts with individual landowners. It is a living document and will be updated as additional strategies develop or new information is obtained.

Watershed Perspectives

Natural Setting

The Pigeon River drains practically all of Haywood County (Figure 1). The headwaters arise in Haywood County and create a unique situation for County residents. We are in control of our own water quality. For the most part, we do not get any trash, sediment, or other pollutants from outside the County. Whatever is in the water, we put there.

The Pigeon River's headwaters gather along the southern boundary of the County and flow northwest into Cocke County, Tennessee. The Pigeon River Watershed in Haywood County contains 343,077 acres. Almost 40% of this acreage (132,172 acres) is in public ownership. The physiography of this watershed consists of mountain ranges, intermountain hills, coves, floodplains, and stream terraces. The mountainous terrain is generally very steep, with terraces and flood plains ranging from nearly level to moderately steep. Elevations in the watershed range from 6,621 feet at the top of Mount Guyot, to about 1,400 feet where the river leaves Haywood County at Waterville, TN. The average elevation in Haywood County is among the highest in the eastern United States, with 18 mountain peaks over 6,000 feet.

This watershed is located in the Southern Blue Ridge Province of the Appalachian Mountain System. The Appalachian Mountain System in the United States extends from Maine to Georgia. The Southern Blue Ridge Province in western North Carolina is composed of several mountain ranges. The province is bounded by the Blue Ridge Mountains on the eastern edge and the Great Smoky Mountains to the west. Most of the Pigeon River Watershed is located along the highly dissected eastern slopes and base of the Great Smokies, and the northwestern headwaters of the watershed rise into the Great Smokies. The Great Balsams and Plott Balsams bound the southern headwaters of the watershed.

There are several major rock divisions exposed within the Pigeon River Watershed. The west and east forks of the Pigeon River, as well as portions of the headwaters of Richland Creek, are underlain by rocks of the Ashe Metamorphic Suite. The rocks in this suite were created some 700 million years ago from sediment layers of gravel, sand, and silt. These layers, after they were buried, compressed, and lithified into rock, were eventually metamorphosed to form the present-day mica gneisses and schists of the unit. Migmatitic zones of quartz and feldspar, also created during metamorphism, give much of the rock a "marble cake" appearance. Much of Richland Creek is underlain by much older biotite gneiss, representing, in part, what geologists refer to as 1.1 billion-year-old "basement" rock. This area of basement rock extends down Richland Creek and includes much of the Waynesville area and middle sections of the Pigeon River. Exposures of younger (~700 million years old) metagraywacke, schist, and quartzite of the Great Smoky and Snowbird Groups underlie the balance of the watershed to the north.

There are two general geologic concerns related to engineering and construction in these geologic units. The first is the presence of "hot rocks"—zones of pyritic and sulfitic rocks, which, when exposed to the atmosphere and begin to weather, produce weak acid. This solution then enters the streams and increases the acidity, endangering aquatic life. The second concern is jointing in the rock. Joints are natural breaks in the rock mass. Road construction, or any other type of excavation, can expose intensely jointed, unstable rock, which can fail during rainstorms, creating rock and mudslides. Interstate 40 provides several examples of this type of problem.

The varied terrain and elevation of the Pigeon River Watershed account for interesting and varied climatic conditions. Precipitation varies depending on elevation. Reliable climatic data has only been gathered for the more populated locations at the lower elevations (Table 1). However, precipitation generally increases at higher elevations, and upper elevation temperatures are considerably cooler than lower elevations along major stream courses. It is not unusual to find a 15 to 20° F temperature range in summer between lower

PIGEON RIVER WATERSHED

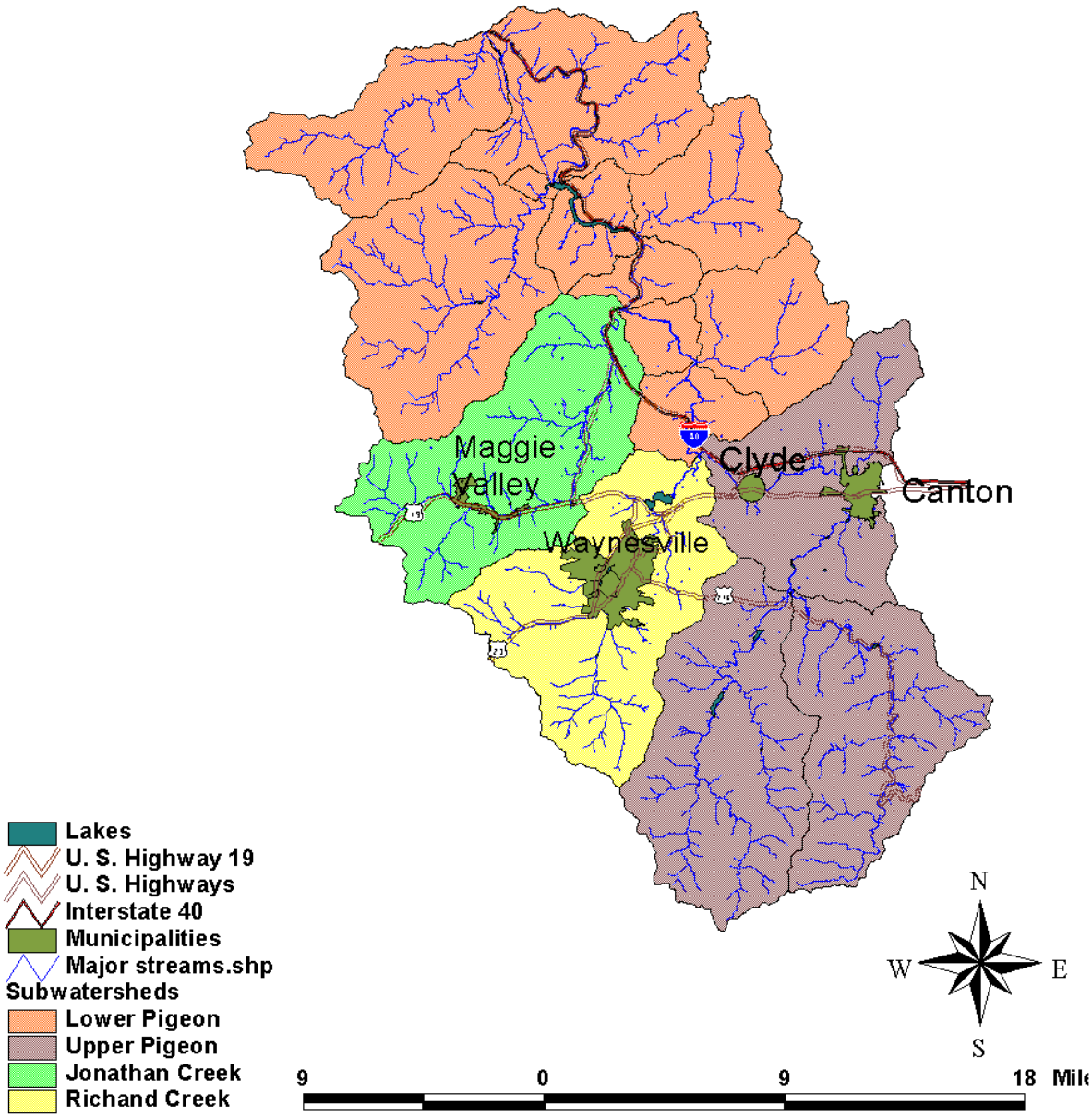

Figure 1. Pigeon River Watershed Map

Table 1. Waynesville Climate Summary

Parameter	Annual Average
January temperature (F)	39
Rainfall (inches)	45
June temperature (F)	71
Snowfall (inches)	13
Days temperature < 32 degrees	111

Source: National Climatic Data Center (Asheville); LINC

and upper elevations. This basin receives more rainfall than many other regions of the United States, which helps produce the abundant and diverse plant life that is so characteristic of this area. It insures that most all of our streams are perennial and support miles of excellent trout streams. The ample rainfall also increases the potential for erosion and creates special challenges for stormwater management.

The soils in this watershed are generally moderately deep to deep and loamy. Most are well drained. Slope is a major limiting factor affecting land use. Soil instability, depth to soft bedrock, and the presence of mica in some soils can also be limiting factors to some of the more intensive land uses. For example, Fannin soils have been identified as having a high content of mica. Careless building on such sites can lead to settling and slope-related failures.

On the other hand, the productive soils, combined with a moderate climate and ample precipitation, encourage a great variety of vegetative growth. Many agricultural crops can be and have been grown in the area. The climatic diversity and productive sites also create tremendous natural vegetative diversity. The Southern Blue Ridge Ecoregion is one of the most biologically significant in the United States. There are as many as 130 different species of flowering trees and 11 conifers in the southern Appalachians - more species than exist in all of Europe. There are also nearly 400 rare plant species.

Land Use Trends

When the Europeans first arrived on the scene, they found streams of outstanding quality. From all reports, fish abounded in the streams. While Native American activities would have had some minimal impact on the watershed, the first substantive changes started in the early 1800s with European settlement. Based on our best estimates, naturally occurring erosion contributes about 200 pounds or 0.1 ton per acre of sediment per year to area waters. Since the early European settlement, several "generations" of land use have dramatically increased the affects on our local watersheds.

Unlike some areas in our nation, Haywood County has generally experienced a steady population growth since its inception (Figures 2 and 3). The areas of population concentration in the County have changed over the years, but the County has continued to grow since 1808. Population growth is significant, because it creates pressure for change in watershed conditions - whether for agricultural use, residential use, roads, commercial uses and other activities.

The nature of the land use associated with this growth is significant. Through much of the 1800s the pattern was one of increasing agricultural use. As land was cleared for farming, sedimentation increased depending on the types of agricultural practices and the consideration given the streams and creek banks. The soils and climate were well suited to growing a great variety of products. In the 1800s, these crops included apples, buckwheat, grapes, grasses, Irish and sweet potatoes, vegetables, burley tobacco, corn, clover, rye, wheat, alfalfa, barley, lespedeza, peaches, blackberries, dewberries, vetch, and watermelons.

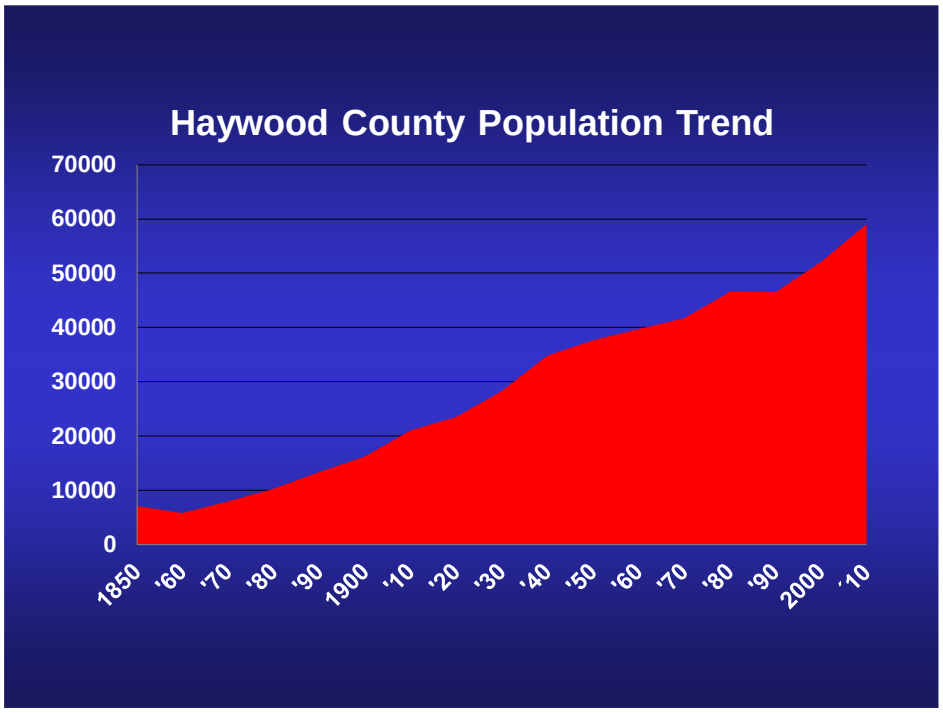

Figure 2. Haywood County Population Trends, 1850-2010

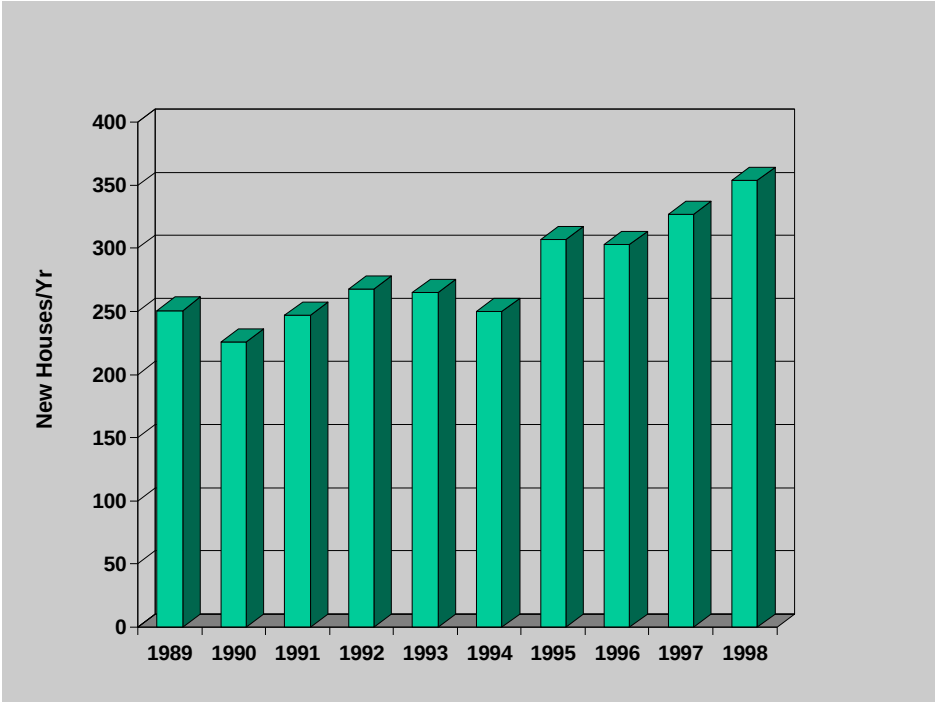

Figure 3. Number of single family dwelling construction per year, Haywood County, 1989-1998; (Haywood County Building Inspection Department).

Livestock production has always been an important component of Haywood County agriculture. In the early life of the County, some land was cleared for crops, and much of the livestock (primarily cattle and hogs) roamed the surrounding land as open range. By the early 1900s, many farmers had begun to move toward fenced and improved pasture for their livestock. In 1930, there were more than five times as many people engaged in farming as in any other industry. In 1933, livestock in the County was valued at more than $500,000, apples at $250,000, and tobacco at $100,000. In 1999, the total income from agriculture is estimated at $23,939,393, with livestock production accounting for about a third of this revenue.

Agricultural use has been gradually declining over the last 20 years, and gross agricultural revenue has declined 30% in the last 10 years. The Integrated Pollutant Source Identification (IPSI) data indicated pasture was the second largest category of land use after forests in 1999, with 37,667 acres classified as some form of pasture. The 2006 data found that number reduced to 31,304 acres. Cropland has also reduced (Figure 4). The 2006 IPSI data (4,617 acres) are nearly identical with 1999, which are significantly less than the previous 120 years.

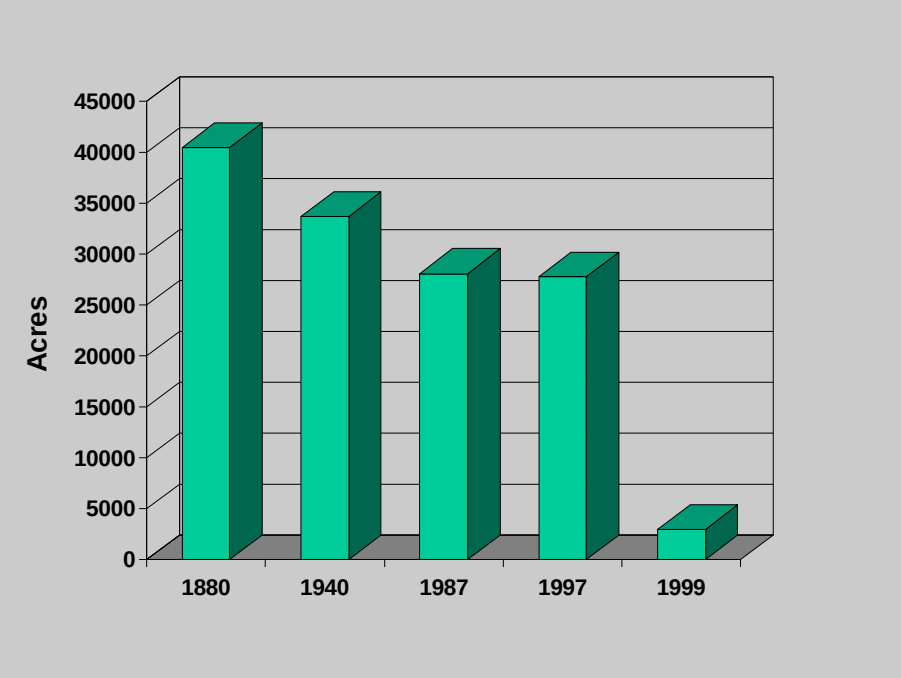

Figure 4. Number of cropland acres in Haywood County, 1880-1997.

On January 28, 1882, an event occurred that would usher in one of the most dramatic changes in watershed condition: the completion of the railroad to Haywood County (Figure 5). This allowed the enormous timber wealth of Haywood County to be exported outside the area (Figure 6). Timber corporations purchased large tracts of timberland, and harvested and transported great quantities of wood by a variety of means. Entire watersheds were harvested for all the salable timber. In many cases, major forest fires burned through the resulting slash piles, further degrading the productivity of the land and adding to the soil loss problems. Huge quantities of silt and sediment filled local streams, damaging fish habitat. While the steep gradient in many of the Pigeon River streams helps flush out sediments, some streams do not appear to have fully recovered.

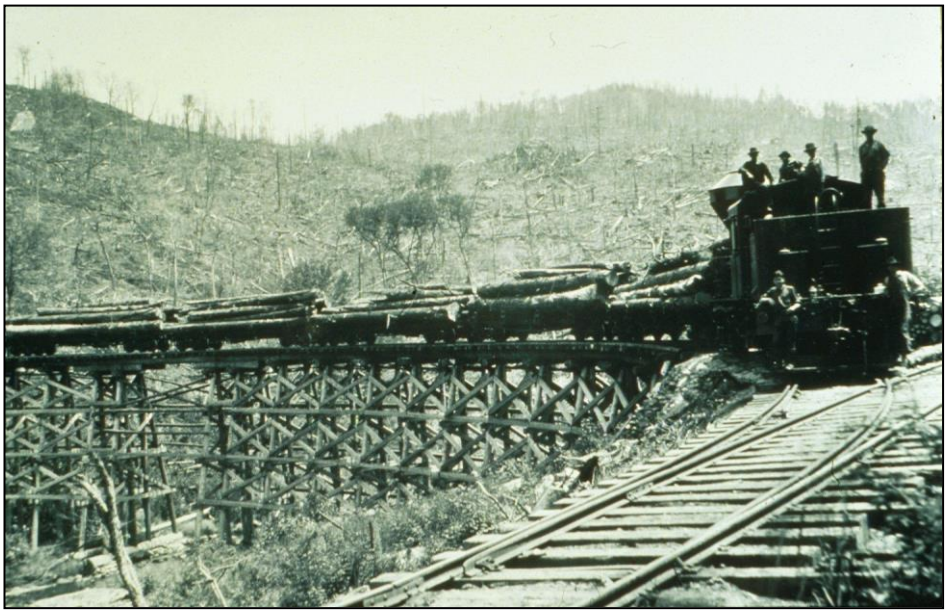

Figure 3. Railroad logging on lands that were to become part of the Pisgah National Forest

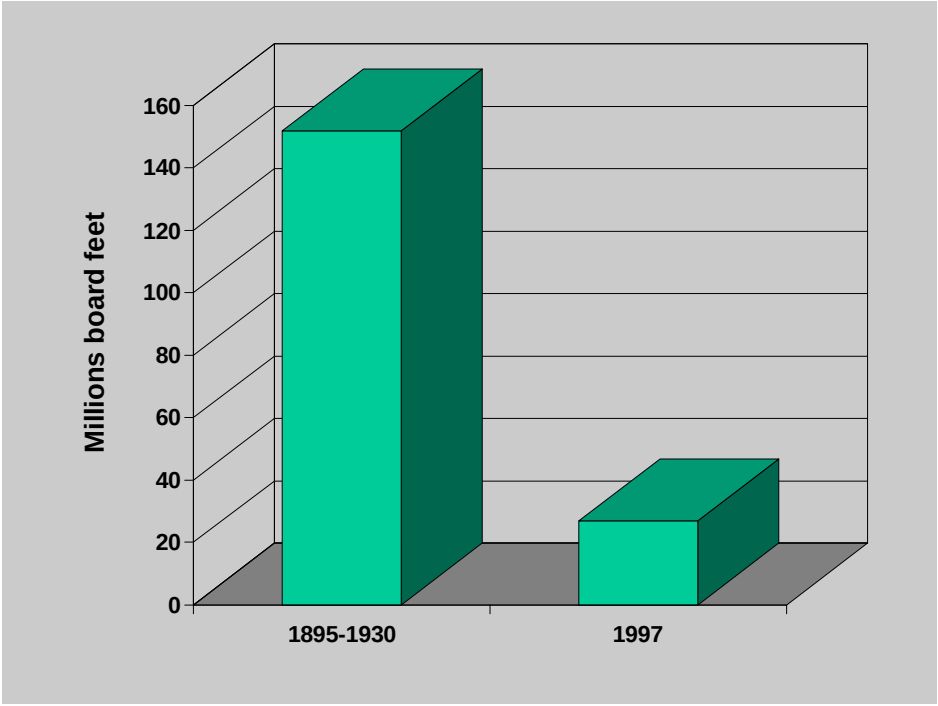

Figure 5. Comparison of annual hardwood harvest, 1895-1930 to 1997. (1895-1930 harvest levels estimated from limited yield data and documented sawmill activity during the 1895-1930 period; 1997 figures from USDA-FS Resource Bulletin SRS-39).

The railroads started a land use trend that accelerated with the completion of several major highways and strong economic growth since World War II. In addition to the residential needs of a growing population, Haywood County became a popular vacation and retirement destination. Many folks preferred to live in the mountains at higher elevations with the associated views. The result has been a proliferation of roads and homes on slopes and soils that are not well suited for the use and were seldom used for residential purposes. This shift in land use is creating a significant challenge to water quality, which will continue as economic activity continues to move away from growing food and fiber to growing roads and houses.

These changes in the Pigeon River Watershed have affected the geomorphology of the streams, the quality of the water, and the fish and wildlife habitat of the streams. For example, the railroad logging in the early 1900s caused dramatic changes in some watersheds. The cumulative effect of the construction of the railroads, the intensive logging, and the fires that often followed moved large quantities of topsoil into the streams. Due to the high gradient (steepness) of many of our streams, much of this material eventually washed out of Haywood County. However, some of this material can still be seen in the bottom of the streams in the form of "legacy" sediment. This sediment has degraded the biological potential of our streams to provide a high quality fisheries habitat. However, much of this sediment would be removed naturally over time if the current rate of sedimentation from present-day activities could be reduced.

Clean Water: To Be or Not To Be

Because Pigeon River surface water in Haywood County originates in Haywood County, we are in the unique situation of being able to decide how clean our water will be. The County is blessed with an abundance of public lands located on many of the headwaters of the Pigeon River. These lands include the Great Smoky Mountains National Park located on Cataloochee Creek and the Pisgah National Forest on the headwaters of the Upper Pigeon River. The Town of Waynesville owns the watershed for its municipal water supply, thus insuring some of the highest quality municipal water in the state.

