CARP MITIGATION SITE
UNNAMED TRIBUTARY TO LAXON CREEK
WATAUGA COUNTY

The 3rd (2004) and 4th (2005) Monitoring Report

Prepared for the

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Transportation Improvement Project R-0529

Period Covered: June 3, 2004 – September 27, 2005

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

2006

The purpose of this report is to summarize 2004 and 2005 monitoring data collected from 542 ft of restored stream channel on an unnamed tributary to Laxon Creek at the Carp stream mitigation site in Watauga County (Figure 1). Pre-construction and as-built survey methods, site conditions, and project objectives are described in previous reports (Mickey and Martinez 2000; Mickey and Scott 2001, 2003). The purpose of the project is to improve water quality, aquatic habitat, riparian area quality, and channel stability as partial fulfillment of the off-site stream mitigation permit 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 is required by the United States Army Corps of Engineers (USACE) and 7,407 linear feet of mitigation is required by the North Carolina Division of Water Quality (NCDWQ).

Monitoring

Monitoring surveys were conducted on June 3, 2004, and July 20 and September 27, 2005. The 2004 and 2005 monitoring data is compared with the as-built and the previous years monitoring data as reported by Mickey and Scott (2001, 2003). The 2004 and 2005 monitoring surveys included a longitudinal profile survey (2004 only), channel cross-section dimensional measurements, pebble counts, stem counts of planted trees and live stakes, and water temperature (2005 only). A photographic log of the site is maintained at several locations along the project length (Appendices 1 - 6). Additional photographs of the site are maintained in the Elkin Watershed Enhancement Program files.

Bankfull Events

Bankfull rain events are monitored through review of the United States Geological Survey's South Fork New River flow gage (station # 03161000) near Jefferson, North Carolina, by photos and by personal observations of bankfull stage pins placed on site. Bankfull at the Carp site has been corresponding to approximately 1,800 cubic feet per second (cfs) at the gage station. However, due to the localization of many rain events, some bankfull events can only be noted by visiting the site or through contact with the landowner. Since completion of the project there have been 10 bankfull or greater flow events at the site (Table 1). The largest, localized storm occurred on November 19, 2003. This storm measured only 1,880 cfs at the gage station; however, conditions at the site resulted in the heaviest flooding ever observed by the landowners (Appendix 1 and personal communication). This localized storm event created more flooding at the site than the September 2, 2004 remnant hurricane rains that resulted in 14,700 cfs at the gage station (Table 1). The November 19, 2003 localized storm and the September 2, 13, and 28, 2004 remnant hurricane storms caused major adjustments to the longitudinal profile and cross-sections.

Longitudinal Profile

The 2001, 2002, and 2003 longitudinal surveys (Figure 2) show a relatively stable channel but one that is making minor natural adjustments from its original construction Mickey and Scott 2001). Channel bed elevations show aggradation from station 0+55 to 1+42. We are uncertain as to the cause of this channel aggradation since no in-stream work was done in this area. From

stations 1+42 to 4+32, the length of fully restored, channel profile adjustments were observed as the new channel settled into it's new position and adjusted to a range of stream flows.

The 2004 longitudinal survey documented channel profile changes that occurred after the November 19, 2003 flood (Figure 1, Appendix 1). Following this flood event streambed aggradation was seen at stations 0+55 – 1+35, 2+00 – 2+30, 2+47 – 2+65, and 2+78 – 3+50. While aggradation has occurred at these locations, it has not been detrimental to the success of the project. Based on yearly visual observations, there has been no shift in the meander pattern and no bank scour or erosion is evident. These aggradations appear to be a result of substrate transported from upstream sources (unstable streambanks, pastures, construction activities, unpaved roads). Furthermore, during the 2003 flood the stream was unable to transport this material through the project reach. Flood waters from the South Fork New River backed up into this area and reduced stream sediment transport power.

Longitudinal profile data were not collected in 2005 since the meander pattern and streambanks have remained stable since construction was completed in November 2000.

Cross-sections

Seven cross-sections were surveyed during 2004 and 2005 and compared with previous cross-sections (Figure 3; Mickey and Scott 2001; Mickey and Hining 2003). Cross-section profiles indicate some major adjustments following the 2003 and 2004 hurricanes. Moderate to major adjustments in thalweg depths (aggradation) occurred at all cross-sections following these storms. All of the cross-sections exhibit build up of the streambanks due to deposition of soil materials (silt, sand, small gravel) during bankfull or greater than bankfull storm events. There has been no lateral movement of the channel as a result of the large storm events. The channel is stable (Figure 3; Appendices 1–6).

CROSS-SECTION 1+69 – riffle (Figure 3.1): Following construction this cross-section was a step-pool complex. Over the years, with the movement of some of the cross-vane rocks and substrate materials, this cross-section has evolved from a step-pool to a riffle complex with a few deep pockets of water. The cross-section is stable with no bank erosion or lateral movement occurring.

CROSS-SECTION 1+94 – run (Figure 3.2): Following construction this cross-section was a pool. Over the years, with the movement of substrate and location of the pool within the streambed, the cross-section has changed characteristics and is now the lower end of a run complex. The cross-section is stable with no bank erosion or lateral movement occurring.

CROSS-SECTION 2+24 – riffle (Figure3.3): Following construction this cross-section was a pool. Over the years, with the movement of substrate the pool has filled in and the site is a riffle. The cross-section is stable with no bank erosion or lateral movement occurring.

CROSS-SECTION 2+45 – pool (Figure 3.4): This cross-section has remained a pool since construction was competed. The pool is maintained by root wads placed along the high left bank. The cross-section is stable with no bank erosion or lateral movement occurring.

CROSS-SECTION 2+79 – run (Figure 3.5): Following construction this cross-section was considered a step-pool complex. Over time, with the movement of substrate following major storm events, it has evolved into a run complex. The cross-section is stable with no bank erosion or lateral movement occurring.

