United States Department of Agriculture

Forest Service

June 2005

Environmental Assessment

Bent Creek Stream Restoration Project

Pisgah Ranger District, Pisgah National Forest
Buncombe County, North Carolina

Bent Creek Stream Restoration Project
Environmental Assessment

Location of Action:	Pisgah Ranger District Pisgah National Forest Buncombe County, North Carolina
Lead Agency:	USDA Forest Service
Cooperating Agency:	Tennessee Valley Authority
Responsible Official:	Forest Supervisor 160-A Zillicoa Street Asheville, NC 28801
For More Information:	Jon Calabria – North Carolina State University Project Leader The North Carolina Arboretum 100 Frederick Law Olmstead Way Asheville, NC 28806 (828) 665-2492 (828) 665-2371 (fax) Michael Hutchins ID Team Leader Appalachian Ranger District Highway 19E Burnsville, NC 28714 (828) 682-6146 (828) 682-9179 (fax)
Send Electronic Comments to:	comments-southern-north-carolina-pisgah-pisgah@fs.fed.us

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's Target Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington DC 20250-9510 or call (202) 720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

Table of Contents

Summary iv

CHAPTER 1 – PURPOSE AND NEED 1
1.1 Document Structure 1
1.2 Background 2
1.3 Proposed Action 2
1.4 Purpose and Need for Action 3
1.5 Decision Framework 4
1.6 Public Involvement 4
1.7 Issues 4

CHAPTER 2 – ALTERNATIVES 12
2.1 Range of Alternatives 12
2.2 Alternatives Considered in Detail 12
2.3 Alternatives Considered but Eliminated from Detailed Study 13
2.4 Comparison of Alternatives by the Key Issue 14
2.5 Mitigation Common to All Alternatives 14

CHAPTER 3 – Environmental Consequences 15
3.1 Key Issue #1 – Water Quality 15

CHAPTER 4 – PREPARERS AND PUBLIC INVOLVEMENT 21
4.1 ID Team Members 21
4.2 Federal, State, and Local Agencies Providing Input 21
4.3 Others Providing Input 22

APPENDIX A – BIOLOGICAL EVALUATION 23

APPENDIX B – MANAGEMENT INDICATOR SPECIES 29

APPENDIX C – ROSGEN STREAM CHANNEL CLASSIFICATION 38

SUMMARY

The Pisgah National Forest is proposing a Priority 1 stream restoration project along about 1,200 feet of the lower reach of Bent Creek (see Section 1.3, Chapter 1, and Figure 1-4). The proposal is financed and supported by efforts of resource specialists with the North Carolina Cooperative Extension Service – North Carolina State University Water Quality Group. Tennessee Valley Authority is a cooperating agency (40 CFR 1501.6). The project area (also called the analysis area) is located on National Forest System (NFS) lands managed under a special use permit with the North Carolina Arboretum (Arboretum). The NFS lands are within the Pisgah Ranger District, Pisgah National Forest, North Carolina. The purpose and need (objectives) of the proposal is to restore about 1,200 feet of Bent Creek to a condition where it can use more of its floodplain to dissipate energy and reduce sedimentation caused by downcutting, thus improving water quality, and aquatic and botanical habitat. The key issue with this proposal is the proposed action may impact water quality (Section 1.7, Chapter 1 and Section 3.1, Chapter 3).

In addition to the proposed action, the Forest Service also evaluated the following alternatives:

- *Alternative A – No Action*
- *Alternative C – Increased use of bioengineering* (use of logs and smaller-sized boulders)

Based upon the effects of the alternatives, the responsible official would decide to select the no-action alternative, an action alternative, or a modification of an action alternative.

CHAPTER 1 – PURPOSE AND NEED

1.1 Document Structure

The Forest Service has prepared this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four parts:

Chapter 1 – Purpose and Need: This section includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2 – Alternatives: This section provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on key issues raised by the public and other agencies. This discussion also includes possible mitigation measures. This section also provides a summary of the environmental consequences associated with each alternative.

Chapter 3 – Environmental Consequences: This section describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by key issues. Within each section, the affected environment is described first, followed by the effects of the No-action Alternative that provides a baseline for evaluation and comparison of the other alternatives that follow.

Chapter 4 – Preparers and Public Involvement: This section provides a list of preparers and members of the public consulted during the development of the environmental assessment.

Appendices: The appendices provide more detailed information to support the analyses presented in the environmental assessment.

1.1.1 Project Record

This EA incorporates by reference the project record (40 CFR 1502.21). The project record contains specialist reports and other technical documentation used to support the analysis and conclusions in this EA. The specialist reports provide additional detailed analysis. This EA incorporates by reference the Nantahala and Pisgah MIS Report. This report along with Monitoring and Evaluation Reports for the National Forests in North Carolina determine the forest population trends for MIS.

Relying on specialist reports and the project record helps implement the CEQ Regulations' provision that agencies should reduce NEPA paperwork (40 CFR 1500.4), and that NEPA documents be analytic rather than encyclopedic and kept concise and no longer than absolutely necessary (40 CFR 1502.2). The objective is to furnish enough site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and how these impacts can be mitigated, without repeating detailed analysis and background information available elsewhere. The project record is located at the Appalachian Ranger District Office in Burnsville, NC.

1.2 Background

This EA documents the results of site-specific analyses concerning proposed activities of the Bent Creek Stream Restoration Project on the Pisgah Ranger District, Pisgah National Forest.

The approximate 6 acre project area is the lower reach of Bent Creek from the Hard Times Trailhead parking lot downstream to the Forest boundary (about 1,200 feet – see Figure 1-1 at the end of the chapter). It is within the French Broad Watershed and is about five miles southwest of Asheville, North Carolina, Buncombe County. The project area is located on National Forest System (NFS) managed under a special use permit with the North Carolina Arboretum (Arboretum). The NFS lands are within the Pisgah Ranger District, Pisgah National Forest, North Carolina.

The proposal is within Management Areas (MA) 8 and 18 as designated in the Land and Resource Management Plan, Amendment 5, for the Nantahala and Pisgah National Forests North Carolina (1994) (hereafter called the Forest Plan). Management Area 8 lands are "[e]*xperimental forests and will be managed for forest research.*"; however, a [p]*ortion of the Bent Creek Experimental Forest will be developed as a regional center for study of trees and other woody plants, in cooperation with the Western North Carolina Arboretum*" (Forest Plan, page III-123). These lands are dedicated to experimentation and education and are designated for special national and international research programs. Even though many management activities take place on these lands, they are not part of usual Forest programs (Forest Plan, page III-123). Management Area 18 lands are embedded in other management areas. These lands are to be "[a]*ctively managed to protect and enhance, where possible, the distinctive resource values and characteristics dependent on or associated with these systems. A high quality riparian area is one that maintains natural hydrologic functioning. It optimizes precipitation infiltration and runoff so as to enhance stream stability and minimize erosion*" (Forest Plan page III-179). This EA tiers to the Final Environmental Impact Statement (FEIS) for the Forest Plan.

A separate analysis was completed in November 2004 and a decision was made on November 9, 2004, permitting stabilization of the upper reach due to damage sustained from the September 2004 tropical storms. A portion of the activities permitted at the upper reach were not completed due to additional permitting required with regulatory agencies. Following completion of the NEPA analysis for this proposal (lower reach), the remaining activities at the upper reach and all of the activities at the lower reach would be permitted together through regulatory agencies.

1.3 Proposed Action

The Proposed Action (Alternative B) has been developed to meet the Purpose and Need of this project. A more detailed discussion on the Proposed Action is located in Chapter 2, Section 2.2.3. The Proposed Action would:

- Implement Priority 1 stream restoration by using heavy machinery to cut a new channel (see Figure 1-4 at end of chapter). Priority 1 restoration raises a stream to the level of its floodplain. Natural materials, such as large woody debris and boulders would be placed in the stream channel. Small areas in the floodplain would be modified to accept the new channel. Some existing vegetation, topsoil, and channel material would be salvaged and would be relocated where feasible;

- ◊ Place up to 12 rock vanes, up to 12 single-arm rock vanes and/or logs, and up to 4 modified rock vanes or boulder clusters in the channel as necessary to redirect the stream's energy away from streambanks (rock vanes may include "j-hook" vanes);
- ◊ Construct depressional floodplain areas (vernal ponds) near the existing channel;
- ◊ Cut several standing trees from within the new channel and place them in the stream;
- ◊ Obtain a Nationwide permit from the North Carolina Department of Natural Resources and Army Corp of Engineers prior to excavation and placement of natural materials;
- ◊ Standard erosion control measures, such as silt fencing, straw bales, and matting would be in place prior to and during implementation;
- ◊ All in-stream work would be implemented outside of the trout rearing moratorium (October 15 – April 15), as specified by permitting agencies.
- ◊ Surveys for nesting migratory birds would take place prior to cutting larger trees for placement in the stream should the larger trees be cut during spring nesting seasons; and
- ◊ A Forest Service Archaeologist would be on-site to monitor protection of heritage resources during cutting of the new channel.

1.4 Purpose and Need for Action

The purpose and need (objectives) of this proposal is to restore about 1,200 feet of Bent Creek to a condition where it can have more immediate access to its floodplain to dissipate energy, minimize near bank stress, and reduce sedimentation caused by lateral migration and incision. Changing the existing pattern, dimension, and profile would improve water quality, and aquatic and botanical habitat.

1.4.1 Why Here, Why Now?

Historically, the valley bottom was logged and farmed, and the channel was straightened and impacted by changes in the sediment and streamflow regimes. Following the creation of the Bent Creek Experiment Station, the influence of farming in the valley bottoms was eliminated and the channel was able to begin the process of regaining more natural channel geometry (pattern and profile). It is evident that this process continues today. Hydrologic measurements of the lower section of Bent Creek over the past three years have shown that the stream is migrating laterally (up to 27 feet of lateral movement in that time) —causing notable channel instability evidenced by excessive bank erosion and slumping to the main entrance road (see Figures 3-1 and 3-2 at the end of Chapter 3). Figure 1-2 at the end of the chapter displays a cross section of a stable stream channel and Figure 1-3 at the end of the chapter displays a cross section of an incised stream channel.

This proposal implemented at this time and in this location would advance natural processes of establishing a stable stream channel. By doing so it would improve water quality and aquatic habitat in Bent Creek and the French Broad River by reducing sedimentation caused by erosion. The desired condition is to have a high quality riparian area that maintains hydrologic functioning and enhances stream stability and minimizes erosion (Forest Plan, page III-179).

1.5 Decision Framework

Based on the analysis disclosed in this EA, the Responsible Official would make a decision and document it in a Decision Notice and Finding of No Significant Impact. The Responsible Official can:

- Select an action alternative that has been considered in detail, or
- Select a modified action alternative, or
- Select the No Action Alternative.

1.6 Public Involvement

The proposal was mailed to 298 individuals, organizations, and agencies for comment during a 30-day scoping period that began on August 6, 2004; nine comments were received and only one was from a member of the general public. An open house was conducted on August 17, 2004, at the Arboretum to provide additional information on the proposal, answer questions, and respond to comments interested members of the public may have had; seven people signed in at the meeting. Field trips to the project area occurred in November 2003 and November 2004 with state and federal agencies, and the proposal was reviewed and refined at each. The proposal was listed in the spring 2005 schedule of proposed actions under the Wayah Ranger District's section.

