Naked Creek Watershed Plan

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Partners

New River Conservancy

New River State Park

Town of Jefferson

NC Division of Water Quality

New River Basin Coalition

Context

A tributary to the New River in Ashe County North Carolina, Naked Creek flows for six miles originating just north of The Town of Jefferson. The first mile of the streams passes tree farms with little riparian buffer and eventually through the Town of Jefferson. At this location, segments of the creek are channelized and underground. In its final stretch, Naked Creek passes through farmlands and Jefferson Landing, a residential area and golf course.

Despite Naked Creek's proximity to residential and public land of high value, the stream is listed as "impaired" by the North Carolina Division of Water Quality. The impaired title is given to waters that are too polluted or degraded to meet water quality standards outlined in Section 303(d) of the Clean Water Act. After a stream is reported as impaired, the water is prioritized and empirical management plans are developed. This plan includes analyses of data and strategies to reaching water quality goals

The reason for the impairment of Naked Creek is likely influenced by the presence of several pollinations. These pollutants can include sedimentation, biological pollutants, and ambient chemicals. The impaired reach of Naked Creek runs through several land use areas associated with particular pollutants. Specifically, the amount of impervious surface, such as pavement, increases the amount of rainwater runoff. Rainwater runoff can carry excess nutrients (such as nitrogen and phosphorous), animal waste, sediment, pesticides, metals, and petroleum. Similarly, increased development along a stream can cause streambank erosion. A lack of planted buffers along the banks of Naked Creek have allowed for significant erosion to occur, shedding sediment into the creek. High sediment loads due to stormwater runoff and erosion negatively impact fish communities and is a possible explanation to this particular impairment.

Purpose

New River Conservancy, a non-profit organization, has a mission to protect the waters, woodlands, and wildlife of the New River Watershed. With the support and aid of its partners, the development of a watershed rehabilitation plan fulfills this mission. The purpose of this plan is to study the Naked Creek watershed. By identifying pollution and degradation, recommendations will provide a vision for Naked Creek. That vision will address how the creek can ecologically, functionally, and economically improve the entire New River watershed and Jefferson Community.

Watershed Characteristics

The Naked Creek Watershed is over 7900 acres and is comprised of mixed land cover features. Forested land covers 53% of the land, while agriculture covers 27%, and developed land covers 20%. The development is primarily residential and within the Town of Jefferson and Jefferson Landing.

While the watershed consists of primarily Deciduous and Mixed Forest, the area surrounding the river is primarily Developed land and Agriculture. Within a 300ft buffer of Naked Creek, 94% of the land is one of these two intensive land uses (See Land Cover Analysis Figure Below). The majority of this development is the Town of Jefferson and Jefferson Landing Resort.

Flowing into Naked Creek is 169.5 kilometers of tributaries, the largest including Ezra Fork, Potter Branch, and Little Naked Creek. In total there are 15 tributaries flowing into naked Creek. Many of these tributaries run through the Town of Jefferson, are channelized, and absent of riparian vegetation.

