YEAR 3 MONITORING and CLOSEOUT REPORT
for the
FOSSON MITIGATION SITE
PAINT FORK CREEK,
MADISON COUNTY, North Carolina

EEP PROJECT NUMBER 92702

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1.0 Executive Summary

The Fosson mitigation site, North Carolina Ecosystem Enhancement Program Project Number 92702, Paint Fork Creek, Madison County, N.C., was constructed in late August and early September 1999; the as-built data was collected in October 1999. It was originally constructed as mitigation for the North Carolina Department of Transportation's (NCDOT) Transportation Improvement Project Number A-10 C& D (A-10) road project. Monitoring year 1 (MY1) and monitoring year 2 (MY2) survey data were collected in 2003 and 2004. The following report summarizes stream survey activities associated with monitoring year 3 (MY3), 2007, the eighth year following project construction, and will serve as the closeout report for the Fosson mitigation site.

Morphometric parameters of the channel are within the range of values expected based on design values and the values recorded during MY1 and MY2. The project reach is classified as a C5 stream type. Although the project reach is characterized by having a low slope and a low sinuosity, the width/depth ratio of the project reach is the main factor the project reach being a C stream type. Based on a surrogate flow gage hydrograph, 15 bankfull events ≥1,000 cfs occurred between September 1999 and September 2007.

Density of woody stems in the larger tree plots (1,350 stems/acre) exceeded the minimum success criterion for woody stems/acre. However, species diversity within the tree plots was limited to 7 species. Silky dogwood *Cornus amomum* and silky willow *Salix sericea* comprised 68% of the woody stems in the tree plots. Woody stems were observed throughout the conservation easement and performing as would be desired eight years after planting. Planted vegetation is not only contributing to channel bank stability, but also helping buffer solar warming of surface water; shading of the stream channel was absent in the pre-project assessment.

Overall, the project site has benefited from the sloping and reshaping of the left channel bank and the establishment of the woody riparian vegetation. The Fosson site is performing as proposed and should be considered for closeout by North Carolina Ecosystem Enhancement Program (EEP) and state and federal regulatory agencies.

2.0 Introduction

This monitoring report is submitted as partial fulfillment of the off-site stream mitigation requirements for the NCDOT A-10 road project (I-26) in Madison County. From 1999 to 2004 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 EEP. This document was prepared using the framework developed by Mulkey, Inc. This was done to maintain consistency with methods used in earlier field collections and reports and to facilitate the comparison of the 2007 data with previous years' data.

2.1 Project Description

The Fosson mitigation site (1.17 acres) is located on Paint Fork Creek, immediately adjacent to Paint Fork Road (SR 1530) in the southeastern portion of Madison County, approximately 3.9 miles east of Mars Hill, N.C. and 16.5 miles northeast of Asheville, N.C. (Figure 1). The project reach is 1,700 linear feet, has a 13.6 mi^2 watershed, and is located in the French Broad River basin.

2.2 Purpose

The purpose of the project was to improve water quality, riparian habitat quality, channel bank stability, and to enhance aquatic habitat of Paint Fork Creek (NCWRC 1999). Specific objectives were to:

1) Increase floodplain width at the bankfull elevation along Paint Fork Creek and an unnamed tributary.
2) Install rock vanes, J-hook vanes, and root wads to reduce near bank stress and to enhance aquatic habitat.
3) Reshape main stem and tributary channel banks to a stable slope from the bankfull elevation up to the existing grade (left banks only).
4) Establish a conservation easement on the left banks of the main stem and the tributary.
5) Revegetate the project area with native flora.

2.3 Project History

The effort to provide mitigation for the A-10 road construction project began in 1996 when a Memorandum of Agreement between the NCDOT and the North Carolina Wildlife Resources Commission (NCWRC) was signed. The MOA called for the NCWRC to provide stream mitigation on NCDOT's behalf for stream impacts under the jurisdiction of the U.S Army Corps of Engineers (USACE). The original USACE section 404 permit and amendments required 25,912 linear feet of mitigation for unavoidable impacts to trout streams due to the road construction project.

The NCDOT also worked with representatives from the USACE, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Natural Resources Conservation Service (NRCS), North Carolina Division of Water Quality, and the Madison County Soil and Water Conservation District to form a mitigation review team (MRT). The purpose of the MRT was to develop criteria and policies for selecting stream reaches for mitigation. Members of the MRT also collaborated on project monitoring components, success parameters, and assessed mitigation credits to be awarded.

The Fosson site was approved by the MRT to provide compensatory mitigation for the A-10 road project. The project site and conceptual mitigation plan also were approved by the MRT in 1998 (Exhibit Table 1; NCWRC 1998). The construction plan was completed in April of 1999 (NCWRC 1999). Project construction began in August 1999 and the as-built report was completed in October of 2000 (NCWRC 2000).

Although it has been eight years since construction was completed, the 2007 site survey reflects only the third year of monitoring. The first monitoring year for morphometric and vegetative surveys was March 2003 (MY1, Mulkey 2003). The monitoring year 2 survey (MY2) was conducted in May 2004 (Mulkey 2004; Exhibit Table 1).