Using comments received from the public, agencies, and organizations during this period, as well as internal review the interdisciplinary team (IDT) developed a list of issues to address.

1.7 Issues

The Forest Service separated the issues into two groups: key (significant) and non-key (non-significant) issues. Issues are defined as a point of discussion, debate, or dispute about environmental effects. Issues are used to develop alternatives or mitigation measures.

The Council on Environmental Quality (CEQ) regulations specifies that environmental analysis focus on significant (key) issues. Issues determined not to be significant (non-key) shall be discussed only briefly and eliminated from detailed study [40 CFR 1500.1(b), 1500.2(b), 1500.4(c), 1501.7(3), and 1502.2(b)]. The key issue will be analyzed in Chapter 3 of this EA and will also help form the decision. The non-key issues will be disclosed here in Chapter 1 with an analysis, but not in Chapter 3. They will not be used to form the decision.

1.7.1 Key Issue

1.7.1.1 Key Issue #1: Water Quality – *Priority 1 stream restoration and use of instream structures may impact water quality*

Indicator

- Type of instream structures

1.7.2 Non-Key Issues

1.7.2.1 Non-key Issue A: Wildlife Habitat – *Using on-site trees for bioengineering may impact wildlife species, especially birds*

- ◊ Non-key because there would be no adverse effect to Threatened, Endangered, Sensitive (TES), or Forest Concern (FC) species as the proposal covers such a small area of NFS lands and surveys have identified no presence of these species (see Appendix A). There would also be no adverse effect to Management Indicator Species (MIS, see Appendix B). The sensitive species Northern bush katydid (*Scudderia septentrionalis*) is known or potentially found in the project area. Much of what we know about the biology of the Northern bush katydid comes from one researcher's work in the early 1940s in Michigan (Forrest, 2004). Based on the Michigan researcher's data, Dr. Forrest of UNC-Asheville selected survey sites having climax oak-hickory forest. While this katydid is known to fly and sing from tree tops, Dr. Forrest's team found no discernable differences between sites where the katydid occurred and those where it did not occur. All sites were dominated by oaks, hickories and maples, with poplar, locust, sweetgum, hemlock and birch as codominants, and with understories of dogwood and rhododendron. Individuals were found calling from red maples and ate red maple in the lab. They were found across a wide range of elevations. Given the new record of northern bush katydid along the Hard Times Trail, it is certainly possible that it occurs along Bent Creek, within the proposed project area. However, there is plenty of habitat available even considering the trees that will be removed. Dr. Forrest noted four things that lend themselves to a determination of no impact to this species. First, western NC is on the southern edge of this species geographical range and so populations are more likely to be fragmented here. Second, known populations appear to be stable. Third, the life cycle may be short and calling sporadic, leading to few records and a misinterpretation that the species is significantly rare. Finally, this species has been recorded in residential areas, suggesting flexibility in habitat use. Impacts on this species are extremely unlikely and it and its habitat will not be negatively impacted. There are no Forest Concern species known to or likely to occur within the proposed project area. Additional analyses on aquatic habitat are disclosed in Appendix A, Biological Evaluation and Appendix B, MIS. Surveys for nesting migratory birds would take place prior to cutting larger trees for placement in the stream should the larger trees be cut during spring nesting seasons.

1.7.2.2 Non-key Issue B: Botanical Resources – *Restoring the 1,200 foot section of Bent Creek may impact sensitive botanical species*

- ◊ Non-key due to site-specific field verification. There would be effects to botanical resources but they would be local and would not affect populations of plants. The Regionally sensitive plant *Hexastylis rhombiformis* is located within the project area and its habitat may be adversely affected if the stream continues migrating and downcutting. The project Botanist has extensive experience with the population of *Hexastylis rhombiformis* in the Bent Creek area and stays in contact with botanists from all agencies and organizations concerning the species and the Bent Creek population (which numbers in the thousands of plants). He is very familiar with the proposed project site and estimates that no more than 5 individual plants would be disturbed by the implementation of this project. He states that this would not jeopardize the population or the species' viability. Without implementation of an action alternative, this section of Bent Creek would continue to migrate, leading to more downcutting and lateral migration (stream shifting to either side) sedimentation, and possible impacts to *Hexastylis rhombiformis*. There are no Forest Concern species known to or likely to occur within the proposed

project area. Additional analyses on aquatic habitat are disclosed in Appendix A, Biological Evaluation and Appendix B, MIS.

1.7.2.3 Non-key Issue C: Cultural Resources – *Restoring the 1,200 foot section of Bent Creek may impact cultural resources*

- ◊ Non-key due to site-specific field verification and avoidance.

1.7.2.4 Non-key Issue D: Soil Resources – *Restoring the 1,200 foot section of Bent Creek may impact soils*

- ◊ Non-key due to implementation of Forest Plan standards and guidelines and best management practices (BMPs)

1.7.2.5 Non-key Issue D: Visual/Recreation Resources – *Restoring the 1,200 foot section of Bent Creek may impact visual or recreation resources*

- ◊ Non-key due to site-specific field verification and project design

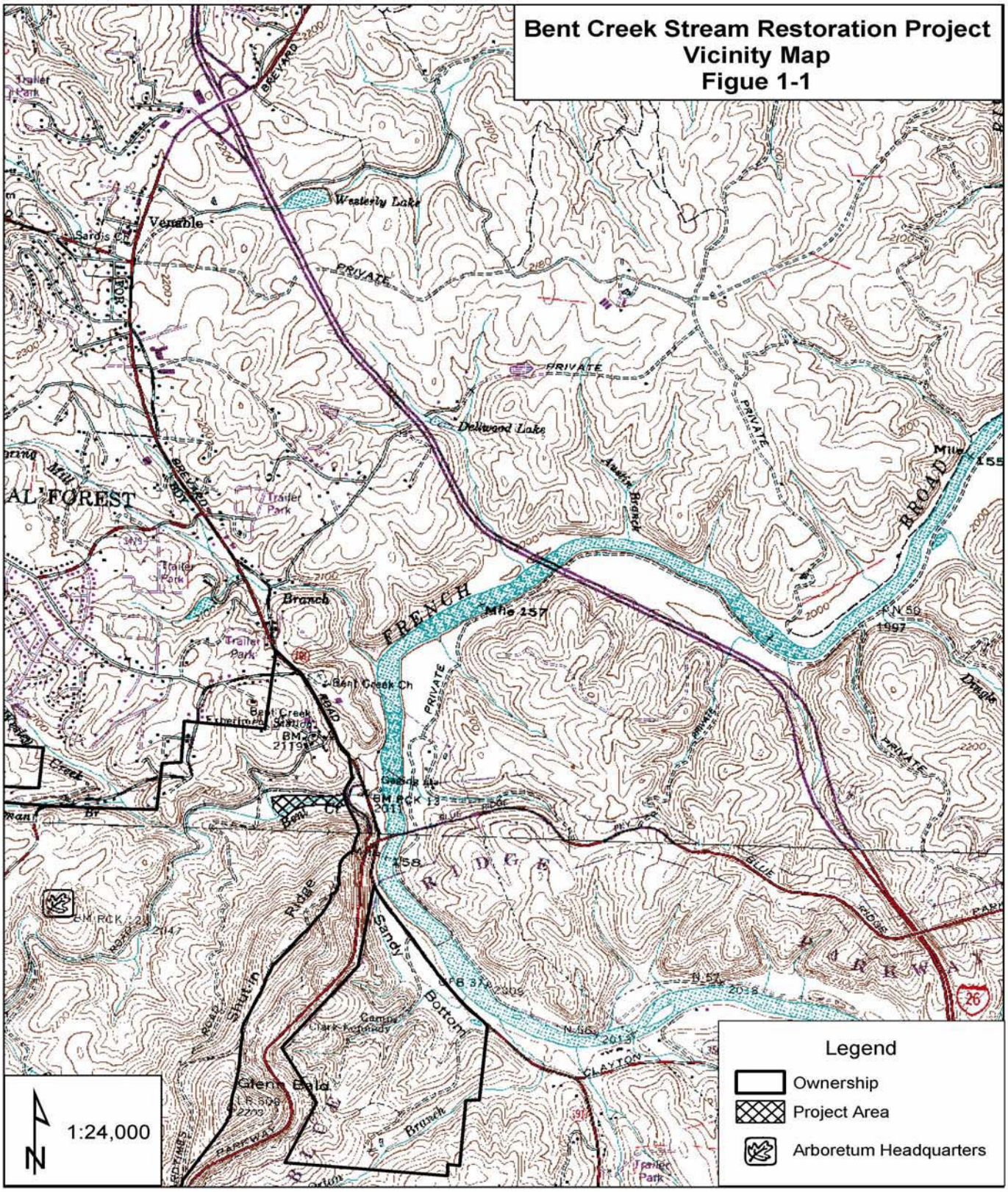
1.7.2.6 Non-key Issue E: Aquatic Habitat – *Priority 1 stream restoration and use of bioengineering structures may impact aquatic habitat*

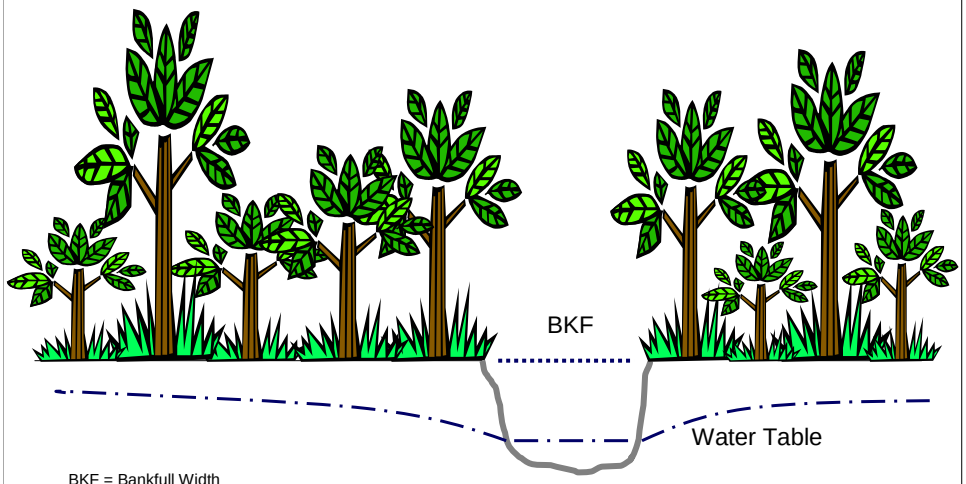
- ◊ Non-key due to field review and determination that the proposal would have no effect on threatened, endangered, or proposed species or their habitats. There are no threatened, endangered, proposed, sensitive, or Forest concern aquatic species known to occupy Bent Creek. Additional analyses on aquatic habitat are disclosed in Appendix A, Biological Evaluation and Appendix B, MIS.