CROSS-SECITON 3+16 – riffle (Figure 3.6): Following construction this cross-section was located in a pool complex located below root wads. The pool has shifted upstream and the cross-section is now a riffle complex. The cross-section is stable with no bank erosion or lateral movement occurring.

CROSS-SECTION 3+76 – run (Figure 3.7): This cross-section has remained a run complex since construction was completed. The cross-section is stable with no bank erosion or lateral movement occurring.

Substrate

Bed material analyses (pebble counts) were conducted in the area of cross-section 2+24 (Figure 4). The D_{50} cumulative distribution particle size ranged from 11 mm (2002) – 26 mm (2005) with a mean of 19 mm. Substrate analysis remained fairly constant for all particle sizes during 2001, 2003, 2004 and 2005. However, particle sizes for all size classes were smaller in 2002 (Figure 4). The unusually small D16 particle size of 0.06 mm represents a large number of silt/clay particles collected in the sample. This is possibly attributed to sampling bias or an unusually heavy silt/sand load in the stream at the time of the sample.

Riparian Improvements

Since construction was completed on November 3, 2000, all disturbed banks have become well vegetated (Appendices 1, 2, and 3). A total of 533 stems (live stakes and rooted plants) were planted in the 0.67 acre conservation easement over a period of three years, 2001, 2002, and 2003 (Table 2). A total of 303 stems were counted in 2004 for a 57% survival rate whereas 260 stems were counted in 2005 for a 49% survival rate (Table 2). The higher stem count in 2004 is attributed to the count being conducted in winter when stems are easier to find. Also, the high survival of stems at this site is attributed to the landowner's efforts to protect newly planted stems from rodents and competing vegetation. The density of stems counted in 2005 is well above the 174 stems/acre required for woody species planted at mitigation sites through year five (USACE 2003). Vegetation has been the key factor in maintaining bank integrity and sinuosity.

Temperature

Because the unnamed tributary to Laxon Creek is classified by NCDWQ as trout water, the WRC wanted to determine if water temperatures would decrease as riparian vegetation increased to provide stream shading through the 542 ft site. Stream water temperature was recorded hourly at the upper and lower site boundaries from July 27 – September 27, 2005 (Figure 5). A comparison of temperature data collected during approximately the same time period (July 26 thru September 27) in 2001, 2002, and 2003 (Mickey and Hining 2004) revealed little change in temperatures over time. The average daily water temperatures at the upper station were 16.4°C,

17.2°C, 15.4°C, and 16.9°C in 2001, 2002, 2003, and 2005, whereas at the lower station water temperatures were 16.6°C, 17.6°C, 16.8°C, and 17.0°C in 2001, 2002, 2003, and 2005. It was hoped that from 2001 to 2005, as the density of the riparian vegetation improved, that the average daily water temperature would be cooler at the lower end than at the upper end of the project. Data shows that the upper and lower daily average water temperatures were nearly identical. During the course of the temperature studies, the differences between the upper and lower site temperatures ranged from a plus 0.1 to 0.4°C. In 2005 the temperature average daily temperature difference was a plus 0.1°C at the lower end of the site. The riparian vegetation has matured enough to provide adequate stream shading. Therefore, it is assumed that the study reach is too short (542 ft) to allow for adequate water cooling too occur.

Site Repairs

Conclusion

Since construction was completed on November 7, 2000 there have been 10 bankfull or greater events that caused no damage to the site other than changes in substrate composition. The streambanks have remained stable and no failures have occurred. Some of the in-stream structures have failed, but this has not negatively impacted the stream channel or habitat conditions. The riparian vegetation is thriving and helping to re-build and stabilize the streambanks.

Recommendation

It has been five years since construction was completed on November 2, 2000. During this period an as-built survey and four monitoring surveys have been conducted and the site has remained stable. It is our recommendation that this site be considered stabilized and released from further monitoring. We recommend NCDOT be awarded 542 mitigation credits (1:1 ratio) for this site as approved by NCDWQ (NCDWQ letter to the NCWRC dated November 6, 2000, office files).

Acknowledgements

We thank the Elkin Watershed Enhancement Team of J. Mickey, Jr., J. Wasseen, II and S. Hining (2004) for collection and analysis of the field data and preparation of this report. J. Borawa improved the report with his thorough review and thoughtful suggestions.

References

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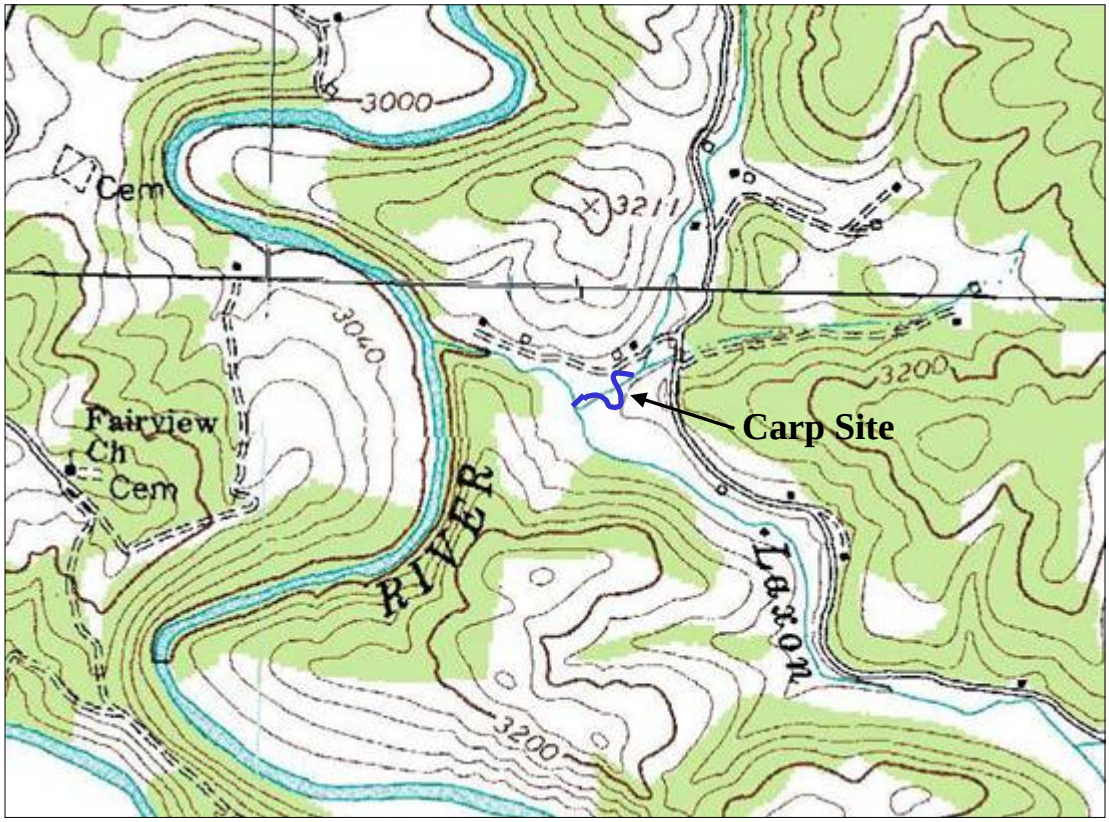
Mickey, J. and S. Scott. 2001. As-built report for the Carp mitigation site, unnamed tributary to Laxon Creek, Watauga County. North Carolina Wildlife Resources Commission, Raleigh.

