MILLER ET AL. MITIGATION SITE ON MEAT CAMP CREEK, WATAUGA COUNTY

Year 4 Monitoring Report
Period Covered: March 30, 2005 – December 22, 2006

Prepared for the

North Carolina Ecosystem Enhancement Program

North Carolina Wildlife Resources Commission
Division of Inland Fisheries
Watershed Enhancement Group
Raleigh

2007

This report summarizes the 2006 monitoring data collected from 652 linear feet of Meat Camp Creek, located on the Miller et al. property in Watauga County (Figure 1), that was enhanced in 2002. Comparisons are also made with previously collected data. Mickey and Scott (2002) described pre-construction survey methods, site conditions, and project objectives. The purpose of the project was to improve aquatic habitat, reestablish riparian area vegetation, and establish channel stability. This monitoring report is submitted as partial fulfillment of the off-site stream mitigation requirements of the North Carolina Department of Transportation (NCDOT) for the R-0529 US 421 road improvement project in Watauga County. For that project, a total of 14,814 linear feet of stream mitigation were required by the United States Army Corps of Engineers (USACE) Section 404 permit and 7,407 linear feet of mitigation were required by the North Carolina Division of Water Quality (NCDWQ) Section 401 water quality certification.

From 2002 to 2005 all reports associated with this mitigation site were prepared for the NCDOT stream mitigation program. In 2005, responsibility for this site was transferred from NCDOT to the North Carolina Ecosystem Enhancement Program (EEP). This document was prepared using guidelines previously developed by the North Carolina Wildlife Resources Commission. This was done to maintain consistency with earlier reports and to facilitate the comparison of the 2006 data with previous years' data without having to change report formats.

Monitoring

The 2006 monitoring survey was completed on December 22, 2006. These data are compared with as-built data collected in March 2003 and monitoring data collected in 2003 and 2005 (Mickey and Hining 2003a; Mickey and Hining 2003b; Mickey and Wasseen 2005). Monitoring data were not collected in 2004 because hurricane-caused damage had not been repaired. The 2006 monitoring survey included a longitudinal profile survey, channel cross-section dimension measurements, channel cross-section photographic log, pebble counts, woody plant stem counts (planted trees/live stakes), and repair site photographic log.

Bankfull Rain Events

Bankfull rain events were monitored through review of the United States Geological Survey's South Fork New River gage (gage number 03161000) near Jefferson, North Carolina, and by personal observations of bankfull stage stakes placed on site. Bankfull at the Miller site corresponded to approximately 1,400 cubic feet per second at the gage station. However, due to the localization of many rain events, some bankfull events could only be confirmed by direct observation (visiting the site after a rain event or through contact with the landowner). Since completion of the project there have been 42 bankfull or greater events at the site (Table 1). Twenty-two of those events occurred since the 2005 monitoring survey. The stream channel and banks have adjusted to these channel forming events and any stream bank and channel instability should be obvious. Additionally, the mitigation site has exceeded the criterion of two bankfull events in 5 years as required by the USACE and necessary to release the mitigation site from further monitoring (USACE 2003).

Longitudinal Profile

The 2006 longitudinal profile data revealed minor changes in the channel thalweg (Figure 2). The pool at station 0+22 aggraded 0.55 feet from 2005; however this pool is deeper than found during the 2003 as-built and 2003 monitoring surveys. The channel profile from stations 0+46 to 1+64 remained virtually unchanged. The pool at station 1+73 continues to evolve into a run. There was little change in the channel profile from stations 1+85 to 2+89 based on the data and observations. The pool at station 3+76 decreased in depth by 2.6 feet since 2005 and is now at a depth found in the as-built and 2003 monitoring surveys. The pool between stations 4+60 and 4+74 has aggraded between 0.54 and 0.62 feet since 2005. At station 4+65 the channel aggraded up to the 2003 monitoring survey elevation. From stations 4+97 to 5+34, the thalweg increased in maximum depth by 0.74 feet since 2005. These minor changes in the longitudinal profile appear to be natural occurrences and not because of instabilities caused by the stream enhancement activities.

Cross-sections

Five cross-sections were surveyed in 2006 and compared with previous cross-section measurements (Figure 3; Mickey and Hining 2003a; Mickey and Hining 2003b; Mickey and Wasseen 2005). Cross-sectional dimensions showed some adjustments following the 2004 hurricanes and November 19, 2004 repairs when compared with previous years' monitoring survey data (Figure 3). This included minor adjustments in thalweg depths and minor lateral movement of the channel.

CROSS-SECTION 1+73 – run (Figure 3.1): This cross-section is located below a rock weir. Following construction this cross-section was a pool. Over the years and with the movement of substrate materials it has evolved to a run. The channel widened slightly following the three September 2004 hurricanes. The cross-section data indicate the stream channel is stable with no bank erosion or lateral movement occurring since the 2005 survey.