The presence of these high quality waters contributes to the quality of life for area residents. There are many economic and conservation benefits. For example, Haywood County is recognized as having excellent trout waters. In addition to contributing to the enjoyment of local residents, this resource draws thousands of fishermen each year from outside our area. The ability of the Town of Waynesville to provide high quality water to businesses is a significant benefit to our community. Many agricultural and other activities draw water directly from area streams to support their economic activity. Vegetable growers generate over $2.5 million each year from their crops in the watershed. The natural beauty of these high quality waters is an aesthetic value and part of the scenery that draws tens of thousands to our area each year. On another level, these high quality waters are home to rare, threatened and endangred wildlife species. The presence of high quality, protected waters helps maintain high biological diversity.

However, there is sometimes a sharp contrast between the quality of the water originating from these publicly owned lands and that in other areas in the County. Activities contributing substantial amounts of sediment are having a variety of adverse impacts. For example, the managers of the Lake Junaluska Assembly are no longer able to keep up with the current rate of sedimentation. To remove all the sediment in Lake Junaluska at this time could cost $2 million or more. Even if money can be found to remove the sediment, it will only be a temporary solution unless the rate of erosion and sedimentation is reduced. In addition, the presence of substantial sediment loads reduces the trout habitat in Haywood County. Subsequent users of water, either in Haywood County or downstream, incur additional costs to remove sediment and other pollutants from the water. The erosion that is creating the sediment also destroys valuable land. In many cases, structures and roads are placed at risk as the eroding stream banks wash out land adjacent to the stream. Valuable agricultural land is at risk. Muddy and silt-choked streams threaten the natural beauty and aquatic habitats of our area.

Water Quality Measurements

The State of North Carolina Surface Water Classifications for the Pigeon River provide some insight as to water quality conditions. Many streams on public lands have classifications reflecting very high quality water. Examples include the Outstanding Resource Waters and High Quality Water classifications given certain streams in the National Park and National Forests as well as Rough Creek near Canton. Many streams have also been designated as trout waters.

The Water Supply Watershed Protection Act was passed in 1989 by the N.C. Legislature to improve protection of surface waters that are used as public drinking water supplies. As a result, the Environmental Management Commission revised water supply watershed classifications and adopted minimum watershed protection rules. Municipal and county governments are required to implement these regulations by developing watershed protection plans and ordinances for any water supply watershed within their jurisdiction. As part of this process, each water supply watershed is assigned one of five classifications, designated WS-I through WS-V, depending on their watershed characteristics. Watersheds classified as WS-I are essentially natural, undeveloped, and usually are assigned to publicly owned watersheds. In Haywood County, the Waynesville water supply on Allens Creek is classified as WS-I. The WS-II through WS-IV classifications apply to watersheds with increasing levels of development. The Pigeon River Watershed includes two other municipal watersheds classified as WS-III (Canton and Maggie Valley).

At the other end of the spectrum are waters classified as 303(d) streams. Streams in this category do not meet water quality standards for their designated uses and hence are identified as impaired waters. There are far fewer of these than the higher quality waters. However, they illustrate the wide range of water quality in the Pigeon River Watershed. Most streams reflect conditions somewhere between the outstanding waters and the streams listed 303(d). Appendix I summarizes the North Carolina Surface Water Classifications for the Pigeon River Watershed in Haywood County.

A number of organizations and agencies have been gathering water quality data in the Pigeon River Watershed for several years. These include the North Carolina Division of Water Quality, NC Wildlife Resources Commission, Tennessee Valley Authority, Evergreen Packaging (formerly Champion International), and HWA's Volunteer Water Information Network (VWIN).

There are a number of ways to monitor and assess water quality. One approach measures specific chemical and physical parameters of the water based on periodic samples taken from a stream at a defined point. Samples are gathered under controlled conditions and analyzed in a qualified laboratory. The resulting information describes what was in the water at the time and place where the sample was taken. VWIN volunteers have been collecting water quality data in this manner since August of 1996. It began as an effort funded by the Pigeon River Fund. The first efforts consisted of 12 water quality sampling sites in various watersheds of the Pigeon River. The effort has grown in number to the present 24 monitoring stations in Haywood County. Volunteers collect water samples once a month at the same location. The samples are analyzed by the Environmental Quality Institute (EQI) in Asheville, NC (a part of the University of North Carolina at Asheville system). An annual report is produced by EQI at the end of each sampling year.

The EQI tests for pH, alkalinity, turbidity, total suspended solids, conductivity, copper, lead, zinc, orthophosphate, ammonia nitrogen, and nitrate/nitrite-nitrogen. The results are compared to estimates of naturally occurring concentration ranges of each substance or quality and established state water quality standards. Based on how the steams compare over time, the stream segment covered by the sample is then assigned a quality letter grade of A (very good), B (good), C (fair), or D (poor). All the stream segments being sampled across all of western North Carolina (more than 148 sample sites) are ranked against each

other with a weighted scoring system. The top score for any stream was 100 points, and the minimum was 25. Since sediment is the biggest water quality issue in western North Carolina, the suspended solids parameter was given double weight. The following chart summarizes how the Pigeon River Watershed sample sites ranked when compared to other sampled waters in western North Carolina.

Figure 7. VWIN Volunteer Robin Minick samples water in Allen Creek

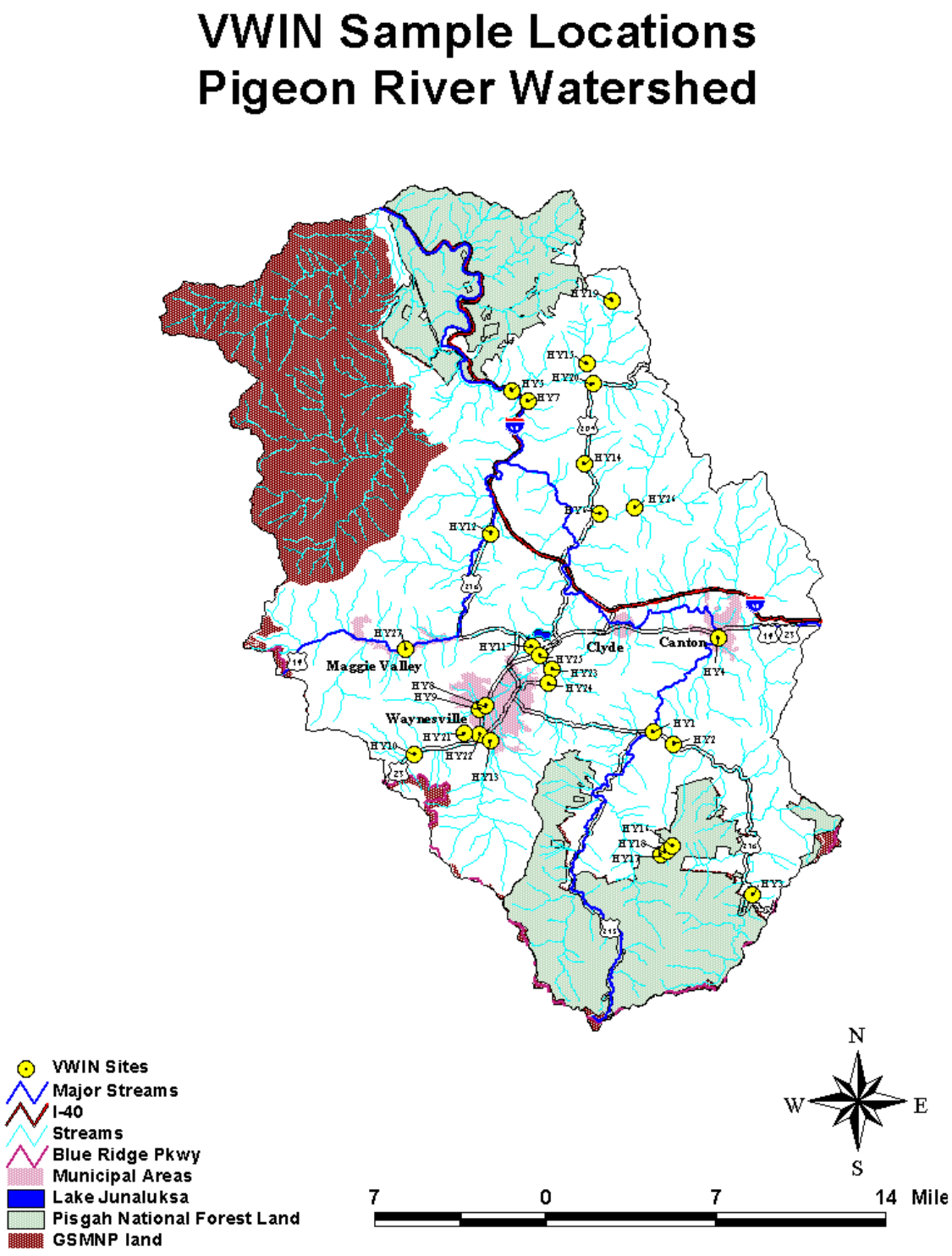

Figure 8. Volunteer Water Information Network (VWIN) Sample Locations

Table 2. VWIN Classifications

Site	Stream	Year 1 1996-97	Year 2 1997-98	Year 3 1998-99	Year 4 1999-00	Year 5 2000-01	Year 6 2001-02	Year 7 2002-03	Year 8 2003-04	Year 9 2004-05	Year 10 2005-06	Year 11 2006-07	Year 12 2007-08	Year 13 2008-09
Richland Creek and Jonathan Creek Watersheds														
13	Allens Creek		91 Excellent	75 Average	83 Good	81 Good	92 Excellent	87 Good	87 Good	87 Good	96 Excellent	98 Excellent	98 Excellent	98 Excellent
8	Eaglenest Creek	84 Good	82 Good	77 Average	78 Average	67 Below Average	68 Below Average	68 Below Average	74 Average	74 Average	67 Below Average	74 Average	78 Average	74 Average
21	Hyatt Creek upstream				47 Poor	49 Poor	51 Poor	51 Poor	53 Poor	51 Poor	51 Poor	51 Poor	53 Poor	51 Poor
22	Hyatt Creek downstream				57 Poor	55 Poor	50 Poor	53 Poor	50 Poor	52 Poor	50 Poor	56 Poor	56 Poor	56 Poor
28	Hyatt Creek Left Branch										52 Poor	72 Average	65 Below Average	65 Below Average
29	Hyatt Creek Owl Ridge Branch										56 Poor	60 Below Average	56 Poor	56 Poor
30	Hyatt Creek Green Valley Branch										47 Poor	58 Poor	52 Poor	52 Poor
9	Plott Creek	84 Good	84 Good	82 Good	81 Good	78 Average	69 Below Average	69 Below Average	69 Below Average	81 Good	81 Good	81 Good	83 Good	83 Good

Site	Stream	Year 1 1996-97	Year 2 1997-98	Year 3 1998-99	Year 4 1999-00	Year 5 2000-01	Year 6 2001-02	Year 7 2002-03	Year 8 2003-04	Year 9 2004-05	Year 10 2005-06	Year 11 2006-07	Year 12 2007-08	Year 13 2008-09
23	Ratcliff Cove Branch					78 Average	76 Average	74 Average	74 Average	67 Below Average	63 Below Average	67 Below Average	67 Below Average	67 Below Average
24	Raccoon Creek upstream					74 Average	81 Good	76 Average	72 Average	60 Below Average	67 Below Average	67 Below Average	73 Average	75 Average
25	Raccoon Creek downstream					81 Good	76 Average	81 Good	76 Average	71 Average	73 Average	73 Average	71 Average	77 Average
10	Richland Creek upstream	86 Good	89 Good	89 Excellent	88 Good	87 Good	80 Good	80 Good	85 Good	85 Good	85 Good	91 Excellent	91 Excellent	91 Excellent
11	Richland Creek at Lake Junaluska	80 Good	82 Good	80 Good	69 Below Average	69 Below Average	66 Below Average	88 Good	90 Excellent	87 Good	87 Good	95 Excellent	83 Good	83 Good
27	Jonathan Creek in Maggie Valley					94 Excellent	97 Excellent	97 Excellent	78 Average	78 Average	76 Average	81 Good	81 Good	81 Good
12	Jonathan Creek downstream	80 Good	75 Average	75 Average	71 Average	69 Below Average	69 Below Average	78 Average	78 Average	91 Excellent	87 Good	83 Good	81 Good	81 Good
Average for this group		**84**	**86**	**81**	**72**	**72**	**71**	**73**	**73**	**72**	**67**	**73**	**73**	**73**
Rural Northeastern Watersheds														
32	Beaverdam Creek upstream												70 Average	72 Average

Site	Stream	Year 1 1996-97	Year 2 1997-98	Year 3 1998-99	Year 4 1999-00	Year 5 2000-01	Year 6 2001-02	Year 7 2002-03	Year 8 2003-04	Year 9 2004-05	Year 10 2005-06	Year 11 2006-07	Year 12 2007-08	Year 13 2008-09
31	Beaverdam Creek downstream												82 Good	82 Good
20	Cove Creek (Fines Creek watershed)				56 Poor	57 Poor	57 Poor	62 Below Average	58 Poor	58 Poor	58 Poor	58 Poor	58 Poor	58 Poor
26	Crabtree Creek					83 Good	70 Average	72 Average	72 Average	75 Average	75 Average	71 Average	79 Average	75 Average
19	Fines Creek upstream				63 Below Average	65 Below Average	65 Below Average	69 Below Average	69 Below Average	65 Below Average	65 Below Average	67 Below Average	67 Below Average	67 Below Average
15	Fines Creek midstream		75 Average	73 Average	58 Poor	66 Below Average	60 Below Average	60 Below Average	59 Poor	55 Poor	64 Below Average	60 Below Average	64 Below Average	64 Below Average
7	Fines Creek downstream	68 Below Average	71 Average	55 Poor	49 Poor	59 Poor	54 Poor	67 Below Average	70 Average	66 Below Average	66 Below Average	66 Below Average	72 Average	68 Below Average
14	Rush Fork upstream (Crabtree Creek watershed)		75 Average	66 Below Average	60 Below Average	62 Below Average	58 Poor	62 Below Average	65 Below Average	60 Below Average	60 Below Average	60 Below Average	60 Below Average	60 Below Average
6	Rush Fork downstream (Crabtree Creek watershed)	66 Below Average	61 Below Average	50 Poor	58 Poor	55 Poor	55 Poor	55 Poor	53 Poor	69 Below Average	79 Average	76 Average	78 Average	78 Average
Average for this group		**67**	**71**	**61**	**57**	**64**	**60**	**64**	**64**	**64**	**67**	**65**	**70**	**69**

Site	Stream	Year 1 1996-97	Year 2 1997-98	Year 3 1998-99	Year 4 1999-00	Year 5 2000-01	Year 6 2001-02	Year 7 2002-03	Year 8 2003-04	Year 9 2004-05	Year 10 2005-06	Year 11 2006-07	Year 12 2007-08	Year 13 2008-09
Pigeon River and Upper Forks														
2	East Fork Pigeon River at Bethel	93 Excellent	84 Good	93 Excellent	92 Excellent	92 Excellent	92 Excellent	100 Excellent	100 Excellent	100 Excellent	100 Excellent	100 Excellent	100 Excellent	100 Excellent
3	East Fork Pigeon River at Cruso	100 Excellent	100 Excellent	100 Excellent	100 Excellent	98 Excellent	98 Excellent	98 Excellent	100 Excellent	100 Excellent	98 Excellent	98 Excellent	96 Excellent	96 Excellent
4	Pigeon River downstream from Canton	68 Below Average	61 Below Average	55 Poor	60 Below Average	60 Below Average	60 Below Average	74 Average	68 Below Average	72 Average	75 Average	74 Average	72 Average	72 Average
5	Pigeon River at Hepco Bridge	73 Average	73 Average	55 Poor	46 Poor	38 Poor	48 Poor	63 Below Average	63 Below Average	77 Average	69 Below Average	69 Below Average	66 Below Average	66 Below Average
1	West Fork Pigeon River at Bethel	93 Excellent	96 Excellent	96 Excellent	98 Excellent	98 Excellent	95 Excellent	98 Excellent	98 Excellent	98 Excellent	100 Excellent	100 Excellent	100 Excellent	100 Excellent
16	Sorrell's Creek (upstream of fish farm)		96 Excellent	96 Excellent										
17	Sorrell's Creek downstream of fish farm)		84 Good	84 Good										
18	Sorrell's Creek (effluent of fish farm)			89 Good										
Average for this group		**85**	**85**	**84**	**79**	**77**	**79**	**87**	**86**	**89**	**88**	**88**	**87**	**87**

Table 3. Pigeon River Stream classifications; 2008 to 2009 VWIN Summary

Site	pH	Alk	Turb	TSS	Cond	Cu	Pb	Zn	Ortho P	NH_3-N	NO_3-N
1- West Fork Pigeon River (Bethel)	A	D	A	A	A	A	A	A	A	A	A
2- East Fork Pigeon River (Bethel)	A	D	A	A	A	A	A	A	A	A	A
3- East Fork Pigeon River (Cruso)	A	D	A	A	A	B	A	B	A	A	A
4- Pigeon River (downstream of Canton)	A	A	B	A	D	B	A	B	D	C	A
5- Pigeon River (Hepco Bridge)	A	A	C	B	D	B	A	B	D	A	B
6- Rush Fork (downstream)	A	A	B	A	C	A	A	A	D	A	C
7- Fines Creek (lower)	A	B	C	C	C	A	A	A	C	A	C
8- Eaglenest Creek (Hazelwood)	A	B	C	C	C	B	A	A	A	A	B
9- Plott Creek (Hazelwood)	A	C	B	C	B	A	A	A	A	A	B
10- Richland Creek (West Waynesville)	A	C	B	A	B	A	A	A	A	A	B
11- Richland Creek (Lake Junaluska)	A	B	C	A	C	B	A	A	A	A	B
12- Jonathan Creek (lower)	A	C	C	B	B	B	A	A	A	A	B
13- Allens Creek (Waynesville)	A	D	A	A	B	A	A	A	A	A	A
14- Rush Fork (upstream)	A	B	D	D	D	A	A	A	C	A	B
15- Fines Creek (middle)	A	B	C	D	C	A	A	A	C	A	C
19- Fines Creek (upper)	A	B	D	D	B	A	A	A	B	A	B
20- Cove Creek (Fines Creek)	A	B	D	D	D	A	A	A	C	A	C
21- Hyatt Creek (upstream)	A	B	D	D	C	C	A	B	C	B	C
22- Hyatt Creek (downstream)	A	A	D	D	C	B	A	B	C	A	C
23- Ratcliff Cove Branch	A	A	D	C	C	A	A	A	B	A	C
24- Raccoon Creek (upstream)	A	A	C	B	C	A	A	A	B	A	C
25- Raccoon Creek (downstream)	A	A	C	A	C	B	A	A	B	A	C
26- Crabtree Creek	A	B	C	B	C	A	A	A	C	A	B
27- Jonathan Creek (upper)	A	D	C	B	B	B	A	A	A	A	B
28- Hyatt Creek Left Branch	A	A	C	D	C	B	A	B	B	A	B
29- Hyatt Creek Owl Ridge Branch	A	A	D	D	C	C	A	B	B	A	C
30- Hyatt Creek Green Valley Branch	A	A	C	C	D	B	A	D	C	C	C
31- Beaverdam Creek (downstream)	A	A	B	B	C	A	A	A	B	A	B
32- Beaverdam Creek (upstream)	A	B	C	D	C	A	A	A	A	A	B

Year 13: 2008 to 2009 VWIN Summary

Site #	Site Description	Site Ranking
		Excellent
HY1	West Fork Pigeon River (Bethel)	100
HY2	East Fork Pigeon River (Bethel)	100
HY13	Allens Creek (Waynesville)	98
HY3	East Fork Pigeon River (Cruso)	96
HY10	Richland Creek (West Waynesville)	91
		Good
HY9	Plott Creek (Hazelwood)	83
HY11	Richland Creek (Lake Junaluska)	83
HY31	Beaverdam Creek (downstream)	82
HY12	Jonathan Creek (lower)	81
HY27	Jonathan Creek (upper)	81
		Average
HY6	Rush Fork (downstream)	78
HY25	Raccoon Creek (downstream)	77
HY24	Raccoon Creek (upstream)	75
HY26	Crabtree Creek	75
HY8	Eaglenest Creek (Hazelwood)	74
HY4	Pigeon River (downstream of Canton)	72
HY32	Beaverdam Creek (upstream)	72
		Below Average
HY7	Fines Creek (lower)	68
HY19	Fines Creek (upper)	67
HY23	Ratcliff Cove Branch	67
HY5	Pigeon River (Hepco Bridge)	66
HY28	Hyatt Creek Left Branch	65
HY15	Fines Creek (middle)	64
HY14	Rush Fork (upstream)	60
		Poor
HY20	Cove Creek (Fines Creek)	58
HY22	Hyatt Creek (downstream)	56
HY29	Hyatt Creek Owl Ridge Branch	56
HY30	Hyatt Creek Green Valley Branch	52
HY21	Hyatt Creek (upstream)	51

Excellent: Median and maximum pollutant levels in all parameters show little effect from human disturbances

Good: One or more parameters show minor or only occasional increases in pollutant levels from human disturbances

Average: Exhibits constant low levels of one or more pollutants or sudden significant, but short term increases

Below Average: Median pollutant levels are abnormally high in one or more parameters, or exhibits very high pollutant levels during certain weather conditions

Poor: Pollutant levels are consistently higher than average in several parameters and/or show extreme levels during certain weather conditions

Source: Water Quality Trends of Haywood County: Year-13 Report. Environmental Quality Institute. November, 2009

The VWIN ranking for Richland Creek and Jonathan Creek streams have declined since the 1999 data was gathered. The lower site on Jonathon Creek has declined one stream rank for three successive years (1999 – 2001), dropping from good, to average, to below average. The longer this data is gathered, the easier it will be to assess meaningful trends.

Other approaches use biological indicators to assess the health of the stream. TVA has been compiling an Index of Biotic Integrity (IBI) for the Pigeon River Watershed during the 1990s. The index is compiled by sampling to determine which fish are in the water, and in what numbers. The ecological health of a body of water is its ability to support communities of animals and aquatic plants that characterize the best expected environmental conditions. Declining environmental health is usually characterized by a loss of species, increased numbers of organisms tolerant of poor environmental conditions, increased disease rate, and eventually decreased number of animals. Since fish are relatively long-lived and use different habitats during their life cycles, they are useful in detecting problems over a longer term (years) as well as problems affecting one or more habitats. TVA has sampled thousands of streams throughout their multi-state area and developed indices or metrics from these samples as a basis for assessing the quality of sampled streams. However, they recognize the higher elevation streams (above 2,000 feet), particularly trout waters, do not have the same diversity of species as lower elevation streams, and the established metrics may not provide a totally accurate assessment of stream conditions for such waters. TVA has rated some Pigeon River Watershed stream segments according to their metrics, recognizing that this information may need to be adjusted as more data is gathered.

The State of North Carolina Department of Environment and Natural Resources (DENR) has also been collecting fish samples to obtain biological indicators of biological health. As with the TVA, they have found that the metrics developed for other streams in the state have limited application for mountain waters. Therefore, the State is continuing to refine its metrics for mountain streams and has not rated Pigeon River streams based on fish sampling data.