Mickey, J. H. and S. Hining. 2003. Carp mitigation site, unnamed tributary to Laxon Creek, Watauga County. Period covered: April 2, 2002 – April 15, 2003. North Carolina Wildlife Resources Commission, Raleigh.

Rosgen, D. L. 1996. Applied river morphology. Wildland Hydrology Books. Pagosa Springs, Colorado.

USACE (US 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. Carp mitigation site, unnamed tributary to Laxon Creek, New River drainage, Watauga County.



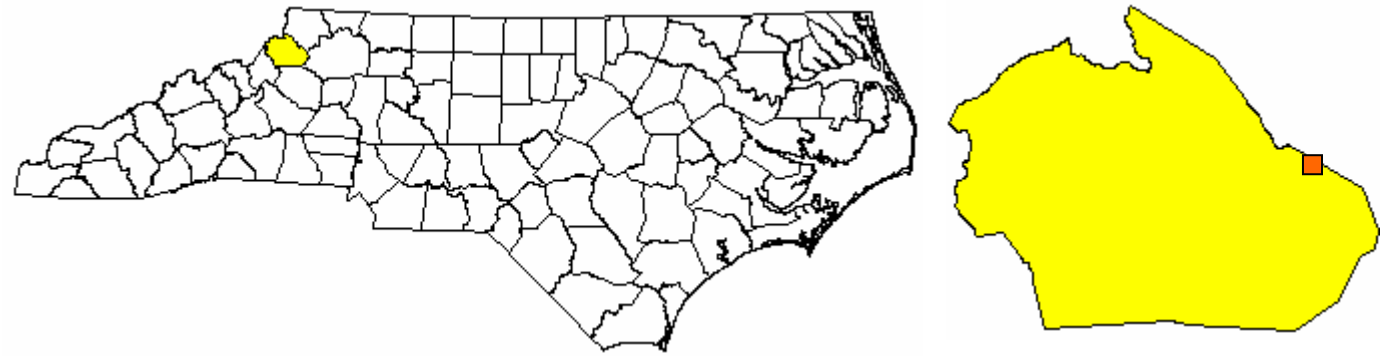
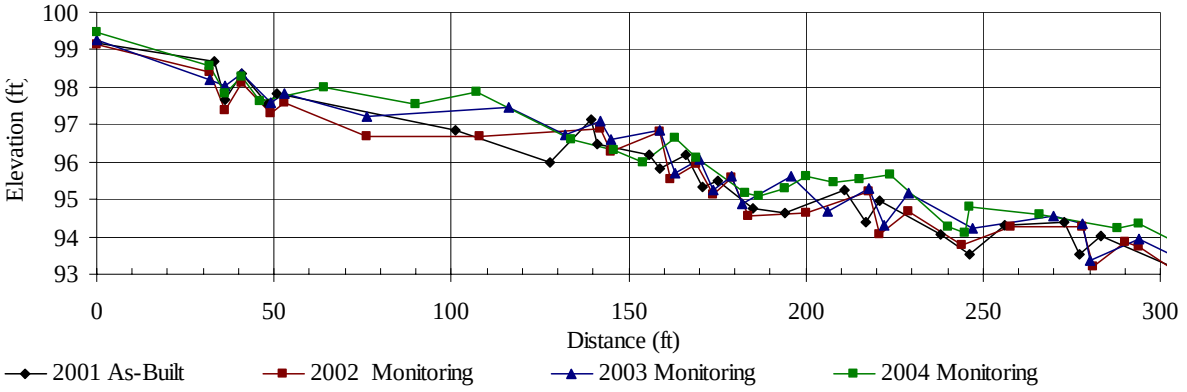


FIGURE 2.—Four longitudinal profile comparisons, Carp mitigation site, unnamed tributary to Laxon Creek, Watauga County, 2001-2004.