CROSS-SECTION 3+37 – riffle (Figure 3.2): This cross-section is situated at the back end of a rock vane and traverses a riffle. The channel has remained stable since repairs were completed in 2004. There is no bank erosion or lateral movement taking place. Note the pin at location 0+00 was positioned in the middle of an overgrazed pasture and could not be located in 2006. Subsequently, the cross-section was measured from a pin at the fence line (location 0+22) to location 0+93.

CROSS-SECTION 3+66 – pool (Figure3.3): This cross-section traverses the middle of a pool just below a rock vane. The right side of this cross-section has aggraded 1.08 ft since the 2005 monitoring survey. However the stream channel is stable with no bank erosion or lateral movement occurring. Note that the pin at location 0+00 was positioned in the middle of an overgrazed pasture and could not be located in 2006. Subsequently, the cross-section was measured from a pin at the fence line (location 0+24) to location 0+95.

CROSS-SECTION 4+74 – riffle (Figure 3.4): This cross-section is situated above a rock weir and traverses a riffle. There has been some minor substrate material build-up between

locations 0+41 and 0+53, when compared to previous years. The thalweg has moved towards the center of the channel away from the right bank. The transect point at location 0+20 is the top of a point bar. The banks are stable and there has been no lateral shift in the stream channel.

CROSS-SECTION 4+97 – pool (Figure 3.5): The channel at this cross-section displays signs of aggradation. Buildup of substrate materials from location 0+45 to 0+50 is due to woody debris being caught by stumps along the bank. Material buildup also occurred between location 0+34 and 0+42, however the banks are stable with no bank erosion or lateral movement occurring.

Substrate

Pebble count data were collected from a riffle at cross-section 3+37 (Figure 4). Substrate analyses indicate most particle size classes have remained stable when compared to the as-built data. In 2006, there was a slight downward trend for all particle sizes except for $D_{50,}$ which was the same as the 2005 count. Since 2003 the D_{50} particle size has ranged from 32 mm to 47 mm and remained in the very course gravel category (Figure 4). The D_{84} cumulative distribution has ranged from of 100 mm (small cobble) to 120 mm (small cobble) (Figure 4). The D_{16} cumulative distribution has decreased from 18 mm (medium gravel) to 4 mm (fine gravel). This is a result of an increase in the percentage of sand and fine gravels since the 2003 as-built survey. The as-built survey did not record any sand or gravel below 3 mm in size. Since the as-built survey the D_{16} cumulative distribution has fluctuated between 4 mm (fine gravel) and 10 mm (medium gravel). These fluctuations in particle size are normal and can be attributed to sampling variability and flood events whereby sediment was transported from disturbed land higher in the watershed. These changes are not significant enough to show any trends or negative impacts.

Riparian Improvements

A total of 232 live stakes and bare root nursery trees were planted within the 0.10 acre of riparian area disturbed during construction and the area repaired during 2004 (Table 2). The remaining 0.60 acre of the conservation easement contained mature trees. Total stem counts (trees and live stakes) were made within the disturbed areas. No effort was made to distinguish between planted stems and naturally regenerated stems. Plantings included tag alder *Alnus serrulata*, silky dogwood *Cornus amomum*, silky willow *Salix sericea*, black walnut *Juglans nigra*, and black locust *Robinia pseudoacacia.* The vegetation survey, conducted on April 24, 2006, revealed a total of 60 woody plants, including one tulip poplar *Liriodendron tulipifera* and three black cherry *Prunus serotina* that had naturally recolonized. The total density of plants in the disturbed areas were 600/acre (60/0.10), which is above the 288 stems/acre required for woody species planted at mitigation sites through year four (USACE 2003).

The invasive exotic plant multiflora rose *Rosa multiflora* was identified on the upper portion of the site. It colonizes by prolific sprouting and stems that root, and spreads by animal dispersed seed. Left unchecked the multiflora rose could spread throughout the project, climbing on trees and shrubs. It can be controlled by grubbing the entire plant and all roots or through herbicide treatment.

Livestock Exclusion

The livestock management program developed for this project included the installation of a well with pressurized water lines, two watering tanks, and fencing to exclude cattle from the riparian zone. These agricultural best management practices, installed as a part of the restoration management plan, are functioning properly.

Site Repairs

Streambank stabilization work at the Miller et al. mitigation site on Meat Camp Creek was completed on September 23, 2002. A storm event on November 19, 2003 caused major bank failures between stations 3+10 and 3+55 (45 linear feet) and 5+00 and 5+34 (34 linear feet). Before repairs could be made, flooding caused by three hurricanes in September 2004 caused additional damage to the site (Appendices 1 and 2). This damage was repaired on November 19, 2004 (Mickey and Wasseen 2005).

A photographic log of the damages, 2004 repairs, and 2006 monitoring from station 3+10 to station 3+55 and station 4+15 to station 4+90 is also provided (Appendices 1 and 2). The repairs stabilized the stream banks and sediment is accumulating on the upstream side of rock vanes. Vegetation has become established on the stream banks from station 3+10 to station 3+55. Vegetation has had a harder time becoming reestablished between station 4+15 and station 4+90 due to the rocky substrate.