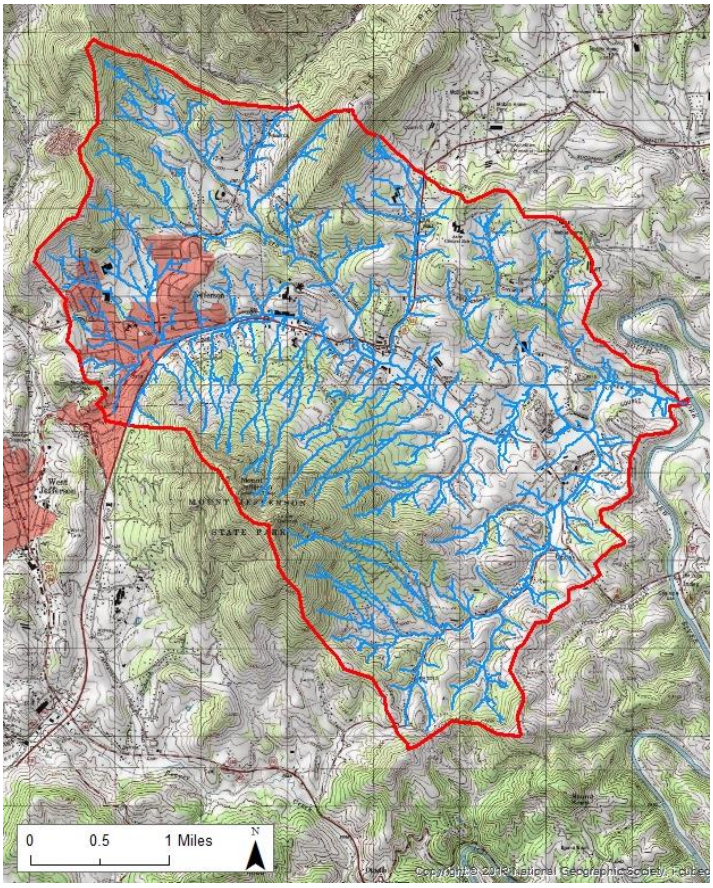


Figure 1: USGS map of the Naked Creek Watershed outlined in red. Flow lines are displayed in blue

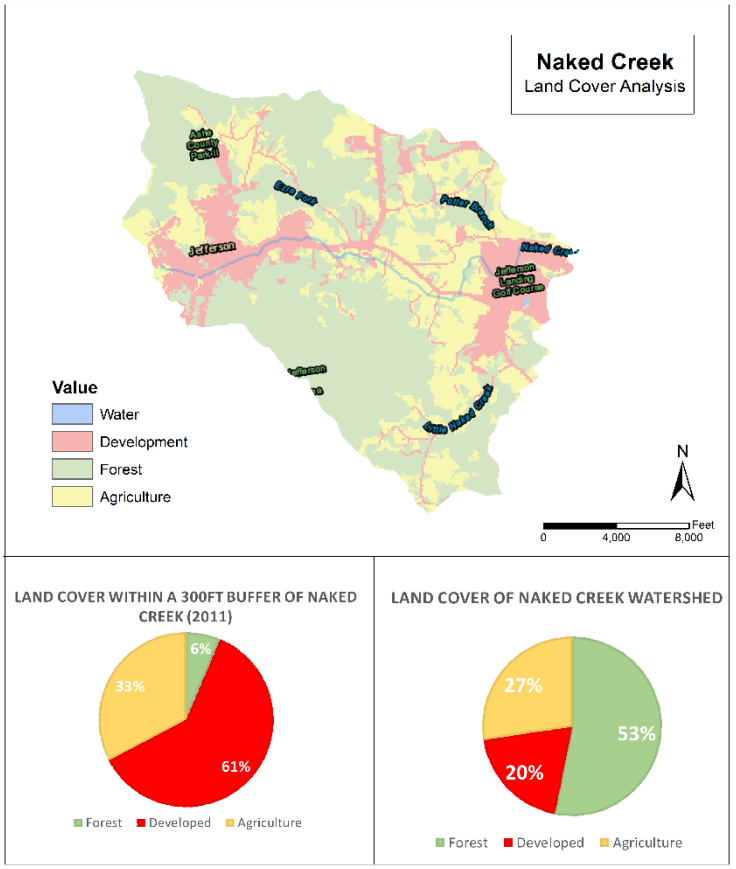


Figure 2: Land Cover Analysis of Naked Creek

Watershed Significance

Naked Creek has significant implications for Ashe County, the Town of Jefferson, and the New River Watershed. As part of the town, several parks, and residential areas the stream provides aesthetic value and water for recreation, agriculture, and industry. Streams in the New River Watershed support populations of trout which attracts thousands of visitors each year. Similarly, the river is a major recreational activity to tourists who generate an economic impact of $47.71 million dollars in Ashe (NC Commerce 2012). Additionally, a small section of the watershed is identified as High Quality Water by the NC Department of Environmental quality.

Within the watershed are several Natural Heritage sites (Figure 3). The largest Natural Heritage site, Mount Jefferson State Natural Area, crosses the creek. Several Ashe County Parks make up the other protected areas in the watershed. The potential for Naked Creek to ecologically improve is a priority in improving the waters of the New River Watershed.