1.7.2.7 Non-key Issue F: Other Areas of Concern – *Restoring the 1,200 foot section of Bent Creek may adversely affect park lands, prime farmlands, wetlands, wild and scenic rivers, ecologically critical areas, or local law or requirements imposed for the protection of the environment.*

- ◊ Non-key because the Bent Creek Stream Project does not propose actions within park lands, prime farmlands, wild and scenic rivers, or ecologically critical areas. It also would not violate local law or requirements imposed for the protection of the environment. There is one small wetland in the project area as defined by 1977 Executive Orders 11988 and 11990. This wetland would be buffered and protected during project implementation and its function would likely improve under either action alternative since the amount of wetland habitat surrounding it would improve.

The following figures display location of the proposal and additional information related to the proposed hydrologic activities (Figures 1-2 thru 1-10 are examples of the type of activities proposed):


Bent Creek Stream Restoration Project
Vicinity Map
Figue 1-1
Legend
Ownership
Project Area
Arboretum Headquarters
1:24,000
Venable
Westerly Lake
Delwood Lake
PRIVATE
BREVARD
FRENCH
BROAD
Mile 157
Bent Creek Ch
Trailer Park
Sandy Bottom
Ridge
Glenn Bald
CLAYTON
BLUE RIDGE PARKWAY



BKF = Bankfull Width

Figure 1-2: Cross Section of a Stable Stream Channel

Figure 1-3: Cross Section of an Incised Stream Channel

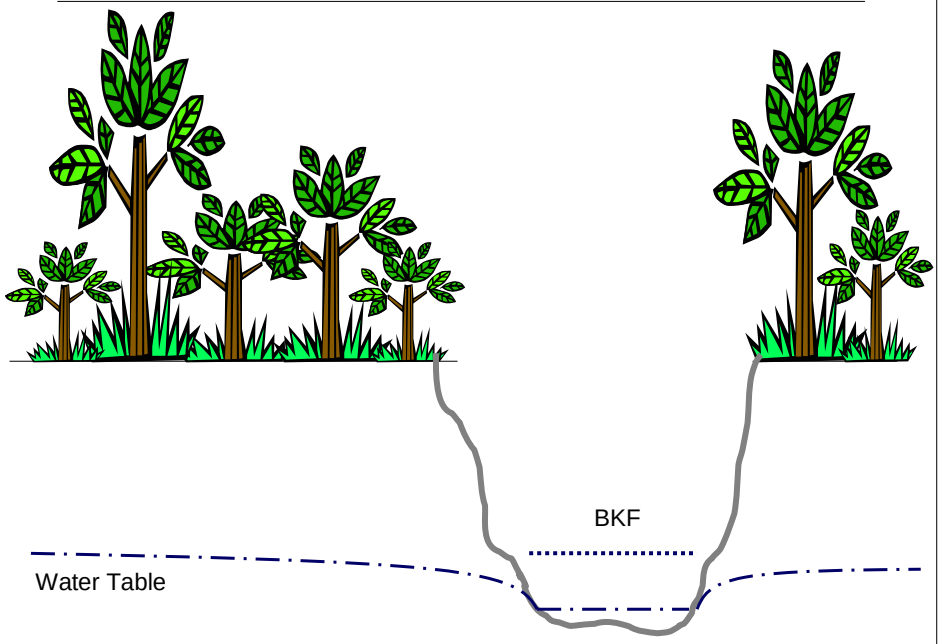


Figure 1-4: Cross Section of Priority 1 Stream Restoration

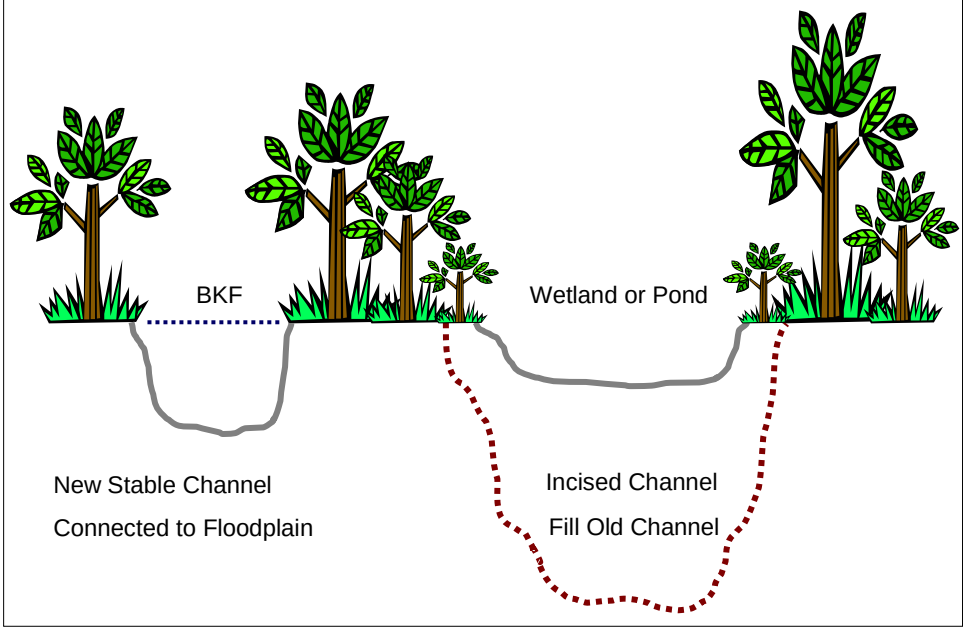
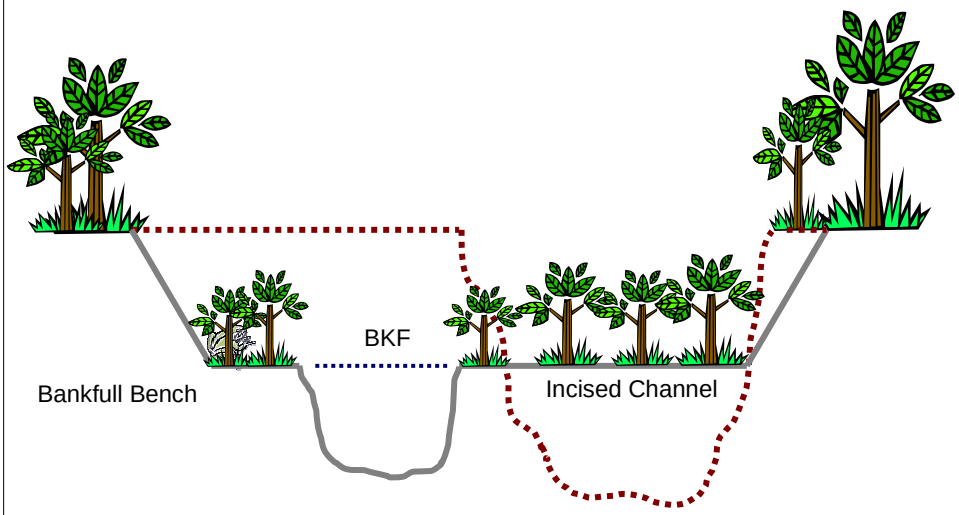


Figure 1-5: Cross Section of Priority 2 Stream Restoration



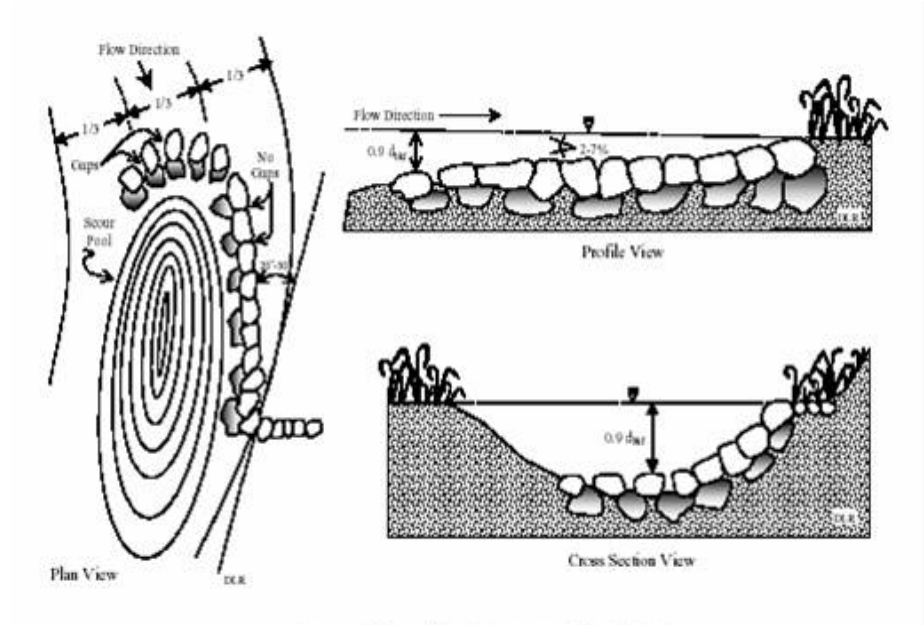


Figure 1-6: Cross Section and Overview of a J-Hook Rock Vane

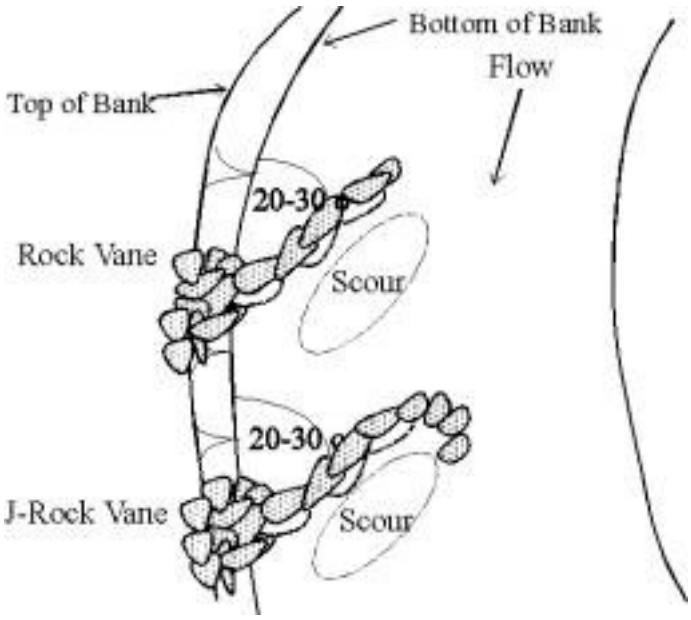


Figure 1-7: Overview of Rock Vane and J-Hook Vane Placement in a Stream Channel

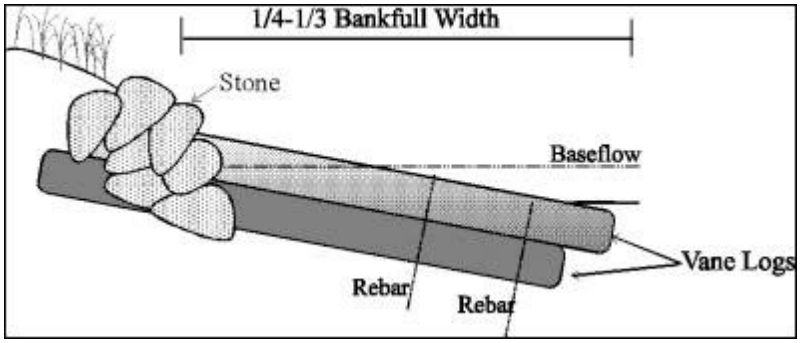


Figure 1-8: Cross Section of a Log Vane

Figure 1-9: Rock Vane (example I)

Figure 1-10: Rock Vane (example II)

CHAPTER 2 – ALTERNATIVES

Chapter 2 is the "heart" of this EA (40 CFR 1502.14) and describes alternatives the agency considered in addition to the proposed action. This chapter also compares each alternative.