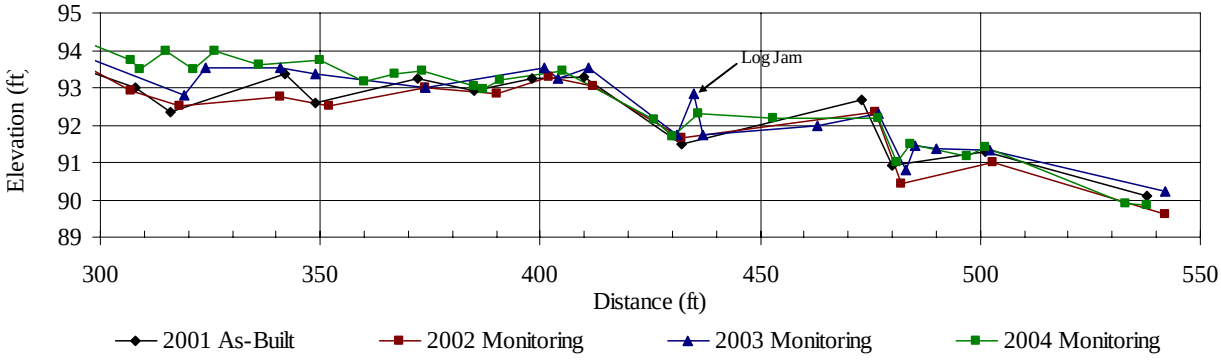


FIGURE 3. — Seven cross-section comparisons, Carp mitigation site, unnamed tributary to Laxon Creek, Watauga County, 2001-2005.

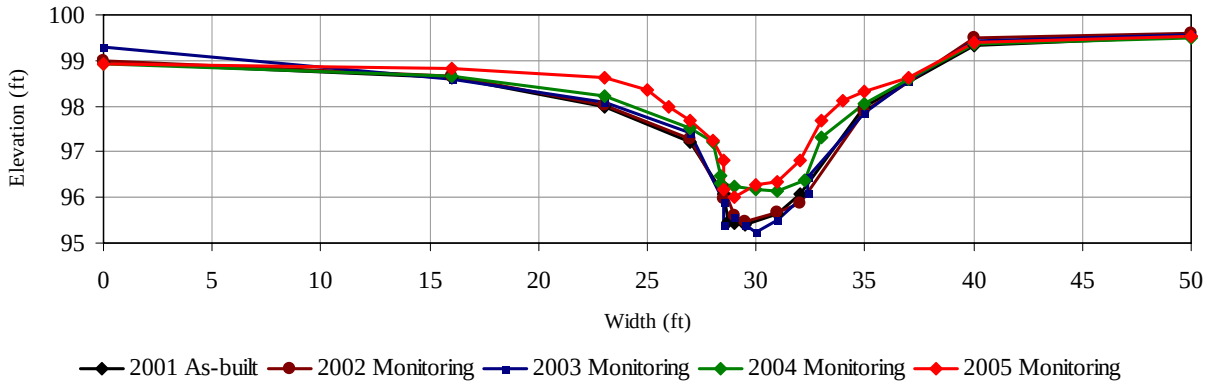


FIGURE 3.1. — Cross-section 1+69, riffle.

FIGURE 3. — Continued.

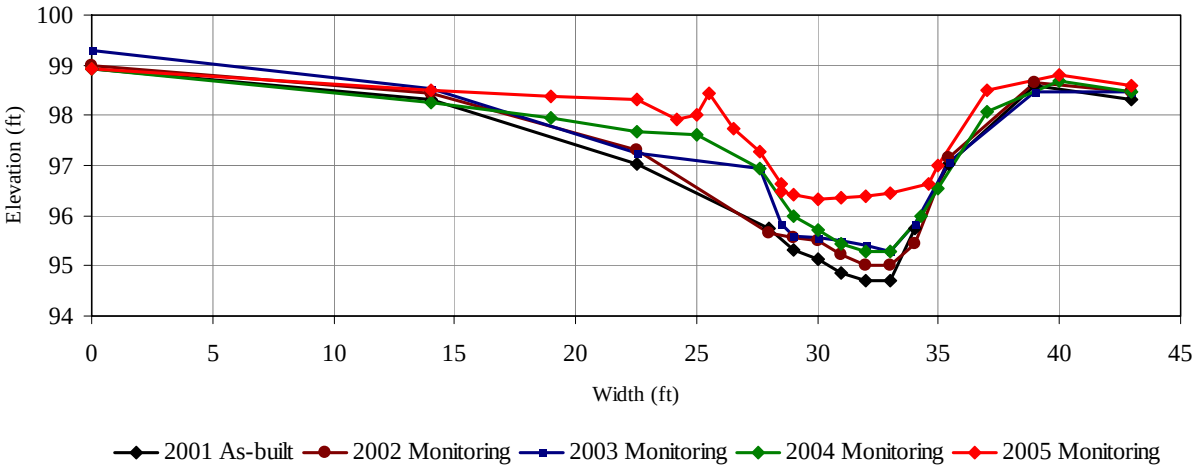


FIGURE 3.2. — Cross-section 1+94, riffle.

FIGURE 3. — Continued.

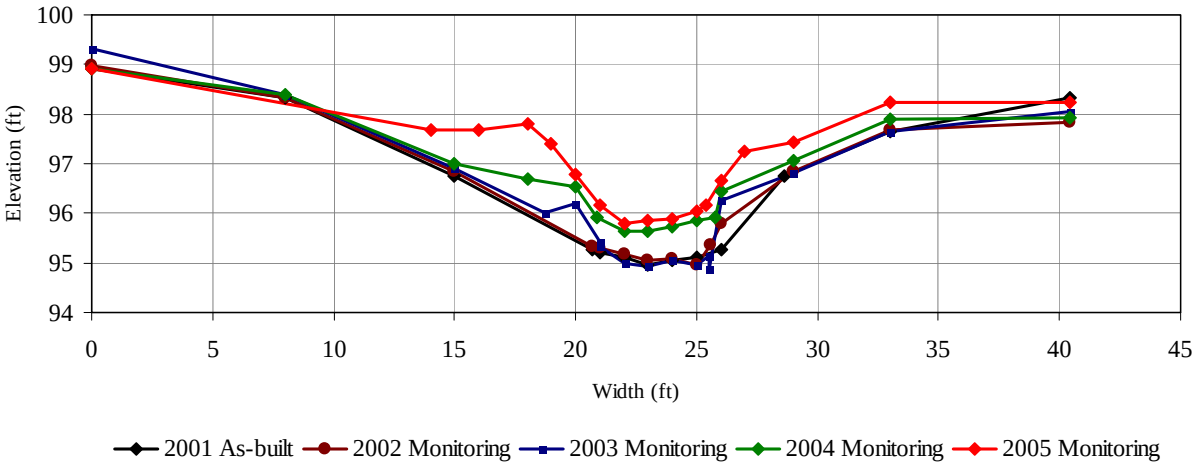


FIGURE 3.3. — Cross-section 2+24, riffle.