Summary

Since completion of the project on September 23, 2002, the Miller et al. mitigation site on Meat Camp Creek remained stable until the November 19, 2003 flood and September 8, 13, 27, 2004 hurricanes. As a result of these floods, some damage occurred to streambanks. Repairs were completed on November 19, 2004. The site remains stable since the 2004 repairs. After 22 bankfull events since monitoring in 2005, the stream channel and banks are stable and in-stream structures are functioning as designed.

Recommendations

1. Complete required annual monitoring in 2007.

2. Implement a multiflora rose control plan to prevent the species from displacing native plants within the easement area before they have matured.

Acknowledgements

J. Mickey, Jr., J. Wasseen, II, and M. Fowlkes of the Elkin watershed enhancement team collected and analyzed the field data; J. Wasseen, II and M. Fowlkes prepared this report. J. Borawa improved the report with his thorough review and thoughtful suggestions.

References

Mickey, J. H. and S. S. Hining. 2003a. As-built report for the Meat Camp Creek mitigation site, Watauga County. North Carolina Wildlife Resources Commission, Raleigh.

Mickey, J. H. and S. S. Hining. 2003b. 2003 monitoring report for the Miller et al. mitigation site on Meat Camp Creek, Watauga County. North Carolina Wildlife Resources Commission, Raleigh.

Mickey, J. H. and S. Scott. 2002. Stream restoration plan, Miller site, Meat Camp Creek, Watauga County. North Carolina Wildlife Resources Commission, Raleigh.

Mickey, J. H. and J. A. Wasseen. 2005. 2005 monitoring report for the Miller et al. mitigation site on Meat Camp Creek, Watauga County. North Carolina Wildlife Resources Commission, Raleigh.

USACE (U.S. Army Corps of Engineers), Wilmington District, U. S. Environmental Protection Agency, North Carolina Wildlife Resources Commission, and the North Carolina Division of Water Quality. 2003. Stream Mitigation guidelines. Wilmington, North Carolina.

FIGURE 1.—Location of the Miller et al. mitigation site on Meat Camp Creek, New River basin, Watauga County.