Several methods have also been developed for ecological indices using the macroinvertebrate communities. These methods range from a simple count of intolerant species (mayflies, stoneflies, and caddisflies) to indices that use several measures of the macroinvertebrate community. The acronym for this type of survey is EPT, for the first letters of the orders of the mayflies, stoneflies, and caddisflies (**E**phemeroptera, **P**lecoptera, and **T**richoptera). Generally, macroinvertebrates are more resilient to environmental problems than fish, less mobile than fish, and may require only a limited amount of preferred habitat for survival. These differences make macroinvertebrate indices more suitable for measuring short-term and localized ecological health. TVA and the State of North Carolina have been collecting this type of biological data in the Pigeon River Watershed for several years. The State of North Carolina relies more heavily on this EPT information when rating stream segments. However, the EPT sampling to date has limitations in assessing sediment problems. Part of this problem is due to the stream segments being sampled, but other limitations are inherent in this type of sampling. The following chart summarizes the biological sampling results in the Pigeon River Watershed.

Table 4. Basinwide Benthic Macroinvertebrate Monitoring Sites in French Broad River Sub-basin (1997 and later). All sites are in the Pigeon River Watershed, Haywood County, NC.

Stream	Monitoring Agency	Road or River Mile	Rating
Pigeon River	NC	NC 215	Excellent
Pigeon River, Hyder Mtn. Bridge	TVA	RM 55.4	Fair/Good
Pigeon River, Pisgah Mem. Stadium	TVA	RM 64.5	Good
West Fork Pigeon River Riverside Baptist Ch.	TVA	RM 3.6	Good
Bird Creek	TVA	RM 0.39	Poor
West Fork Pigeon River	NC	SR 1216	Excellent
East Fork Pigeon River	NC	US 276	Excellent
East Fork Pigeon River, above Lenoir Creek	TVA	RM 3.5	Good
Pigeon River	NC	SR 1642, Clyde	Fair
Pigeon River at new Hepco Bridge	TVA	RM 42.6	Fair
Pigeon River	NC	SR 1338, Hepco	Good-Fair
Pigeon River	NC	I-40, Waterville	Good
Raccoon Creek at Junaluska School	TVA	RM 0.5	Fair
Richland Creek	NC	US 23 Business	Good-Fair
Richland Creek	NC	SR 1184	Good-Fair
Richland Creek at Vance Street Park	TVA	RM 5.7	Poor/Fair
Shiny Creek	NC	Upstream Allen Cr. Reservoir	Excellent
Richland Creek	NC	SR 1519	Fair
Jonathan Creek	NC	SR 1306	Excellent
Jonathan Creek	NC	SR 1322	Excellent
Jonathan Creek	NC	SR 1349	Excellent
Jonathan Creek at Whiteoak Road	TVA	RM 0.7	Good
Fines Creek	NC	SR 1355	Good-Fair
Cataloochee Creek	NC	SR 1395	Excellent
Big Creek above Walters Power Plant	TVA	RM 0.2	Good
Big Creek	NC	in GSMNP	Excellent

Source: French Broad River Basinwide Water Quality Plan (May 2000) and IPSI Summary for the Pigeon River Watershed provided by TVA.

The VWIN and biological sampling water quality findings demonstrate considerable variability, depending on the sampling station. As a general rule, the VWIN data ranks streams better than the EPT or IBI approaches. EPT data often provides higher rankings than the fish information at specific stations.

Some of these differences are probably a result of the unresolved standards issue mentioned above. In addition, some sample stations may reflect very localized conditions (like straight piping in the vicinity). However, some of these differences may reflect the watershed history. The intensive upstream uses, such as agriculture and railroad logging, have created a large streambed load of sediment in many area streams. The water flowing above this sediment may appear clean, but the sediment has destroyed considerable biological habitat. Research at Coweta Hydrologic Laboratory indicates that some of these affects may be reduced if the current levels of erosion and sedimentation are reduced. The steep gradients and intense storms that occasionally visit the mountains will help flush out these stream channels. However, they will never clean themselves if sediment continues to be added as rapidly as it is removed.

For the purpose of this report, priority has been given to addressing problems in subwatersheds where the majority of the water quality information indicates a problem. Stream segments with mixed sampling results or more limited data have been assessed based on any available specific knowledge about the sample site and sampling conditions. Where local knowledge helps explain the variability, the data has been considered accordingly.

The Pigeon River has very variable water quality. Some of its headwaters are producing very high quality water. Examples include the West Fork of the Pigeon River on National Forest land, Allen Creek above the Town of Waynesville Municipal reservoir, and Big Creek and Cataloochee Creek in the Great Smoky Mountains National Park. However, some stream segments are also rated in poor condition. The summary table in Appendix I indicates the state stream classification by segment for all streams in the Pigeon River Watershed.

The VWIN sampling has identified the primary pollutants affecting the surface waters of the Pigeon River Watershed. As in so much of the nation, sediment from nonpoint sources is the most significant pollutant. A few subwatersheds also show higher than average nitrogen levels. While this issue is not as significant as sediment, it may provide clues as to the source of the sediment.

Stormwater management issues are an integral part of any discussion of nonpoint pollution issues in the Pigeon River Watershed. As human activities increase within an area, various pollutants are deposited on the surface of the land. These pollutants are washed off by precipitation and flushed into storm drains or directly into streams, rivers, and lakes. Sediment, nutrients, bacteria and viruses, oil and grease, trace metals, toxic chemicals, and other pollutants are commonly found in stormwater runoff. The increased amount of impervious area in roads, parking lots, roofs, and driveways accelerates the rate of runoff, increasing the erosion potential from any storm event. Most of the sediment that washes into Pigeon River Watershed streams occurs during periods of high precipitation when stormwater runoff is at its greatest. Although this report focuses on nonpoint pollution issues, the sampling results in the Lower Pigeon River also reflect the effects of point source pollution from the paper mill at Canton, NC. During the last 10 years, Champion International and now Blue Ridge Paper Products have greatly reduced the point source discharges from the mill. The 2000 French Broad River Basinwide Water Quality Plan documents substantial improvements in the quality of water below the Blue Ridge Paper Products discharge. Conductivity dropped by about 50% at the Clyde sampling station. The report also states that the water quality conditions have improved tremendously since 1990. More detail about these improvements can be found in the French Broad River Basinwide Water Quality Plan, published by the North Carolina Department of Environment and Natural Resources.

Sources of Non-Point Pollution

Once the quality of the water has been ascertained, it is helpful to identify the sources of identified pollutants. This information allows the development of focused abatement plans, supports grant requests for Best Management Practices projects, and helps federal, state and local governments and agencies address the highest priority issues. It would be prohibitively expensive and logistically difficult to gather this information through field surveys and measurements of all the local watersheds. Fortunately, there is technology that can provide this information in a more efficient manner.

In the case of the Pigeon River Watershed, HWA obtained a grant from the Pigeon River Fund to contract with TVA for an Integrated Pollutant Source Identification (IPSI) project. This project consisted of obtaining leaf-off color infrared aerial photographs in April of 1999. Experienced photo interpreters on the staff of TVA interpreted these aerial photographs using 8x mirror stereoscopes. The interpreted data was digitized so it could be displayed and analyzed within a geographic information system (GIS) environment (ArcView). This makes it possible to not only graphically display what the photo interpreters found on the photographs, but also spatially analyze the information to determine numbers of points, length of lines, and area of polygons. When this data is combined with appropriate coefficients provided by the field office of the Natural Resources Conservation Service (NRCS) and the Haywood Soil and Water Conservation District (HSWCD), it is possible to identify, quantify and compare the various sources of nonpoint pollution in the Pigeon River Watershed. The analysis started by using the GIS data to quantify the sources (feet of eroding stream bank, acres of eroding pastureland, etc). NRCS and the HSWCD provided soil loss equation coefficients representing Haywood County conditions for each particular source. The soil loss data was adjusted by local area factors to develop an estimate of the amount of sediment and other pollutants actually deposited in the streams. That analysis was completed in the spring of 2000, and the results were presented to the public in a series of public forums.

A great many land uses contribute to nonpoint pollution. TVA's inventory includes a variety of sources, ranging from industrial sites to hog farms. However, after the analysis was done, five sources were found to contribute about 95% of the sediment being deposited in Pigeon River Watershed streams. Two sources (eroding stream banks and roads) contribute 73%. Most of the erosion from these sources occurs during periods of high stormwater runoff.

The following graph summarizes the soil movement off site from several significant activities. While these numbers do not represent the amount of sediment getting in the creek, they do provide a comparison of soil loss from the major sources.

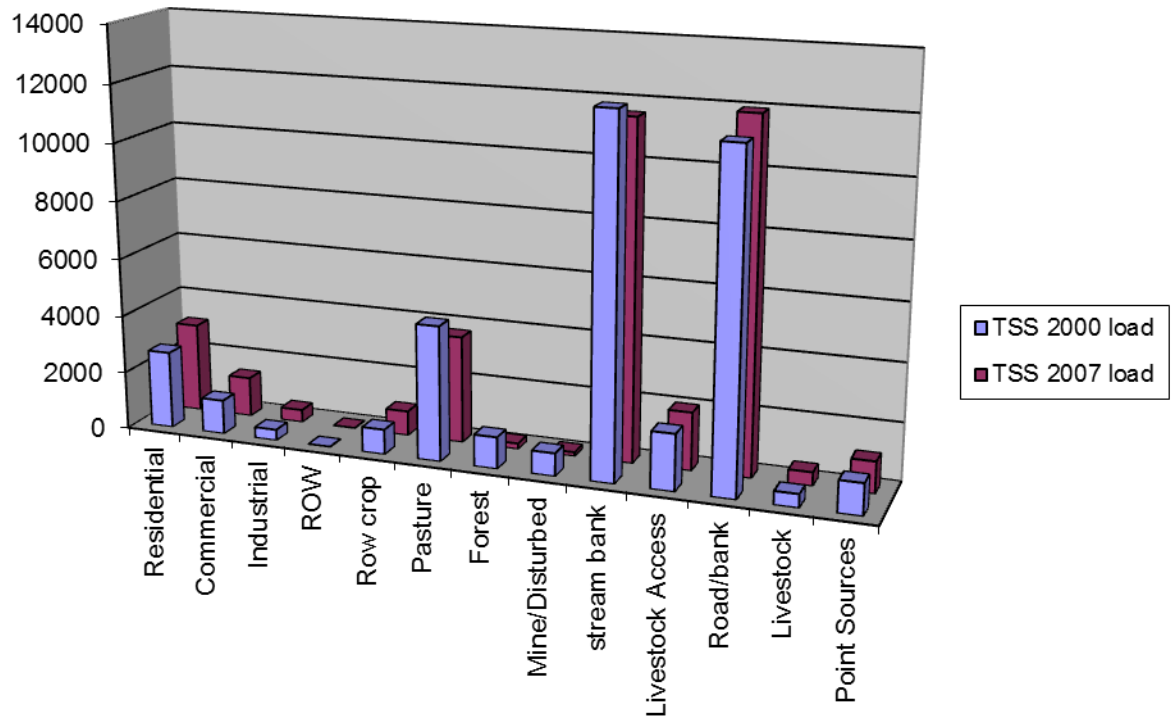

Figure X. Soil Loss by Land Use in the Pigeon River Watershed

This report focuses on the leading sources of sediment. However, there are several other sources of pollution the inventory identified that need to be addressed. Examples include an estimated 237 illegal dumpsites and 222 animal access points to streams. This water quality information is now summarized for the entire Pigeon River Watershed in Haywood County, as well as four major subwatersheds (Upper Pigeon, Lower Pigeon, Richland Creek, and Jonathan Creek) that make up the Pigeon River Watershed.

Pigeon River

As part of the IPSI analysis, TVA classified all the land in the Pigeon River Watershed into 24 land use/land cover classes. Many of these subdivisions were a qualitative subdivision of a larger group, such as good pasture, fair pasture, woodland pasture, heavily overgrazed pasture, and poor pasture. In the interest of illustrating relationships and watershed differences, these categories were aggregated into six land use groups: forest, pasture, cropland, residential, commercial and other.

The cropland figure was based on the appearance of the land in April of 1999. It was classified as cropland if evidence of row cropping was visible from the air. In some cases, farmers had planted cover crops on their cropland, and some of what USDA classifies as cropland was interpreted as pasture, probably in the good pasture category.

The predominant land cover in the watershed is forest. TVA classed about 77% of the watershed as forest. However, that is the visible cover on the aerial photographs or what a visitor sees when driving for pleasure. It does not reflect infrastructure and institutional changes that have committed these forested lands to other uses. These changes can often be illustrated by examining the TVA road information and the Haywood County land records. In some watersheds, the majority of the forest area has been committed to residential uses through the construction of subdivision roads and/or the sale of small parcels for residential use. The future of some areas of Haywood County has already been determined—it was just not visible in April of 1999. The development of these more intensive uses will have long-lasting effects on the watershed.

Pastures are the next largest land use category, representing about 11% of the watershed. The condition of these pastures varies widely, with the largest area represented by pasture in fair condition. Residential use makes up about 6% of the land area, with low density residential use (fewer than two residences per acre) representing over 85% of this category. Several uses were included in an “other” category (open water, mines, orchards, and brushland). This group accounts for about 4% of the land area. Commercial and cropland uses account for 3%.

There are numerous sources that contribute sediment to area streams. Even undisturbed forestland contributes sediment, albeit at a very low level. While the data is available for all uses, this report focuses on those activities and land uses that contribute the majority of sediment in the Pigeon River Watershed. The two most significant contributors are eroding stream banks and roads. These two sources contribute 73% of the total sediment being deposited in Pigeon River Watershed streams. The third most significant contributor was pastureland (15%) with pastures in fair condition contributing 11% of sediment to streams. The following chart summarizes the primary sources of sediment in the watershed.

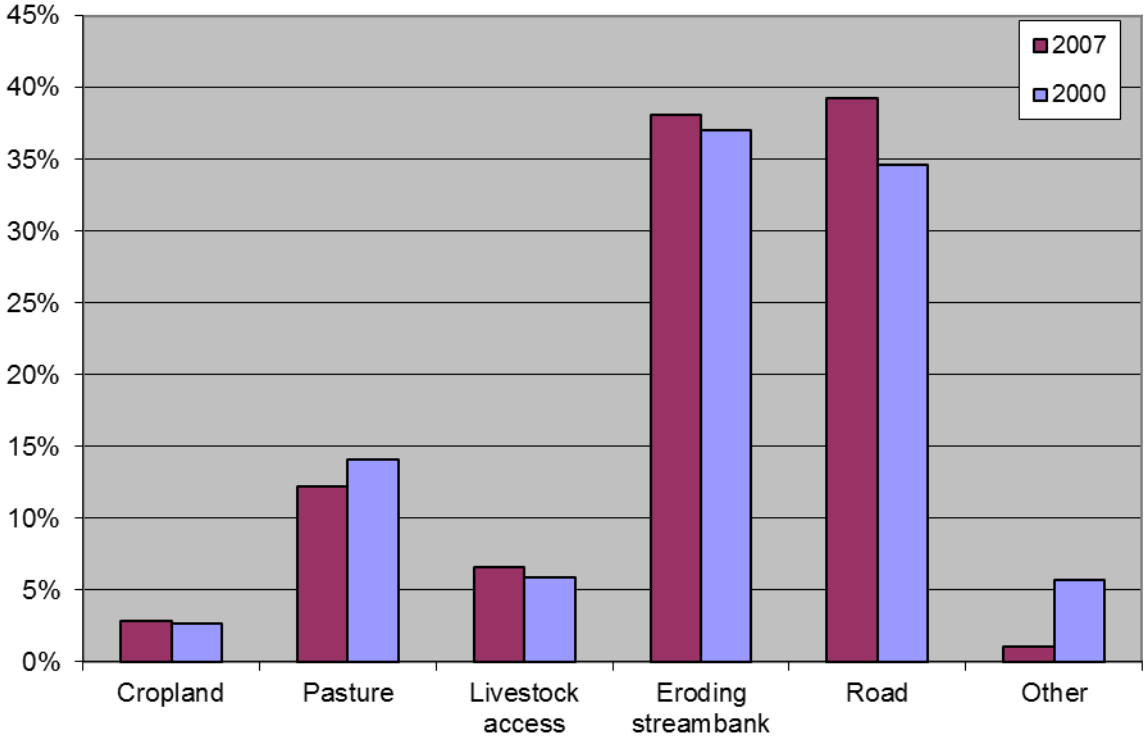

Figure 10. Primary Sources of Sediment to Streams in the Pigeon River Watershed (source: IPSI)

Eroding stream banks represent a small percentage of the total mileage of streams in the County. However, every cubic foot of soil that falls off the bank goes directly into the stream. The IPSI data indicates that 6% of the Pigeon River Watershed streams have eroding stream banks. Much of this is concentrated in a few subwatersheds. Analyses of the aerial photographs identified the eroding stream banks along the larger, perennial streams. There are additional eroding steam banks on several small tributaries.

The roads category includes runoff from road surfaces, ditches, and eroding cut and fills slopes. Roads serve a variety of purposes. Many are constructed for residential subdivisions. However, roads are also built as access to individual residences, as well as for forestry, agricultural, and industrial purposes.

The land use changes occurring in the watershed have important implications for this source of sediment. We are experiencing a "sustained yield" of new roads. The hundreds of new houses being built each year often require new or upgraded roads. An annual flush of sediment from new roads is maintained in the watershed by building new homes and roads. In addition, the "background" sediment level continues to increase from the roads added in previous years.

Figure 11. Severe erosion from an unpaved road

The impact of the roads on Pigeon River water quality reflects a number of factors. These include whether the road is paved or unpaved. If it is a gravel surface, how good a gravel surface is on the road? A well-graveled road surface will contribute substantially less than one where the protection of the surface material has been worn away. What is the grade on the road? Steep roads are at much greater risk for erosion. Another significant item is the condition of the road ditches. Much of the sediment from roads comes from road ditches, where the storm runoff is concentrated. Are there adequate culverts to avoid long grades where the water can gather force? Have the ditches been vegetated or hardened? Is the stormwater concentrated or dispersed? Have the road banks (cut and fill banks) been vegetated and stabilized? Is the road newly constructed? What type of soil is the road constructed across?

Haywood County has a substantial number of roads and road mileage. There are about 3,200 miles of private and state roads in the Pigeon River Watershed. This is a road density of one mile of road for every 107 acres. This density is increasing every year. Much of the new mileage is on steep slopes with erodible soils. Haywood County does have a Subdivision and Predevelopment Ordinance to provide some guidelines on slope for road construction, but some consider it to be limited. Many roads are built in support of new housing developments. The roads and associated housing and driveways are substantially increasing the percent of impervious area in some watersheds. The more impervious area there is, the

faster stormwater will run off into the creeks and river. This accelerated runoff causes streams to rise more rapidly. The increased flows can damage stream banks, property, roads, bridges, and important wildlife habitat. The faster it runs off, the more damage it does, and the more sediment it carries with it. Downstream stream banks will be eroded away at increasing rates, and flooding will be a greater risk. Many residents have experienced the results of a new house being constructed on the hill above them. There is suddenly a lot more water to deal with. Multiply that hundreds of times in a small watershed and the consequences are significant.

The Pigeon River Watershed has a small percentage of its land base (1.9%) in impervious surfaces such as roads, roofs, driveways, parking lots, etc. However, this watershed includes large acreages of public land where there are few impervious areas. Focusing on a smaller watershed can give a more accurate picture. A good example is the Plott Creek Watershed off Richland Creek. The TVA data indicates that about 76% of this small watershed is forested. However, the road data indicates that much of the forested land has already been committed to subdivision development, with some houses already in place. Once this portion of Plott Creek is fully developed as a low density residential subdivision, over 60% of this small watershed will go from almost 0% impervious areas to around 10% of the area dedicated to impervious surfaces, increasing runoff rates and pressure on downstream lands and resources.

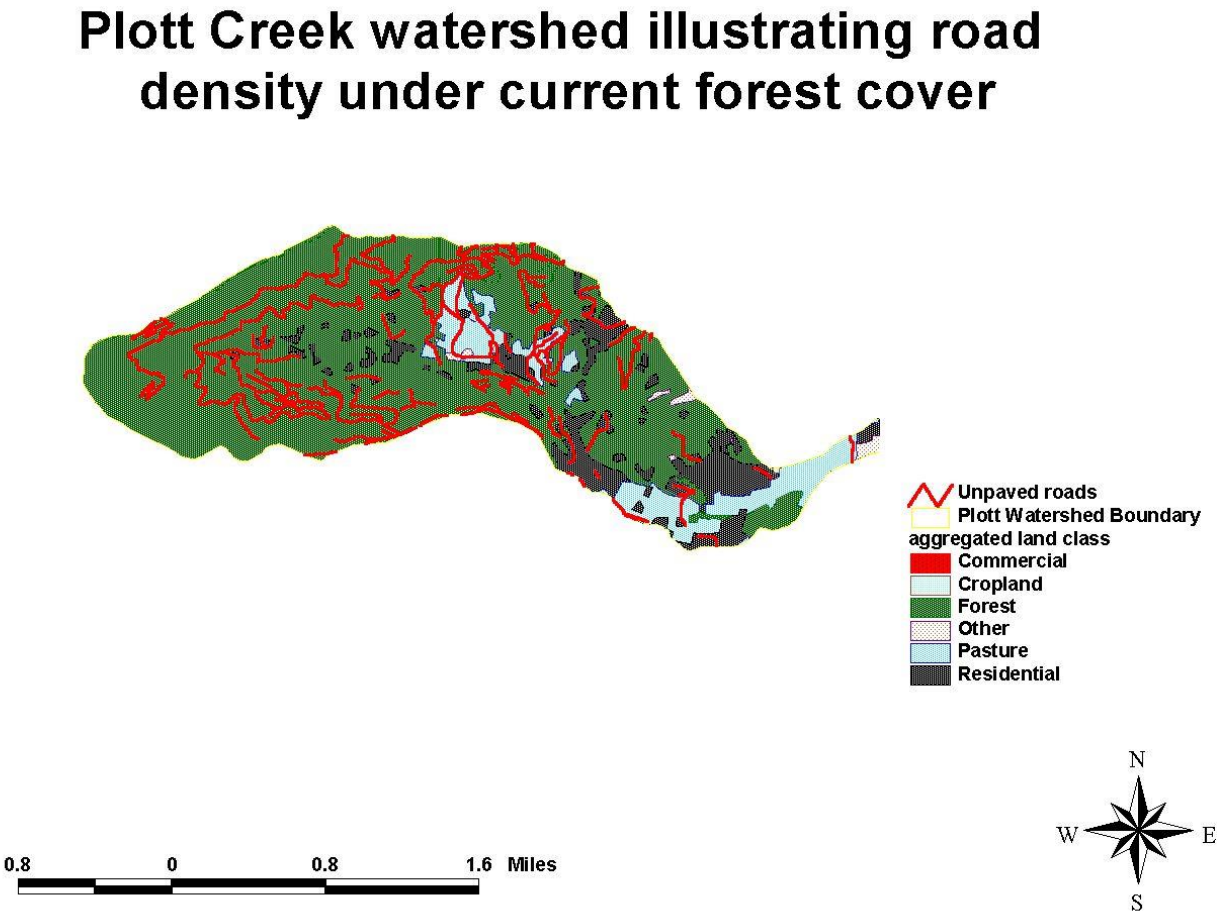

Figure 12. Example of IPSI data

Upper Pigeon

The Upper Pigeon River Watershed consists of 107,569 acres of land on the waters of the Pigeon River above the point where Richland Creek joins the Pigeon River. It includes the East and West Forks of the Pigeon River and that portion of the watershed between the junction of the Forks and Richland Creek (including the towns of Canton and Clyde). The State of North Carolina has classified the upper portion of this watershed a WS-III watershed (Water Supply III). This imposes certain land use guidelines within the watershed. Much of the headwater acreage is part of the Pisgah National Forest. There are many designated trout streams in the upper portion of this watershed, as well as a significant acreage the state has classified as High Quality Waters. Land uses intensify below the Forks of the Pigeon, and water quality reflects these changes.