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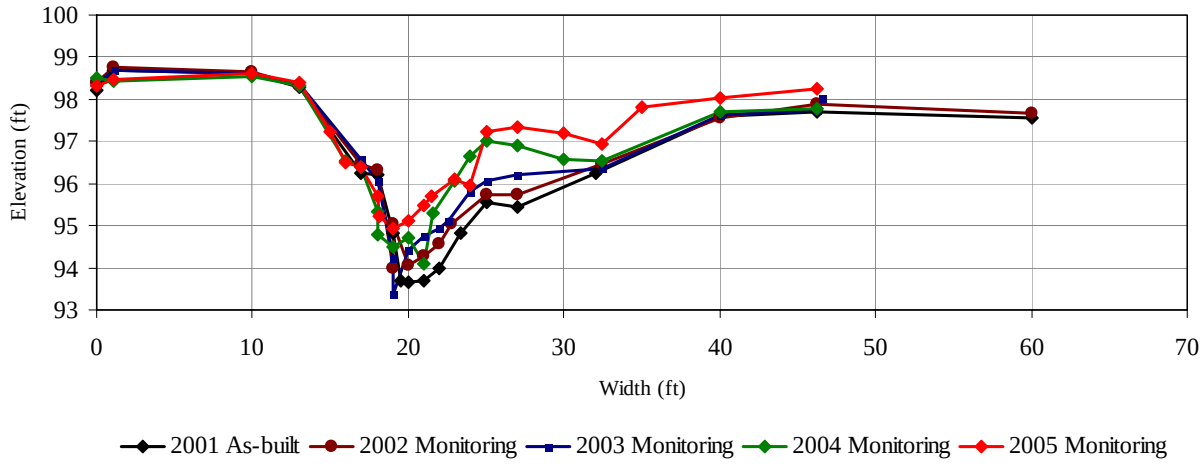

FIGURE 3.4. — Cross-section 2+45, pool.

FIGURE 3. — Continued.

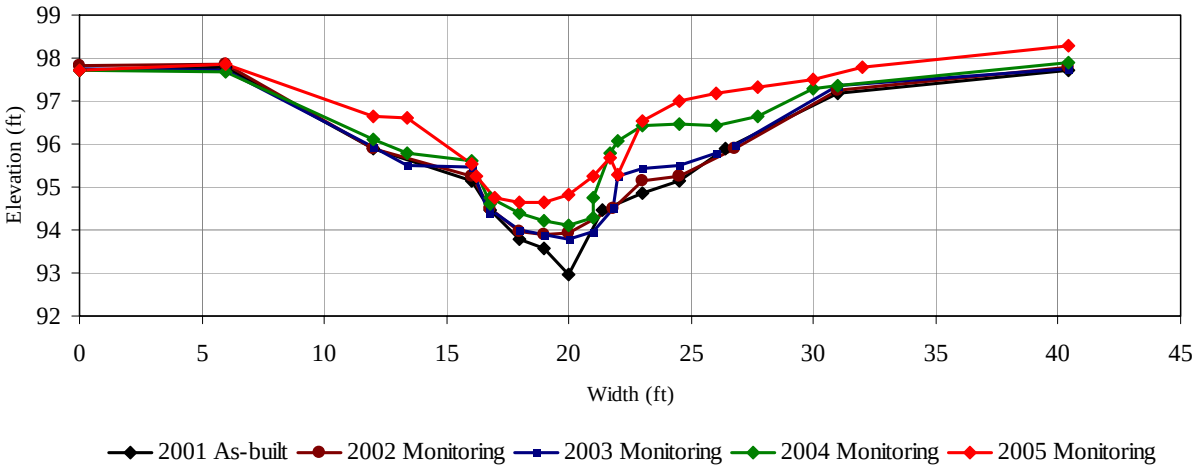

FIGURE 3.5. —Cross-section 2+79, run.

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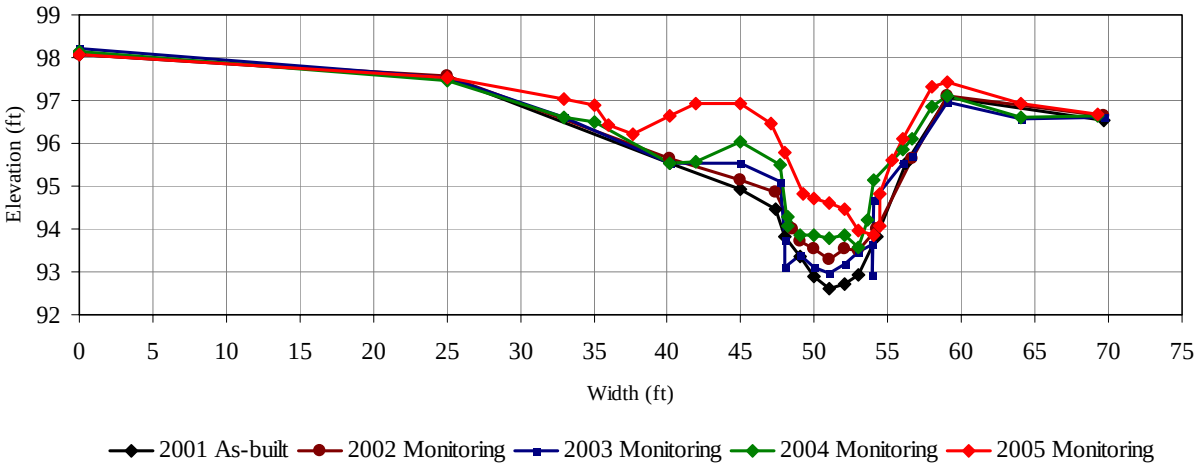


FIGURE 3.6. — Cross-section 3+16, riffle.