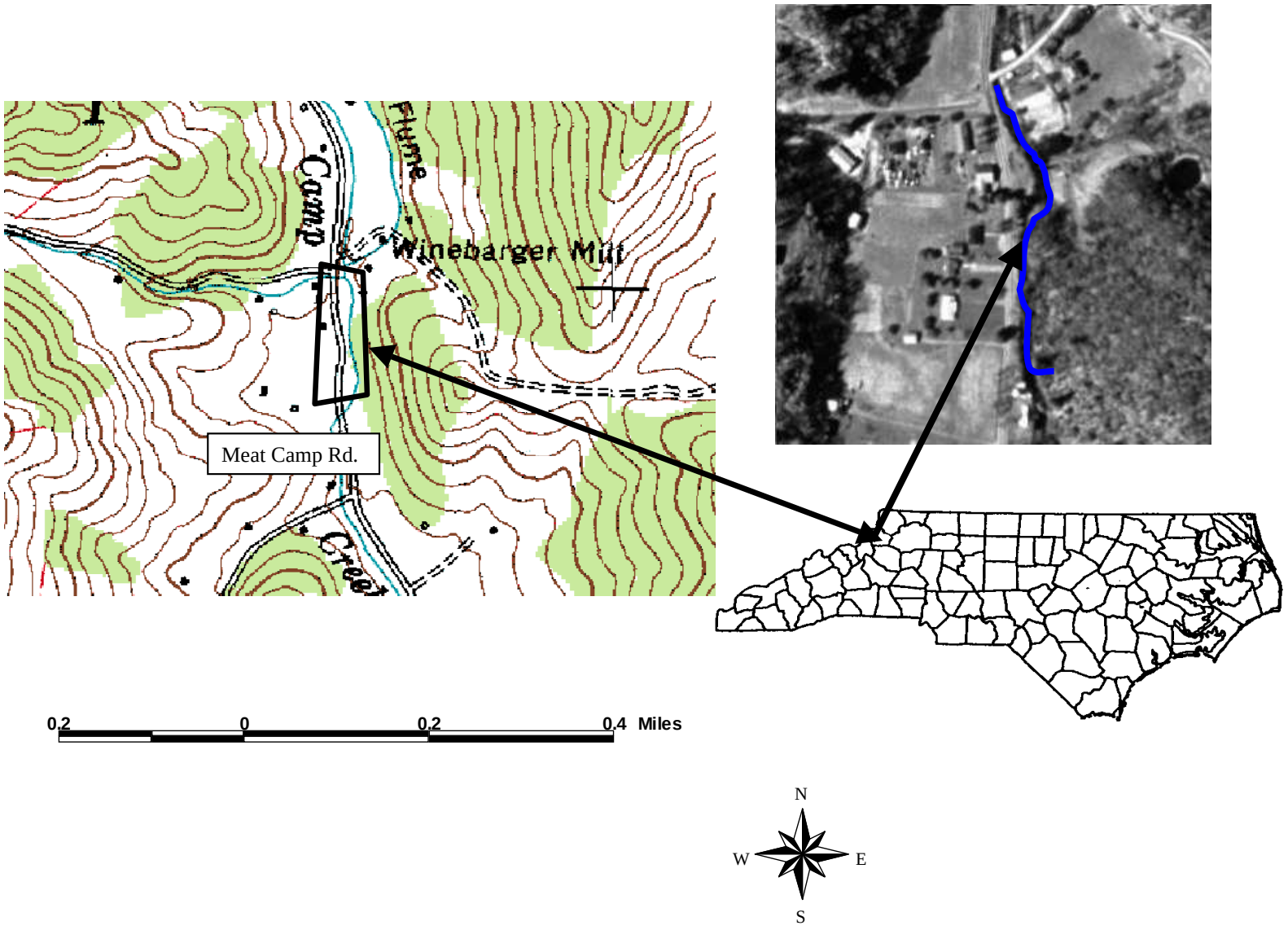


FIGURE 2.—Comparison of the 2003 as-built, 2003, 2005, and 2006 longitudinal profile data taken at the Miller et al. mitigation site, Meat Camp Creek, New River basin, Watauga County.

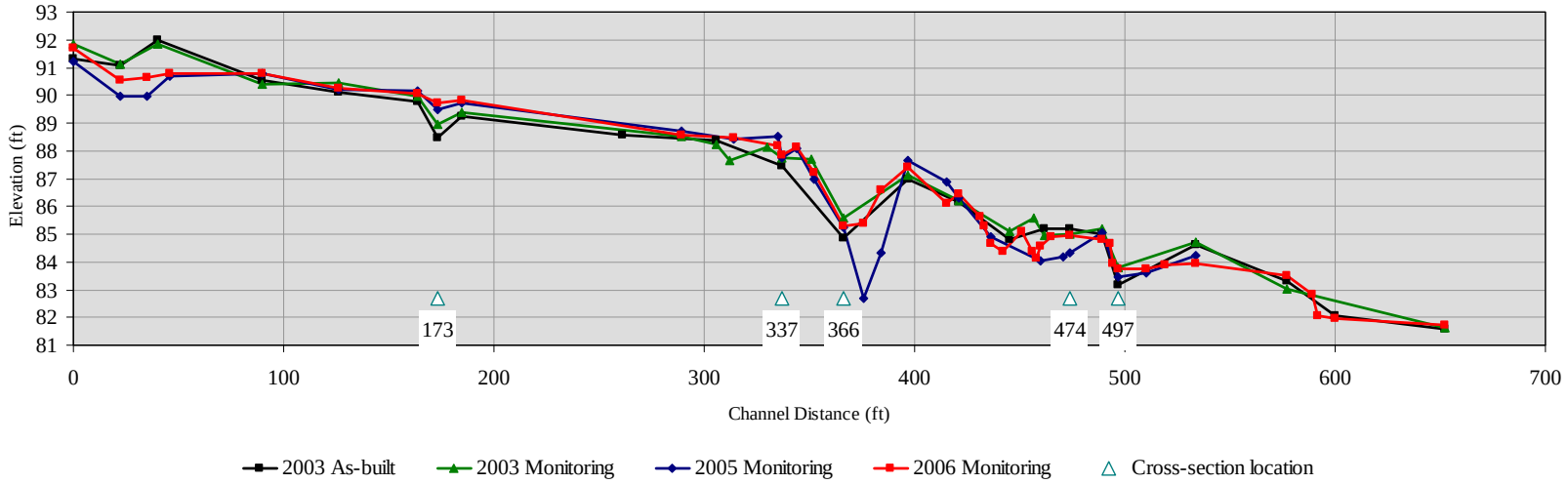


FIGURE 3.—Cross-sectional dimension comparisons at five locations on the Miller et al. mitigation site, Meat Camp Creek, New River basin, Watauga County, 2003-2006. All views are looking downstream. The flood prone area (fpa) and bankfull (bkf) elevations are depicted with red and blue horizontal lines.