There is a smaller watershed of note near the town of Canton. The Rough Creek Watershed is less than 1,000 acres in size and has been designated as WS I, Outstanding Resource Waters, and a trout stream. Much of this watershed is owned by the town of Canton and had been acquired as a site for a municipal reservoir. The presence of this high quality water so close to developed areas represents a significant resource.

Blue Ridge Paper Products obtains water for their Canton mill from Upper Pigeon Watershed, as does the Town of Canton. Water quality is an important consideration for both uses. In addition, this watershed contains popular trout streams.

The Episcopal Church Diocese for Western North Carolina recently acquired the property around Lake Logan on the West Fork of the Pigeon River. This property was acquired to serve as a major retreat center for the Episcopal Church. The public acquisition of much of the land above this reservoir will help assure a permanent source of high quality water for this facility. Clean water and minimum sedimentation of the lake are important issues for the success of the retreat center.

There are two active trout farms on the West Fork of the Pigeon River. These aquaculture businesses produce fish for commercial markets and recreational use.

About 73% of this subwatershed is classified as forest. Pasture is the next largest category of land use, accounting for about 11% of the acreage. About 9,400 acres (8.7% of the total) are classified as pasture in fair condition. Since the towns of Canton and Clyde are located in this watershed, about 8% of the watershed is dedicated to residential uses, with the majority of this acreage being low density residential use. The percent of the watershed in impervious area is 2.3%. The “other” land use category accounts for 5% of the acreage. Lands dedicated to commercial uses account for 2% of the land area, and croplands occupy about 1%.

There are 1007 miles of all categories of roads in the Upper Pigeon Watershed. This is a road density of 1 mile of road for 107 acres of land.

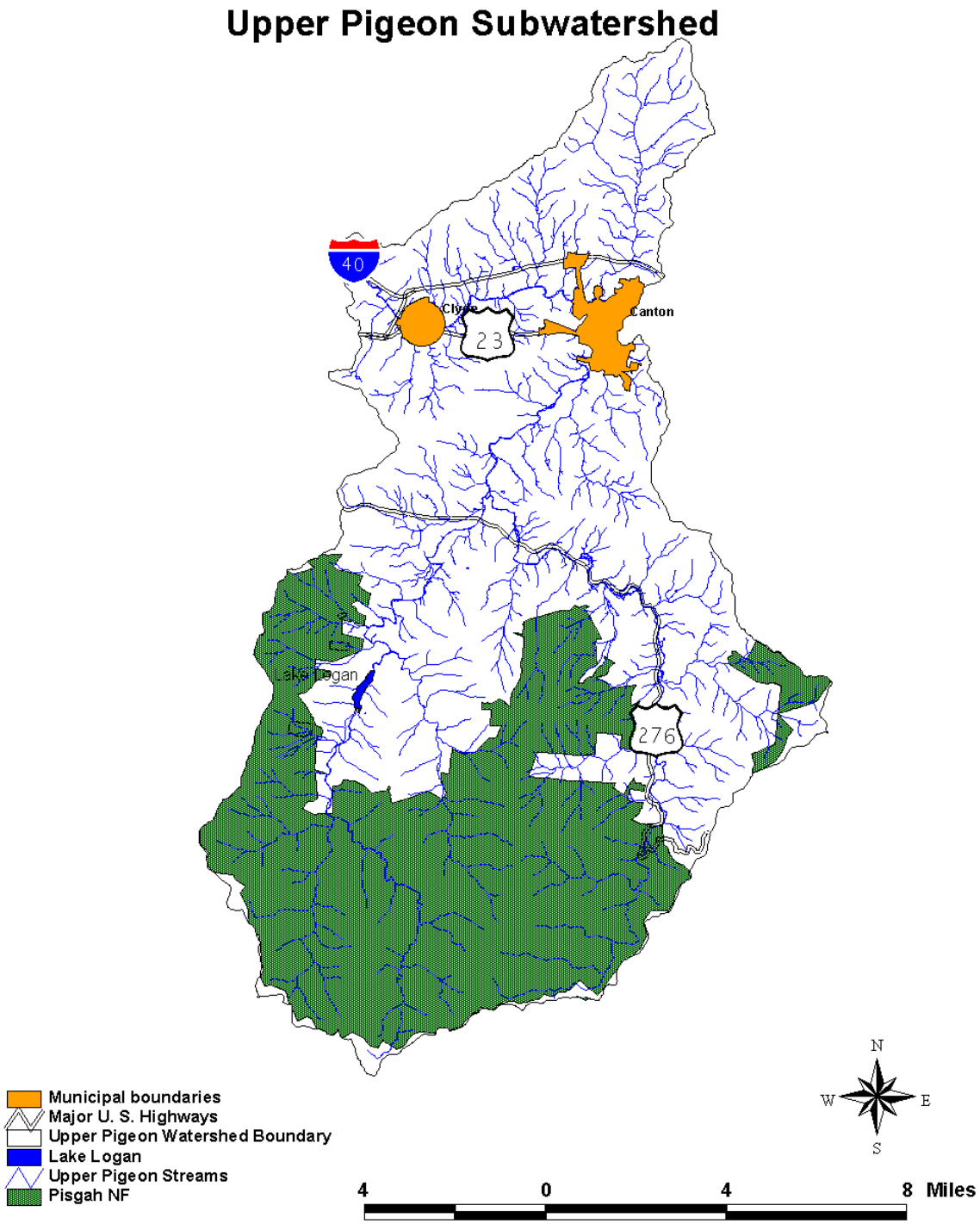

Figure 13. Upper Pigeon River Subwatershed Map.

Eroding stream banks are the single largest contributor of sediment in this watershed (45%). Roads account for about 30%. Eroding pastures contribute 12%. The remaining 13% arise from a variety of other sources ranging from construction sites, animal access points, and other assorted activities.

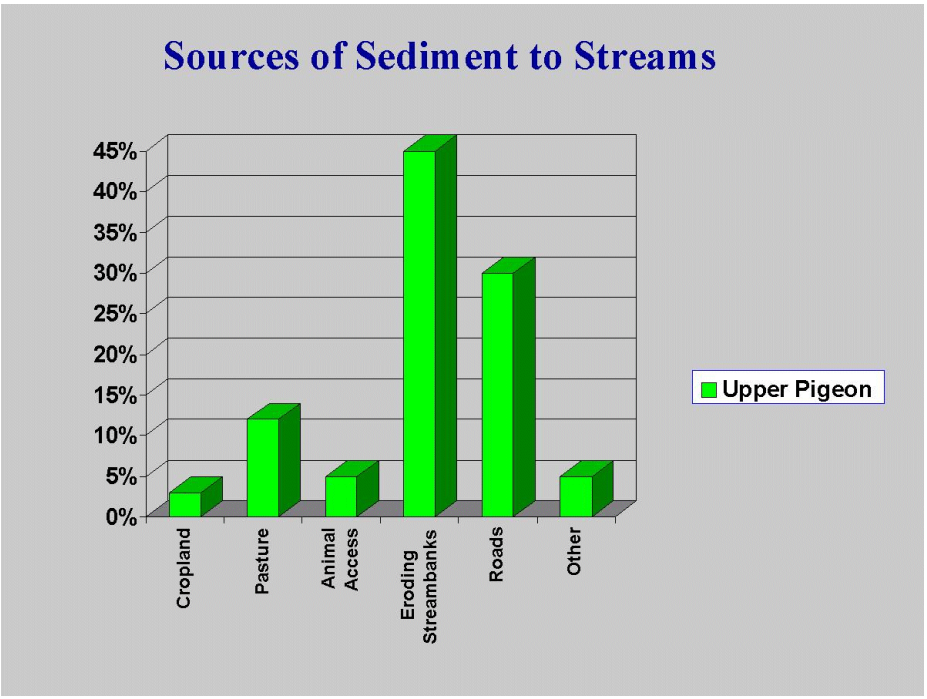

Figure 14. Sources of Sediment to Streams in the Upper Pigeon River Subwatershed

About 7% of the stream banks in this subwatershed have been identified as eroding. This is slightly more than the average for the Pigeon River Watershed, and reflects a concentration of eroding banks in the north half of this subwatershed.

The water quality data for this subwatershed clearly indicates the changing conditions from its origin to the mouth of Richland Creek. The four active VWIN sites in this watershed were described in the November 2001 report. Three of these sites were ranked in the excellent range. Only the Canton sample site was ranked in the below average category. Factors affecting the rating of the Canton site included conductivity levels, pH, alkalinity, and nutrients, particularly orthophosphate.

The State of North Carolina summarized 40 EPT samples taken from 11 sites at different locations in this watershed. Ten of the eleven sites were located above the Canton paper mill, and all recent samples at these sites test in the good to excellent range. The 11th site was located on the Pigeon River in Clyde. Earlier samples had been testing in the poor to fair ranges, but the latest sample information provided by the State indicated the site had improved to the good to fair range.

TVA gathered biological data at five sites in this watershed. They monitored both the fish (IBI) and the macroinvertebrates (EPT). Conditions at two of the sites (Pigeon River at Pisgah Memorial Stadium and West Fork of the Pigeon at Riverside Baptist Church) tested among the best in Haywood County. Fish populations were fair to good, and the EPT tests were both good. A July 1997 downstream sample site at the Hyder Mountain Bridge sampled poor to fair for fish and fair to good for aquatic insects. This location has historically been suppressed by industrial pollution, so these readings reflect a substantial improvement since the early 1990s.

One of the sites on Bird Creek tested poor for fish and macroinvertebrates in April of 1999. This sample reflects unexpected conditions, and may be the result of some localized habitat and nutrient pollution. In addition, physical habitat problems were evident at the sample site. A site on the East Fork of the Pigeon River above Lenoir Creek tested poor for fish, but good for the insects. The cause for the poor fish rating may reflect long-term degradation of habitat, unresolved metric issues, or localized environmental problems.

While this watershed has significant sources of sediment contributing to downstream degradation, it generally supports higher water quality than many other mixed ownership watersheds on the Pigeon River Watershed. Local residents have suggested that one of the factors that may be helping is the designation of much of this watershed as a WS-III watershed by the State of North Carolina. The presence of the public land at the headwaters also helps protect the water quality. However, there are also localized sources of pollution affecting certain stream segments.

Lower Pigeon

The Lower Pigeon Watershed contains 149,087 acres of land on the waters of the Pigeon River. This watershed begins at the junction of Richland Creek and the Pigeon River and runs to the North Carolina/Tennessee state line. It includes all watershed lands within this area, with the exception of the Richland and Jonathan Creek subwatersheds.

This watershed includes the portion of the Great Smoky Mountains National Park that is in Haywood County. The National Park encompasses almost all of the Big Creek and Cataloochee Creek Watersheds (about 61,680 acres). The State has classified Big Creek as high quality waters and Cataloochee Creek as Outstanding Resource Waters, a rating reserved for the highest quality watersheds.

The north end of the Lower Pigeon Watershed also contains several thousand acres of National Forest land. There are several designated trout waters flowing from these lands.

The balance of this subwatershed is largely dedicated to low density residential, agricultural, and forestry uses. There are several small communities in the area, but no urbanized centers.

Water uses in this subwatershed include the 340-acre Walters Reservoir used for generating hydropower. This unit began operation in 1930 with three hydroelectric generators capable of generating 108,000 kilowatts of electricity. It is one of the largest hydroelectric facilities operating in the South.

A few farms intermittently withdraw water for agricultural use. These water withdrawals are primarily for vegetable crop production.

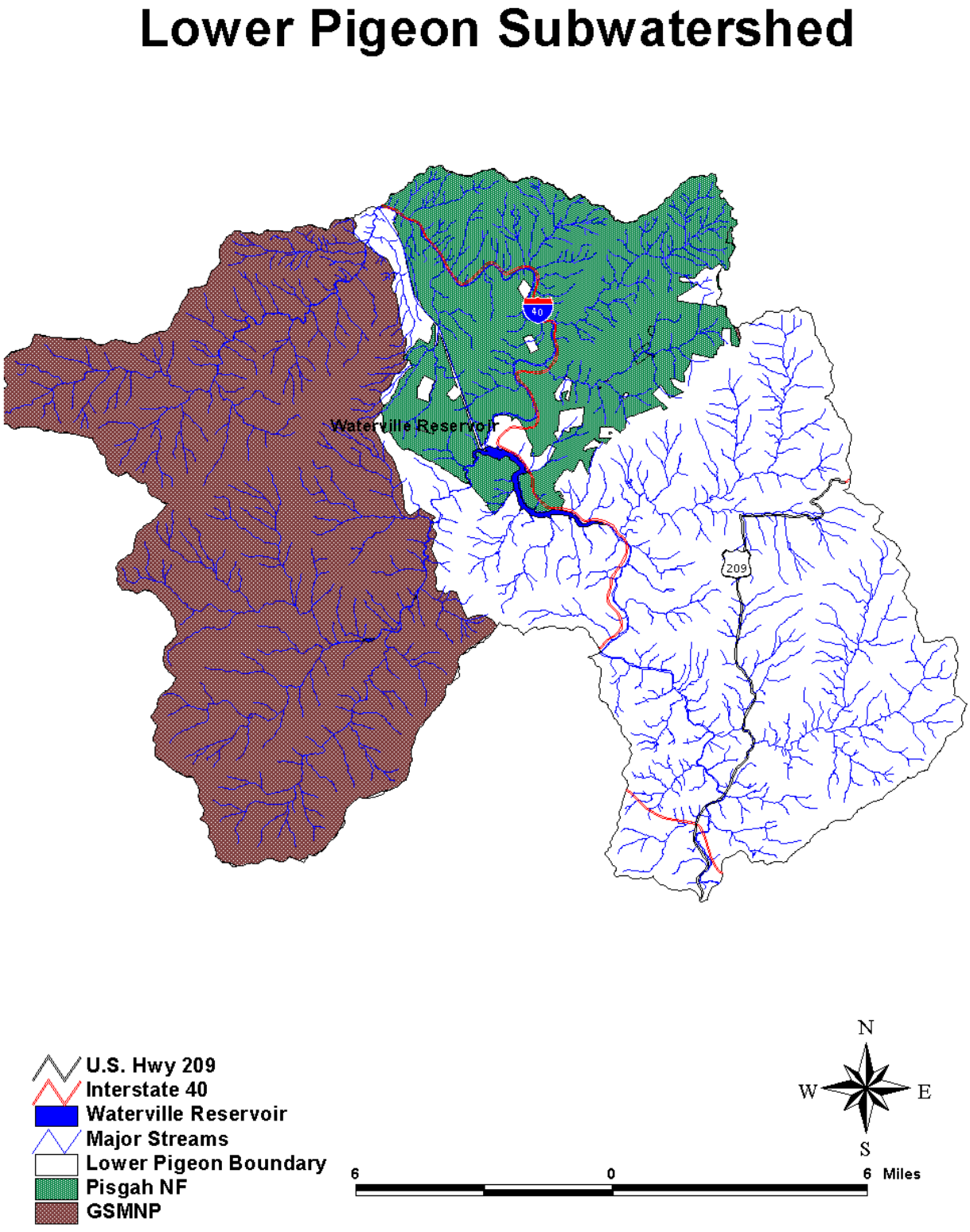

Figure 15. Lower Pigeon River Subwatershed Map

This segment of the Pigeon River is located below the Evergreen Packaging paper mill in Canton. Substantial investments in the latest environmental technology by the owners have improved the quality of the water in this segment of the river. This portion of the river is now used for occasional fishing and limited recreational use by canoeists and kayakers.

About 84% of this subwatershed is classified as forest—the highest percentage in the Pigeon River Watershed. Pasture accounts for 11% of the remaining acreage, with 9% of the total watershed being classified as pasture in fair condition. Cropland, commercial, and residential uses each account for about 1% of the land area. The "Other" category accounts for the remaining acreage. The residential and commercial figures confirm that this is the most rural of all the subwatersheds in the Pigeon River Watershed.

There are 1032 miles of all categories of roads in this subwatershed. This represents a road density of 1 mile of road for every 144 acres.

Roads contribute the greatest percentage of the sediment in this subwatershed (35%). This is followed by eroding stream banks (32%) and pastures (20%). Pastures contribute a higher percentage of the sediment load in the Lower Pigeon than in any of the other three subwatersheds. This is consistent with the agrarian nature of this area and relatively high percentage of land area in pasture. The remaining 13% comes from animal access points, cropland, construction sites, and other activities.

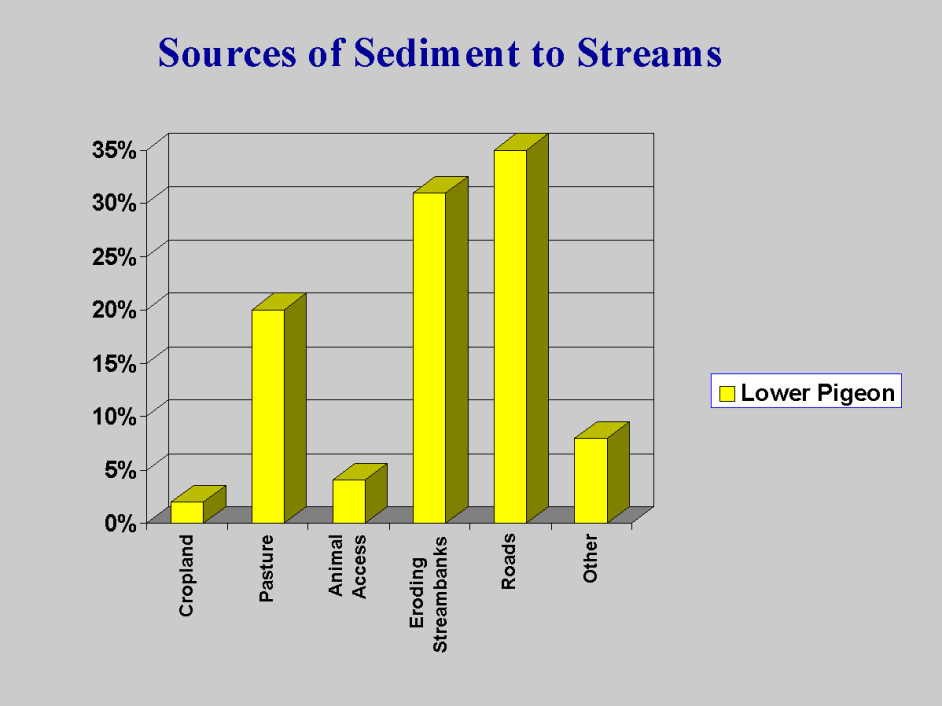

Figure 16. Sources of Sediment to Streams in the Lower Pigeon River Subwatershed

There are seven active VWIN sites located in this subwatershed and described in the November 2001 Annual Report from the Environmental Quality Institute. Four are on Fines Creek, two are on Rush Fork Creek, and one is on the Pigeon River at the Hepco Bridge near the mouth of Fines Creek.

The six sites on Fines Creek and Rush Fork Creek show some of the most significant sedimentation and nutrient loading problems of the 24 Haywood County VWIN monitoring sites. The lower sites in these streams have median levels for almost all parameters that exceed the average median for the VWIN monitoring region in western North Carolina. Maximum levels at the two downstream sites also tend to be higher than the average maximum levels for the region. This is particularly true for the nutrient parameters. The upstream sites on Fines Creek and Rush Fork Creek rank as below average. All downstream sites on Fines Creek and Rush Fork Creek are in the poor range. These two watersheds consistently have some of the poorest ratings among the streams being sampled in Haywood County.

Nutrient loading is significant and persistent in both of these creeks. Sediment and nutrient loading in Rush Fork Creek and Fines Creek, which flow from the western slopes of the Newfound Mountains, closely resembles levels common to streams on the eastern slopes of this mountain range in Buncombe County. This region has long been deforested and cleared for agriculture, even to the headwaters of the watersheds. Streams have been extensively straightened and buffer zones largely eliminated. Much of the land, especially in Haywood County, is pasture. Some areas that were once agricultural are now being developed with rural housing, but remain largely clear of trees. The steep slopes and weakened stream banks make stream sedimentation a persistent problem. In fact, the upstream sites show even higher median levels of turbidity than the downstream sites. Even median turbidity levels exceed the water quality standard for trout waters at these sites. The downstream sites show higher maximum levels than most other sites in the County and exceed the majority of maximum levels in the region as well.

Very few sites in the VWIN monitoring program have ever exceeded the nutrient loading maximums that have occurred on Fines Creek and Rush Fork Creek. The downstream site on Rush Fork Creek reached a peak in July 1999 when nitrate/nitrite concentrations were 4.5 mg/L and ammonia-nitrogen concentrations were 1.55 mg/L, exceeding the ammonia nitrogen (NH_3) water quality standard of 1 mg/L in the summer.

There has been no biological sampling completed in either Rush Fork Creek or Fines Creek. However, since the chemical and physical sampling generally indicates higher water quality than the biological samples, these subwatersheds warrant further study and assistance to address the identified concerns.

The State of North Carolina has collected several EPT samples from this section of the Pigeon River. The latest results from those samples indicate good to fair results for this stream segment. The TVA has also collected biological samples at the Hepco Bridge on the Pigeon River. They gave that site an EPT rating of fair and an IBI rating of poor. As mentioned previously, the IBI rating may reflect limited comparison data for higher elevation mountain streams, the consequences of long-term impacts to the habitat, or both. As a point of comparison, the VWIN rating for this site was the poorest of any stream segment sampled in the six county area.

Richland Creek

The Richland Creek Watershed contains 43,647 acres. This watershed originates on the southwestern boundary of the Pigeon River Watershed and flows to the northeast through the most heavily developed portion of Haywood County. The municipal water supply for the Town of Waynesville is located on the headwaters of Allen Creek. It is one of the highest quality municipal water supplies in North Carolina. The State has classified it as a WS-I watershed. It is a publicly owned watershed, dedicated to the preservation of high quality water. The Town has shown considerable initiative in maintaining the quality of this water supply for its residents and businesses.

The balance of the watershed is privately owned. The Town of Waynesville, numerous industries, and thousands of residences are located in this watershed. The largest rock quarry in Haywood County is

located on Allen Creek, a tributary of Richland Creek. There are a few minor water withdrawals for agricultural use in portions of this watershed. However, one of the most significant water resources in this subwatershed is Lake Junaluska.

Completed in 1914, this 200-acre lake hosts thousands of visitors to the area each year. The annual economic contribution to Haywood County from payroll, general expenditures, and tourist monies exceed $30 million. There are 750 privately owned residences around the lake with a tax base value of $74,000,000 that contribute about $370,000 in tax revenue each year. The lake is a place of beauty that is a major recreation center for visitors and residents alike.

As with any reservoir, sedimentation is a fact of life. In the case of Lake Junaluska, all sediment arriving in the lake is generated by activities in Haywood County, within the Richland Creek Watershed. However, the sediment loads being delivered to Lake Junaluska far exceed naturally occurring levels.

Over the years, the Lake Junaluska Assembly has spent hundreds of thousands of dollars removing sediment from the Lake. The first sediment removal project was in 1964 when between 400,000 and 500,000 cubic yards were removed. However, sediment was arriving at an increasing rate, and in 1973 another 391,000 cubic yards were removed. There have been subsequent removals since that time. In recent years, the Assembly has been spending about $25,000 per year to try to remove some of the most recent sediment. However, sediment is arriving at such a rate that this work does not begin to keep up with deposition. It is now estimated that it will require between $2 and $3 million to remove the majority of the sediment.

The long-term answer to this problem is to reduce the rate of sedimentation to a level that can be managed over the long term. The IPSI data, by identifying the sources of sediment, helps focus efforts to reduce the erosion and sedimentation that is causing the problem.

About 63% of this subwatershed is classified as forest—the lowest percentage in the Pigeon River Watershed. However, even this number is misleading. Land use and infrastructure decisions have already been made that will further reduce this percentage. Residential use accounts for 16% of the land use—not surprisingly, the highest percentage in this category among the subwatersheds. Pasture accounts for 10% of the area (with pasture in fair condition accounting for 7% of the total land area). Other uses account for 8%, with commercial uses accounting for 2% of the land area, and cropland 1%.