FIGURE 3. — Continued.

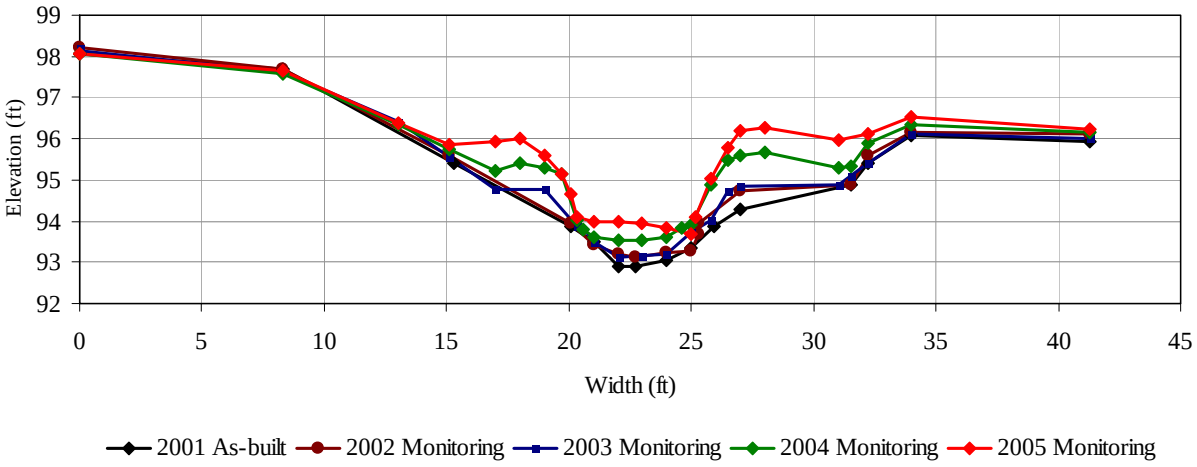
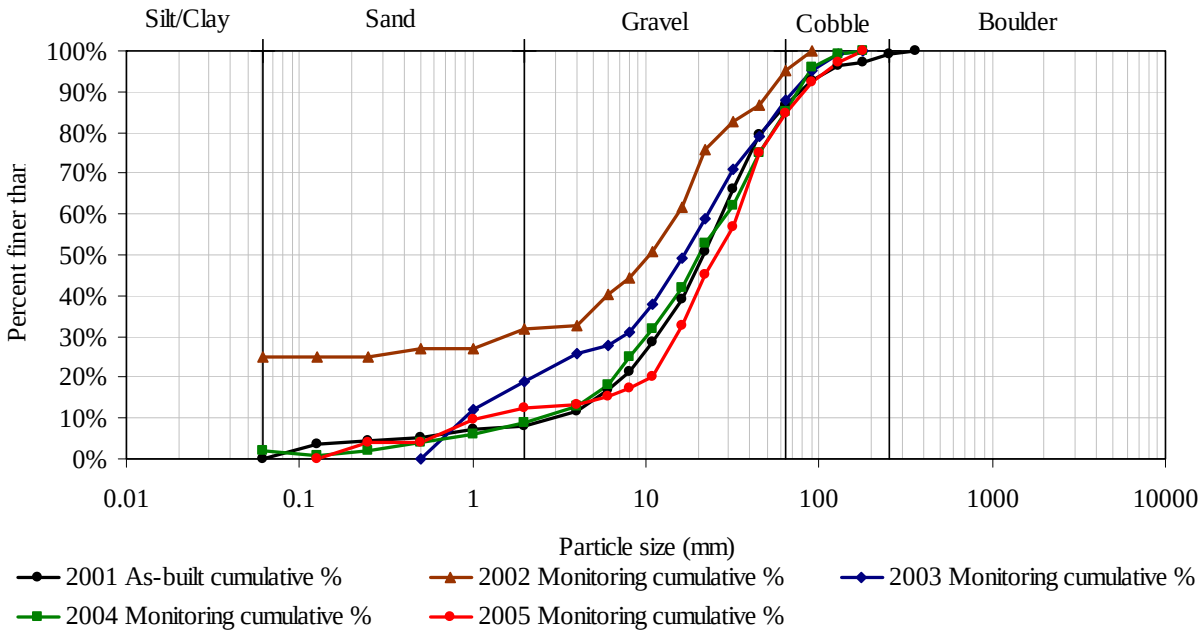


FIGURE 3.7. — Cross-section 3+76, run.

FIGURE 4.—Pebble count comparisons, Carp mitigation site, unnamed tributary to Laxon Creek, Watauga County, 2001-2005.



	Particle size (mm) in year sampled				
	2001	2002	2003	2004	2005
D 16	5.6	0.06	1.5	5.1	6.6
D 35	14.0	4.5	9.6	12.0	17.0
D 50	21.0	11.0	17.0	20.0	26.0
D 84	56.0	36.0	55.0	62.0	63.0
D 95	110.0	64.0	90.0	87.0	110.0

FIGURE 5.—Comparisons of daily average water temperatures at the upper and lower boundaries of the Carp mitigation site from July 27 – September 27, 2005, unnamed tributary to Laxon Creek, Watauga County.