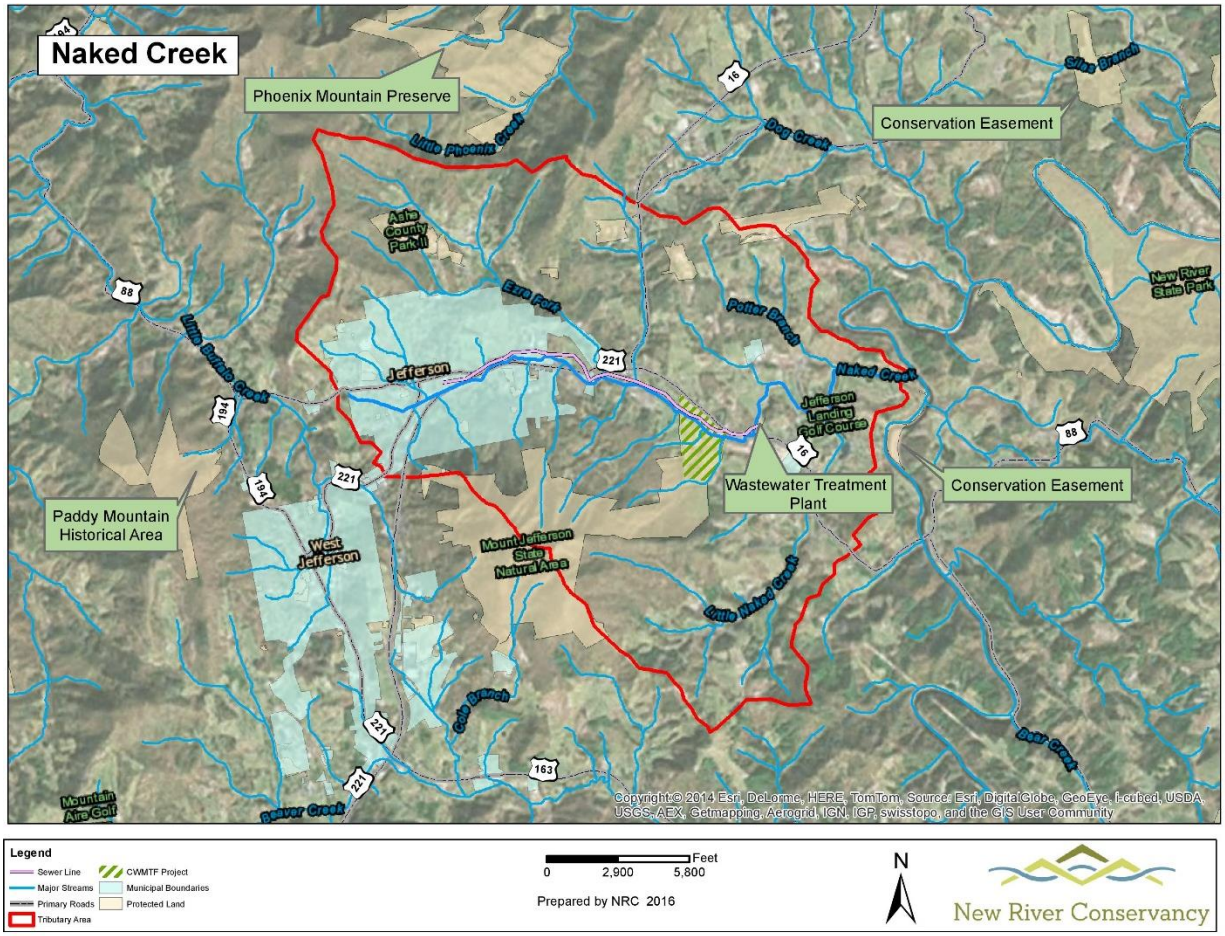


Figure 3: Map of Natural Heritage sites located in and around the Naked Creek Watershed

Element Occurrences

The Natural Heritage program "collects information on occurrences of rare plants, animals, natural communities, and animal assemblages" and records this data as Element Occurrences. Element Occurrences, or EOs are defined as an area of land where a species is, or was, present. EOs are generally created for native species that are at risk or imperiled.