2.1 Range of Alternatives

The range of alternatives developed and analyzed by the interdisciplinary team (IDT) was driven by the purpose and need underlying the proposal (Section 1.4, Chapter 1), and by the key issues responding to the proposal. An alternative should (1) reasonably respond to the purpose and need, and (2) address one or more key issues. The only exception is the No Action Alternative, which is required by regulation [40 CFR 1502.14(d)].

The interdisciplinary team (IDT) considered four alternatives. Following review, three alternatives were developed in detail and one was eliminated from detailed study.

2.2 Alternatives Considered in Detail

Three alternatives were developed by the IDT in response to the issues and concerns regarding the proposed action; Alternative A – No Action, Alternative B – Proposed Action, and Alternative C. The action alternatives fulfill the specific purpose and need for these actions.

2.2.1 Alternative A – No Action

Under this alternative, the projects described in the proposed action (Section 1.3, Chapter 1) would not be accomplished. No management actions would take place at this time to improve the existing condition of the environment in the project area. There would be no stream restoration activities implemented. This section of Bent Creek would continue to migrate, leading to more downcutting, sedimentation, and possible impacts to the sensitive plant *Hexastylis rhombiformis*. This alternative serves as the environmental baseline for analysis of effects.

2.2.2 Alternative B – Proposed Action

This alternative was developed to improve existing stream conditions in the project area. It would:

- Implement Priority 1 stream restoration that consists of cutting a new channel that has stable pattern, dimension, and profile. The sinuous channel would use natural materials, such as large woody debris and boulders to raise its elevation to the floodplain (about 1-2 feet in height). Small areas in the floodplain would be modified to accept the new channel. Some existing vegetation, topsoil, and channel material would be salvaged and would be relocated where feasible;
- Heavy machinery, such as an excavator, would be used to cut a new sinuous, stable channel on top of the floodplain;
- Place up to 12 rock vanes, up to 12 single-arm rock vanes and/or logs, and up to 4 modified rock vanes or boulder clusters in the channel as necessary to redirect the stream's energy away from streambanks (rock vanes may include "j-hook" vanes);

- Construct depressional floodplain areas (vernal ponds) near the existing channel;
- Cut several standing trees from within the new channel and place them in the stream;
- Obtain a Nationwide permit from the North Carolina Department of Natural Resources and Army Corp of Engineers prior to excavation and placement of natural materials;
- Standard erosion control measures, such as silt fencing, straw bales, and matting would be in place prior to and during implementation;
- All in-stream work would be implemented outside of the trout rearing moratorium (October 15 – April 15), as specified by permitting agencies.
- Surveys for nesting migratory birds would take place prior to cutting larger trees for placement in the stream should the larger trees be cut during spring nesting seasons; and
- A Forest Service Archaeologist would be on-site to monitor protection of heritage resources during cutting of the new channel.

2.2.3 Alternative C

This alternative was developed to respond to public input provided on the proposed action alternative. Alternative C is the same as Alternative B except to respond to public comments by increasing the use of bioengineering (logs and smaller-sized boulders) to the greatest practical extent. In addition to the activities proposed under Alternative B, this alternative would also:

- Minimize quarried surge and rip-rap stone (large rock and boulders) and use existing channel material in the proposed channel to the greatest practical extent;
- Increase the use of bioengineering (use of logs and smaller-sized boulders) and forestry planting techniques that utilize native riparian plant species would be used.

2.3 Alternatives Considered but Eliminated from Detailed Study

As per 40 CFR 1502.14(a), the following alternative was considered but eliminated from detailed study:

2.3.1 Alternative 1 – Utilize Priority 2 Stream Restoration

Alternative 1 proposed Priority 2 stream restoration (see Figure 1-5 at the end of Chapter 1) and was eliminated from detailed study because it would impact more overall floodplain area with excavators and tree removal (about 5 acres) than Priority 1 restoration (less than 4 acres, which includes stock piling of materials). Priority 2 restoration brings the floodplain down to the level of the stream instead of raising the stream to the level of the floodplain. Priority 2 restoration would cause adverse impacts to the existing Buell research plot (the oldest research plot at BCEF), and could cause adverse impacts to populations of the sensitive plant *Hexastylis rhombiformis* and archaeological sites resting below the 3 feet of deposition. Priority 1 would impact the stream more; however, less overall floodplain area would be impacted. The existing geomorphology of the lower reach indicates stable geometry is not present to allow Priority 2 restoration.

Priority 2 Stream Restoration

Advantages:
Results in long-term stable stream
Improves habitat values
Enhances wetlands in stream corridor
May decrease flooding potential

Disadvantages:
Requires wide stream corridor
Requires extensive excavation
Disturbs existing vegetation

2.4 Comparison of Alternatives by the Key Issue

The following table compares the alternatives by the key issue:

Table 2-1: Comparison of Alternatives by the Key Issue

Key Issue	Indicator	Alternative A (No Action)	Alternative B (Proposed Action)	Alternative C
Key Issue#1: Water Quality	Type of instream structures	Static	Vanes employ large rock and logs where applicable	Vanes employ bioengineering to the greatest practical extent

Priority 1 Stream Restoration

Advantages:
Results in long-term stable stream
Restores optimal habitat values
Enhances wetlands by raising the water table
Requires minimal excavation

Disadvantages:
Increases flooding potential
Requires wide stream corridor
Has unbalanced cut/fill
Disturbs existing vegetation

2.5 Mitigation Common to All Alternatives

This project has been designed to improve natural stream condition. No mitigation measures are required for this project.

CHAPTER 3 – ENVIRONMENTAL CONSEQUENCES

This chapter forms the scientific and analytical basis for the comparison of alternatives as required by the National Environmental Policy Act (NEPA). Included in this chapter are disclosures of direct, indirect, and cumulative effects of the alternatives on the different resources relevant to the key issues. Direct and indirect effects occur at, or near the same time and place as a result of the action [40 CFR 1508.8 (a) and (b)]. They have been combined in this chapter, as it is difficult to completely separate between the two effects. Cumulative effects result "*…from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such action. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time"* (40 CFR 1508.7). Reports from different resource specialists supplied information for portions of the analysis in this chapter. The project area is the location of the proposal. The analysis area is the anticipated extent of effects by resource and is generally larger than the project area.

Effects analyses are disclosed by key issue in this chapter. The four key issues associated with this proposed project were identified through a public participation process, which included input from Forest Service natural resource specialists, other government agencies, organizations, and individuals (see Section 1.6, Chapter 1). The key issues were determined to be relevant to the decision to be made concerning the Bent Creek Stream Proposal. Other resources and issues (non-key issues) were eliminated from discussion in this chapter (see Section 1.7, Chapter 1).

3.1 Key Issue #1 – Water Quality

Issue Statement: *Priority 1 stream restoration and use of instream structures may impact water quality*

Indicator:

- Type of instream structures

3.1.1 Existing Condition

This analysis addresses project area waters—Bent Creek down to the French Broad River (about 6 acres). Existing channel morphology integrates all past and present disturbances and natural processes. In all stream systems, there exists a unique balance between many interrelated variables: sediment quantity and size, streamflow, substrate size, and channel geometry. A major shift in any of these variables would cause the stream channel to adjust one or more of the other variables. This adjustment is necessary to maintain equilibrium between the components. The adjustment process would normally move the stream channel toward a new, usually less stable condition. An unstable stream generally has an inefficient form and is sensitive to further disturbance. A stream in equilibrium can efficiently process both flow and sediment (both bed load and suspended) under which the system formed. Stable streams dissipate their energy transporting sediment, accessing the floodplain, and flowing over obstructions and other channel roughness elements. When streams move out of equilibrium, the system generally responds in one of two ways, it may become energy-limited or sediment-limited. In an energy-limited

stream, deposition occurs as quantities of sediment exceed the stream's energy to transport it. In a supply-limited stream, where flows are increased or roughness elements are removed, an energy surplus may occur, causing channel scour as the stream tries to transport (route) more or larger materials. When this scoured material moves into an energy limited reach it would be deposited along with fine sediment from other sources.

Historically, the Bent Creek watershed was logged and the valley bottom farmed. Logging activities likely increased hillside erosion and runoff of sediment and water to the stream channel network. Farming and valley bottom roads caused channel reaches to be straightened from their natural meander pattern, and also increased erosion and runoff to channels. Following the creation of the Bent Creek Experiment Station, the direct influence of farming in the valley bottoms was eliminated and the channel was able to begin the process of regaining a natural channel geometry (pattern and profile). However, changes in water and sediment routing continued in the watershed with construction of roads, the NC Arboretum facilities, development in the Wesley Creek drainage, and the creation of instream impoundments, such as Lake Powhatan. Thus, alterations of the natural streamflow and sediment runoff regimes in Bent Creek remain today.

The largest influence to the hydrologic system in the Bent Creek drainage today is the impoundments. Lake Powhatan and other impoundments (i.e., Bent Creek Ranch Lake) efficiently trap and store streambed material that is carried by the streams (bedload). As a result, water exiting the impoundments does not carry bedload although it has the energy to do so. This energy can be used to scour downstream reaches. A review of the reach of Bent Creek from the Wesley Creek confluence down about 600 feet indicates that this is occurring, evidenced by an entrenched channel and bank erosion, possibly an extant mill pond.

In the lower approximately 1,200 feet of Bent Creek, above the confluence with the French Broad River, channel slope decreases and channel form is inefficient to process the sediment load delivered to this reach, and the stream becomes energy-limited. Therefore, deposition of sediment scoured and transported from upstream reaches is occurring—causing aggradation (filling up) of the channel bottom. Hydrologic measurements of the lower section of Bent Creek over the past three years have shown that the stream is migrating laterally (up to 27 feet of lateral movement the past three years) in response to sediment deposition; causing notable channel instability evidenced by excessive bank erosion. Bank erosion is occurring at a rate that is well above that of a stable stream channel.

Protected water uses were designated by the State of North Carolina, Department of Environment and Natural Resources for all state waters, including those in the Bent Creek drainage. These are inclusive of the following: aquatic life propagation and maintenance of biological integrity, wildlife, primary recreation (swimming on a frequent basis), agriculture, and water supply for drinking, culinary, or food processing. In addition to these protected water uses, water quality in Bent Creek from its source to Powhatan Dam is to be maintained and protected to sustain and allow for trout propagation and survival of stocked trout on a year-round basis.

Bent Creek is not listed as "water quality limited" by the N.C. Department of Environment and Natural Resources, Division of Water Quality as of the latest 303(d) listing of stream channels impaired from meeting State water quality standards. Therefore, all protected water uses are currently identified as "supported" at some level. Although the State information does not make

clear the current condition of Bent Creek relative to sediment impacts, it is apparent that erosion does not support maintenance of channel integrity.