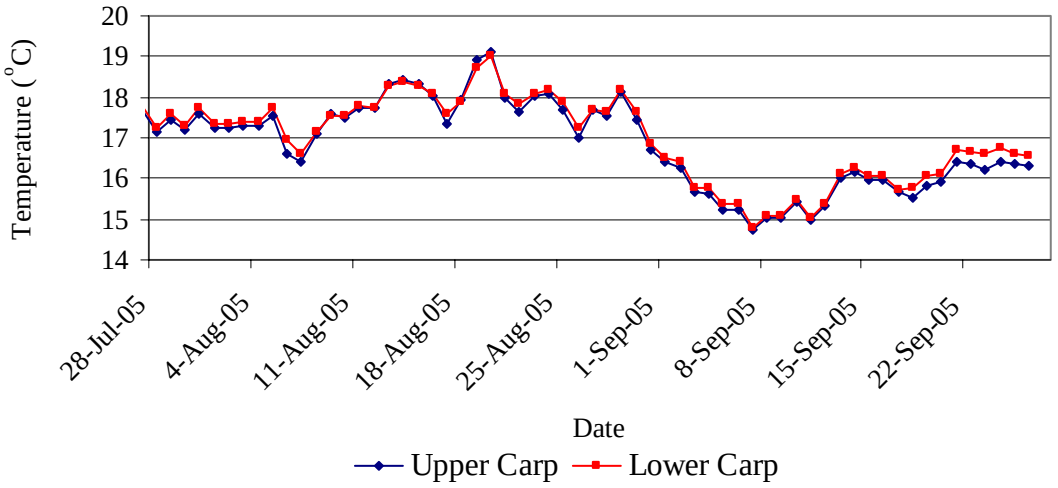


TABLE 1.—Monitoring of inner berm and bankfull events at the Carp mitigation site based on data from the United States Geological Survey South Fork New river gage (No. 03161000) near Jefferson, Ashe County, North Carolina and from visual observations.

Date	Gage height (ft)	Flows (cfs)	Comments
2/22-23/03	5.0	2,250	Gage quit working
3/16/03	4.4	1,725	Inner berm 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	Inner berm event
6/17/03	4.7	2,000	Bankfull event
8/9/03	4.2	1,450	Inner berm event
8/10/03	4.1	1,400	Inner berm event
11/19/03	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)
6/2-3/05	[a]	[a]	Observed bankfull event
6/14/05	[a]	[a]	Observed bankfull event
7/8/05	4.6	2,000	Bankfull event (tropical storm)

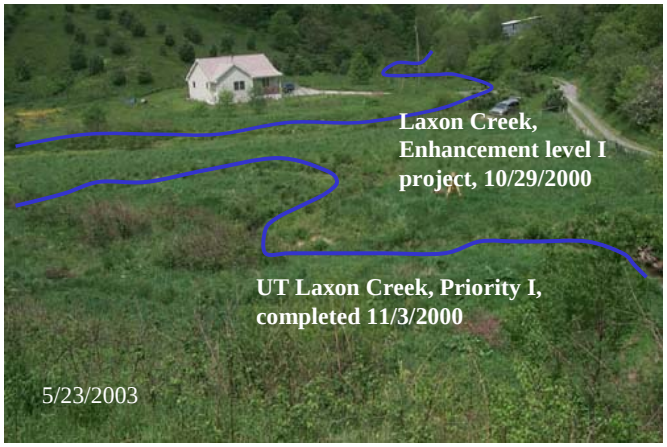
[a]Observations not correlated to gage data.

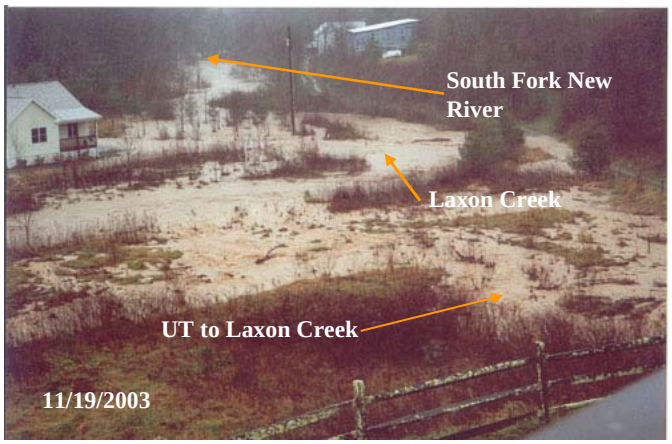
TABLE 2.—Vegetation monitoring at the Carp mitigation site UT to Laxon Creek, Watauga County, 2001-2005.

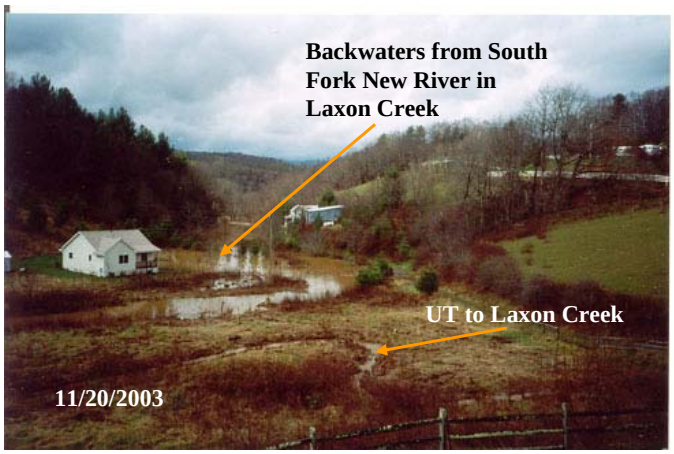
Number of stems planted in March 2001, November 2002, and May 2003.	Common name	Number planted	May 14, 2003 stem count	February 25, 2004 stem count	June 23, 2005 stem count
Live stakes					
Cornus amomum	Silky dogwood	94	56	81	83
Salix sericea	Silky willow	77	85	121	98
Bare root nursery stock					
Alnus serrulata	Tag Alder	35	20	8	5
Celtis laevigata	Sugarberry	5	5	3	
Cornus florida	Dogwood	15	8	3	3
Diospuros virginiana	Persimmon	72		6	2
Fraxinus americana	White ashe	65	1	4	1
Juglans nigra	Black walnut	12	9	6	3
Pinus strobes	White pine	40	10	19	16
Prunus serotina	Black cherry	50	28	27	27
Quercus rubra	Northern red oak	57	20	20	19
Robinia pseudoacacia	Black locust	8	7	4	2
Tsuga canadensis	Hemlock	3	3	1	1
Total (trees and livestakes)		533	252[a]	303	260[a]
Percent survival			47%	57%	49%

[a]Stem survival required by DWQ at this 0.67 acre site after 3 years is 214 stems and after 5 years is 174 stems.