Scientific Name	Common Name	State Rank	Type	Taxonomic Group
Lophozia excisa	A Liverwort	S1	Terrestrial	Liverwort
Tritomaria exsectiformis ssp. exsectiformis	A Liverwort	SH	Terrestrial	Liverwort
Barbilophozia hatcheri	A Liverwort	S1	Terrestrial	Liverwort
Lophozia heterocolpos	A Liverwort	S1	Terrestrial	Liverwort
Diplophyllum apiculatum var. taxifolioides	A Liverwort	S1	Terrestrial	Liverwort
Scapania mucronata	A Liverwort	S1	Terrestrial	Liverwort
Barbilophozia barbata	A Liverwort	S1	Terrestrial	Liverwort
Plagiochila virginica var. virginica	A Liverwort	S1	Terrestrial	Liverwort
Sylvilagus obscurus	Appalachian Cottontail	S3	Terrestrial	Mammal
Solidago uliginosa	Bog Goldenrod	S1S2	Wetland	Vascular Plant
Glyptemys muhlenbergii	Bog Turtle	S2	Wetland	Reptile
Micranthes caroliniana	Carolina Saxifrage	S3	Terrestrial	Vascular Plant
Erora laeta	Early Hairstreak	S2S3	Terrestrial	Butterfly
Spartina pectinata	Freshwater Cordgrass	S1	Wetland	Vascular Plant
Stenelmis gammoni	Gammon's Stenelmis Riffle Beetle	S2	Aquatic	Beetle
Rhytidium rugosum	Golden Tundra-moss	S2	Terrestrial	Moss
Rhytidium rugosum	Golden Tundra-moss	S2	Terrestrial	Moss
Carex argyrantha	Hay Sedge	S1	Wetland	Vascular Plant
Satyrium caryaevorus	Hickory Hairstreak	S1	Terrestrial	Butterfly
Satyrium caryaevorus	Hickory Hairstreak	S1	Terrestrial	Butterfly
Etheostoma kanawhae	Kanawha Darter	S3	Aquatic	Freshwater Fish
Phenacobius teretulus	Kanawha Minnow	S2	Aquatic	Freshwater Fish
Notropis sp. 1	Kanawha Rosyface Shiner	S2	Aquatic	Freshwater Fish
Clematis occidentalis var. occidentalis	Mountain Clematis	S1	Terrestrial	Vascular Plant
Caulophyllum giganteum	Northern Blue Cohosh	S1	Terrestrial	Vascular Plant
Silphium perfoliatum	Northern Cup-plant	S1	Terrestrial	Vascular Plant
Crocanthemum bicknellii	Plains Sunrose	S1	Terrestrial	Vascular Plant
Dendrolycopodium dendroideum	Prickly Ground-pine	S2	Terrestrial	Vascular Plant
Speyeria idalia	Regal Fritillary	SX	Terrestrial	Butterfly
Woodsia ilvensis	Rusty Cliff Fern	S1	Terrestrial	Vascular Plant
Passerculus sandwichensis	Savannah Sparrow	S2B,S5N	Terrestrial	Bird
Passerculus sandwichensis	Savannah Sparrow	S2B,S5N	Terrestrial	Bird
Leptoxis dilatata	Seep Mudalia	S1	Aquatic	Freshwater or Terrestrial Gastropod
Percina oxyrhynchus	Sharpnose Darter	S1	Aquatic	Freshwater Fish
Pohlia lescuriana	Spherical Bulb Nodding Moss	S1	Terrestrial	Moss
Elliptio dilatata	Spike	S1	Aquatic	Freshwater Bivalve
Aconitum reclinatum	Trailing Wolfsbane	S3	Wetland	Vascular Plant
Aconitum reclinatum	Trailing Wolfsbane	S3	Wetland	Vascular Plant
Hackelia virginiana	Virginia Stickseed	S1S2	Terrestrial	Vascular Plant
Carex woodii	Wood's Sedge	S3	Terrestrial	Vascular Plant
Carex woodii	Wood's Sedge	S3	Terrestrial	Vascular Plant

Figure 4: Element Occurrences in the Naked Creek Watershed

Figure 5. Kanawha Darter—an endemic species of southeastern US

Conservation Status Ranks	
Status	Definition
S1	Critcally Impaired
S2	Imperiled
S3	Vulnerable
SX	Presumed Extirpated
*S#S#	Indicates a numeric range rank
Breeding Status Qualifiers	
Qualifier	Definition
B	Breeding Population
N	Non-Breeding Population

Figure 6. Key to Element Occurrence Species Rank

Within Naked Creek Watershed there are 41 EO species. Twenty of the EO species are considered critically impaired. The abundance of Element Occurrences in the watershed highlight the potential of the Creek as a biodiversity hotspot.

Town of Jefferson

The impaired reach of Naked Creek runs through the Town of Jefferson. The town, and its associated nonpoint source pollution, factors into its impairment, and it will benefit from its rehabilitation. The wastewater treatment center and its sewer lines are located within the watershed.