3.1.2 Water Quality Direct, Indirect, & Cumulative Effects

Alternative A – No Action

Direct & Indirect Effects

Under a "no action" alternative the current rate of bank erosion is expected to continue or increase because of unstable bank conditions. A slight increase in the current rate of erosion could occur as the undercut trees on the bank fall over and expose more soil, and adverse effects to channel integrity would continue and water quality would be at risk.

Cumulative Effects

The direct and indirect adverse effects to channel integrity and water quality associated with this alternative would continue to add to adverse cumulative effects within Bent Creek. Sedimentation produced from the Bent Creek drainage would continue to be transported to the French Broad River. Stream channel restoration work was completed upstream about one-half mile from this proposal in winter 2004 to ensure protection to cultural resources. Additional restoration is proposed at this upstream area and would use various stabilization techniques to protect the banks by installing natural materials, such as large woody debris and boulders to dissipate flow energy. The additional restoration is likely to temporarily (a few days to a week) increase sediment in Bent Creek during and following the construction phase of the work. The long-term effect (one month and later) would decrease chronic sediment loading to the channel by improving channel stability in an unstable reach of stream.

Ongoing or past activities listed below for Alternatives B and C both above and below the Lake Powhatan dam are not expected to add measurable cumulative effects with this alternative.

Alternatives B and C

Direct & Indirect Effects

These two alternatives are expected to improve existing stream conditions by implementing Priority 1 stream restoration in the lower approximately 1,200 feet of Bent Creek. Since both action alternatives would similarly improve hydrologic conditions, the effects are disclosed together. The main difference in the two alternatives is the increased use of bioengineering techniques with Alternative C.

The objective of the proposed Priority 1 stream restoration work is to replace the incised Bent Creek channel with a new, stable stream at a higher elevation. Both of these alternatives would accomplish this by excavating a new channel with the appropriate dimension, pattern, and profile, based on reference reach data, to fit the watershed and valley type. The new channel would be a C stream type under the Rosgen stream channel rating guide (see Appendix C) with bankfull stage located at or in close proximity to the ground surface of the original floodplain. Much of the Priority 1 work would occur in dry conditions while streamflow continues in the original incised channel. The new channel would be stabilized with structures and erosion control matting, and temporary seeding before water is directed into the new channel. Permanent riparian vegetation would be installed during plant dormancy for optimum survivability.

The amount of soil excavated in constructing the new channel would be less than required to fill the old channel. Therefore, sections of the old channel would be filled while other shorter sections would be left as depressions for wetlands or depressional floodplain areas that will likely form vernal pool habitat. Higher flood stages above bankfull discharge are expected in the new channel, since streamflow is able to access its floodplain at a lower stage than in the old incised channel. It is anticipated that the Priority 1 restoration would produce a long-term stable stream system and is likely to raise the water table and enhance the wetland habitat in the floodplain and the proposed depressional floodplain areas that will likely form vernal pools.

The proposed Priority 1 project is likely to temporarily increase sediment to both the Bent Creek and French Broad River channels during and following the construction phase of the work. However, following stabilization of the disturbed sites (approximately within a year of construction) sediment yield from bank erosion sources is expected to decrease and remain lower than previous years. The new stream channel would also improve aquatic habitat diversity, and thus both Alternative B and C would have positive direct and indirect effects on water quality and protected uses.

Cumulative Effects

Activities above Lake Powhatan Dam

Effects of activities that are occurring or have occurred above the Lake Powhatan Dam are not expected to cumulatively be added to activities that are occurring or have occurred below the dam because the dam and the lake are expected to contain sediment and not allow it to reach lower Bent Creek or the French Broad River. A portion of the Bent Creek Experimental Forest research timber sale is located above the Lake Powhatan Dam and within waters that flow towards the lake. Activities include 123 acres of single tree and group selection harvesting along with one mile of road reconstruction; six acres of regeneration harvest along with 2/3 mile of road construction; construction of a van pullout; and use of herbicides to control competing vegetation and exotic invasives on 126 acres. In addition to the dam retaining sediment and keeping it from moving to the lower reach of Bent Creek, the timber sale activities implement silt fences, grass seeding, and straw bales to reduce potential for sediment to reach aquatic resources to begin with.

Activities below Lake Powhatan Dam

A July 2004 decision was made to install and upgrade sewer and water lines from the Arboretum offices to Lake Powhatan Campground—this action has been implemented. The utility lines were installed within a trench cut along an existing road (Bent Creek Gap road). The decision also authorized constructing three vault toilets at the Rice Pinnacle and Hard Times trailheads, and near Ledford Branch. An August 2004 update to the decision authorized installation of water to these three locations. These activities are not expected to add measurable cumulative impacts to the lower reach of Bent Creek because the activities occurred or are occurring within previously disturbed areas and appropriate erosion control measures are applied where impacts could reach aquatic resources.

An April, 2005 decision was made to repair a 200 foot section of the Homestead Loop Trail damaged by the September 2004 tropical storms. Repairs include constructing 75 feet of new trail; obliterating 190 feet of the exiting trail; constructing a 30 foot drainage ditch; constructing five rock retaining walls to support the trail; removing the existing wooden foot bridge with a log stringer bridge; installing drainage dips; removing hazard trees; and installing stepping stones at two stream fords. These actions are not expected to add measurable cumulative impacts to the

lower reach of Bent Creek because the repairs were designed to reduce existing impacts caused by sedimentation and erosion.

A February 2004 decision was made to remove hazard trees, and expand and upgrade the existing parking area near the entrance to the Arboretum. These activities are not expected to add measurable cumulative impacts to the lower reach of Bent Creek because erosion control measures have taken place (silt fencing installed) and the parking area has not been expanded closer to Bent Creek than what existed.

An October 2003 decision was made to construct an expanded entrance facility to the Arboretum near the existing facility. This action is not expected to add measurable cumulative impacts to the lower reach of Bent Creek because the facility is being constructed on a previously disturbed area, silt fencing has been installed, and a sediment catch-basin has been constructed.

A September 2003 decision was made to repair two bridges located on Wesley Creek and Wolf Creek. The Wesley Creek Bridge had its headwall repaired and sediment removed to redirect flow away from the repaired headwall. The Wolf Creek Bridge had new concrete footings constructed within a dry-working area. These actions are not expected to add measurable cumulative impacts to the lower reach of Bent Creek because the project was designed to reduce impacts by keeping heavy equipment out of the stream, a dry-working area was developed to keep wet concrete out of the stream, and removed sediment was taken off-site.

A portion of the Bent Creek Experimental Forest research timber sale is located within waters that flow below the dam. Some of it is already completed and erosion control measures have been implemented, such as grass seeding, silt fences, straw bales, and placement of waterbars. Activities include: 23 acres of regeneration harvest along with 2/3 mile of road construction and use of herbicides to control competing vegetation and exotic invasives on 130 acres. These activities are not expected to add measurable cumulative impacts to the lower reach of Bent Creek because erosion control measures have been implemented for the road construction, Forest Plan standards require buffers be applied along streams (Forest Plan, page III-187), and herbicide application is applied under approved methods and per risk assessments (www.fs.fed.us/foresthealth/pesticide/risk.htm) and the Vegetation Management in the Appalachian Mountains (VMAM) FEIS, issued in July 1989, would be followed.

There is a future proposal to develop a four acre Canopy Walk near the Bonsai Garden and Arboretum visitor center. The proposal would remove less than 50 existing trees (scarlet, black, and white oaks about 18 inches in diameter) and replant with trees exhibiting greater autumn foliage color (over 75 different species). About ½ acre of existing lawn within the Canopy Walk would be graded (2 feet) to a more level slope and a retaining wall would be constructed. The activities of this future action are not expected to add measurable cumulative impacts to the lower reach of Bent Creek because silt fences would be placed prior to grading, the area is already impacted, and there would be an increase in the number of trees that currently exist.

The following figures are taken from within the project area to better display the existing condition of the affected area:

Figure 3-1: Downcutting along Bent Creek

Figure 3-2: Slump along Road to Arboretum Gatehouse

Figure 3-3: "Oxbow" along Bent Creek near Slump

Figure 3-4: Live Staking along Bent Creek

Figure 3-5: Erosion Control Matting along Bent Creek

Figure 3-6: Downcutting along Lower Reach

Figure 3-7: Panorama of Bent Creek Project Area Where Priority 1 Restoration is Proposed

CHAPTER 4 – PREPARERS AND PUBLIC INVOLVEMENT

The following individuals helped develop this environmental assessment:

4.1 ID Team Members

4.1.1 Core IDT

Scott Ashcraft - Zone Archaeologist, Pisgah National Forest
Sheryl Bryan - Forest Fisheries Biologist, NFs NC
Jon Calabria - Project Leader, North Carolina State University Water Quality Group
David Danley - Zone Botanist, Pisgah National Forest
Brady Dodd - Forest Hydrologist, NFs NC
Mae Lee Hafer - Forest Wildlife Biologist, NFs NC
Michael Hutchins - IDT Leader, Pisgah National Forest
Chris Kelly - Wildlife Biologist, Pisgah & Highlands Ranger Districts (resigned 12/2004)

4.1.2 Other USFS Personnel Providing Input

Randy Burgess – District Ranger, Pisgah Ranger District
Dr. David Loftis – Project Leader, Bent Creek Experimental Forest
Anthony Matthews – Planning and Ecosystems Staff Officer, NFs NC
Susan Matthews – Forester/Technology Transfer, Bent Creek Experimental Forest
Terry Seyden – Forest Public Affairs Officer, NFs NC
Rodney Snedeker – Forest Archaeologist, NFs NC

4.2 Federal, State, and Local Agencies Providing Input

Alison Arnold – North Carolina Arboretum
Dave Baker – Army Corps of Engineers
Kevin Barnett – North Carolina Division of Water Quality
Jim Borawa – North Carolina Wildlife Resources Commission
George Briggs – North Carolina Arboretum
Daniel Brown – National Park Service
Eric Caldwell – North Carolina State University
Sherry Ceallaigh – North Carolina Arboretum
Daniel Clinton – North Carolina State University
Brian Cole – USDI Fish and Wildlife Service
Harold Draper – Tennessee Valley Authority
Anita Goetz – United States Fish and Wildlife Service
Matt Jarvis – North Carolina Arboretum
Greg Jennings – North Carolina State University
Amanda Jones – Army Corps of Engineers
Jon Loney – Tennessee Valley Authority
Dave McHenry – North Carolina Wildlife Resources Commission
Rebekah Newton – Army Corps of Engineers

Ann Prince – North Carolina Natural Heritage Program
Allen Ratzlaff – United States Fish and Wildlife Service
Peter Sandbeck – North Carolina Historic Preservation Office
Kirsten Young – Aquatic Specialist, North Carolina State University

4.3 Others Providing Input

Stephen Earsom
Steve Foster
Charles Parris
Henry Lancaster
Lee Sherman
Linda Wilkerson

APPENDIX A – BIOLOGICAL EVALUATION

BIOLOGICAL EVALUATION

FOR THE

RESTORATION AND STABILIZATION OF A LOWER REACH OF BENT CREEK

PISGAH NATIONAL FOREST

PISGAH RANGER DISTRICT

BUNCOMBE COUNTY, NORTH CAROLINA

Contact Person:

Sheryl A. Bryan
Fisheries Biologist
National Forests in North Carolina
160-A Zillicoa Street
Asheville, NC 28801

Phone: 828.257.4271
Fax: 828.257.4263
Email: sbryan@fs.fed.us

Prepared by:

_/s/ Sheryl A. Bryan_____ Date: __March 29, 2005_____
Sheryl A. Bryan, Fisheries Biologist

BIOLOGICAL EVALUATION
for the
STABILZATION OF AN UPPER REACH OF BENT CREEK

The Pisgah National Forest is proposing a Priority 1 stream restoration project along about 1,200 feet of the lower reach of Bent Creek (Section 1.3, Chapter 1). The proposal will also be supported by efforts of resource specialists with the North Carolina Cooperative Extension Service – North Carolina State University Water Quality Group. Tennessee Valley Authority is a cooperating agency (40 CFR 1501.6). The project area (also called the analysis area) is located on National Forest System (NFS) lands administered by the Bent Creek Experimental Forest and managed under a special use permit with the North Carolina Arboretum (Arboretum). The NFS lands are within the Pisgah Ranger District, Pisgah National Forest, North Carolina. The purpose and need (objectives) of the proposal is to restore about 1,200 feet of Bent Creek to a condition where it can use more of its floodplain to dissipate energy and reduce sedimentation caused by downcutting, thus improving water quality, and aquatic and botanical habitat.