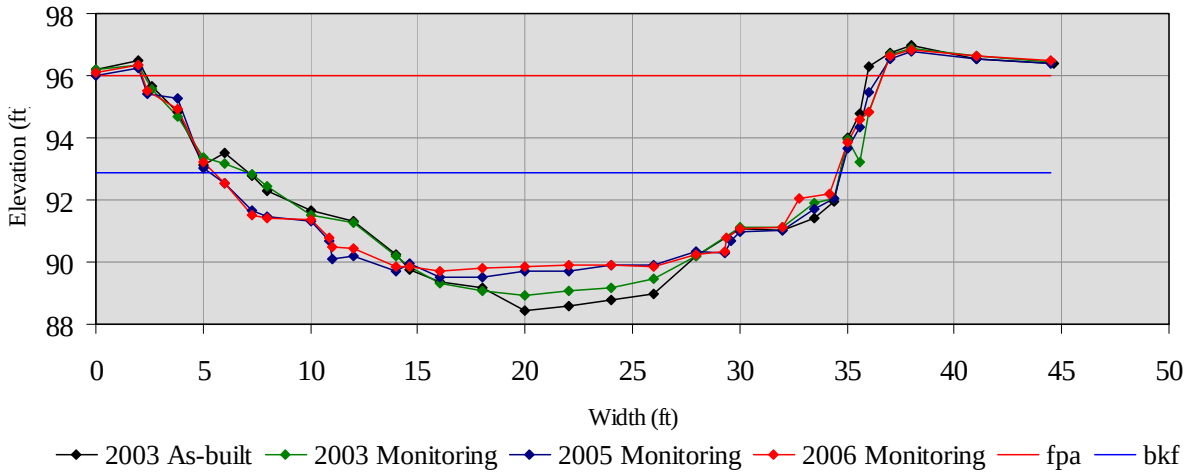


FIGURE 3.1.—Cross-section at station 1+73, run.

FIGURE 3.—Continued.

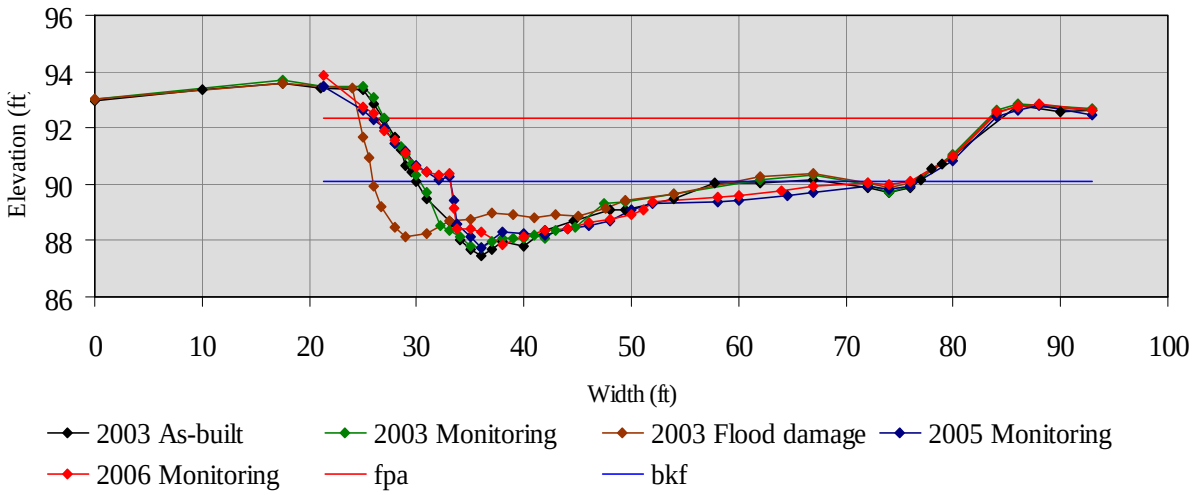


FIGURE 3.2.—Cross-section at station 3+37, riffle.

FIGURE 3.—Continued.

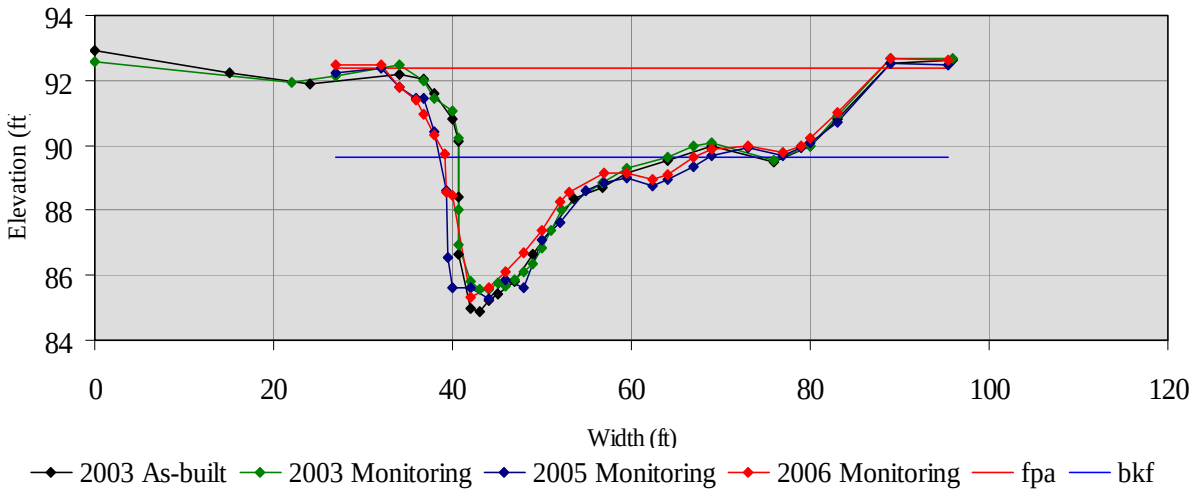


FIGURE 3.3.—Cross-section at station 3+66, pool.