There are 625 miles of all categories of roads in the subwatershed—a road density of 1 mile of road for every 69 acres of land. The road density in this subwatershed exceeds that of any of the other three subwatersheds.

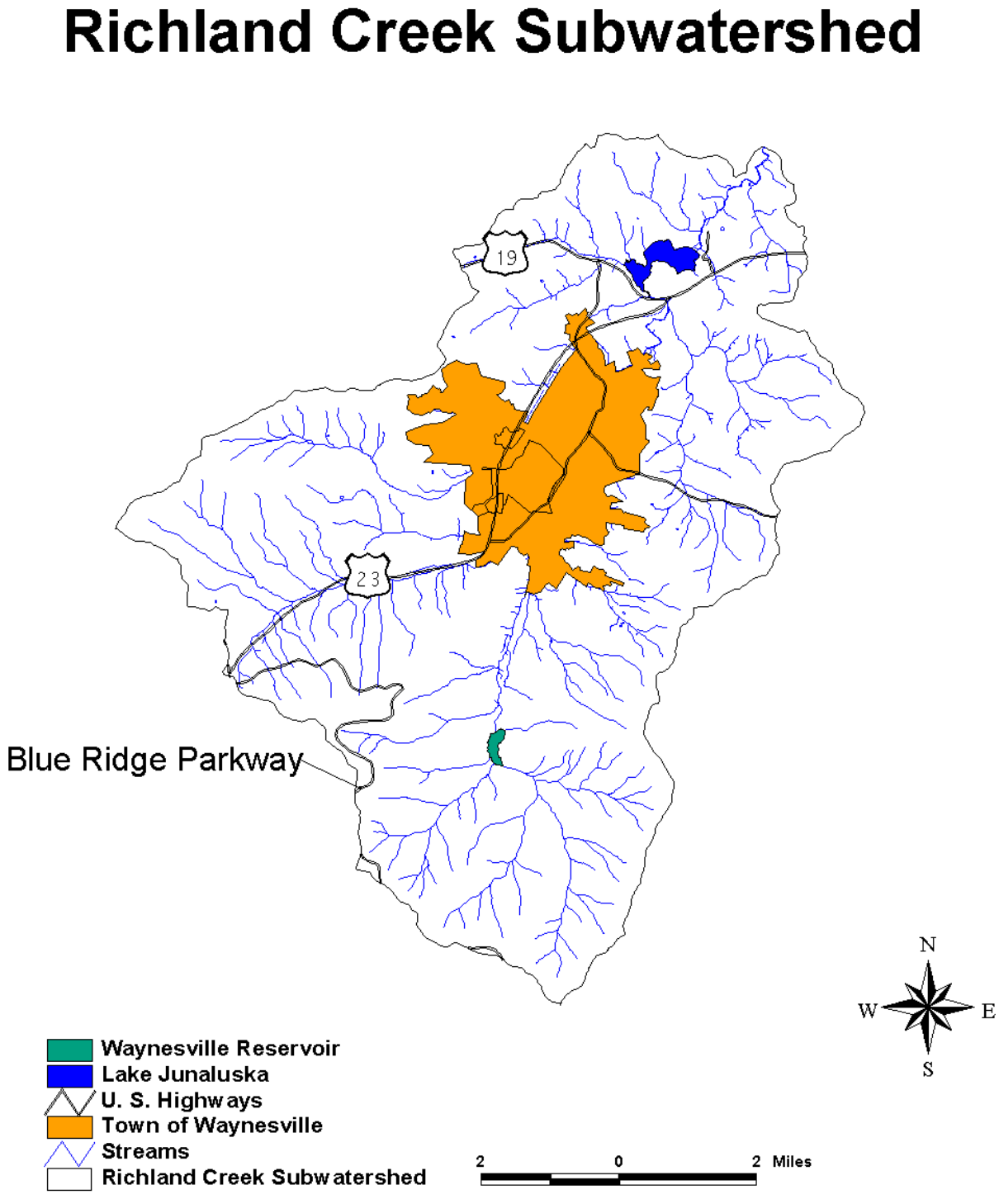

Figure 17. Richland Creek Subwatershed Map

Eroding stream banks contribute 47% of the sediment to streams in this watershed. Eroding roads, ditches, and road banks contribute 32%. Pastures contribute 9%, other uses 6%, animal access 5%, and cropland 1%. The eroding stream banks tend to be located in a few subwatersheds of Richland Creek.

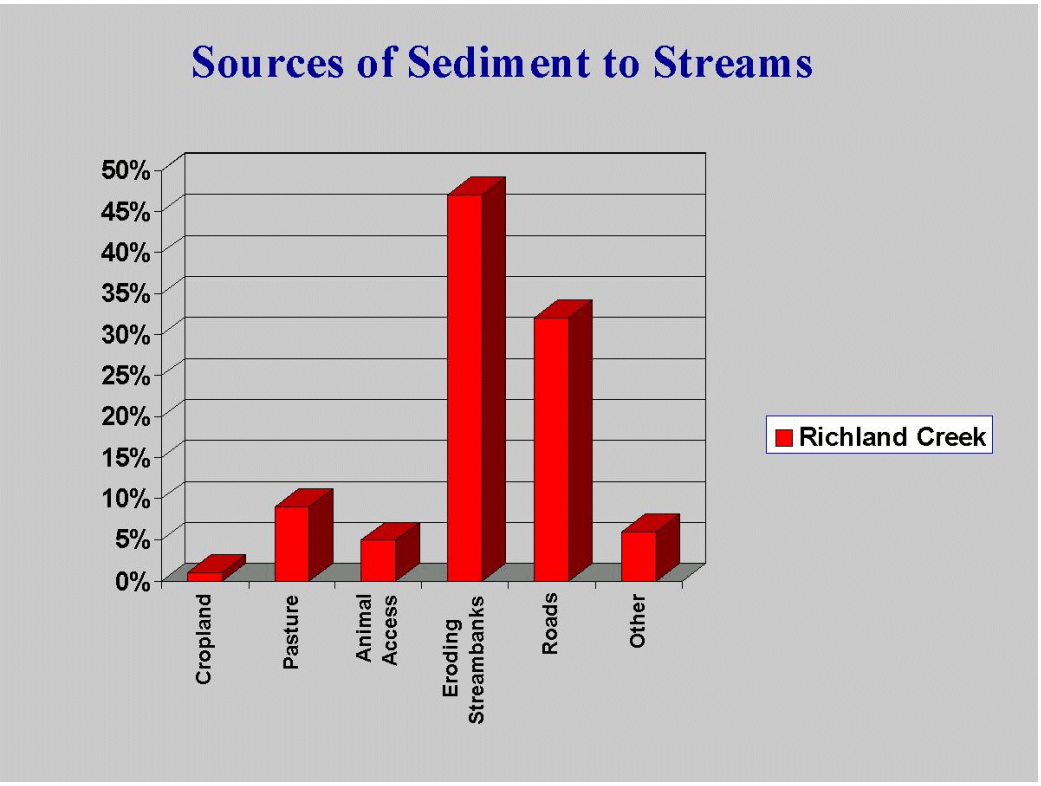

Figure 18. Sources of Sediment to Streams in the Richland Creek Subwatershed

There are seven VWIN Richland Creek sites reported in the November 2001 Annual Report from the Environmental Quality Institute. One is located on Richland Creek above Waynesville, two on Hyatt Creek, one on Plott Creek in Hazelwood, one in the Allen Creek Watershed, one on Eaglenest Creek in Hazelwood, and one on Richland Creek at Lake Junaluska.

The site on Richland Creek above Waynesville (about a mile below Balsam Gap) tested in the good range—a reduction from earlier years. The Allen Creek VWIN site also tested in the good range. The Plott Creek site was in the average range - a reduction from previous years. The sites on Eaglenest Creek and on Richland Creek above Lake Junaluska ranked below average – both reductions from earlier years. Both the upper and lower Hyatt Creek sites tested in the poor range. The median levels for turbidity, total suspended solids, orthophosphate, and nitrate/nitrite-nitrogen for these two Hyatt Creek sites were substantially above the median average for all the VWIN sites in western North Carolina.

TVA did biological monitoring (EPT and IBI) at two sites in Richland Creek—at Vance Street Park and on Raccoon Creek at the Junaluska Elementary School. The fish assessment for both sites (IBI data) was in the poor range. The EPT data was in the poor to fair range at the Vance Street Park site, and fair at the Raccoon Creek site. TVA's evaluation of the Vance Street Park site indicated that the diversity of both fish and intolerant insects was much less than expected, suggesting poor water quality. The proportions of omnivorous fish and diseased fish among the fish sampled were the worst found at any site in Haywood County. At the Lake Junaluska School site, the TVA comments indicated that compared to other streams

of its type, the aquatic communities would be classified as poor. Severe problems observed in the physical habitat included reduced instream cover, sedimentation, low habitat diversity, bank instability, and limited riparian vegetation. These TVA site observations in 1998 seemed to be borne out by some of the IPSI source data.

The State of North Carolina listed six EPT sample sites in the Richland Creek subwatershed. One was in the Shiny Creek Watershed above the Allen Creek reservoir, and it tested in the excellent range. Two were in the Hyatt Creek Watershed and they tested in the poor to fair range. Two of the sites were on Richland Creek at SR 1519 and the old Dayco site—they both tested in the fair or fair to good range. The most encouraging site was in Waynesville at SR 1184. Several samples were taken over a 14-year period from 1983 to 1997. The first samples tested poor but gradually tests improved to fair, and the latest sites were ranked in the fair to good range.

There are a variety of water quality conditions in this subwatershed. The contrast between the biological data indicates some long-term habitat issues that are not being picked up by the grab samples taken by the VWIN volunteers. Some of the volunteers have commented on the fact that it is seldom raining when they take samples, so sediment levels would be low. Stormwater events quickly turn the streams brown with sediment. More detailed sediment monitoring is needed to better identify the nature and quantity of the material actually moving down Richland Creek. At this point, Lake Junaluska provides one of the best measures of sediment movement within the watershed.

Jonathan Creek

The Jonathan Creek Watershed contains 42,777 acres. It is the smallest of the four subwatersheds. Originating on the western boundary of the Pigeon River Watershed, it flows in a northeasterly direction to its confluence with the Pigeon River. The Town of Maggie Valley is located along Jonathan Creek. The Town of Maggie Valley obtains their municipal water from an intakes on Campbell Creek and Jonathan Creek. The State has designated this municipal supply watershed as WS-III. However, unlike the Waynesville water supply, this watershed is privately owned. The quality of the water supply, and the cost of treatment, depends on minimizing the adverse effects of upstream activities.

The Town of Maggie Valley has initiated greenway efforts along a portion of Jonathan Creek. These efforts, in addition to providing additional recreation opportunities, will provide permanent streamside buffer for Jonathan Creek and increase public awareness of water quality issues.

The IPSI data classified 74% of this watershed as forested. As with Richland Creek, this percentage does not reflect the infrastructure changes that have already been made with planned and developing subdivisions. The forested acreage will be substantially less in a few years. Residential land use accounts for 10% of the land area—second highest to Richland Creek. Pasture accounts for 9% (pasture in fair condition accounts for 7.5% of the subwatershed acreage). Commercial use accounts for 2% of the land area. Other uses account for 4%, and tilled cropland accounts for 1%.

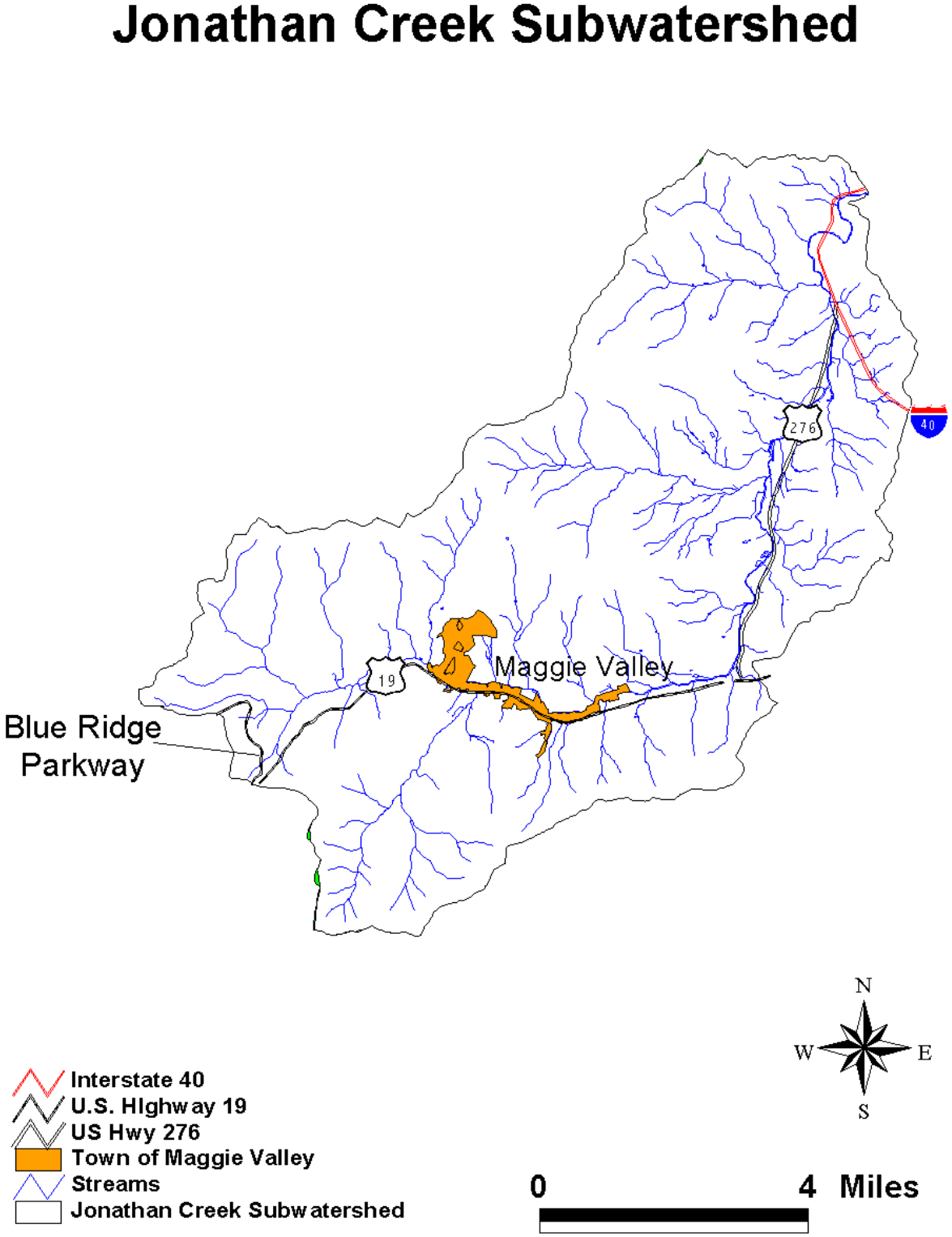

Figure 19. Jonathon Creek Subwatershed Map

There are 567 miles of all categories of roads in this subwatershed. This amounts to a road density of one mile of road for 75.4 acres of land. This road density is second only to the Richland Creek Watershed.

Erosion along roads accounts for 46% of the sedimentation originating in this subwatershed. Eroding stream banks account for 29%. Eroding pastures account for 9%, animal access 7%, cropland 5%, and other uses about 4%.

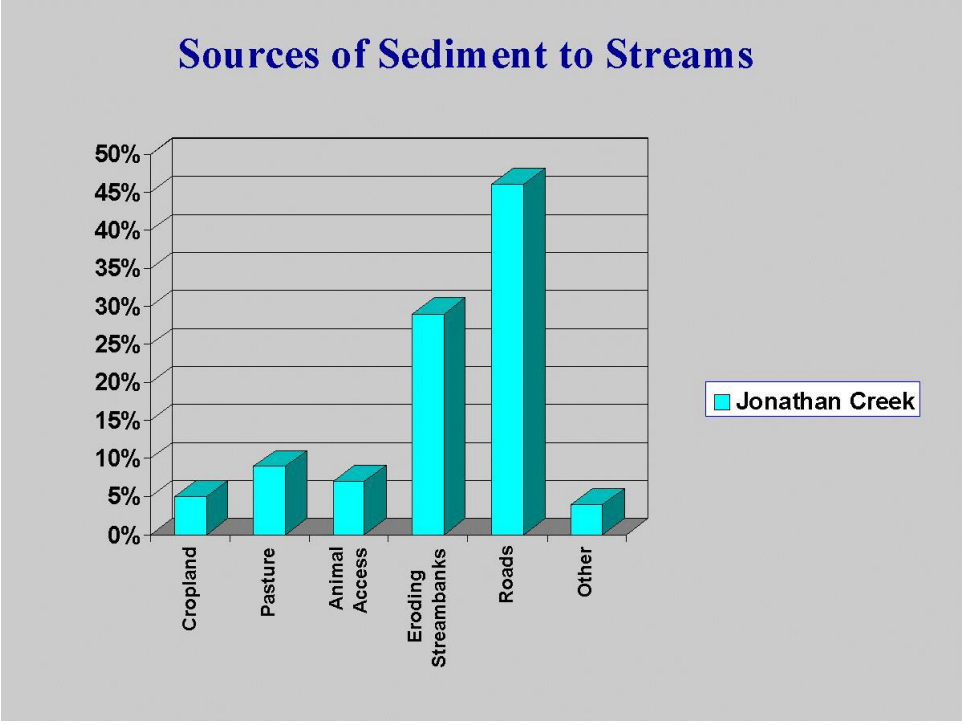

Figure 20. Sources of Sediment to streams in the Jonathon Creek Subwatershed

Two VWIN site were included in the 2001 report. The upstream site is located at Moody Farm Road; the lower site is located near the confluence with the Pigeon River. The upstream site tested in the excellent range, but the lower site fell to below average. This is the third consecutive drop in the rankings for this site. TVA conducted biological monitoring on one site in Jonathan Creek in July of 1997. That site is located where White Oak Road crosses the creek. The EPT ratings were in the good range, with a good variety of intolerant insects and no serious problems in observed stream habitat. The IBI (fish) sampling indicated the site was in the poor/fair range, with too many omnivorous and diseased fish. There were also moderate deficiencies in expected fish diversity and abundance. The State of North Carolina lists three EPT stations in Jonathan Creek, at SRs 1306, 1322, and 1349. These sites were sampled in August of 1992 and July of 1997. The site off SR 1306 tested in the excellent range both times. The other two sites tested good or fair to good in 92, but in the excellent range in 1997.

As with the Upper Pigeon Watershed, this watershed is in better shape than either Richland Creek or the Lower Pigeon. The long-term concern is protecting the riparian corridor and minimizing adverse affects from increased development in the watershed. Careless mountainside development is one of the greatest risks to the long-term health of this watershed.

Reducing Sediment

Sediment originates from hundreds of sources. This report focuses on the major sources, as it is more cost effective to apply limited funds to the activities causing the greatest problems. However, all of us can identify localized sources of sediment in our own neighborhoods and often in our own yards.

Sediment in streams originates from water flowing over exposed soil and carrying it to nearby watercourses. It has been defined as soil particles, namely sand, silt, and clay, being carried by flowing water. The amount of soil carried off the site is a function of a number of factors, including soil types and conditions, slope, rate of precipitation (volume), land use, and land form. To reduce the amount of sediment produced from an activity, it is necessary to interrupt some aspect of the erosional process that carries sediment to the stream. The North Carolina Sedimentation Pollution Control Act of 1973 requires that sediment be retained on site. Current attempts to achieve this goal in the Pigeon River Watershed have been ineffective.

Any discussion about reducing sediment in the mountains of the Pigeon River Watershed must focus on managing runoff from storm events. Practically all soil loss and sedimentation occurs during periods of heavy rains. For example, while an established roadway will erode as long as it is in use, at least 10-20 times the average annual erosion occurs as a result of storm events during the first year of its existence. Until effective practices can be found to eliminate this flush of sediment during this initial construction phase, we will continue to have a serious sedimentation issue in this watershed.

The following concepts are a few of the components in an integrated approach to reduced erosion and sedimentation. They often have to be combined in creative ways to address the challenges of developing land and resources on steep and fragile sites.

One of the simplest approaches is to revegetate exposed soil areas. The key to successful use of this approach is rapid revegetation. Much of the soil loss occurs when the site is newly disturbed. The sooner vegetation is restored, the less soil will leave the site. The type of vegetation depends on the site, but in many cases sediment can be substantially reduced by proper and timely application of seed, fertilizer, soil amendments, and mulch.

As the Pigeon River Watershed is developed, some changes made to the landscape can cause expensive problems in the future. It is far more economical to prevent pollution and degradation of our waterways than it is to clean them up after the damage has been done. Simply leaving a buffer strip of natural plants along our streams can help avoid problems that would be costly to correct. This vegetation helps protect the riparian zone of the stream.

"Riparian" comes from the Latin *riparius,* meaning "that which frequents river banks," which in turn was taken from the Latin noun *ripa* meaning "bank of the river." The riparian area is the land adjacent to rivers and streams, and it is influenced by the stream's natural hydrologic cycle. Riparian areas improve water quality by serving as buffer zones that help protect our waterways from nonpoint source pollution.

Healthy functioning wetlands and riparian areas are important for a variety of reasons. They provide ecological, social, and economic benefits. They also provide income from commercial and recreational uses and provide savings from improved water quality.

Wetlands and riparian areas are critical to wildlife. They improve water quality and provide wildlife habitat by:

- Slowing and reducing stormwater runoff and reducing soil erosion

- Removing chemicals and excess nutrients
- Recycling nutrients and removing sediment from surface water
- Serving as habitat for fish, shellfish, waterfowl, endangered species, and other wildlife
- Providing shade and cooling trout streams
- Providing transportation corridors for wildlife to move from one area to another
- Retaining water during heavy rainfall and slowly releasing it to downstream areas, thus lowering floodwater peaks and maintaining stream flows during dry periods
- Softening the landscape with ribbons of green and undeveloped natural areas
- Providing opportunities for recreation, scientific study, and aesthetic enjoyment of our wildlife in their natural habitat.

As wetlands and riparian areas are lost to development, soil erosion, flooding and sedimentation of our lakes, rivers, and streams will increase. These problems can be reduced with proper planning and conservation-based development. The quality of life and outdoor experience enjoyed in Haywood County is directly related to our water quality, and water quality depends on the existence of wetlands and riparian areas.

In cases where there is no adequate streamside buffer at the time of site disturbance, a number of artificial means can be employed to reduce erosion. The effectiveness of these practices depends on proper installation and maintenance. They operate on the same principle as the buffer—slowing the water flow so the sediment load can settle out on the land rather than in the stream. These approaches include silt fences, hay bales, and other filter materials placed so as to intercept overland water flows.

Retention ponds can also serve to slow the running water, allowing the sediment to settle out on site before the water moves downstream.

Another approach is to avoid concentrating water flows, particularly in steep terrain. Concentrating flows greatly increases the erosive capacity of the water. Culvert spacing on roads illustrates this concept. If there are not enough culverts along road sections, the volume and velocity of the water will greatly accelerate erosion in the ditch line of the road and eventually the adjacent cut banks and roadbed. Intercepting the water with properly spaced and installed culverts, then dispersing the water from the culvert outlet so it can be readily absorbed into the ground, will reduce this problem.

Concentrating stormwater runoff creates major problems downstream in the watershed. Concentrating large volumes of water from roads, driveways, roofs, and other impervious sources can alter stream morphology. Destabilizing stream courses not only destroys aquatic habitat but also greatly accelerates the rate of bed and stream bank erosion. If enough water is concentrated in a stream course, there may be no option short of hardening the stream course to hold the banks in place. However, this practice merely transfers the problem to other downstream segments.