The proposed action may impact water quality.

In addition to the proposed action, the Forest Service also evaluated the following alternatives:

◊ *Alternative A – No action*
◊ *Alternative C – Increased use of bioengineering*

This report documents the findings of aquatic, botanical, and terrestrial wildlife resource analyses for the proposal to stabilize approximately 600-1200 feet of Bent Creek. Largely due to the restriction of flow and severe channel downcutting, the reach of Bent Creek considered in this evaluation is not able to access its floodplain. The project area is within the North Carolina Arboretum, on the Bent Creek Experimental Forest, adjacent to Lake Powhatan in Buncombe County, North Carolina. The proposed project involves approximately 1,200 feet of Bent Creek and associated floodplain and riparian areas, within the French Broad River drainage basin. Please reference the project file for detailed location maps and site design and erosion control plans.

The proposed project would:

- Implement Priority 1 stream restoration that consists of cutting a new channel that has stable pattern, dimension, and profile. The sinuous channel would use natural materials, such as large woody debris and boulders to raise its elevation to the floodplain (about 1-2 feet in height). Small areas in the floodplain would be modified to accept the new channel. Some existing vegetation, topsoil, and channel material would be salvaged and would be relocated where feasible;
- Heavy machinery, such as an excavator, would be used to cut a new sinuous, stable channel on top of the floodplain;
- Place up to 12 rock vanes, up to 12 single-arm rock vanes and/or logs, and up to 4 modified rock vanes or boulder clusters in the channel as necessary to redirect the stream's energy away from streambanks;
- Construct depressional floodplain areas (vernal ponds) near the existing channel;
- Excavate several standing trees from within the new channel and place them in the stream;
- Obtain a Nationwide permit from the North Carolina Department of Natural Resources and Army Corp of Engineers prior to excavation and placement of natural materials;

- Standard erosion control measures would be in place prior to and during implementation;
- All in-stream work would be implemented outside of the trout rearing moratorium (October 15 – April 15), as specified by permitting agencies.
- Surveys for nesting migratory birds would take place prior to cutting larger trees for placement in the stream or the larger trees would be cut outside of spring nesting seasons; and
- A Forest Service Archaeologist would be on-site to monitor protection of heritage resources during cutting of the new channel.

A fisheries biologist, archaeologist, hydrologist, and/or an engineer will be on-site during project implementation. Best management practices will be implemented throughout project implementation to reduce adverse effects. All proposed activities include site runoff control measures and the minimum vegetation disturbance necessary to achieve project objectives. Threatened, endangered, sensitive, and Forest concern species (hereafter referred to as rare species) considered in this Biological Evaluation (BE) are those listed as threatened or endangered by the United States Fish and Wildlife Service, listed as sensitive by the United States Forest Service, Region 8, listed as Forest concern by National Forests in North Carolina, and any species considered to be locally rare during the project analysis. In addition to individual biological resource analysis for the proposed project, this Biological Evaluation considers actions necessary to maintain compliance with environmental laws and the Forest Plan.

Rare Species Evaluated

Sheryl Bryan, Fisheries Biologist, conducted site surveys on October 15, 2004 to assess biological resource condition. Based on this site visit, the following resource specialists were contacted to evaluate existing resource conditions, identify rare species and suitable habitat, and evaluate potential impacts on biological resources for the proposed project:

David M. Danley, Forest Botanist	Contact date: October 18, 2004
Sheryl A. Bryan, Fisheries Biologist	Survey date: October 15, 2004
Chris Kelly, Wildlife Biologist	Report date: August 28, 2004

These people used information from their surveys, data available from other resource agencies and organizations, primary and secondary scientific literature, and consultations with knowledgeable individuals from the public and private sectors.

A threatened or endangered species (T or E) is a species that has been formally listed as such by the United States Fish and Wildlife Service. These species receive protection under the Endangered Species Act (ESA).

A sensitive species (S) is a species appearing on the Regional Forester's Sensitive species List. These species may or may not have a federal or State status, but generally have a global rank of G1, G2, or G3 and a State rank of S1 or S2. These species receive protection under the North Carolina Endangered Species Act (NCESA) and the Nantahala and Pisgah National Forests Land and Resource Management Plan (LRMP).

A Forest concern species (FC) is a species which National Forests in North Carolina considers to be generally rare and an important part of biodiversity across the Forests that is not within one of the above categories. These species may or may not have a federal or State status, and generally have a global rank of G3 or lower and a State rank of S1 or lower. Some of these species receive

protection under the LRMP; however, most are addressed in terms of their contribution to diversity across the Forests.

Four types of rare species (T, E, S, and FC) are addressed in the National Environmental Policy Act (NEPA), National Forest Management Act (NFMA) and the Forest Plan. MIS are addressed in the Forest Plan. This Biological Evaluation addresses the Forest Service's responsibility to evaluate potential effects on rare species and their habitats, on species viability and diversity at the local, regional, and range-wide scales.

Based on site visits, field surveys, and existing information on the Bent Creek area, there are no federally threatened, endangered, or proposed species known or likely to occur within the proposed project area. Sensitive species that are known or are likely to occur within the proposed project area include a vascular plant, the French Broad heartleaf (*Hexastylis rhombiformis*) and an insect, the Northern bush katydid (*Scudderia septentrionalis*). There are no Forest Concern species known to or likely to occur within the proposed project area. No rare aquatic species have been documented from Bent Creek.

Potential Effects

The purpose and need (objectives) of this proposal is to restore about 1,200 feet of Bent Creek to a condition where it can have more immediate access to its floodplain to dissipate energy, minimize near bank stress, and reduce sedimentation caused by lateral migration and incision. Changing the existing pattern, dimension, and profile would improve water quality, and aquatic and botanical habitat.

Dave Danley has extensive experience with the population of *Hexastylis rhombiformis* in the Bent Creek area. He stays in contact with botanists from all agencies and organizations concerning the species and the Bent Creek population (which numbers in the thousands of plants). He is very familiar with the proposed project site and estimates that no more than 5 individual plants would be disturbed by the implementation of this project. He states that this would not jeopardize the population or the species' viability.

Much of what we know about the biology of the Northern bush katydid comes from one researcher's work in the early 1940s in Michigan and nothing is known of the species ecology in North Carolina (Forrest, 2004). Based on the Michigan researcher's data, Dr. Forrest of UNC-Asheville selected survey sites having climax oak-hickory forest. While this katydid is known to fly and sing from tree tops, Dr. Forrest's team found no discernable differences between sites where the katydid occurred and those where it did not occur. All sites were dominated by oaks, hickories and maples, with poplar, locust, sweetgum, hemlock and birch as codominants, and with understories of dogwood and rhododendron. Individuals were found calling from red maples and ate red maple in the lab. They were found across a wide range of elevations. Given the new record of northern bush katydid along the Hard Times Trail, it is certainly possible that it occurs along Bent Creek, within the proposed project area. However, there is plenty of habitat available even considering the trees that will be removed. Dr. Forrest noted four things that lend themselves to a determination of no impact to this species. First, western NC is on the southern edge of this species geographical range and so populations are more likely to be fragmented here. Second, known populations appear to be stable. Third, the life cycle may be short and calling sporadic, leading to few records and a misinterpretation that the species is significantly rare.

Finally, this species has been recorded in residential areas, suggesting flexibility in habitat use. Impacts on this species are extremely unlikely.

Mitigation Measures

This project has been designed to improve natural stream condition. No mitigation measures are required for this project.

Mitigation measures are actions, which are required to remain in compliance with environmental laws such as (but not limited to) the Endangered Species Act or Clean Water Act, or with the Forest Plan. In most cases, resource protection has been incorporated into project design prior to the writing and signing of this BE to minimize potential adverse effects. The mitigation measures stated here are for unavoidable actions associated with the proposed resource management. Unless otherwise stated, the determination of effect considers the successful implementation of these measures. Should a mitigation measure be implemented and subsequently fail, corrective measures must be taken and appropriate Forest Service officials notified immediately.

Determination of Effect

Implementation of this project will have no effect on threatened, endangered or proposed species or their habitats since none are known to or are likely to occur within the project area. In addition, individual plants of the species *Hexastylis rhombiformis* may be impacted; however the population will not be jeopardized, nor will the species' status trend towards listing. The Sensitive insect, *Scudderia septentrionalis*, and its habitat will not be negatively impacted. As natural streamflow and channel conditions are established within the upper reach of Bent Creek, aquatic habitat quality and quantity will improve.

APPENDIX B – MANAGEMENT INDICATOR SPECIES

Management Indicator Species (MIS) Analysis

Introduction

A summary of the assessment of habitat changes in biological communities and special habitats and the effect of these changes on terrestrial and aquatic species used as MIS is documented in this section. These assessments provide a checkpoint of project level activities, the anticipated change in habitat used by MIS, and the likely contribution to forest-wide population trends.

Process

The forest-wide list of MIS was considered as it relates to this project analysis area. The project analysis area includes forests dominated by eastern or Carolina hemlock, forests where these species are important components and aquatic habitats associated with these forests. Only those MIS that occur or have habitat within the project analysis area and may be affected by any of the alternatives were carried through the in-depth analysis. All MIS were evaluated and this documentation shows which MIS were or were not chosen to represent the effects of management actions along with the rationale for these selections.

Consistent with the Forest Plan and the associated FEIS, the effects analysis focuses on changes to MIS habitat. These project-level effects are then put into context with the forest-wide trends for populations and habitats.

To process and document the information efficiently, a series of tables are used as follows:

1) **Tables MIS-1** and **MIS-2:** These tables display the biological communities, special habitats, associated MIS, and reasons species were, or were not, selected to reflect management activities in the project area. The source of these tables is the Final Supplement to the Final Environmental Impact Statement (FSFEIS), Vol. I, Tables III-8 and III-9.