FIGURE 3.—Continued.

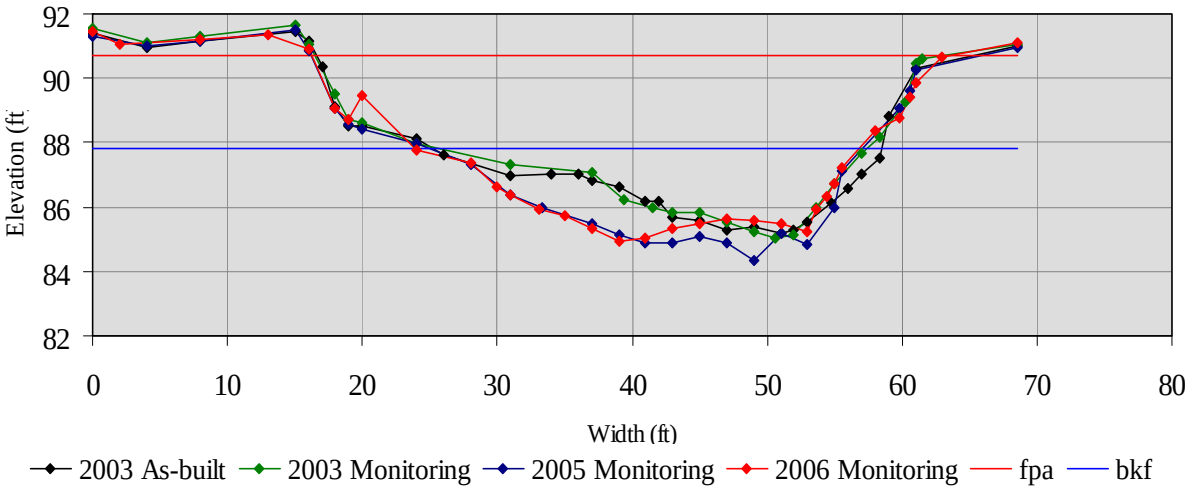


FIGURE 3.4.—Cross-section at station 4+74, riffle.

FIGURE 3.—Continued.

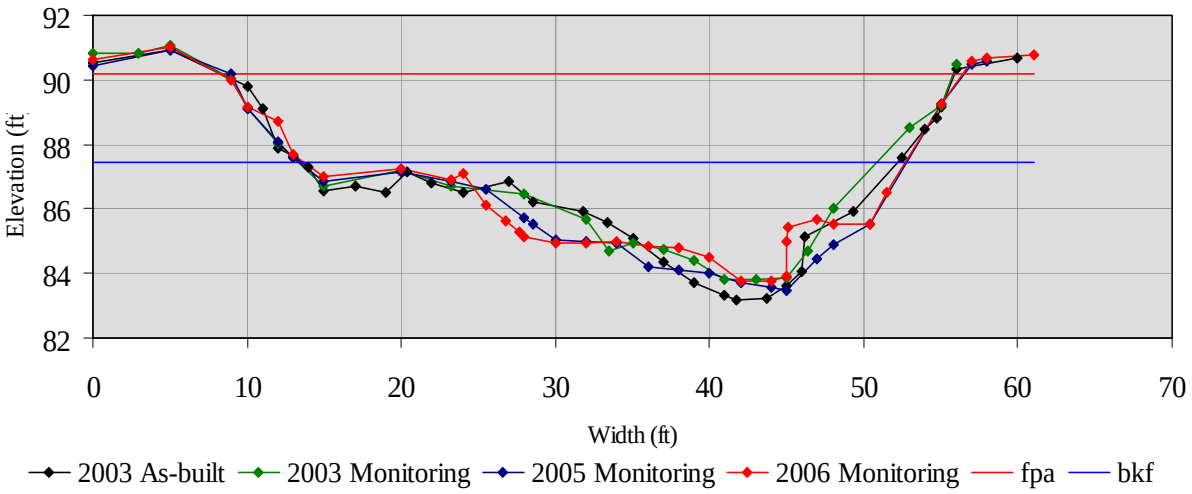
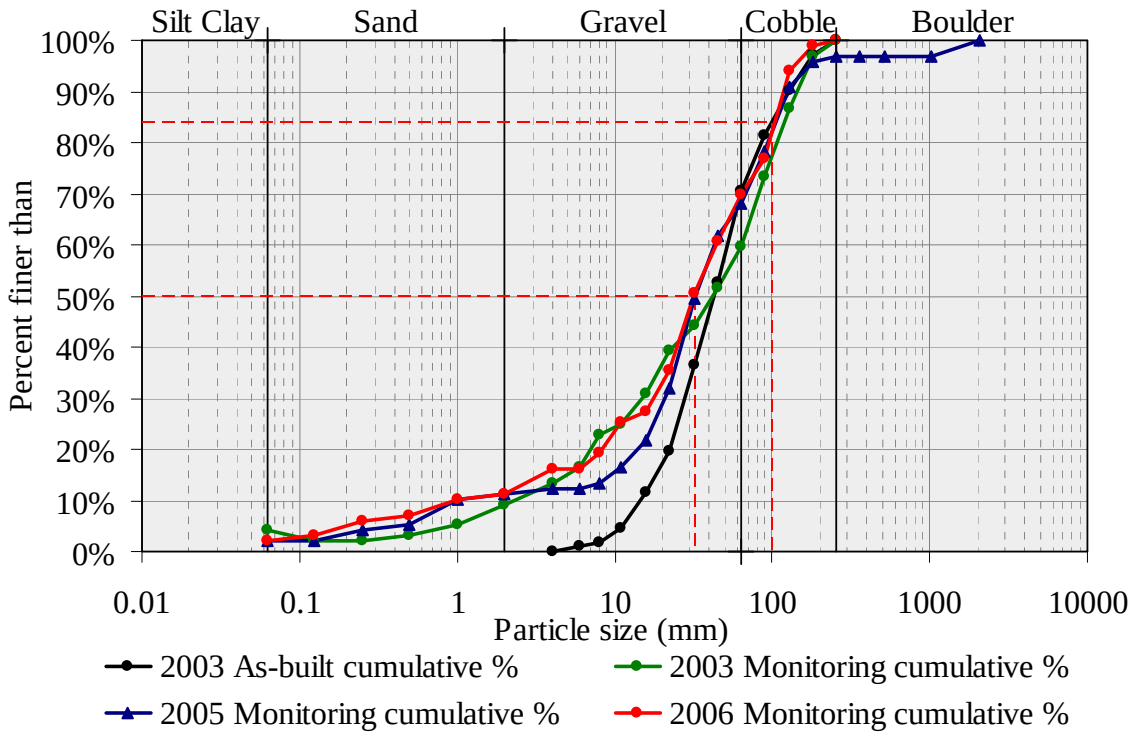