The most effective tool to minimize erosion is a good plan. A good plan will identify where the desired practices will best fit on the landscape and incorporate proven measures to minimize erosion. Avoiding problem areas and sites during the planning and design phase is one of the most cost-effective strategies for good project design and good conservation.

Installing these planned sediment retention structures and practices before construction may be one of the most effective ways to minimize downstream impacts. Installing properly designed sediment retention practices before the first earth is moved for the project avoids having to play catch-up later during the project.

Financial and Technical Assistance

Management of our watersheds and the water quality of our streams, lakes, and river are closely related. The stewards of land resources can and do impact the water quality of our streams. The land management decisions they make are critical for present and future water quality in Haywood County. Reducing erosion on one parcel of land not only benefits that landowner but all those downstream whose land was impacted by the problem before it was corrected.

Most landowners want to be sure that their practices have a minimum impact on the streams that flow through their property. In some cases, an individual or corporation may inherit or acquire problem sites. In both cases, the landowner may not fully recognize the nature of the problem, and may not have the experience, training, or resources to design and implement the most effective ways to maintain or improve water quality. Many forms of technical and financial assistance have been developed to help landowners in these situations.

Almost all assistance will involve some form of professional help to insure that the planned measures accomplish the desired objective. Cost share payments can substantially reduce the cost to the landowner of implementing specific practices. Cash payments and/or tax incentives are also available to landowners interested in protecting critical resource areas in perpetuity through conservation easements and similar instruments. Much of the assistance available for Pigeon River projects is summarized in Appendix II.

Financial Assistance

A variety of financial incentives and assistance are available to qualifying landowners. Some conservation programs offer cash payments, others offer tax relief for income tax and estate taxes. Qualifying program uses may include riparian area improvements and protection, wetland restoration, and cost share programs for other qualifying land improvements.

Proven conservation techniques called Best Management Practices (BMPs) can be employed to minimize the impact of land-disturbing activities. Some BMPs are simple and inexpensive. Others may require extensive analysis, careful planning, and significant investment. Due to the cost of some land improvements, cash payments are often needed to enable landowner participation. Cost share payments for such things as stream bank repairs, excluding cattle from streams, providing alternate water sources, and revegetating riparian areas are a few examples of direct financial assistance.

Figure 21. Agricultural site in Elk Garden, VA before and after pasture and stream BMPs were installed. BMPs were in place for one year.

Indirect benefits in the form of tax credits or reduced state and federal taxable income may interest other landowners. In some instances, a substantial reduction in estate taxes will be possible. Reduced tax

obligations may enable the heirs to keep the estate intact. If the primary incentive is tax benefits, landowners should consult a qualified tax advisor.

Landowners interested in permanently protecting important riparian areas on their properties could benefit from a variety of conservation easement programs supported by the state and federal government. Some programs provide cash payments for conservation easements or fee purchase of riparian areas. The State of North Carolina provides significant income tax credits for the donation of conservation easement to an appropriate entity. The federal government may provide income tax deductions for such donations. If so desired, easements can be written to maintain less intensive land uses—such as agriculture in lieu of subdivision development. Such easements may serve to reduce property and inheritance taxes, permitting a property to remain in the family.

Technical Assistance

Technical assistance, including engineering in some cases, is available through the Haywood Soil and Water Conservation District and the local offices of the USDA Natural Resources Conservation Service. These organizations work with landowners on a variety of programs and administer cost share programs for agricultural improvements. They provide help in analyzing land and water quality problems, help landowners select BMP options best suited to their land, and provide current information on the availability of program funds they administer. Their local personnel, addresses, and telephone numbers are listed in Appendix II of this plan.

Landowners have a range of options and may select those programs that meet their individual needs and land management strategies. Appendix II outlines some basic program information that may be helpful in identifying programs of interest to the reader. The North Carolina publication "A Guide for North Carolina Landowners" goes into a more in-depth discussion of the available programs and the types of property, such as riparian areas, wetlands, prior converted wetlands, agricultural land, and forests that may qualify. The availability of program funds varies annually with appropriation levels approved in state and federal budgets and public demand for these funds. Contact the administering agency for current funding levels and eligibility criteria.

Other Options for Nonpoint Pollution Abatement

Technical and financial assistance addresses current problems. However, it is more effective to prevent problems in advance. This approach has the greatest potential for avoiding water quality degradation of the Pigeon River and its tributaries in Haywood County. There is substantial information in this field for many agricultural practices. There is considerably less guidance for managing stormwater runoff and erosion from mountainside development. Therefore, much of this section will focus on issues associated with stormwater runoff, roads, and mountainside development.

Research, Training, and Education

Most individuals want to insure that their particular use of a property does not adversely affect water quality. However, as became evident during discussions of the Lake Junaluska issue, many people do not recognize erosion issues in their neighborhood until faced with an immediate problem directly affecting them. One of the first priorities must be to increase awareness and understanding of nonpoint pollution and its consequences within the Pigeon River Watershed.

Some awareness training is already occurring and needs to continue. Examples include the annual Kids in the Creek program where all 8th graders in Haywood County have a hands-on introduction to water quality issues. Increasing the awareness of students will pay large dividends in the future. The Haywood Soil and Water Conservation District also provides classroom training to Haywood County school children through classroom programs tailored to the specific needs of the class. Conservationists also provide staffing for public information booths at local fairs and other events.

The North Carolina Cooperative Extension Service, Haywood Soil and Water Conservation District, and the Natural Resource and Conservation Service have considerable information to assist landowners in determining everything from the best plants to grow under various conditions to the best practices to apply to prevent or cure an erosion problem. Helping people find and use this information is an ongoing challenge.

The Haywood Waterways Association makes regular presentations to interested organizations and individuals about the sources of and solutions to nonpoint source pollution in the Pigeon River Watershed. That information provides perspective on the issues we are facing, and these efforts need to continue.

More education and training is needed in the area of stormwater management. Stormwater management is often thought of as an urban issue. However, mountainside development greatly concentrates water runoff. Certain stormwater control practices can be effective in reducing problems within and downstream of the development. These practices utilize the processes of detention/retention, settling, percolation, evaporation, evapotranspiration, filtration, adsorption, and biological uptake to reduce flows and remove pollutants. Proper maintenance of such practices on a long-term basis in new developments could reduce the impacts of the development on downstream waters. The Land Of Sky Regional Council publication *Stormwater Management in North Carolina: A Guide for Local Officials* provides more information about these specific practices.

However, reducing nonpoint pollution in the face of accelerating development pressure requires new initiatives. For example, state approved BMPs do not exist for roads in mountainside developments. There are some guidelines in a few brochures published by various agencies. Such information needs to be made available to builders, contractors, realtors, property owners, and others. However, more is needed. Substantial research is necessary to find practices that actually contain the sediment on the site. This research will require new partnerships between landowners, developers, local governments, and

qualified research institutions and agencies. Our soils, slopes, and precipitation patterns provide special challenges. Various practices need to be applied and monitored to gauge their effectiveness in road construction, subdivision design, and stormwater management. A collection of proven local practices could then be made available through local training sessions, local, state, and federal conservation agencies, the public libraries, the Haywood Waterways Association website, and other locations.

Examples, principles, and practices associated with conservation-based development need to be collected and distributed. There is a gradually developing body of knowledge associated with development that begins with the objective of minimizing impact while maintaining profitability. Before the first spade of earth is turned, the site is evaluated based on its assets and suitability. Problem areas (such as steep slopes, wet areas, unstable soils, etc.) are dedicated to open space with the appropriate trails and other amenities. Houses are built closer together on the more suitable lands. The result is that up to 50% fewer miles of roads are built, and almost as many lots are sold at higher prices. The net profit remains about the same, and land and water resources are less impaired.

Part of the education process involves learning more about the nature of the sediment problem. There is a lot of helpful water quality information being collected by a variety of entities for a number of purposes. However, sediment is the greatest water quality issue we face, and there is no specific sediment monitoring occurring in the watershed. Proportional sediment and bedload monitoring stations at key points in the watershed would provide useful information about the nature of the sediment (particularly particle size), the quantity, and changes over time. Sediment monitoring would help assess the effectiveness of BMPs and assess trends over time.

There is a need to better understand the factors controlling basin sediment yields, sediment transport and storage dynamics, and channel stability within the Pigeon River Watershed. Much of this understanding can be obtained by analyzing the watershed's geomorphic history; more specifically, how the channels have responded to catastrophic flooding, previous land use alterations, natural shifts in climate, wildfires, and a host of other disturbances. For example, railroad logging in the early 1900s may still be affecting drainage systems and sediment delivery within the Pigeon River Watershed. Without understanding how the river system is responding to these past impacts, we may be treating more of the symptoms than the overriding problems. Unfortunately, there is little data related to these factors in the southern Appalachians. Studies that focus on the river systems geomorphic stability and sediment transport kinematics would help explain and address some of the underlying causes of the current degradation in water quality.

Incentives

Incentives can be effective tools in implementing change. A common tool used by many public and private organizations is a performance bond. Before an undertaking commences, the contractor is required to post a performance bond. Compliance with the terms of the contract insures that the bond is released after the project is completed. However, if there are portions of the contract that are not completed to standard, the bond can be used to correct those problems. In the case of subdivision development, Haywood County already includes provisions for obtaining performance bonds for soil and water conservation measures. Implementing this existing authority would provide another tool for insuring that agreed upon BMPs are properly applied during development.

Another approach would be to establish a fee for a development permit. All or part of the fee could be waived for those builders and developers that have successfully completed training in soil and water conservation practices for road and subdivision development, including stormwater management.

County or town impact fees could be assessed based on the acres disturbed. These funds could be used to correct nonpoint pollution problems in Haywood County.

Another form of incentive is to place attractive features beside waterways. Greenways provide a number of watershed benefits. The undisturbed space adjacent to the stream serves as a filter and buffer for runoff entering the stream. Much of the sediment is trapped before it reaches the stream. The woody vegetation along the stream maintains cooler stream temperatures, enhancing aquatic habitat conditions. Greenways are also good places to locate recreational facilities, such as trails. Trails provide outstanding places to educate visitors about watershed conditions. In addition, recreation users will be concerned and effective monitors of changing water quality conditions. This public awareness will generate its own incentives to encourage good stewardship of watershed lands.

The State of North Carolina has passed laws to encourage the donation of conservation easements. Individuals or corporations making such donations receive a $250,000/ $500,000 tax credit for such donations. In addition, donors may qualify for tax deductions from the federal government. If developers or other landowners were encouraged to make such donations, either to the County/Towns or a qualifying nonprofit land trust, it would help minimize the adverse affects of the associated surface disturbance while enhancing the attractiveness of the development. It would also be an effective way of reducing the development density and pressure on the watersheds.

Regulations and Ordinances

Haywood County officials are very aware of the issues associated with roads on steep mountain slopes. There are ongoing efforts to develop appropriate ordinances for road construction. If such ordinances could be written to incorporate the most effective BMPs for roads and stormwater management, they could lessen some of the problems associated with new roads.

A number of communities are dealing with similar issues in western North Carolina. Some municipalities and counties are developing innovative approaches to reducing watershed impacts. In Haywood County, the Town of Waynesville has implemented a slope/density ordinance that is intended to reduce the density of development on the steeper slopes. Effective sharing of these experiences and practices can benefit all communities.

Some of the current procedures in the building trade industry tend to encourage builders to do their stabilization work after all other work is done. Some lending institutions currently include stabilization work as a part of the last “draw” on the approved construction funds. Stabilization work could be more effective if some of the practices could be encouraged as soon as the site is graded and foundation completed.

By the same token, occupancy permits could incorporate staged stabilization requirements. This would help insure that appropriate erosion control measures are in place before the interior work begins on the house.

Regulations/ordinances could also be developed for riparian zones. Establishing requirements that minimize the disturbance of the riparian areas and encourage revegetation of problem areas would be an effective tool in the efforts to maintain water quality.

There are other approaches being used in other jurisdictions. While they may not all be applicable to Haywood County situations, they indicate the range of options used to address the issue of rapidly expanding development adjacent to fragile resources.

The first of these addresses the protection of riparian areas. As mentioned previously, riparian areas play key roles in water quality protection. They serve as buffers, stabilize stream banks, and keep the water cool. They are also great "open space" places that attract people. They can make good locations for trails and are important wildlife habitat components.

Montgomery County, Maryland, places a lot of value on its riparian corridors. Because of the water quality issues affecting the Chesapeake Bay, the State of Maryland has provided statutory guidance to counties to insure that riparian zones are protected. The counties adopt various approaches. Montgomery County is a suburban county adjacent to Washington, DC, with a population of about 800,000. The development permitting process involves sign off by several County agencies. During the process, the riparian corridors on the property are evaluated based on their water protection needs as well as their value as corridors for trails, utilities, etc. Depending on the location, terrain, and infrastructure needs of the area, the developer is required to donate a no-disturbance easement, or an easement that does not allow residential development in the corridor, but will accommodate such needs as utility corridors, trails, etc. The easement width on each side of the stream will vary between 100 and 200 feet.

The State of Vermont has enacted statutes to guide or regulate development in all areas of the State. One of the best known is Act 250, which was originally enacted in 1970 and subsequently has been amended. The legislature created a state environmental board and district environmental commissions with the power to regulate the use of lands and to establish state planning capability. The control of the commissions is exercised through a permitting process. The permitting process is often triggered by project or lot size. For example, subdivisions containing more than ten lots require an Act 250 permit.

Some states have tried legislative approaches to encourage local planning that addresses a number of issues, including conservation and nonpoint pollution issues. During the past quarter-century, at least nine states have adopted laws that establish policy and regulatory frameworks for governmental guidance of urban development and conservation. These statutes followed many decades in which states generally authorized local governments to control the location and nature of development. These states erected new legal and institutional structures that integrate state, regional, and local guidance of urban development and conservation of natural resources. The laws establish comprehensive state goals and policy priorities for community development and institute new intergovernmental procedures for achieving those goals and priorities.

Monitoring and Enforcement

There are a number of good guidelines already in place. Haywood County has an erosion and sediment control ordinance. While it does not address all of the issues mentioned above, full compliance with the provisions will reduce sedimentation. However, there is only one person to enforce the provisions of this ordinance. Due to workload, violations may go unchecked. The more support and assistance the County can give that position, the cleaner our waters will be.

State and federal agencies also have effective erosion control practices built into contracts. However, these entities have limited resources dedicated to monitoring and enforcement of these important provisions. It is always easier to obtain appropriations to build than to monitor. In the rush of a project, situations can develop in which erosion control practices are ignored or improperly applied. This can be particularly critical on watersheds like Richland Creek where Lake Junaluska collects all the sediment that gets into the stream. It would be in the best interest of Haywood County for interested individuals to become familiar with these erosion control requirements and alert the appropriate state or federal official of observed problems. Such action to enforce existing requirements will not only reduce erosion, but also let everyone know that folks in Haywood County do not want their waters to serve as settling ponds for poorly implemented projects.

Recommended Strategies and Action Plans

The members of the Technical Advisory Committee (TAC) plan to implement the following 14 strategies to maintain and improve the water quality in the Pigeon River Watershed. The recommended strategies reflect agreed upon actions to reduce nonpoint pollution. The specific action plans make assignments, assign priorities, set targets, and monitor progress. Some action plan items require prioritization across the watershed; others apply to the entire watershed. Each strategy will have priority depending on need. The strategies and action plans will be periodically updated as needed to reflect new information, funding levels, and organizational adjustments.

1. Strategy: Continue existing public awareness programs.

There are several excellent educational and awareness efforts focused on water quality issues in Haywood County. These include the Kids in the Creek program, conservation presentations in the schools, newspaper columns, various newsletters, the HWA website (www.haywoodwaterways.org), distributing informational brochures, making water quality presentations to interested organizations, facilitating formal training sessions in erosion control, increasing membership in Haywood Waterways Association, and participating in fairs and other local events. These efforts need to be maintained.

Action Plan:

Program Name	Schedule	Coordinator	Partners	Audience	Status
Kids in the Creek	Fall	HWA HC Schools	HS&WCD, TVA, Blue Ridge Paper, Haywood Community College, N.C. Cooperative Extension Service, Town of Canton, Haywood County Swift Water Rescue, GSMNP, US F&WS, NC WRC, Univ. of TN	8th grade students	On-going
Land Judging Day	Fall	HS&WCD	VoAg teachers; NRCS soil scientists	High School Students	On-going
Poster, Essay, Speech contests	Throughout school year	HS&WCD	Haywood County School System	3rd to 9th grade students	On-going
Enviroscape Presentations	Throughout school year	HS&WCD	Haywood County School System	Various grades	On-going
Conservation Field Day	Fall	HS&WCD	Local, State, and Federal Conservation Agencies	5th grade students	On-going
Y.E.S. - Youth Environmental Stewardship	June (8thgrade) July (9th grade)	HS&WCD	Mark Ethridge- Haywood County School System	8th and 9th grade students	On-going
Conservation Presentations in schools	Throughout School Year	HS&WCD	Haywood County School System	Students—various grades	On-going
Newspaper Columns	Throughout year	TAC members	HWA TAC members	Haywood County residents	Need to encourage
Newsletters, website, and membership emphasis	Throughout year	HWA	HWA TAC members	HWA membership and general public	On-going, need to encourage membership

Program Name	Schedule	Coordinator	Partners	Audience	Status
Water quality, nonpoint source presentations to community	Throughout year	TAC members	HWA TAC members	Interested organizations and general public	On-going, have given > 60 present.
Training in erosion control practices	Annually	HWA	HWA TAC members Clear Water Contractor Wkshop	Homebuilders, realtors, farmers, etc.	On-going
Displays at community events	During event	TAC members	HWA TAC members	General public	On-going
HWA Summer Youth Program	Summer	HWA	HWA, HC Schools	Rising 6th and 7th grader students	On-going
Distributing informational brochures	Throughout year	TAC members	HWA TAC members	General public	Some members are doing this

2. Strategy: Expand public awareness programs.

The public has expressed concerns about how invisible the technical and financial assistance programs are to folks with water quality issues on their property. Part of this perception results from the fact that the target audience for some of these services is changing. The TAC will explore a variety of options to increase public awareness of what is available and where to get information and/or help. These ideas include major newspaper inserts, coverage on local TV broadcast and Haywood County access channels, public service announcements on local radio stations, participating in on-air interviews, and meeting with property owner associations and community organizations. We must respond to every opportunity to increase public understanding of the water quality issues facing residents of the Pigeon River Watershed.

Action Plan:

New Initiative	Schedule	Coordinator	Partners	Target Audience	Status
Training in stormwater management	Phase II SW permit period	HWA	TAC members	Canton, Clyde and Waynesville, developers	Starting 2006
Create library of mitigation measures for land disturbing activities.	On-going	HWA	TAC members	Developers, public officials	Starting 2006
TV PSAs on local access channels and WLOS—TV; Radio Interviews	On-going	HWA, Project Leader	TAC members	Haywood County Residents	Some events have occurred but more should be done
Presentations for property owners, realtors, builders, farmers, and other community associations	On-going	HWA, Project Leader	TAC members	Organizations with specific activities directly affecting the watershed	On-going but could do more
Distribute copies of the revised Watershed Action Plan	On-going	HWA, Project Leader	TAC members	Haywood County residents, local, state, and federal agencies, granting institutions	Starting 2006

3. Strategy: Continue and improve water quality monitoring.
The VWIN monitoring by local volunteers will be continued. The data that is gathered and the need for more sites are good reasons for future grants. Continued biological monitoring by DWQ, WRC, TVA, and others will be encouraged. In addition, sediment-monitoring stations will be continued and established in the watershed as funding permits. These stations are needed to better define our current situation, validate model estimates, assess trends over time, and monitor the effectiveness of pollution abatement practices and projects installed in the watershed.

Action Plan:
Water quality monitoring can be performed through several methods: physical/chemical monitoring, such as is obtained through the VWIN program; biological monitoring, such as the EPT and IBI data; and sediment monitoring, such as provided by bedload and proportional samplers. The VWIN program is developing good baseline data from a growing number of stations. However, the number and location of some of the stations need to be adjusted from time to time to provide assessments of changing conditions. The EPT and IBI data provide longer-term indicators of water quality, but there are still unresolved issues as to the appropriate metrics for IBI information. Sediment is the most significant issue in the Pigeon River Watershed. However, sediment-monitoring efforts have been limited to total suspended solids and turbidity samples taken during the VWIN process. Therefore, the TAC plans the following measures to enhance the water quality monitoring process in the Pigeon River Watershed:

1. Share information about changing conditions and threats to the watershed to determine if the VWIN sites need to be increased or relocated. Annually assess the number and location of the sample stations to insure they represent the highest priority needs for water quality information.
2. Annually review the parameters included in the VWIN tests to determine if they are the measurements that provide the most useful information about watershed conditions.
3. Insure that grant requests incorporate appropriate levels of funding to support monitoring. Adding sediment-monitoring stations will be a priority.
4. Stay current with water quality sampling science and technology to insure that the Pigeon River Watershed monitoring provides cost-effective and useful information.
5. Increase monitoring to evaluate the success of BMP projects.
6. Support the Pigeon River Recovery Project with mapping the Pigeon River and collect habitat and sediment data, which can be used as baseline for achieving measurable results.
7. Support TVA with IBI evaluations on target streams.
8. Evaluate DWQ monitoring sites and recommend moving, if necessary.

4. Strategy: Encourage studies of sediment yields, transport, and storage and channel stability.
What is occurring in stream channels is a reflection of upstream watershed conditions; both current and past. Upstream changes can have long-lasting effects. However, there is little information about these dynamics in the Pigeon River Watershed. Geomorphic and stratigraphic studies in the watershed are needed to better understand the forces shaping the drainage system. In cooperation with interested universities, research organizations, and agencies, funding will be sought to initiate such studies.

Action Plan:
The long-term effectiveness of many stream stabilization and erosion control practices depends on a sound understanding of the dynamics at work within the watershed. For example, it is critical to determine how much of the sediment being deposited in Lake Junaluska is a function of past practices, how much is stored in the stream bed, and how much of it originates from overland flows over new disturbance. Of that which is eroded as a result of new activities, it is essential to refine our information on where most of the sediment is derived. Also of importance is an assessment of whether the current stream course is down cutting or aggrading and why. Sediment monitoring will provide some of these

answers, but will not answer the important question of "why" they are occurring. The following actions are planned to address the lack of needed information:

1. A literature search will be conducted to gather what information exists for the southern Appalachians.
2. Public and private research organizations will be contacted to determine where the interest and capability resides to develop cost-effective geomorphic-stratigraphic studies.
3. A study approach will be developed with interested cooperators.
4. Grant funding will be sought for these studies.
5. The results will be published to disseminate the information to those involved with restoration efforts; and assist in the development of sound, fiscally responsible restoration activities.
6. Rate Haywood County streams using the Rosgen stream classification system; this information will help identify needs for stream restoration projects and possibly help resolve sedimentation issues.
7. Use the 2006 IPSI data set to locate new areas of erosion and compare to the 1999 data to determine how the watershed has changed with development and the 2004 floods.

5. Strategy: Coordinate with the Haywood Erosion Control Board and County Commissioners.

The Erosion Control Board and the County Commissioners share an interest in clean water for Haywood County. They are in a position to effect some of the most beneficial long-term watershed protection measures for the Pigeon River Watershed. The TAC must keep these County officials fully informed of all pollution abatement efforts underway on the Pigeon River Watershed. On another level, these officials often struggle with the appropriate responses to the changes occurring in Haywood County. The TAC can increase their ability to assess the watershed impacts of a variety of "what if" scenarios.

Action Plan:

The Erosion Control Board generally meets on a quarterly basis and the County Commissioners meet twice a month.