Furthermore, stormwater systems located in the Town of Jefferson contribute to the creek. Stormwater pollution are a source of damaging pollutants and is significant in impairing Naked Creek

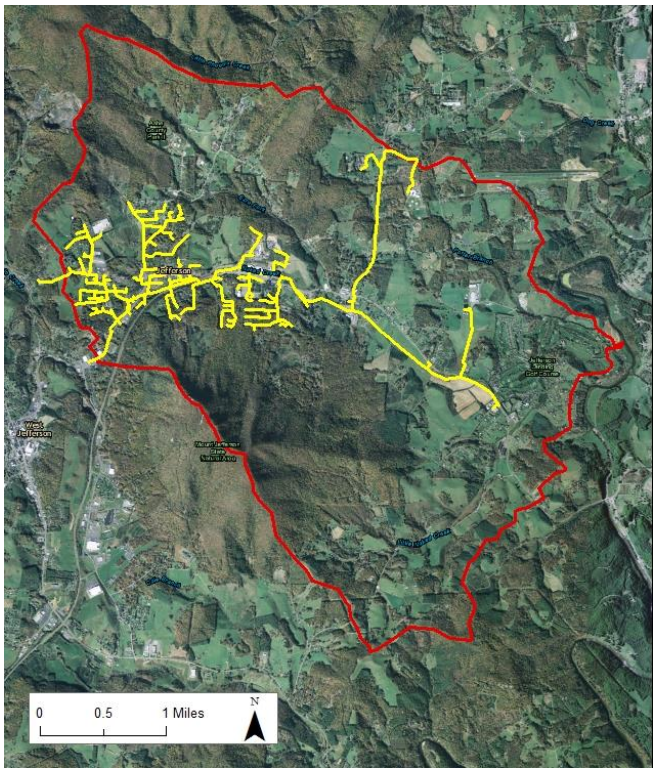


Figure 7: Town of Jefferson Sewer Lines

Extent of Impairment

The impairment of Naked Creek starts 1.38miles south of the Town of Jefferson and 0.4miles above Jefferson's Waste Water Treatment Plant. The impairment continues for the remainder of Naked Creek's reach. It is important to note that despite the impairment occurring downstream of the town. Pollution from Jefferson is contributing to the rivers status as impaired.

Naked Creek was first labeled as impaired in 2008 for Mercury found in Fish Tissue. North Carolina has a statewide Mercury Total Maximum Daily Load (TMDL) of 0.3mgMeHg/kg-fish. Mercury impairment is overwhelmingly the largest source of impairment in NC. Of greater importance to this plan, an assessment in 20102 of the fish community in the stream revealed a fair condition, resulting in placement on NC's Clean Water Act section 303(d) list of impaired waters for biological impairment. This plan will focus in brining Naked Creek off the 303(d)list for fish impairment

Type of Pollutants

Non-Point Source

Pollution sources are divided into nonpoint source pollutants and point source pollutants. Nonpoint sources derive from multiple diffuse sources. Typically, rainwater is the vector. Farms, parking lots, rooftops, and roads contain pollutants that wash into the creek during rain events

In Naked Creek, examples of nonpoint source pollutants include:

- Sediment: Loose soil and erosion
- Bacteria: Potentially+ pathogenic microbes typically from agricultural waste
- Nutrients: Nitrogen and Phosphorous that build up in the water and affect ecosystem health

Sedimentation

According to the EPA, sediment is the most common pollutant in rivers, streams, lakes, and reservoirs. Increased sedimentation in Naked Creek can be attributed to anthropogenic erosion and agriculture. Concentrated sediment releases are a product of construction activities and development. However, lack of erosion, due to lack of vegetation continually releases sediment into the creek. This riverside vegetation, or a riparian buffer, stabilize the banks with roots, slow the flow of stormwater, and diffuse out pollutants before they reach the stream

Similarly, channelization often requires widening, deepening, dredging, or aligning. All of these actions change the flow rate of the creek. Habitats dependent on natural pooling are disturbed and exposed, steep river banks deposit more sediment.