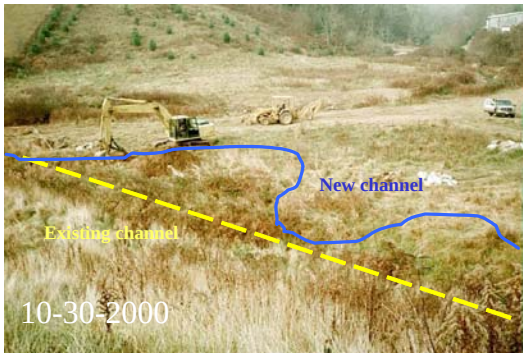
Appendix 1: — Carp and Racey sites before, during, and after the November 19, 2003 flood, Watauga County. The unnamed tributary (UT) to Laxon Creek (0.7 mi^2) suffered no damage while Laxon Creek (drainage area 2.65 mi^2) had some minor bank erosion and one cross-weir needed repair.

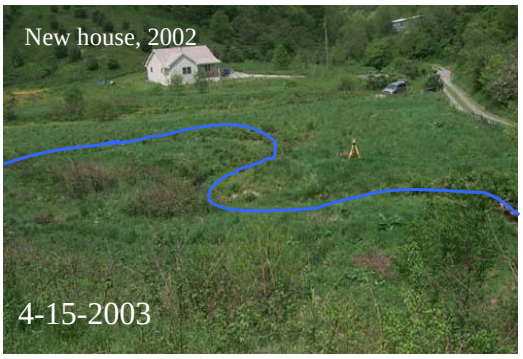




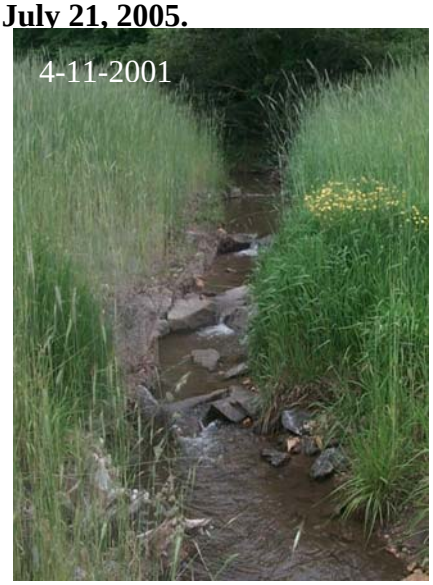


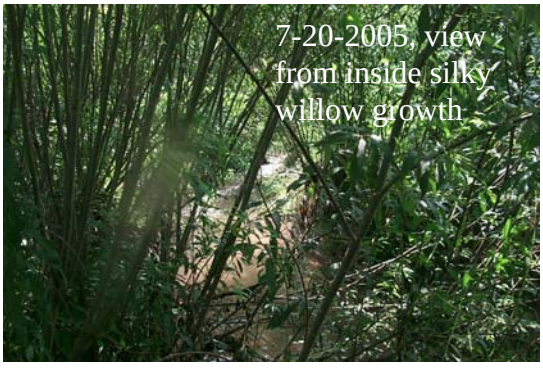
Appendix 2. — Overview of Carp restored stream mitigation site, unnamed tributary to Laxon Creek, Ashe County, October 30, 2000 – July 20, 2005.



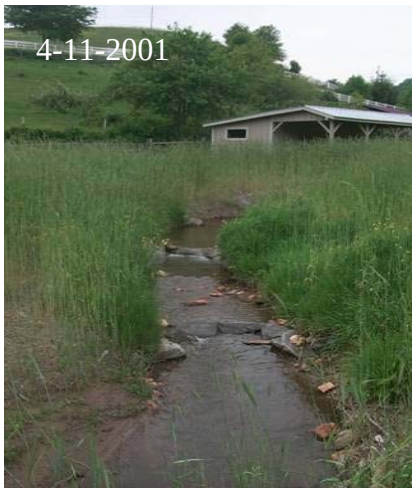


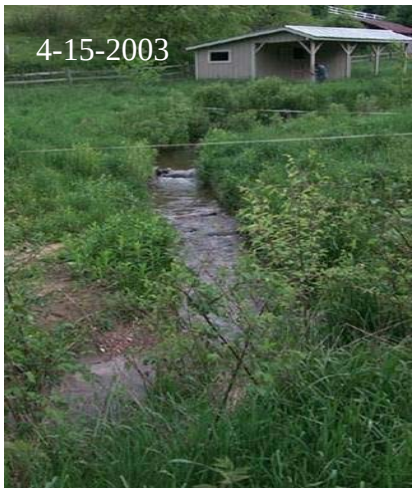
Appendix 3. — Photographic log of Carp Priority I stream mitigation site, unnamed tributary to Laxon Creek, Ashe County, looking upstream from station 1+82 to 1+32, November 3, 2000 – July 21, 2005.





Appendix 4. — Photographic log of Carp restored stream mitigation site, unnamed tributary to Laxon Creek, Ashe County, looking upstream from station 2+45 to 1+94, November 3, 2000 – July 21, 2005.





Appendix 5. — Photographic log of Carp restored stream mitigation site, unnamed tributary to Laxon Creek, Ashe County, looking upstream from station 3+16 to 2+45, November 3, 2000 – July 21, 2005.

Appendix 6. — Photographic log of Carp restored stream mitigation site, unnamed tributary to Laxon Creek, Ashe County, looking upstream from station 4+30 to 3+16, October 30, 2000 – July 21, 2005.