FIGURE 3.5.—Cross-section at station 4+97, pool.

FIGURE 4.—Pebble count data comparisons, Miller et al. mitigation site, Meat Camp Creek, New River basin, Watauga County, 2003-2006.



Size Class Index	Particle size (mm) in year sampled			
	2003 As-built	2003	2005	2006
D_{16}	18	6	10	4
D_{35}	32	19	23	22
D_{50}	47	42	32	32
D_{84}	106	120	110	100
D_{95}	165	170	170	140

TABLE 1.—Bankfull stream flow events occurring at the Miller et al. mitigation site as documented from the United States Geological Survey South Fork New River gage (gage number 03161000) near Jefferson, Ashe County, North Carolina and from on-site observations.

Date	Gage height (ft)	Flows (ft^3/s)	Comments
2/22-23/03	5.0	2,250	Gage quit working
3/16/03	4.4	1,725	Bankfull event
4/10/03	5.4	2,819	Bankfull event
4/18/03	5.6	3,200	Bankfull event
6/7/03	4.1	1,820	Bankfull event
6/17/03	4.7	2,000	Bankfull event
8/9/03	4.2	1,450	Bankfull event
8/10/03	4.1	1,400	Bankfull event
11/19/03[a]	5.4	1,880	Bankfull event
2/7/04	4.8	2,080	Bankfull event
9/2/04	11.7	14,700	Bankfull event (hurricane)
9/13/04	8.6	7,550	Bankfull event (hurricane)
9/28/04	6.3	3,820	Bankfull event (hurricane)
11/25/04	4.2	1,490	Bankfull event
12/23/04	4.6	1,850	Bankfull event
12/24/04	4.6	1,820	Bankfull event
1/14/05	6.5	4,050	Bankfull event
1/15/05	4.5	1,790	Bankfull event
3/28/05	5.0	2,260	Bankfull event
3/29/05	4.5	1,790	Bankfull event
4/2/05	4.5	1,740	Bankfull event
4/3/05	4.3	1,560	Bankfull event
7/8/05	4.6	1,840	Bankfull event
7/16/05	5.0	2,270	Bankfull event
10/7/05	4.0	1,410	Bankfull event
11/29/05	6.5	4,130	Bankfull event
11/30/05	6.4	3,930	Bankfull event
1/18/06	5.2	2,460	Bankfull event
2/5/06	4.4	1,690	Bankfull event
4/22/06	4.3	1,610	Bankfull event
4/23/06	4.2	1,510	Bankfull event
6/25/06	6.8	4,470	Bankfull event
6/26/06	5.3	2,610	Bankfull event
6/27/06	5.7	3,130	Bankfull event
6/28/06	4.2	1,510	Bankfull event

TABLE 1.—Continued.