2) **Tables MIS-3** and **MIS-4:** These tables compare the effects (expressed as changes in habitat) by alternative to the forest-wide estimates of habitats for each biological community and special habitat selected in the project-level analysis. Following these tables is a discussion of how the project's effects to habitats affect forest-wide trends and the cumulative effects for these selected habitats.

3) **Table MIS-5:** This table displays by potentially affected MIS the Forest-wide population trend along with the associated biological community or special habitat selected in the project-level analysis. The information in this table is included in the MIS Report for the Nantahala and Pisgah National Forests and is incorporated by reference. This table is used in conjunction with the information presented in Tables 3 and 4 to explain how the project's effects to habitats affect forest-wide population trends for the species considered. Following these tables is a discussion of the cumulative effects for the selected species.

Table MIS-1: Biological Communities, Associated MIS (per the Final Supplement to the Final Environmental Impact Statement Volume I, Table III-8), and why Species were Chosen to Reflect Management Activities or Eliminated from Further In-depth Analysis

Biological Community	MIS	Analyzed Further/ Evaluation Criteria
Fraser fir forests	Fraser fir, golden-crowned kinglet, Carolina N. flying squirrel	No/1
Red Spruce/fraser fir forests	Golden crowned kinglet, Carolina northern flying squirrel, solitary vireo	No/1
Grassy and heath balds	Mountain oat-grass, Catawba rhododendron	No/1
Northern hardwood forests	Carolina northern flying squirrel, twisted stalk, solitary (blue-headed) vireo	No/1
Carolina hemlock bluff forests	Golden-crowned kinglet, Carolina hemlock	No/1
Cove forests	Ginseng, black cherry, buckeye, basswood, solitary (blue-headed) vireo	No/2
Oak and oak/hickory forests	Red oak, white oak, hickories	No/2
White pine forests	White pine (natural community only)	No/1
Yellow pine mid-successional communities	Pine warbler (low elevational shortleaf/Virginia pine)	No/1
Xeric yellow pine forests	Pine warbler (pine/oak/heath low elevation habitats) pitch pine, table mountain pine, turkey beard, mid-successional)	No/1
Reservoirs	Index of biotic integrity, largemouth bass, bluegill	No/1
Forested seep wetlands	Golden saxifrage, umbrella leaf, mountain lettuce	No/1
Bogs	*Sphagnum spp.*	No/1
Mountain ponds and ephemeral pools	Spotted salamander (vernal pools)	No/1
Barrens and glades	Prairie dropseed, slender wheatgrass	No/1
Shaded rock outcrops and cliffs	Green salamander (granitic gneiss rock outcrops with crevices and mesic conditions), Jordan's salamander, alumroots, saxifrages	No/1
Open rock outcrops and cliffs	Raven, peregrine falcon, Biltmore sedge, wretched sedge, mountain oat-grass	No/1
Caves	Bats (all cave-using species)	No/1
Alluvial forests	Two-lined salamander (mid-late successional stages), raccoon (all forest types), mink	Yes
Coldwater streams	Brook, brown, and rainbow trout; sculpin, blacknose dace	Yes
Coolwater streams	Smallmouth bass, white sucker, moxostoma spp., index of biotic integrity	Yes
Warmwater streams	Index of biotic integrity, smallmouth bass, freshwater mussels, spotfin chub	Yes

/1 Biological Community and its represented species do not occur within the project area; therefore, this biological community will not be affected by any of the alternatives. Given no effects to the community, the alternatives in this project will not cause changes to forest-wide habitat trends or changes in population trends of species associated with this community.

/2 Biological Community is imbedded in only a small portion of the analysis area and will be excluded by project management activities. This biological community will not be affected by any of the alternatives or effects are discountably small. Given no effects to the community, the alternatives in this project will not cause changes to forest-wide trends or changes in population trends of species associated with this community.

Table MIS-2: Special Habitats, Associated MIS (per Final Supplement to the Final Environmental Impact Statement Volume I, Table III-9), and why Species were Chosen or Eliminated from Further Analysis

Special Habitat	MIS	Analyzed Further/ Evaluation Criteria
Old Forest Communities (100+ years old)	Black bear (dens, low levels of disturbance), bats (roosting and foraging habitats in mature forests), pileated woodpecker (cavities, foraging habitat), lung lichens	No/[2]
Early successional (0-10 years old)	White-tailed deer (all communities and elevations), eastern wild turkey (all communities), ruffed grouse (early and mid-successional all communities) rabbits, rufous-sided (eastern) towhee, bobcat, field sparrow (brushy, riparian thickets)	No/[1]
Early successional (11-20)	Rufous-sided (eastern) towhee, ruffed grouse (early and mid-successional all communities)	No/[1]
Soft mast producing species	Wild grape (*vitus spp.)*, cedar waxwing (all communities soft mast)	No/[1]
Hard mast-producing species (>40 yrs)	Black bear, wild turkey, gray squirrel, white-tailed deer	No/[2]
Cove forests	Ginseng, black cherry, buckeye, basswood, solitary (blue-headed) vireo	No/[2]
Mixed pine/hardwood forest types (successional stage and hard mast)	Black bear, eastern wild turkey, gray squirrel, white-tailed deer	No/[1]
Contiguous areas with low disturbance (< 1 mile open travelway/4 square miles	Black bear (all communities)	No/[1]
Contiguous areas with moderate disturbance levels (<1 mile open travelway/2 square miles)	Eastern wild turkey (all communities)	No/[1]
Large contiguous forest areas	Ovenbird (in breeding range, moderately productive sites), northern parula warbler (in breeding range, requires cover and riparian habitats) veery, solitary (blue-headed) vireo	No/[1]
Permanent grass/forb openings	Eastern wild turkey, eastern meadowlark, rabbit	No/[1]
Den trees (>36” dbh)	Black bear (large dens)	No/[1]
Snags and dens (>22” dbh)	Pileated woodpecker, raccoon (moderate sized dens)	No/[1]
Small snags and dens	Gray squirrel, white-breasted nuthatch, yellow-bellied sapsucker (breeding populations)	No/[1]
Downed woody material – all sizes (foraging and cover habitats)	Black bear (all communities), pileated woodpecker, ruffed grouse (down logs for drumming), Jordan’s salamanders	No/[2]

/1 Special habitat and its represented species do not occur within the project area; therefore, this special habitat will not be affected by any of the alternatives. Given no effects to the habitat, the alternatives in this project will not cause changes to forest-wide trends or changes in population trends of species associated with this habitat.

/2 Biological Community is imbedded in only a small portion of the analysis area and will be excluded by project management activities. This biological community will not be affected by any of the alternatives or effects are discountably small. Given no effects to the community, the alternatives in this project will not cause changes to forest-wide trends or changes in population trends of species associated with this community.

Table MIS-3: Biological Communities, Forest-wide Estimates, and Expected Changes Resulting from the Alternatives[1]

Biological Community	Forest-wide Estimate	Estimated Changes		
		Alternative A	Alternative B	Alternative C
Alluvial forests	21,000 ac Alluvial Forest 55,000 ac other flood-prone areas	No change from its current condition	Although there will be a temporary change from its current condition (6 acres), there will be no long-term change in acres of riparian forest habitat.	Although there will be a temporary change from its current condition (6 acres), there will be no long-term change in acres of riparian forest habitat.

[1] See following sections below for aquatic analysis and population trends

Table MIS-4. Special Habitats, Forest-wide Estimates, and Expected Changes Resulting from the Alternatives[1]

Special Habitat	Forest wide Estimate	Estimated Changes		
		Alternative A	Alternative B	Alternative C
None	N/A	N/A	N/A	N/A

[1] See following sections below for aquatic analysis and population trends

Forest-wide Trends and Cumulative Effects of Project-level Activities for Biological Communities and Special Habitats

Alluvial Forests

Alluvial Forests currently are static, i.e. they are not expanding or being reduced in extent. Forest composition is also fairly static because few vegetation management activities have occurred in the past, are currently ongoing, or are foreseeable in the future because these forests are considered riparian areas and only activities that enhance riparian benefits are permitted by the Nantahala and Pisgah National Forest LRMP.

The elm-ash-cottonwood forest-type group declined in the mountain counties of North Carolina between 1990 and 2002 (Brown 2002). The decline of alluvial forests on private lands and the implementation of this project are not likely to cumulatively impact the extent of alluvial forests on the Nantahala and Pisgah National Forest because: (1) they are not included in any foreseeable land exchanges, and (2) riparian standards in the LRMP require that management activities would maintain riparian benefits in these Forests.

Cold-, Cool- and Warmwater Streams

The following aquatic MIS were selected for analysis in this project because they are known to be present within the project area: blacknose dace (coldwater), mottled sculpin (coldwater), smallmouth bass (cool- and warmwater), and white sucker (warmwater). Because if its proximity to upper, coldwater reaches, and larger mainstem river (i.e. warmwater) reaches, it is reasonable to see representatives of several fish communities within lower Bent Creek. Bent Creek, below Lake Powhatan, represents “transitional” aquatic habitat.

Brook, brown, and rainbow trout were not selected as MIS because lower Bent Creek exhibits cool- to warmwater characteristics, and any trout present are likely of hatchery origin. Habitat for trout within lower Bent Creek is marginal. It is possible to occasionally find a trout within lower Bent Creek at the mouth of a tributary. Wild trout do occur within the Bent Creek area, above Lake Powhatan and within upper reaches of tributaries.

Redhorse suckers (Moxostoma sp., coolwater streams), freshwater mussels (warmwater streams), and the spotfin chub (Cyprinella monacha) were not selected as aquatic MIS because they do not occur, nor is habitat suitable for them, within the project area. These species are large river species, and would be more likely to be found within the mainstem French Broad River.

Index of Biotic Integrity (IBI) was not selected as an aquatic MIS because it is not an effective tool in streams like Bent Creek. The transitional nature of lower Bent Creek would make evaluating biotic integrity difficult – metrics for several versions of the IBI would apply, but not fit together in a reliable index. It would be very easy to over- or underestimate biotic integrity (either of which misrepresents true condition) within Bent Creek due largely to local conditions. The IBI would be extremely effective in the mainstem French Broad River, and is, in fact a valuable management tool in that respect.

Implementation of the no action alternative would allow for the continued degradation of the lower reaches of Bent Creek. Fish communities would continue to be suppressed by habitat loss (direct effect) and interruption of the food chain (i.e. loss of invertebrate production associated with habitat degradation, indirect effect). Cumulatively, implementation of the no action alternative would allow Bent Creek to continue to be a substantial source of sediment to the mainstem French Broad River in Buncombe County.

Restoration of the lower Bent Creek stream channel would allow natural restoration of the fish and invertebrate communities within the system. Increasing habitat diversity and improving stream condition would allow for more diverse fish and invertebrate communities over time. And ultimately, result in a more sensitive aquatic community (i.e. we would be better at detecting both positive and negative changes associated with forest use and management over time). These changes, however, would be restricted to Bent Creek, and not readily observable within the main stem French Broad River.