1. The TAC will periodically request opportunities to brief the Board and Commissioners when significant actions are about to occur (release of WAP, receipt of grant funds, initiation of significant watershed research or other initiatives, release of potentially controversial information, etc.).
2. In order to further a regular dialog, the Project Leader of HWA will submit quarterly summaries of HWA/TAC activities to both organizations.
3. Representatives of these County organizations will be invited to annual HWA meetings and significant field trips within and adjacent to Haywood County.
4. The Chairman of the Erosion Control Board and the County Manager will be given ad hoc briefings on current activities and issues.

6. Strategy: Encourage development of greenways along riparian corridors.

Riparian corridors are critical elements for water quality. Greenways can serve as multi-use corridors along streams that protect riparian values while providing recreation and wildlife corridors. In many cases, they can be coordinated with corridor planning to provide sites for certain types of linear land uses that do not conflict with riparian protection objectives. There are several ongoing efforts in Haywood County focused on greenways; examples include efforts at Canton Recreation Park, Maggie Valley, and Richland Creek Greenway between Lake Junaluska and Vance Street Park. These efforts often need support and specific resources to succeed, including grant writing, trail planning and design, easement-drafting services, negotiating skills, and other assistance.

Action Plan:

Greenways are multi-function corridors providing multiple public benefits while conserving critical resources. Many are located adjacent to streams. Greenways provide a site for a variety of linear uses, including recreation trails. They help maintain wildlife corridors and habitat. However, one of their most

significant values is that they protect riparian zones along streams. In this capacity, they help stabilize stream channels, maintain cooler water temperatures, and serve as effective filters that prevent harmful pollutants from entering the stream.

There are several greenway efforts currently underway in the Pigeon River Watershed. These include the greenway at the Canton Recreation Park, the Maggie Valley Greenway effort, and the Richland Creek greenway currently being developed between Lake Junaluska and Vance Street Park. The TAC will support the Greenways Advisory Council efforts in the following ways:

1. Provide publicity and public support to these efforts through conservation columns in local newspapers, organization newsletters, web sites, and other media.
2. Provide technical support where members of the TAC and HWA have skills and/or resources that can further the establishment and long-term maintenance of the greenways.
3. Assist in grant writing where the proposed greenway will provide significant riparian protection in threatened stream corridors.
4. Host public forums as needed to focus attention and support for greenway initiatives.
5. Maintain a library of resources to assist in the planning and development of greenways.

7. Strategy: Encourage donation of conservation easements.

Conservation easements can be gifts that keep on giving. They provide a mechanism whereby a landowner can donate property rights to a public agency or qualifying nonprofit corporation. The rights they donate can insure that the property is maintained in its present use—whether agriculture, forestry, or limited residential. Easements can maintain certain desirable land uses and open space, reduce development pressure on sensitive watersheds, protect riparian areas, and perform many other functions. Since such gifts are considered to be in the public interest, the federal government and the State of North Carolina have enacted favorable tax laws for such gifts. In the case of North Carolina, an individual can receive up to $250,000 in tax credits for a donated conservation easement. The federal government allows a tax deduction for the donation. Conservation easements can also provide a substantial estate and inheritance tax advantage. Federal estate taxes imposed on the value of a person's assets after he or she passes away can be severe, sometimes forcing heirs to sell the land to pay the taxes. An easement reduces the value of the taxable assets, therefore lowering the potential estate tax liability.

There are a number of ways to encourage such donations, ranging from public support to providing specialized skills to complete such transactions. There are numerous situations in Haywood County where such easements could reduce the pressure on the watershed, allowing other watershed improvement practices to be more effective and long-lasting.

Action Plan:

The value of conservation easements includes protecting special places; maintaining open spaces; protecting water quality, wildlife habitat, and viewsheds; providing recreation and educational opportunities; and maintaining prime farmland in agriculture. From the standpoint of the Pigeon River Watershed, one of the key values is reducing development density on steep mountain slopes. Reducing development density means fewer roads, house sites, driveways, and other watershed impacts. Reducing density also reduces the amount of impervious surfaces in the watershed and the associated stormwater runoff. The TAC plans the following actions to support the Haywood Soil &Water Conservation District and the Southwestern NC Resource Conservation & Development Council:

1. Provide publicity and public support to easements through conservation columns in local newspapers, organization newsletters, web sites, and other media.
2. Provide technical support where members of the TAC and HWA have skills and/or resources that can further the donation of conservation easements.

3. Maintain a library of resources providing introductory information on the nature of easements; their structure, form, and function; and the federal and state tax implications.
4. Link up interested landowners with the appropriate agencies and organizations to facilitate the donation of appropriate easements.
5. Support efforts to obtain state, federal, and grant funding to acquire easements to protect prime farmland and sensitive mountain resources.
6. Maintain membership in the Southern Appalachian Highlands Conservancy, a regional land trust serving the southern mountains.
7. Identify and prioritize sites for easements.

8. Strategy: Continue to provide financial and technical assistance.
The TAC members represent the organizations in Haywood County providing technical and financial assistance for correcting sources on nonpoint pollution. These efforts will continue and focus on specific problem areas, such as the Lake Junaluska Watershed. The variety of GIS data available to the TAC, together with the knowledge and experience of committee members should help obtain funds to address many of the most significant existing sources of nonpoint pollution. Grants will be sought from the Pigeon River Fund, the NC Clean Water Management Trust Fund, EPA Section 319 Program, and other grant-making organizations with conservation goals. Other sources of funding and assistance, including state and federal appropriations, will be investigated.

Action Plan:
Haywood County has access to a variety of state and federally funded programs that can assist landowners in dealing with a variety of conservation issues. Many of the TAC members are responsible for delivering those services. Funding for this work is generally very limited, but the existing programs and service contacts are listed in Appendix II.

9. Strategy: Design and implement BMPs to improve water quality.
Once landowners have indicated an interest in correcting a problem on their property, and agreed on an approach, the specific practice must be designed and installed. In some cases, the practice may be very simple, such as planting appropriate tree species along a creek bank. In other cases, considerable thought and design goes into identifying the most effective practice and designing it to achieve the desired result. This is particularly true of structural modifications along streams and roadways, as well as those designed to manage stormwater runoff. The TAC members include a number of people with experience and skills to implement the BMPs. Also, the revised 2006 IPSI data will update the extent of impact, measure possible improvements, and identify possible new sites to focus efforts.

Action Plan (the specific action items are found at the end of this section):
This strategy addresses correcting existing known problems by putting into place practices that will stop or substantially reduce erosion and sedimentation. There are many approved BMPs for specific land-use issues. For example, eroding stream banks can be stabilized by establishing woody vegetation along the banks or hardening the stream banks with gabions or other structures, with several practices between these extremes. The most suitable practice depends on the nature of the stream, soil structure, adjacent land use, downstream considerations, and other factors. Once the most suitable practice is determined, that practice must be properly designed to withstand peak water flow conditions as well as accomplish the desired objective. After design, the practice is installed by trained professionals with the Haywood Soil and Water Conservation District, or by hired contractors specializing in watershed restoration.

These practices can be expensive, and financial resources are limited. Individual landowners decide whether they are willing to participate in installing the practice on their property. The funding formulas

often require some percentage of cost sharing or in-kind support from the landowner. Therefore, while it may be possible to agree on priorities in the abstract, practical considerations may require a more flexible approach to specific watershed improvement implementation. Improvements that are not in the highest priority watersheds will still make substantial contributions to the overall condition of the Pigeon River.

In the case of the Pigeon River Watershed, two areas stand out as having the most significant water quality issues: the Lake Junaluska Watershed (primarily the Richland Creek subwatershed) and the Fines Creek–Rush Fork section of the Lower Pigeon subwatershed. Lake Junaluska has experienced major sedimentation problems that appear to be increasing in severity and cost to cure. The Lake is of critical importance to Haywood County for its sense of place and substantial economic benefits. There are also a limited number of acceptable options as to where to place the silt once it is removed. Reducing the rate of sedimentation is critical to the long-term viability of this resource. The VWIN data indicates the Fines Creek–Rush Fork Creek Watersheds have some of the most significant water quality issues of any streams flowing into the Pigeon River and should be a priority for water quality improvement efforts.

All streams included on the 303(d) list are also priority. These are streams in the Pigeon River Watershed that the State of North Carolina has classified as being impaired to the point of not meeting the water quality standards for their designated uses. Since this plan is focused on nonpoint pollution, we are only concerned with those stream segments that are impaired due to nonpoint pollution. The following stream segments are on the most current list: portions of Richland Creek and Raccoon Creek.

There is also a developing concern in the Jonathan Creek Watershed. The mountainsides around Maggie Valley are subject to substantial development pressure. There are a number of new or planned developments in the area. The latest VWIN sample indicated a reduction in water quality. Given that roads are the primary source of sediment in the watershed, and many new roads are being built, it deserves attention. The first approach has to be the application and enforcement of the existing Haywood County Erosion and Sediment Control Ordinance. In addition, this watershed is an excellent candidate for applied research on practices to contain sediment on site. Monitoring may need to be enhanced.

There can be special circumstances where nonpoint pollution problems outside the above watershed areas will rank high for funding. For example, situations threatening public health and safety (road hazards, etc.) or people's homes could be priorities regardless of the watershed location. There can also be situations where a local government may want to cooperate in correcting erosion issues on public property. The opportunity to demonstrate progress in such a visible and cooperative way may outweigh some other considerations. If there is hesitancy on the part of landowners in a particular watershed to participate in watershed improvement projects, establishing significant demonstrations in adjacent watersheds may further long-term water quality objectives.

There are many sources of nonpoint pollution. However, the IPSI information indicated certain sources were particularly significant. For purposes of BMP implementation, the focus will be on practices that address the most significant pollutants and sources.

Richland Creek

Eroding stream banks are the number one cause of sedimentation in this watershed. There are 43,654 feet of eroding stream bank. These eroding banks are on properties ranging from a few tenths of an acre to farms that are over a hundred acres in size. Hundreds of properties are faced with this problem. While it would be a desirable goal to correct all eroding stream banks, it is probably not feasible. The experience of a sister association in the Little Tennessee Watershed indicates that after a watershed improvement program is funded, the long-term limitation will be landowner participation. While many landowners are willing to participate, not everyone will be interested at the time the funds are available. This plan

proposes a 5-year goal of stabilizing 23,000 feet of eroding stream bank. This is just over 4,000 feet a year, and at the end of five years is estimated to reduce sedimentation from current sources by 25%.

Roads are the next most significant source of sediment in this watershed. There are 625 miles of roads, with 308 miles unpaved. About 26% of the unpaved roads in this watershed have eroding road banks, visible from aerial photographs. About 8% of the paved roads have eroding road banks. Eroding road banks are one of the greatest contributors of sediment from roadways. Just stabilizing the eroding road banks in this watershed would make a substantial improvement in water quality.

Making progress in this area may take more time than with the eroding creek banks. There are no state approved BMPs for stabilizing existing road networks in the mountains. However, roads are a major and growing source of sediment and stormwater runoff for all the Pigeon River subwatersheds. This plan proposes to obtain funding for one or two demonstration projects within the Richland Creek Watershed over the next year. The projects will be done in areas with established homeowners associations. The potential treatment areas will be identified by the number of feet of eroding road banks. Associated erosion control needs will be addressed while working in the area. These funds will be used to apply and evaluate a variety of practices where needed—stabilizing road banks, hardening ditches, adding culverts, installing settling ponds, and other practices. Very steep sections of roads may even be considered for paving to reduce gully and sheet erosion. The work and effects of the practices will be monitored. Those successful practices will be documented and incorporated in subsequent grant requests. The goal for this plan is to reduce the existing backlog of eroding road banks and other road-associated erosion problems by 25% over the next five years (about 26 miles of stabilized road banks—just over 5 miles per year). That accomplishment could reduce sediment in Richland Creek by 8%.

Pasture condition and animal access points account for 14% of the sediment in Richland Creek streams. There are 3,071 acres of land in the watershed classified as pasture in fair condition. There are 35 clearly identified animal access points. The variety of proven practices to address these concerns ranges from fencing for pasture rotation to providing alternate water sources so livestock can be fenced out of the streams. Many of the properties with eroding stream banks also have pasture condition and animal access concerns. Therefore, to make the most efficient use of resources, landowners participating in stabilizing eroding stream banks will also have an opportunity to obtain assistance in improving pasture and animal access situations. Any additional federal or state funding for programs focused on these resources will further improve accomplishments in this area. The five-year goal for addressing the agricultural concerns is to move 30% of the pastureland from the fair category to the good category, and to achieve a similar reduction in animal access points (921 acres of improved pasture, ten animal access points). This accomplishment would reduce sedimentation by an additional 4%.

Richland Creek has the highest percentage of riparian area in marginal to inadequate condition. Although the right and left bank totals differ slightly, there are roughly 40 miles of riparian corridor in marginal to inadequate condition along each bank of the streams in this subwatershed. Some of the stream bank stabilization work may be as easy as reestablishing a narrow tree- or brush-covered strip adjacent to the stream. In other cases, establishing riparian vegetation may be a component of a larger project that stabilizes the bank and stream flow characteristics. There will also be a variety of incentives offered to landowners willing to restore riparian conditions along streams. The goal for the 5-year planning period is to move 10 miles of the riparian corridor on each side Richland Creek streams from inadequate or marginal to adequate. While there is not a specific sedimentation reduction benefit calculated for this practice, the presence of restored riparian corridors will prevent future stream bank erosion and filter sediment from other sources before it reaches the stream.

The total targeted reduction for the five-year period is 37% from all BMPs in the Richland Creek Watershed. This reduction will have a measurable affect on water quality and the amount of sediment

arriving in Lake Junaluska, provided the other strategies are implemented concurrently with these practices. It is as necessary to prevent new sources as it is to fix existing problems.

Fines Creek

Fines Creek is a rural watershed, containing 16,878 acres. Residential use is a fraction of what it is in the Richland Creek Watershed. However, there are 196 miles of roads in this subwatershed (1 mile for every 86 acres). Agriculture is a significant land use. Pasture uses account for 23% of this watershed area, compared with 10% in the Richland Creek Watershed. There are over 600 acres of pasture in poor condition, and 2,637 acres of pasture in fair condition. About 15% of the stream banks are eroding (62,193 feet), and only 7% of the riparian zones were classified as adequate condition. There are about 100,000 feet of eroding road banks. There are at least 16 animal access points.

Based on the assumptions used for the Richland Creek action plan, a 35% reduction in nonpoint pollution from existing sources in five years would be a reasonable goal. An EPA Section 319 Program grant obtained by HWA and the Haywood Soil and Water Conservation District will provide funds to begin work. Those funds are earmarked for Fines Creek and Hyatt Creek (in the Richland Creek Watershed). It is likely that the money available for Fines Creek will correct 5% of the eroding stream banks and up to 10% of the poor pasture conditions. Those funds should also address about 5% of the existing animal access points. That would leave a five-year target of correcting an additional 30,000 feet of eroding stream banks, fencing livestock out of the creek at five points, and improving the poor pasture conditions.

Rush Fork Creek

Rush Fork is also a rural watershed, containing 3,763 acres within the Lower Pigeon subwatershed. Less than 1% of this watershed is dedicated to light residential land use. However, pasture land accounts for 29% of the land area. The majority of the pasture was classified as being in fair condition, though there was a small acreage of overgrazed and poor pasture. It has one of the smallest percentages of eroding stream banks in the County; just over 1% of the stream banks in this small watershed were classified as eroding in the IPSI. However, it has the highest density of animal access points of any of the watersheds studied in this analysis, about one per 376 acres compared to 1 per 1000 acres in Fines Creek, and one per 1,250 acres in Richland Creek. There are 44 miles of roads in this small watershed (1 mile per 86 acres).

Much of the work in this watershed will need to focus on reducing the number of animal access points by providing alternate water sources and fencing. Pasture improvement practices will also be a priority. The goal over the next five years will be to reduce the number of animal access points by 50%, improve the condition of the 60 acres of overgrazed and poor pasture, and assist farmers in improving pasture conditions on 40% of the pastures in the fair category.

Specific action items:

1. There are many different sources of nonpoint pollution in the Pigeon River Watershed. For the purposes of BMP implementation, the focus will be on practices that address sources contributing the largest amount of sediment. The following table lists the primary sources of nonpoint source pollution in the Richland Creek, Fines Creek and Rush Fork Creek subwatersheds and the five-year goals for improving water quality.

Two other concerns in this action item are the limited number of options to place silt from Lake Junaluska once it is removed and how to address development pressure in the Jonathan Creek watershed. The first approach to address development pressure mentioned in the WAP was the application and enforcement of the existing Haywood County Erosion and Sediment Control Ordinance.

Table 1. Goals and progress for design and implementation of Best Management Practices. (*revision needed*)

Nonpoint Sources	Problem	1 yr goal	5 yr goal	Improvements[a]	Notes
***Richland Creek (Lake Junaluska, not including Hyatt Creek)**:* total target sediment reduction for five years is 37%					
Eroding stream banks	43,654 ft	Stabilize 4,600 ft	Stabilize 23,000 ft	6,250 ft	Estimate reduce sedimentation 25%.
Eroding road banks	105.5 miles (80.1 unpaved; 25.4 paved)	Stabilize 5.3 miles (4 unpaved, 1.3 paved)	Stabilize 26.4 miles (20 unpaved, 6.4 paved)	None	Conceptual[b]; could reduce sediment in Richland Creek 8%.
Pasture condition[c]	3,071 acres in fair condition	Improve 184 acres to good condition	Improve 921 acres to good condition	In construction phase	Along with reducing animal access points, would reduce sedimentation 4%.
Animal access points[c]	At least 35	Decrease by 2	Decrease by 10	~1	Along with improving pasture condition, would reduce sedimentation 4%.
Riparian corridor	~40 miles in marginal to inadequate condition	Improve 2 miles on each stream-side to adequate	Improve 10 miles on each stream-side to adequate	9,250 ft	
***Fines Creek**:* total target sediment reduction for five years is 35%, funding provided by EPA Section 319 grant					
Eroding stream banks	62,193 ft	Stabilize 6,621.9 ft	Stabilize 33,109.7 ft	750 ft	5% from EPA 319 grant
Eroding road banks	~100,000 ft (probably most unpaved)	--	--	--	Roads were not a target of the EPA 319 grant
Pasture condition	600 acres in poor condition; 2,637 acres in fair condition	Improve 120 acres of poor pasture to good	Improve the 600 acres of poor pasture to good	111 acres	10% from EPA 319 grant
Animal access points	At least 16	Decrease by 1+	Decrease by 6	~3	5% from EPA 319 grant
Riparian corridor	93% classified as inadequate condition	--	--	9,455 ft[d]	Riparian corridors were not a target of the EPA 319 grant
Rush Fork Creek (no target sediment reduction goal established in the WAP)					
Eroding stream banks	~ 1+% classified as eroding	--	--	--	Not included as goal in the WAP
Eroding road banks	Information not available	--	--	--	Not included as goal in the WAP
Pasture condition	Majority of 1091.3 acres in fair condition, 60 acres in poor condition	Improve 12 acres of poor pasture and 8% of fair pasture	Improve all poor pasture and 40% of fair pasture	None	Funding has not been received
Animal access points	~ 10	Decrease by 1	Decrease by 5	None	Funding has not been received
Riparian corridor	Information not available	--	--	--	Not included as goal in the WAP

[a] Improvements include projects completed, in the construction phase or in the design and engineering phase.

[b] Questions that need addressed: Is landowner interest high? Because it is a new initiative, are funds obtainable? Have any state approved BMPs for stabilizing existing road networks in the mountains been established? One goal is to obtain funding for one or two demonstration projects.

[c] Many properties with eroding stream banks also have pasture condition and animal access concerns. To make the most efficient use of resources, landowners participating in stabilizing eroding stream banks will also have an opportunity to obtain assistance in improving pasture and animal access situations.

[d] Although improving riparian corridors were not a target of the EPA 319 grant, riparian conditions were improved with improvements to pasture condition and stream banks and reducing animal access points.

10. Strategy: Identify and support effective state and federal water quality improvement programs, and local organization dedicated to improving water quality in the watershed.

There are a variety of federal and state funded programs focused on reducing nonpoint source pollution. A few of these could be particularly effective in the Pigeon River Watershed, such as the US Environmental Protection Agency, Tennessee Valley Authority, Wildlife Resources Commission, DENR Division of Water Quality, Pigeon River Fund, Clean Water Management Trust Fund, and the Pigeon River Recovery Project. One example is the Environmental Quality Incentives Program (EQIP). The program provides assistance with BMPs to landowners that have approved conservation plans. However, this program depends on federal appropriations. Increased awareness and support of such programs could result in increased appropriations for Haywood County.

Action Plan:

A number of federal and state programs focus on conservation and reducing nonpoint source pollution. However, funds are limited, with stiff competition for the available appropriations. The TAC is an excellent coordination and networking resource that can function to improve the chances for funding important conservation needs in Haywood County. The following actions are planned with HWA's Project Manager acting as coordinator:

1. Maintain a current database of existing programs. The database will include primary program objectives, responsible agencies and local contacts, federal or state oversight and appropriation committees, Haywood County funding history, and an estimate of qualifying projects in the Pigeon River Watershed.
2. Annually identify and focus efforts on those programs that have the greatest potential to substantially contribute to nonpoint pollution source reduction in the Pigeon River Watershed.
3. Compile briefing papers in support of these selected programs.
4. Increase public awareness of the potential benefits of obtaining state and federal appropriations through the targeted programs.
5. Annually contact our elected officials to inform them of the opportunities to assist Haywood County in addressing nonpoint pollution issues.
6. Support the Bethel Rural Community Association in their farmland preservation efforts.

11. Strategy: Seek additional skills as needed to meet ongoing and project needs.

While the skills exist for the current level of BMP implementation, these strategies should substantially increase the rate at which BMPs will be designed and installed. In order to keep up with the needs, additional technical assistance skills will be needed. There are a number of approaches that could be used, depending on the amount of funding, length of the funded programs, and nature of the skills needed. These options include increased staffing for the Haywood Soil and Water Conservation District Office, detailing personnel from other locations, or contracting with private specialists. A combination of all three may be appropriate.

Action Plan:

As funds are obtained to install BMPs and to address increasingly complex nonpoint pollution issues, conservation agencies in Haywood County may need additional staff and/or a different mix of skills. Much of the effectiveness of nonpoint source pollution abatement efforts will depend on the skills available to the County. The TAC provides a valuable coordinating structure among conservation organizations in the Pigeon River Watershed to assess skill needs. The following actions are proposed to address this issue:

1. At least once a year, devote a portion of a regular TAC meeting to an assessment of existing watershed protection skills and identification of any shortages.
2. When substantial shortages are identified, the TAC will consider a range of options on how best to obtain those skills.

3. In cases where it appears most effective to add permanent positions, the TAC will develop a strategy to decide where the position should be located and how to obtain the necessary funding and support for the increased staffing.
4. Implement the agreed-upon strategy.

12. Strategy: Provide incentives for watershed protection.

In order to maintain and improve the water quality of the Pigeon River Watershed, we will have to change our practices. Change is difficult. Incentives can provide recognition to conservation leaders, help defray costs, and reward new initiatives. They can take many forms. Examples include certification programs, County and State recognition, fee offsets for important training, and providing materials to implement practices (such as grass seed and trees). Designing incentives in support of the most needed changes will provide additional publicity and provide affirmation to the individuals and corporations willing to be first.