Thermal Pollution

In addition to bank stabilization, a riparian buffer provides shade that will keep the creek relatively cool. This ecosystem service is critical for trout populations. Without shade, Naked Creek is likely to warm to a point of determent to fish populations. Furthermore, without riparian buffers, rainwater warmed by parking lots and roads, flows quickly into the creek resulting in temperature spikes. Trout prefer water from 55 to 60 degrees Fahrenheit

Nutrients

Nutrient pollution, typically excess of nitrogen and phosphorous is another widespread environmental problem. In a river, nitrogen and phosphorous support the growth of algae and aquatic plants. Both nutrients are natural and necessary for any aquatic ecosystem. In too high of concentrations, nitrogen and phosphorus have negative impacts. Large spikes of nutrients, typically resulting from stormwater runoff, harms water quality, food resources, and habits. In

extremely high concentrations, algae growth will deplete the water of oxygen, leading to illnesses in fish and macroinvertebrates.

Bacteria

Agricultural drainage is responsible for high levels of bacteria levels in many rivers and creeks. Excessive bacteria levels can starve fish of oxygen. High bacteria levels are more likely to influence human health. Bacteria, such as E.coli, have adverse effects on humans including anemia or kidney failure

Baseline Watershed Information

Establishing baseline information is critical to the watershed planning process. Collecting baseline data will allow the project team to demonstrate progress and revaluate Best Management Practices and recommendations. Data has been collected for the physical, biological, and chemical conditions of the creek. The chemical data, collected at ambient chemical monitoring stations, hasn't been continued since the 1970s and has been left out of this report.

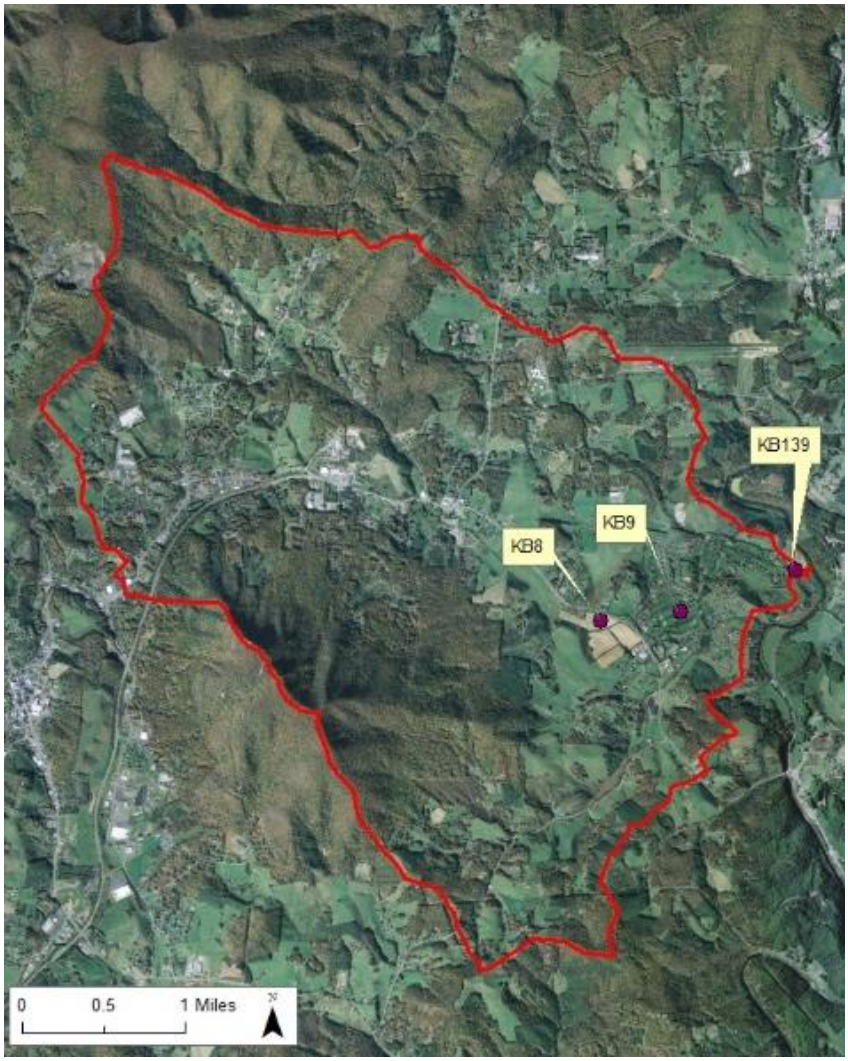
Cross Sectional Elevation Data

-Waiting for Data from Brushy Fork

Benthic Macro Invertebrate and Habitat Data

Benthic Macro Invertebrate surveys have been an emphasis of NC Division of Water Resources in determining water quality. These surveys, conducted by water quality professionals, survey aquatic insects that live in streams. Some of these insects (Mayflies, Stoneflies, and Caddisflies) are indicators of water quality. During these surveys certain values are calculated: taxa richness, biotic indices, and abundances. Each of these values are important in determining water quality and are defined as by the state below.