Date	Gage height (ft)	Flows (ft^3/s)	Comments
8/31/06	4.5	1,780	Bankfull event
9/1/06	4.8	2,090	Bankfull event
9/5/06	4.2	1,530	Bankfull event
11/8/06	4.9	2,160	Bankfull event
11/9/06	4.1	1,460	Bankfull event
11/16/06	5.4	2,670	Bankfull event
11/17/06	5.0	2,310	Bankfull event

[a]This event produced rainfall in excess of 6 inches at the Miller et al. site that resulted in major localized flooding.

TABLE 2.—Vegetation monitoring results for the Miller et al. mitigation site, Meat Camp Creek, New River basin, Watauga County, 2003-2006.

Scientific name	Common name	Number planted[a]	2006 Stem count	Percent change in numbers
Live stakes				
Salix sericea	Silky willow	166	26	-84
Bare root nursery stock				
Alnus serrulata	Tag alder	35	27	-23
Juglans nigra	Black walnut	5	1	-80
Robinia pseudoacacia	Black locust	26	6	-77
Volunteers				
Liriodendron tulipifera	Tulip poplar		1	
Prunus serotina	Black cherry		3	
Totals[b]		232	60	-74

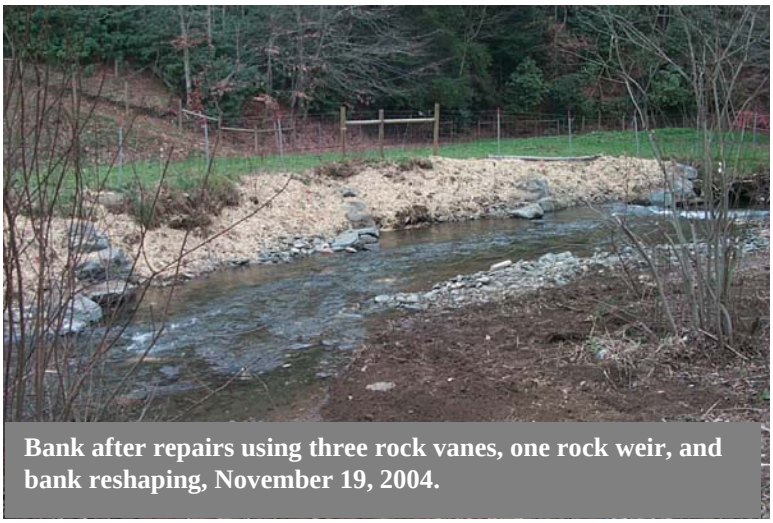
[a]Total number of plants planted in 2003 and 2005.

[b]Totals do not include volunteers in the 2006 survival calculations.

Appendix 1: Photographs of damage and repairs between station 3+10 and station 3+55 at the Miller et al. mitigation site on Meat Camp Creek, New River drainage, Watauga County, November 19, 2003 – November 19, 2004.

After November 19, 2003 flood. Notice that 6 ft of the watering tank drainage pipe is exposed.

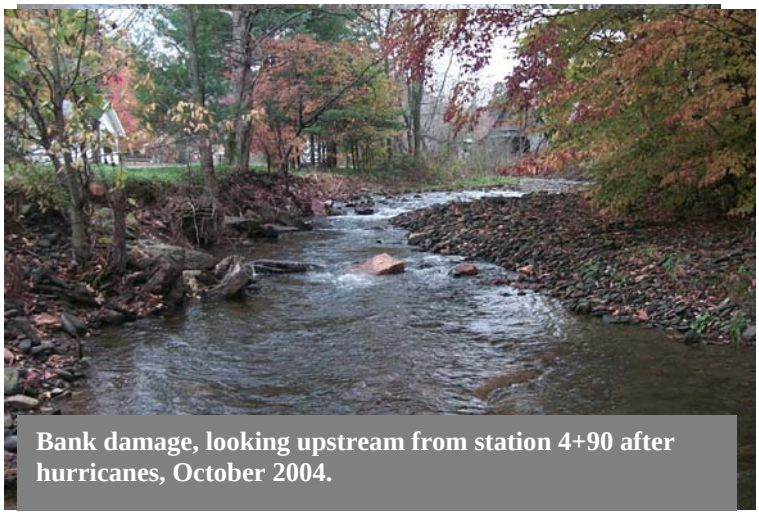
Bank damage after September 8, 13, and 27, 2004 hurricanes.



Bank after repairs using three rock vanes, one rock weir, and bank reshaping, November 19, 2004.


May 1, 2006

Appendix 2: **Photographs of September 8, 13, 27, 2004 hurricane damage between station 4+15 and station 4+90 at the Miller et al. mitigation site on Meat Camp Creek, New River drainage, Watauga County. This site was repaired on November 19, 2004.**



Bank damage, looking upstream from station 4+90 after hurricanes, October 2004.

Looking upstream from station 4+90 after bank repairs to rock vanes and bank reshaping, November 19, 2004.