Table MIS-5: Management Indicator Species, Estimated Population Trend, and Biological Community and Special Habitat Indicated by the Species

Species	Estimated Population Trend	Biological Community or Special Habitat		
		1	2	3
Blue Ridge two-lined salamander	Static	Alluvial Forests		
Raccoon	Increasing	Alluvial Forests	Snags and dens (>22 dbh)	
Mink	Static	Alluvial Forests		
Blacknose dace	Static	Coldwater streams		
Mottled sculpin	Static	Coldwater streams		
Smallmouth bass	Static	Cool- and warmwater streams		
White sucker	Static	Warmwater streams		

Cumulative Effects of Project-level Activities on Forest-wide Trends for Aquatic and Terrestrial MIS on the Nantahala and Pisgah National Forests

The lower reach of Bent Creek is located from the parking area for the Hardtimes Trailhead (Recreational Parking), just past the Arboretum's fenced entrance gate, and continues downstream to the Forest boundary. The stream is unstable and meandering laterally as it seeks to create a floodplain at a lower elevation which discharges excessive sediment. Based on the difference in surveys completed in 2001 and 2003, the channel has moved laterally 27 feet near

the beginning of the proposed project. Excessive erosion causes adverse impacts to the stream channel and biota.

Wildlife habitat on the north side of the Lower Reach is more typical of "backyard" wildlife habitat, with dense wildflowers and scattered trees in a park-like setting. Flowering plants (black-eyed susan, joe pye weed, and others) growing in this area provide nectar and seed for insects, birds and small mammals. Two areas were mapped as wetland habitat. Given the Lower Reach's proximity to the road (Fredrick Law Olmstead Way) and the walking path bisecting this section of the activity area, the site is not currently suitable habitat for wildlife species requiring freedom from human disturbance. The opposite bank consists of rhododendron upstream, with greater dominance of herbaceous vegetation and deciduous trees downstream in this Lower Reach. Common wildlife using this section of Bent Creek and the surrounding upland may include raccoons, opossums, bats, beavers, small mammals, songbirds, and butterflies.

The proposal (Alternative B) at the lower reach is to raise the channel by creating a sinuous, stable channel on top of the floodplain using heavy machinery, such as an excavator. Natural materials, such as large woody debris, boulders, and woven erosion control fabric will be used to create a stable channel. Depressional floodplain areas will be constructed in some areas of the existing channels to encourage habitat found in vernal ponds (see enclosed maps for location and general channel design). Woody debris would come from several trees cut within the new channel. A Nationwide permit would be required from the North Carolina Department of Natural Resources and Army Corp of Engineers prior to excavation and placement of natural materials. All instream work would be implemented outside of the trout rearing moratorium (October 15 – April 15), as specified by permitting agencies. During excavation of the new channel, a Forest Service Archaeologist would be on-site to monitor protection of heritage sites. Alternative C is a modification of Alternative B.

Blue Ridge Two-lined Salamander

The estimated population trend of the Blue Ridge two-lined salamander is static. Initially, populations of Blue Ridge two-lined salamander may appear to decline after the remeandering project is complete because of the tree removal and change in location of the stream channel. However, these salamanders are able to take refuge in surrounding moist forested areas until the stream-side vegetation can recover and once again provide shade (i.e., moisture) and leaf litter to the forest floor. Implementation of this proposed project (either of the action alternatives) would help reduce the excessive sedimentation that is currently occurring, which is detrimental to the salamander's survival by providing a more hospitable environment in which to live. Implementation would not have an effect on the Blue Ridge two-lined salamander in the long term, thus not changing its current static population trend.

Raccoon

The population trend of the raccoon is upward. Although the composition of alluvial forests, the primary habitat for the species, may change to some degree initially, this would not impact habitat suitability for the species. In fact, habitat conditions for raccoon are likely to improve because the riparian habitat would improve for its prey. As the stream recovers and settles into its correct alignment, much riparian faunal habitat would improve. Implementation of either of the action alternatives would not change the upward population trend of the raccoon.

Mink

The population trend of mink is static. Mink is an alluvial forest-associated species whose populations tend to be limited by the availability of denning sites (e.g., dens of other species such

as the bank dens of beavers or muskrats) or food sources. In fact, habitat conditions for mink are likely to improve because the riparian habitat would improve for its prey. As the stream recovers and settles into its correct alignment, much riparian faunal habitat would improve. Thus, implementation of either of the action alternatives would not change the static population trend for this species.

Blacknose Dace

The overall Forest trend of this species is static. Local increases in density or biomass can occur when aquatic habitat diversity improves. Blacknose dace are extremely sensitive to sedimentation (they are benthic insectivores), so when substrate composition and habitat conditions improve, local populations would improve. However, local improvements within Bent Creek would not be measurable across the species' range on the Forests. Implementation of the proposal would favor blacknose dace in approximately 0.4 mile of lower Bent Creek; however, the cumulative positive impact on the species would not be great enough to influence the Forest-wide static trend (see MIS report sections 4.44, 4.45 for detailed Forest habitat and trend discussion).

Mottled Sculpin

The overall Forest trend of this species is static. Local increases in density or biomass can occur when aquatic habitat diversity improves. Mottled sculpin are sensitive to changes in substrate composition (they are benthic predators) and flow velocities and depth (their morphology supports their predatory nature, rather than high mobility and maneuverability). So when substrate composition and habitat diversity improve, local populations would improve. However, local improvements within Bent Creek would not be measurable across the species' range on the Forests. Implementation of the proposal would favor mottled sculpin in approximately 0.4 mile of lower Bent Creek; however, the cumulative positive impact on the species would not be great enough to influence the Forest-wide static trend (see MIS report sections 4.44, 4.45 for detailed Forest habitat and trend discussion).

Smallmouth Bass

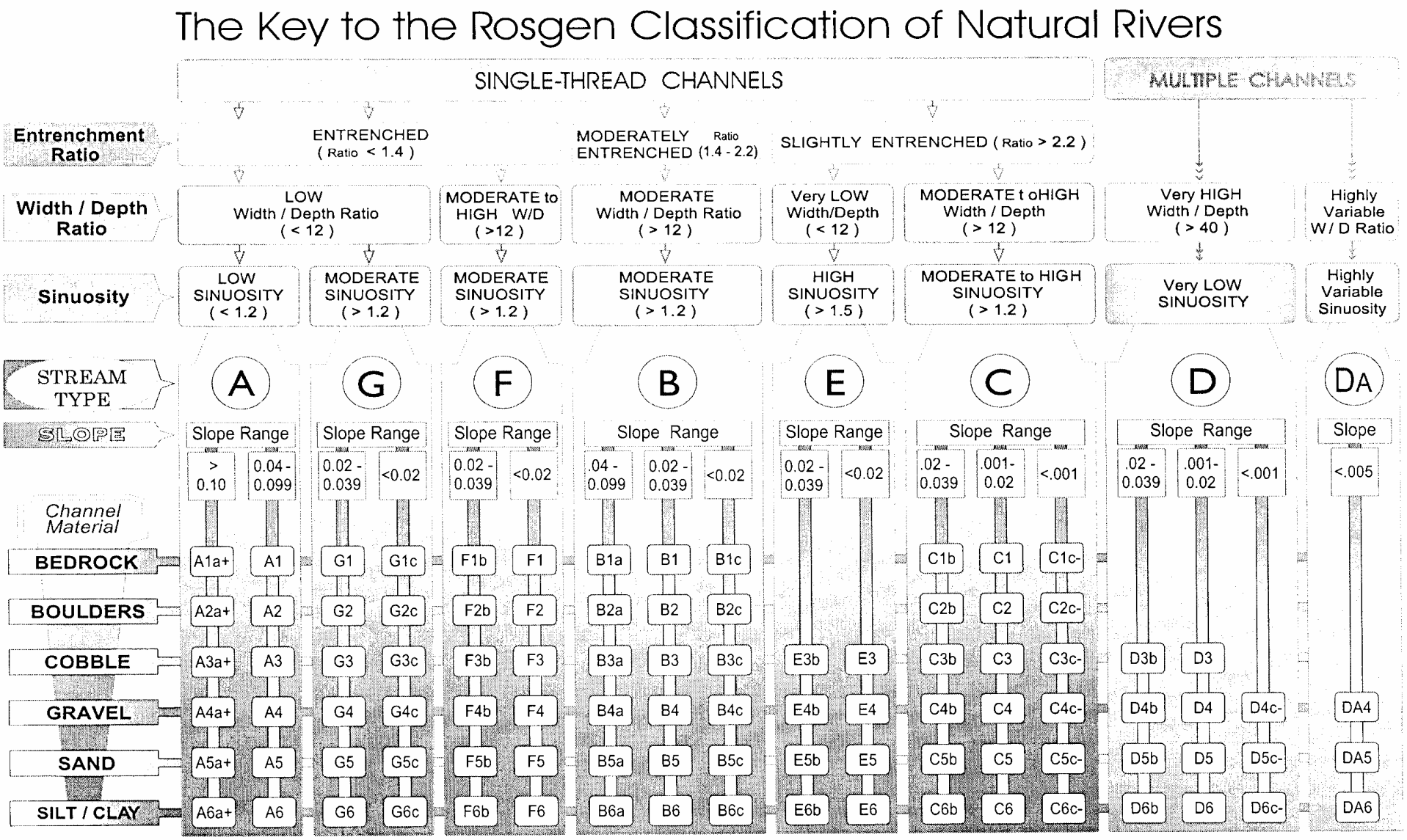
The overall Forest trend of this species is static. Local increases in density or biomass can occur when aquatic habitat diversity improves. Smallmouth bass are sensitive to changes in water quality and substrate composition (they are predators, relying heavily on species that are very sensitive to these parameters, such as minnows, darters, and crayfish). So when substrate composition and habitat diversity improve, local populations would improve. However, local improvements within Bent Creek would not be measurable across the species' range on the Forests. Implementation of the proposal would favor smallmouth bass in approximately 0.4 mile of lower Bent Creek; however, the cumulative positive impact on the species would not be great enough to influence the Forest-wide static trend (see MIS report sections 4.44, 4.45 for detailed Forest habitat and trend discussion).

White Sucker

The overall Forest trend of this species is static. Local decreases in density or biomass can occur when aquatic habitat diversity improves. This is due to increases in species requiring specific habitats, such as (but not limited to) the other aquatic MIS discussed in this report. Simply put, as habitat condition and diversity improve, white sucker populations would likely decrease, but not disappear, as populations of species sensitive to habitat change increase. It is much more natural to see a transitional fish community with suckers as a component of that community rather than the dominant species. Therefore, as substrate composition and habitat diversity

improve, local populations of white suckers would decrease, but find stability at reduced densities. However, local decreases within Bent Creek would not be measurable across the species' range on the Forests. Implementation of the proposal would favor white suckers at reduced densities, allowing for the restoration of a healthy transitional fish community within approximately 0.4 mile of lower Bent Creek. The cumulative impact on the species would not be great enough to influence the Forest-wide static trend (see MIS report sections 4.44, 4.45 for detailed Forest habitat and trend discussion).

APPENDIX C – ROSGEN STREAM CHANNEL CLASSIFICATION



KEY to the *ROSGEN* CLASSIFICATION of NATURAL RIVERS. As a function of the *"continuum of physical variables"* within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units; while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

Figure C-1: Rosgen Stream Classification of Natural Rivers