- *Taxa Richness*: The number of different species represented



- *Biotic Indices*: 1 to 10 scale indicating quality of an aquatic environment based on types of organisms found
- *EPT Abundance*: The number of Mayflies, Stoneflies, and Caddisflies found

Macro invertebrate samples were taken from three sites on Naked creek between the years 1986 and 2008. The data for each site is presented below

Site 1

StationID	Date	Latitude	Longitude	EPT Taxa richness	EPT Biotic Index	EPT Abundance	Number of Different Taxa	Biotic Index	Bioclass
KB9	7/29/1986	36.409167	-81.419444	6	3.868	25	41	7.673481	Poor
KB9	7/15/1993	36.409167	-81.419444	18	5.030769	39	54	6.864646	Fair
KB9	8/17/1998	36.409167	-81.419444	13	4.921875	32	49	7.393902	Poor
KB9	8/19/2003	36.409167	-81.419444	23	4.30102	98	57	5.326341	Good-Fair

Upstream

Downstream

Site 2

StationID	Date	Latitude	Longitude	EPT Taxa richness	EPT Biotic Index	EPT Abundance	Number of Different Taxa	Biotic Index	Bioclass
KB139	8/21/2008	36.412902	-81.406828	23	4.035461	141	79	5.028477	Good-Fair
KB139	8/27/2013	36.412902	-81.406828	12	3.909804	54	12	3.909804	Fair

Upstream

Downstream

Site 3

StationID	Date	Latitude	Longitude	EPT Taxa richness	EPT Biotic Index	EPT Abundance	Number of Different Ta	Biotic Index	Bioclass
KB8	7/29/1986	36.408333	-81.428333	29	3.676027	146	78	5.02053	Good-Fair
KB8	7/14/1993	36.408333	-81.428333	36	3.16	125	84	4.335764	Good
KB8	8/18/1998	36.408333	-81.428333	32	3.282353	170	71	4.606709	Good-Fair
KB8	8/19/2003	36.408333	-81.428333	30	3.661491	161	70	4.68968	Good-Fair
KB8	8/20/2008	36.408333	-81.428333	34	4.127869	122	34	4.127869	Good
KB8	8/27/2013	36.408333	-81.428333	20	3.357813	68	20	3.357813	Good-Fair

Upstream

Downstream

Fish Species Data

Electrofishing to collect and document number and types of fish was done three times since 1998. The following data indicates the

StationID	Date	Location	Latitude	Longitude	IBI_Score	Bioclass
KF14	6/26/2013	off SR 158	36.41303	-81.407049	2/9/1900	Good-Fair
KF14	5/9/2008	off SR 158	36.41303	-81.407049	2/3/1900	Fair
KF11	6/9/1998	NC 16/88	36.40917	-81.428611	2/1/1900	Poor

Upstream

Downstream

Field Assessments

General field assessments accompanied the biological and physical data to better understand the practices contributing to Naked Creek's impairment. There were numerous common practices that are detrimental to the health of the river and its ability to serve as an ecosystem. The following were considered widespread:

- Mowing to edge and removing any native trees and shrubs destabilizes the bank. This is a common practice for most of the creek and its tributaries.

Figure 8. The picture above, taken at Foster Tyson Park, is an example of a destabilized bank.

- Straightening the channel cause the creek to flow more rapidly. This can increase soil erosion. Similarly, fast flows eventually reach choke points resulting in floods. Furthermore, studies point to declines in fish populations in channelized rivers. Fish and invertebrates require "natural pools" as habitat.

- Dredging the creek can cause additional sedimentation and erosion. The increased turbity may influence aquatic metabolism and spawning success.

- Stormwater Management

Figure 8. The picture above is an example of a destabilized bank.

Best Management Practices

The following Best Management Practices are recommended for Naked Creek based off the data and conclusions made by the NC Basinwide Water Quality Plan as well as water quality data provided by multiple organizations.