Action Plan:

Achieving the North Carolina goal of keeping the sediment on the site will require changed behavior on the part of many segments of our society. Incentives provide a means of making the change easier by focusing on a goal rather than a regulation. They may also help homeowners, developers, and farmers increase profits. Any incentive should include signage and/or articles. These will require support from HS&WCD and NC Cooperative Extension to do certifications. A certification program may also help gather support for future 319 funded projects. The following measures will be adopted to encourage the development of incentives to encourage improved practices:

1. The TAC will develop a range of watershed protection incentives, such as "Certified Green Farmer", "River Friendly Farmer", "River Friendly Homeowner", and "River Friendly Subdivision".
2. The TAC will contact development and agricultural interests to determine the most effective form of incentives, and contact other jurisdictions to learn from their experience.
3. The TAC will adopt three of the most promising incentives to put in place by January 1, 2007.
4. HWA/HS&WCD will request funding to support implementation of these incentives.
5. The TAC will develop and implement a public information campaign to develop understanding and support for these incentives.

13. Strategy: Support our public officials as they consider changes in watershed protection and enforcement of watershed protection ordinances.

It is important for HWA to be proactive and get on the front end of ordinance changes. We need to increase our presence in the county, which will increase our ability to help our public officials. Several good ordinances exist for protecting water quality (e.g., the erosion control ordinance). The tough part is enforcement. One of the key positions in the effort to control nonpoint pollution is the County Erosion and Sedimentation Control Officer. Haywood County is fortunate to have an experienced person on the job who is committed to seeing that the ordinance is enforced. However, there is more work than one person can accomplish.

There are potential benefits in exploring the opportunities to have the three municipalities adopt the Haywood County ordinance. This would provide a consistent ordinance for all activities on the Pigeon River Watershed. This unified approach would have the potential of generating enough support to hire a second erosion control officer for the area. For example, there are state cost-share funds available for helping start or expand erosion and sedimentation control programs. A broader, county-wide effort may make Haywood County eligible for such funding. Haywood County is also developing ordinances for rural subdivision development and other activities that affect water quality. As with erosion control, it is important that effective enforcement of these regulations be supported.

The members of the TAC have to understand the basis for current ordinances, the barriers to change, and incentives that would encourage change. This strategy includes sharing information, participating in the development of ordinances, publicly supporting key issues, lobbying for new ordinances, and lobbying for increased funding and staff. The TAC has a variety of technical resources that can help implement this strategy. Many committee members bring years of experience to the task of protecting water quality in the Appalachian Mountain areas. The addition of a variety of GIS resources permits a level of analysis that was only dreamed of a few years ago. The members are pooling their hardware, software, GIS and GPS data, databases, and other information to provide a useful watershed analysis tool. The technical assistance provided by Haywood Community College greatly increases the effectiveness of the committee members in completing such analyses.

Action Plan:
This is one of the most important and challenging action items. It includes issues that range from visible public support for actions taken to protect water quality to support for appropriate funding and staffing levels. The identified actions are:

1. Understand and stay up to date with the Haywood County watershed protection ordinances (such as the erosion and sediment control ordinances, proposed subdivision ordinances, etc.)
2. Participate in the development of effective ordinances to protect water quality.
3. Become familiar enough with the County processes to determine if there are barriers to effective enforcement. Identify any such limitations, and implement strategies to help remove those barriers.
4. Encourage a consistent set of watershed protection ordinances for the county and municipalities of the Pigeon River Watershed.
5. Identify sources of funding that may be available to assist in improving enforcement of existing ordinances. Work with the County and municipalities to obtain such funds when needed.
6. Increase public understanding of the ordinances through presentations, conservation columns, and other media. Support public training sessions for contractors and others in the application of practices called for in the County ordinances.
7. Assist the County Commissioners gather all local, state and federal ordinances relating to land development for creation of a public information brochure and a master document for use by the public officials.
8. The TAC will identify existing infrastructure and construction practices that adversely affect water quality.
9. The TAC will select those identified practices that have the most potential for improving water quality. The TAC will develop a strategy for implementing the needed changes.
10. In cases where implementation of the changes can be facilitated with financial assistance, HWA will apply for the needed funds.
11. Evaluate what state-wide ordinances don't work in the mountains and what holes exist in the current local, state and federal ordinances.
12. Track ongoing local and state legislation, rule making, and planning processes that have significant implications for water quality. Submit appropriate comments and recommendations at the appropriate time.
13. Participate in committees, task forces, forums, and other collaborative planning processes focused on reducing nonpoint pollution.
14. Develop an ongoing relationship with local, state, and federal officials whose decisions affect the quality of water in the Pigeon River Watershed. Keep them aware of the need to maintain the quality of water in the Pigeon River Watershed.
15. Assist local governments obtain funds and skills to address nonpoint source pollution abatement opportunities.
16. Recognize and support initiatives by all levels of government that help keep our waters clean.

14. Strategy: Participate in the planning, design, and monitoring of publicly funded surface-disturbing projects in the Pigeon River Watershed.

The members of the TAC have years of experience and special knowledge that may be of help to federal, state, and local agencies when planning and designing publicly funded projects. Participating with those agencies from the beginning of any proposed project could reduce watershed impacts and planning/implementation costs. Participation will also help insure that design and contract specifications address watershed concerns for the specific project. Once the contracts are let, periodic monitoring of the work will help insure that the design and contract provisions are fully implemented.

Action Plan:

Action items include:

1. Maintain a current list of all planned and active publicly funded construction projects in the Pigeon River Watershed.
2. Maintain a current record of the watershed protection requirements incorporated in federal, state, and local government contracts.
3. Request placement on the appropriate mailing lists to obtain advance notices of public planning processes, contract schedules, and other activities leading to surface-disturbing activities in the Pigeon River Watershed.
4. Participate in public forums in advance of contract development to insure that the water quality concerns of the Pigeon River Watershed are fully addressed in subsequent plans and contract specifications.
5. Consider establishing monitoring sites in advance of major construction projects to monitor changes in water quality directly attributable to the project. Look for opportunities to have this monitoring incorporated as a contract requirement.
6. Periodically visit ongoing projects. Document obvious contract violations. Share the documentation with the appropriate agency contact and request appropriate corrective action.

Literature Cited

Anderson, Brian, *Riparian Zones.* Illinois Steward.

Board of Conservation and Development, *Water Resources of NC.* Raleigh, NC, Jan. 1955.

Carter, Mark W., et al., *A Geologic Adventure Along the Blue Ridge Parkway in North Carolina.* Bulletin 98. Raleigh: North Carolina Geological Survey Section; Division of Land Resources, 1999. 60pp.

DeMers, Michael N., *Fundamentals of Geographic Information Systems (Second Edition).* New York: John Wiley & Sons, Inc. 2000. 498pp.

Eaker, William M., *Stormwater Management in North Carolina: A Guide for Local Officials.* Land of Sky Regional Council, February 1994. 60pp.

Environmental Quality Institute, *Water Quality Trends of Haywood County: Year-Four Report.* Technical Report #00-076, UNCA, October 2000. 24pp.

Frome, Michael, *Strangers in High Places.* Knoxville: University of Tennessee Press 1994. 392pp.

Haywood County Economic Development Commission, *Community Profile, Haywood County, NC.* Waynesville, NC.

Iowa State Agroforestry Research Team, *Your Guide on How to Make a Riparian Buffer Strip*. Iowa State University, 1995.

Medford, W. Clark, *Mountain People, Mountain Times.* Asheville, NC: Miller Printing Company, 1963.

Nebel, Bernard, *Environmental Science.* Englewood Cliffs, NJ: Prentice-Hall, 1981. 715pp.

N.C. Department of Environment and Natural Resources, Division of Water Quality, *A Guide for North Carolina Landowners: Financial Incentives and Technical Assistance Programs Which Apply to Wetlands, Streams and Streamside (Riparian) Areas*. Raleigh: September, 1999. 53pp.

North Carolina Department of Environment and Natural Resources, Division of Water Quality, *French Broad River Basinwide Water Quality Plan.* Raleigh, NC. May 2000. 137pp.

Porter, Douglas R., *State Framework Laws for Guiding Urban Growth and Conservation in the United States.* Mr. Porter first delivered this paper at a seminar held in White Plains at a conference sponsored by the Land Use Law Center of the Pace University School of Law in 1993. http://www.kapa.org/statepla.htm

Reeves, Thomas H., *A History of Haywood County*. Graduate School of Arts and Sciences of Duke University, 1937. 121pp.

Rivers Alliance of Connecticut, *The Importance of Streamside Buffers*. Collinsville, CT: 1977.

Smith, Wendy, *et al.,* "A Landowner's Guide to Streambank Protection and Stabilization," *The Tennessee Conservationist* (September/October 1999)

Swank, W. T., et al., *Long-term hydrologic and water quality responses following commercial clearcutting of mixed hardwoods on a southern Appalachian catchment.* Otto, North Carolina: USDA Forest Service, Southern Research Station, Coweeta Hydrologic Laboratory, 2000. 16pp.

Stuckey, Jasper Leonidas, *North Carolina: Its Geology and Mineral Resources.* Raleigh: Department of Conservation and Development, North Carolina State University Print Shop,1965. 550pp.

Swanson, Robert E., A *Field Guide to the Trees and Shrubs of the Southern Appalachians.* Baltimore: Johns Hopkins University Press, 1994. 399pp.

Tagliapietra, Ron, *The Southern Sixers.* Taylors, SC: Faith Printing, 1997. 134pp.

The Nature Conservancy and Southern Appalachian Forest Coalition. *Southern Blue Ridge Ecoregional Conservation Plan: Summary and Implementation Document*. The Nature Conservancy: Durham, NC, 2000.

Trails and Greenways. www.trailsandgreenways.org/TAG_active_pages/TechnicalAssistance/FactSheets/

United States Department of Agriculture, Forest Service *Healthy Riparian Areas* (FS-445); January 1990.

United States Department of Agriculture, Forest Service, *North Carolina's Timber Industry: An Assessment of Timber Product Output and Use, 1997* (Resource Bulletin SRS-39). Asheville, NC: Southern Research Station, June 1999. 34pp.

United States Department of Agriculture, Natural Resources Conservation Service, *Soil Survey of Haywood County Area, North Carolina.* Washington: Government Printing Office, October 1997. 276pp.

Appendix I. North Carolina Surface Water Classifications for the Pigeon River
Stream Classification Descriptions (Fresh Water)

B	Primary Recreation
C	Aquatic Life, Secondary Recreation
CA	Critical Area
FWS	Future Water Supply Waters
HQW	High Quality Waters
N/A	Not Applicable/Out of State
NSW	Nutrient-Sensitive Waters
ORW	Outstanding Resource Waters
Sw	Swamp Waters
Tr	Trout Waters
WS-I	Water Supply I—Natural
WS-II	Water Supply II—Undeveloped
WS-III	Water Supply III—Moderately Developed
WS-IV	Water Supply IV—Highly Developed
WS-V	Water Supply V—Upstream

Appendix II. Summary of Technical and Financial Assistance Programs in Haywood County, North Carolina

Haywood County Environmental Health Office, 1233 N. Main St. Box 8, Waynesville, NC 28786, 828-452-6682, http://www.haywoodnc.net/health.html

Haywood County Planning Office, Haywood County Annex II, 1233 North Main Street Waynesville, NC 28786, 828-452-6632, http://www.haywoodnc.net /planning.html

Haywood County Erosion Control Program, Haywood County Annex II, 1233 North Main Street, Waynesville, NC 28786, 828-452-6706. http://www.haywoodnc.net/erosion.html

Haywood Soil and Water Conservation District, 589 Raccoon Road Suite 203, Waynesville, NC 28786, 828 452-2741 x 3. http://www.haywoodnc.net/soil.html

Haywood Waterways Association, PO Box 389, Waynesville, NC 28786, Info@haywoodwaterways.org, www.haywoodwaterways.org

NC Cooperative Extension Service, Haywood County Center, P.O. Box 308, Waynesville, NC 28786, 828-456-3575, www.ces.ncsu.edu/haywood/

NC Department of Environment and Natural Resources, Division of Forest Resources, Haywood County Headquarters, 88 Ed Greene Road, Clyde, NC 28721, 828-627-6551. http://www.dfr.state.nc.us/

NC Department of Environment and Natural Resources, Division of Water Quality, 2090 US Highway 70, Swannanoa, NC 28778, 828-296-4500. http://h2o.enr.state.nc.us/

NC Department of Environment and Natural Resources, Wetlands/401 Water Quality Certification Unit, 1621 Mail Service Center, Raleigh, NC 27699-1621, 919-733-1786, http://h2o.enr.state.nc.us/wetlands.html

NC Department of Environment and Natural Resources, Aquifer Protection Section, 2090 US Highway 70, Swannanoa, NC 28778, 828-296-4500. http://h2o.enr.state.nc.us/agw.html

NC Department of Environment and Natural Resources, Land Quality Section, 2090 US Highway 70, Swannanoa, NC 28778, 828-296-4500. http://www.dlr.enr.state.nc.us/pages/landqualitysection.html

NC Department of Transportation, 1500 Mail Service Center, Raleigh NC, 27699, 1-877-DOT-4YOU. http://www.ncdot.org/

NC State Historic Preservation Office, Department Of Cultural Resources, 4617 Mail Service Center, Raleigh, NC 27699-4617, 919-733-4763. http://www.hpo.dcr.state.nc.us/

NC Wildlife Resources Commission, Mountain Region Coordinator, 20830 Great Smoky Mountain Expressway, Waynesville, NC 28786, 828-452-2546. http://www.ncwildlife.org/

Southwestern NC Resource Conservation and Development Council, PO Box 1230, Waynesville, NC 28786, 828-452-2519, www.rcdnet.org/directories/northcarolina

US Army Corps of Engineers, Asheville Regulatory Field Office, 151 Patton Avenue, Room 208, Asheville, NC, 28801-5006, 828-271-7980. http://www.saw.usace.army.mil/wetlands/where/ashville.htm

USDA, Natural Resources Conservation Service, PO Box 425, Waynesville, NC 28786, 828-456-5132 www.nc.nrcs.usda.gov

US Fish and Wildlife Service, Asheville Field Office, 160 Zillicoa Street, Asheville, North Carolina 28801, 828-258-3939. http://nc-es.fws.gov/

Appendix III. Glossary

Biological Monitoring: Assessing water quality by analyzing the health, diversity, and habitat of living organisms in a given stream segment. The sample data is compared against benchmark measurements to describe the water quality conditions in the stream. Two commonly used forms of biological monitoring evaluate ish populations and macroinvertebrate communities. The principle behind biological monitoring is that the ecological health of a body of water is reflected by its ability to support communities of aquatic animals and plants that characterize the expected environmental conditions.

BMPs: Best Management Practices. A conservation practice or combination of practices designed to maintain the productivity of the land while reducing point and nonpoint source water pollution. State water quality agencies (or their designees) recommend BMPs based on local conditions and the most efficient use of natural resources and purchased inputs.

Conservation Easement: A legally enforceable, two-party agreement between a landowner and a conservation group or government body. Conservation easements typically separate from ownership of land the rights that could adversely impact important conservation resources. The rights separated from the land are generally called development rights, and often include subdivision and development, road building, mining, and other activities whose exercise would damage important natural resources. The easement is based on the principle of the separability of land ownership rights. Easements are placed on lands devoted to specified long-term conservation uses.

EPT Monitoring: A form of biological monitoring in streams or other bodies of water which focuses on certain sensitive species within the aquatic macroinvertebrate communities. The acronym EPT comes from the first letters of the orders of the mayflies, stoneflies, and caddisflies (Ephemeroptera, Plecoptera, and Trichoptera). The structure of the complex macroinvertebrate community reflects the physical and chemical condition of the water.

EQI: Environmental Quality Institute, which conducts research on water contamination issues through the University of North Carolina at Asheville (UNC-A). Under the supervision of the chairman of the Environmental Studies Department at UNC-A and the Institute's director, the EQI serves citizen groups, governmental agencies, and the private sector by providing information on water quality and other environmental concerns. The objective of the EQI is to conduct technically rigorous and unbiased research to help interested parties gain accurate technical understanding of complex environmental issues. (http://bulldog.unca.edu/eqi/)

GIS: Geographic Information Systems. Geographic information systems are tools for processing spatial data into information to make decisions about some portion of the earth. As spatially oriented relational databases, they deal with space-time data and often employ computer hardware and software. They include data input, storage and retrieval, manipulation and analysis, and reporting subsystems.

Greenways: Greenways are corridors of protected open space managed for conservation and recreation purposes. Greenways often follow natural land or water features and link nature reserves, parks, cultural features, and historic sites with each other and with populated areas. Greenways can be publicly or privately owned, and some are the result of public/private partnerships. Some greenways include trails—paths used for walking, bicycling, horseback riding, or other forms of recreation or transportation—while others do not. Some greenways appeal to people, while others attract wildlife. From the hills of inland America to the beaches and barrier islands of the coast, greenways provide a vast network linking America's special places. http://www.trailsandgreenways.org/TAG_active_pages/TechnicalAssistance/FactSheets/view_text.asp?SheetID=3)

HWA: Haywood Waterways Association, Inc. A membership nonprofit corporation located in Haywood County, North Carolina. This organization was created for the sole purpose of reducing nonpoint pollution in the Pigeon River Watershed.

IBI Monitoring: Index of Biotic Integrity, a tool (index) used to determine the health (integrity) of the fish community (biotic) in a given river or stream. It provides a numerical measure of the biological completeness of a system. By measuring the abundance (total number of fish), the diversity (number of different species), and trophic (food chain) interactions, it provides a snapshot of how healthy the fish community is in a given area. (http://www.dnr.state.md.us/bay/monitoring/tidalfish/ibi.html)

IPSI: Integrated Pollutant Source Identification. This model was developed by the Tennessee Valley Authority using data obtained from color infrared photographs. Interpreted data from the aerial photographs is entered in a geographic information system to facilitate spatial analysis. Local soil loss, delivery ratios, and other coefficients are applied to various land uses and pollutant sources identified from the aerial photographs. The resulting computer model allows users to calculate pollution contribution from a variety of nonpoint sources within any geographic area included in the study boundary.

Macroinvertebrates: Macroinvertebrates are animals that do not have backbones and can be seen with the naked eye. Macroinvertebrates, or "bugs", that live mainly on the stream bottom or among the debris on the bottom of a stream are called *benthic* macroinvertebrates. Although most bottom dwellers are insects, they can also be aquatic worms, crustaceans (shrimp, crabs, crayfish), snails, clams, or arachnids (spiders, etc). (http://www.wavcc.org/wvc/cadre/WaterQuality/macroinvertebrates.htm)

Nonpoint Source Pollution: Nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. Sources of nonpoint source pollution can come from any activity that disturbs the land, including road construction, residential development, forestry, agriculture, physical changes to stream channels, and many other activities.

Point Source Pollution: Point sources are discernible and confined sources (such as pipes and ditches) from which pollutants are or may be discharged. Sources may include an industry or municipality that discharges pollutants through pipes, ditches, lagoons, wells, or stacks or a single identifiable source such as a mine.

Riparian: Pertaining to the banks of a stream. Riparian vegetation includes trees, shrubs, grasses, and herbs that grow along creeks, streams, rivers, and lakes.

Sediment: Soil particles, namely sand, silt, and clay, that are carried by flowing water, and the same material after being deposited. Because of the different rates of settling, deposits are generally pure sand, silt, or clay.

Soil Loss: Longtime average annual soil loss due to water flowing over the surface of specified slopes in specified cropping and management systems. It includes the factors of climate, soils, topographic conditions, and the degree to which the use and management of the soil reduces erosion. It is often expressed in tons/acre/year. Soil loss reflects the displacement of soil particles from one location to another. However, soil loss is not the same as sediment delivered to a stream. Depending on the location and surrounding conditions, much of the water-borne soil may be captured by buffers, other land areas, and erosion control structures before reaching area streams to become sediment.

TAC: Technical Advisory Committee. A professional coordinating committee of Haywood Waterways Association. The membership consists of individuals with hundreds of years of professional conservation expertise in a wide variety of fields and disciplines. The members represent a variety of agencies, educational institutions, nonprofit corporations, and individual skills and interests. A current list of the membership can be obtained by visiting the Haywood Waterways Association website (www.haywoodwaterways.org).

VWIN: Volunteer Water Information Network, a partnership of groups and individuals dedicated to preserving water quality in western North Carolina. Volunteers collect water samples once a month from designated sites along streams and rivers in the region.

Watershed: An area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake, or groundwater. The divide separating one drainage basin or catchment area from another.

Appendix IV. Technical Advisory Committee, Haywood Waterways Association, May 2014

Agency	Representative	
Attorney	Sexton	Tony
Bethel Rural Community Organization, Haywood County citizen	Ivey	George
DENR DWR Hydrogeologist	Campbell	Ted
DENR Natural Heritage, Western Region Freshwater Ecologist	Leslie	Andrea
Ecosystem Enhancement Program, Western Project Manager	Daniel	Deborah
Evergreen Packaging, Director of Sustainability	Brown	Derric
Haywood Community College, Natural Resources Instructor	Bishop	Blair
Haywood Community College, Natural Resources Instructor	Rabby	Shannon
Haywood Community College, Natural Resources Instructor	Stoneking	Kesi
Haywood Community College, Natural Resources Instructor, Dept Head	Sherman	John
Haywood County citizen, retired USFS	Small	Gordon
Haywood County citizen, retired National Fish & Wildlife Assoc.	Clay	Alric
Haywood County Cooperative Extension	Skelton	Bill
Haywood County Erosion Control Officer	Pruett	Marc
Haywood County Planning Director	Boyd	Kris
Haywood Soil and Water Conservation District, Soil Conservationist	Smathers	Leslie
Haywood Soil and Water Conservation District, Soil Conservationist	Vanhook	Duane
Haywood Waterways Association, Inc., Executive Director	Romaniszyn	Eric
Haywood Waterways Association, Project Assistant	O'Brien	Christine
Dept of Agricultural and Consumer Services	Yarborough	Bill
HWA, Lake Junaluska Assembly, Director of Property Management	Ebaugh	Don
HWA, Land of Sky Regional Council, Director of Environmental Programs	Eaker	Bill
Manager, Maggie Valley Sanitary District	Carpenter	Neil
Michael Baker Engineering, Inc, Principal	Clemmons	Micky
NC Cooperative Extension Service, Area Specialized Agent, Aquaculture	Thompson	Skip
NC Department of Transportation, Biologist	McHenry	David
NC Division of Water Quality, Watershed Project Coordinator	Williams	Ed
NC Geological Survey, Senior Geologist	Wooten	Rick
NC Wildlife Resources Commission, Fisheries Biologist, District 9	Fraley	Steve
NC Wildlife Resources Commission, Watershed Enhancement Coordinator	Loftis	Scott
NCDWQ, Aquifer Protection Section, Regional APS Supervisor	Davidson	Landon
NCDWQ, Surface Water Protection, Supervisor	Cranford	Chuck
North Carolina Forest Service	Vigil	Dwayne
Duke Energy	DeBrew	Craig
Southern Appalachian Highlands Conservancy, Farmland Protection Director	Hamilton	William
Southern Appalachian Highlands Conservancy, Land Protection Director	Pugliese	Michelle
Southern Blue Ridge Program Coordinator Nature Conservancy	Sutton	Megan
Southwestern Community College, Civil Engineering Technology Instructor	White	Jeannette
Southwestern Resource Conservation & Development Council	Dudek	Dave
Southwestern Resource Conservation & Development Council, Coordinator	Sprague	Lynn
Tennessee Valley Authority, Watershed Representative	Podren	Martha
The University of Tennessee, Research Specialist II	Coombs	Joyce
U. S. Fish & Wildlife Service, Public Affairs	Peeples	Gary
USDA, NRCS, District Conservationist	Ottinger	John
USEPA, Watershed Representative	Fausselt	Veronica
Western Carolina University, Whitemire Professor of Environmental Science	Miller	Jerry
Western Programs Coordinator, Office of Land and Water Stewardship	Francis	Judy

The TAC is the strength of Haywood Waterways. The membership represents Haywood County, State of North Carolina, federal government, private corporations, nonprofit organizations, and interested individuals. The professional skill mix is as varied. The common goal of permanently reducing nonpoint pollution in the Pigeon River Watershed continues to be the vision that guides this effective team.