Livestock Management

- Farm no closer than 75-90 feet from the edge of a streambank and establish a permanent riparian buffer
- Do not place excessive weight on top of the bank near the stream
- Fence livestock out of the creek and its tributaries.
- Pipe the water to a tank or livestock waterer
- Develop nutrient management plan to address manure handling and storage, feed management, and land management

Streambank Stabilization

- Preserve the natural streambank by allowing the natural vegetation to grow or become re-established
- Incorporate bioengineering systems using native riparian vegetation to restore hydrological and ecological balance
- Remove excess debris from the streambank that negatively impacts the safety of the community or the stream's stability

Riparian Buffer Rehabilitation

- Riparian buffers should be a widely used and preserved. Vegetation is extremely important for the biological, chemical, and physical health of the stream as well as the bank's stability
- Native riparian vegetation is preferred. Certain species, such as willow's, can be inserted into the banks as live stakes and are economically effective

Innovative Stormwater Management

- Rain Gardens have the ability to filter Stormwater runoff as provide habitat for native plants and animals
- Permeable pavement, bioswales, and urban vegetation can improve water quality and reduce flooding

Plan Implementation

Implementing the recommendations in this plan will involve several steps. Along with coordination among the project team, involving community members, landowners, and institutions will be the initial priority. The following steps envisioned are listed below:

1. NC Department of Environmental Quality approval of plan

2. Work with landowners, Town of Jefferson, and community institutions to implement the Best Management Practices outlined above

3. Focus on specific sites to implement Best Management Practices. This involves State Park land near Town of Jefferson's Waste Water Treatment Plant and Tyson Park.

4. Continue to monitor biological and physical characteristics of Naked Creek and its Tributaries. Similarly, establish a monthly chemical monitoring station.

5. Apply the recommendations and results of this plan to other impaired waters in the New River Watershed, including three impaired reaches in Watauga County.

Financial Expertise

This project is levering funds from several institutions. New River Conservancy will work with landowners and the Town of Jefferson to provide cost shares. This team has completed similar projects, including projects within the Naked Creek Watershed

Prioritization

Prioritization will be given to sites base on multiple factors:

- Sites will be given a higher priority depending on the extent of erosion and sedimentation.
- Sites with public access or high visibility are higher priority.
- Priority will be based to the number and degree of improper land uses as described in the General Field Assessment section of this plan.

Project Phasing

To implement this project, we propose a 1-2-year timeline for sites deemed high priority. Projects after that timeline will be implemented as funding is available.

Conclusion

Naked Creek has the opportunity to be a healthy ecosystem. However, the fish community data collected by the NC-DEQ suggest that the creek is unable to support the fish population as expected. Implementing the Best Management Practices outlined in this plan will improve the water quality, provide economic benefits, and enhance ecosystem services. Without the implementation of BMPs the stream will continue to degrade, resulting in higher costs to rehabilitate.

Finally, the success of this plan depends on the communities' support. Landowners must be willing to implement the practices outlined. The project team has already begun the process of working with landowners and institutions in the watershed. Several projects have been proposed and funding is being sought. Finally, the project serves as an excellent opportunity for the community to learn about water quality. Having the community of Jefferson as stewards of their watershed will inspire future generations.

References

Biedenharn, David S., Charles Morelle Elliott, and Chester C. Watson. *The WES stream investigation and streambank stabilization handbook*. Vicksburg, MS: US Army Engineer Waterways Experiment Station, 1997.

NC Department of Environmental Quality, Water Resources, *2014 NC Water Quality Assessment*. Available at http://portal.ncdenr.org/c/document_library/get_file?uuid=140d4802-dc9e-4e4a-8db2-1ec3a336ceca&groupId=38364

NC Department of Environmental Quality, Division of Water Quality Basinwide Planning Unit, *2011 new River Basinwide Water Quality Plan*.

Schueler, Thomas R., P. A. Kumble, and M. A. Heraty. "A current assessment of urban best management practices." *Washington, DC: Metropolitan Washington Council of Governments* (MWCOG) (1992).

US EPA, Water: Monitoring and Assessment, North Carolina Water Quality Assessment Report. Available at https://iaspub.epa.gov/waters10/attains_index.control?p_area=NC#total_assessed_waters

Urbonas, Ben, and Peter Stahre. *Stormwater: best management practices and detention for water quality, drainage, and CSO management*. 1993.

Watauga River Partners 2012, *Beaverdam Creek Watershed Plan*