Exhibit Table 1. Project History

Completion Date	Activity
August 1996	USACE permit for A-10 (I-26) acquired – action ID 199505135
July 1998	NCWRC Conceptual Site Plan Completed
May 28, 1999	Conservation Easement Acquired
April 1999	NCWRC Construction Plan Completed
August 1999	Site Grading Commenced
August 1999	Site Planted with Temporary and Native Perennial Seed Mix
January 2000	Site Planted with Live Stakes and Bare Rooted Trees
October 2000	NCWRC As-built Report Completed
March 2003	Stream Channel Monitoring (MY1)
March 2003	Vegetation Monitoring (MY1)
May 2004	Stream Channel Monitoring (MY2)
May 2004	Vegetation Monitoring (MY2)
October 2007	Stream Channel Monitoring (MY3)
October 2007	Vegetation Monitoring (MY3)
June 2008	NCWRC Monitoring Year 3 Report

2.4 Debit Ledger

The MRT anticipated that the Fosson project would generate 1,700 linear feet of stream mitigation credits. This was based on a system of one mitigation credit for every foot of channel placed in a conservation easement.

2.5 Success Criteria

The MRT developed the framework of success criteria used to evaluate the A-10 mitigation projects that included a number of metrics (Exhibit Table 2). These criteria, developed by the MRT with input from the USACE, were the early framework of monitoring success criteria and were later adopted in part by USACE in their stream mitigation guidelines document (USACE 2003). These criteria included a combination of the following parameters: two bankfull events within a five year monitoring period, reference photos, channel stability, riparian vegetation survival, and response of fish and invertebrate populations, if specifically required by permit conditions. Overall success or failure of the A-10 mitigation project sites was to be based on a combination of three of these four parameters.

Exhibit Table 2. Early Framework of Mitigation Monitoring Success Criteria			
Parameter	**Success[a] (requires no action)**	**Failure[a]**	**Action**
Photo Reference Sites			
Longitudinal Photos Lateral Photos	No significant aggradation, degradation, or erosion	Significant aggradation, degradation, or erosion	When significant aggradation, degradation, or erosion occurs, remedial actions will be undertaken
Channel Stability			
Cross-Sections Longitudinal Profiles Pebble Counts	Minimal evidence of instability (down-cutting, deposition, erosion, decrease in particle size)	Significant evidence of instability	When significant evidence of instability occurs, remedial actions will be undertaken
Plant Survival			
Survival Plots Stake Counts Tree Counts	>75% coverage in Photo Plots >80% survival of stakes 4/m^2 >80% survival of bare rooted trees	<75% coverage in Photo Plots <80% survival of stakes, 4/m^2 <80% survival of bare-rooted trees	Areas <75% coverage will be reseeded or fertilized or both. Live stakes and bare-rooted trees will be replanted to achieve >80% survival
Biological indicators (only used for projects with potential to make watershed level changes)			
Invertebrate Population Fish Population	Population measures remain the same or improve	Population measures indicate a negative trend	Reasons for failure will be evaluated and remedial action plans developed and implemented

[a] Subjective determinations of significance or success was to be determined by majority decision of the MRT.

3.0 Stream Assessment

3.0.1 Pre-Construction Conditions

The main stem project reach was classified during the initial site assessment as a C4b stream type using the Rosgen (1996) classification system. It had an entrenchment ratio of 5.9, width/depth ratio of 12.6, and a sinuosity of 1.2 (Exhibit Table 3; NCWRC 1999). The stream also had a bankfull width of 34.0 ft, mean depth of 2.7 ft, and a bankfull cross-sectional area of 88.1 ft^2. Historically, the left channel bank was adjoined by agricultural fields and had a narrow riparian buffer width. Woody vegetation was absent on the left bank, with the exception of few mature trees. The adjoining landowner (right bank), elected not to participate in the mitigation program, but did agree to perform recommended improvements within the riparian area and to the right channel bank adjoining the Paint Fork Creek. Therefore, the conservation easement at the Fosson mitigation site protects only one side (left bank) of Paint Fork Creek and the unnamed tributary. Agricultural fields (row crops and landscape nursery) bordered the narrow right bank riparian area where few large trees existed within the upper two-thirds of the project reach. The lower third (≈400 ft) of the right bank riparian area (portion between the SR 1530 right-of-way and the stream channel) contained a denser stand of mature hardwoods. Herbaceous vegetation consisted primarily of reed canarygrass *Phalaris arundinacea* and tall fescue *Festuca sp.* (NCWRC 1998).

The small unnamed tributary (0.13 mi^2 watershed) that forms the eastern boundary of the project extent also contained sparse riparian vegetation and was adjoined on the both banks by agricultural fields. This tributary is the common property boundary between the two landowners, as is the case on Paint Fork Creek. During the pre-project assessment it was determined that the tributary was a deeply entrenched G type channel with severely eroding channel banks (Rosgen 1996; NCWRC 1998).

3.0.2 Post-Construction Conditions

By sloping and reshaping the left channel bank of Paint Fork Creek to a more natural condition, the left bank floodplain width was increased. Coir logs were installed on the left bank to define the bankfull channel width and elevation. Two single arm rock vanes were installed on the left bank (sta. 4+65; sta. 6+00). A J-hook vane was constructed upstream of the 2 single arm rock vanes (sta. 4+59). Four root wad structures were installed on the left bank at sta. 0+50 (2) and 2+50 (2). The left bank riparian zone was replanted with native herbaceous and woody vegetation (Exhibit Table 4). Although outside the conservation easement area, the adjacent landowner did slope and reshape the right channel bank along the upper portion (≈700 ft) of the property. Because the right channel bank is within the SR 1530 right-of-way along lower portion of the project reach and is heavily wooded, work was not done in that area. A farm management plan developed for the site included fencing on the left bank and one gravity fed watering tank. However, the landowner (Mr. Fosson) decided the fencing and watering tank were not necessary, so the farm management plan for this site was not executed.

The left bank of the unnamed tributary was sloped, reshaped, and a flood plain bench excavated at the bankfull elevation for the first 200 ft upstream from the confluence with Paint Fork Creek. Coir logs were used on the left bank to define the bankfull channel width and elevation. The left bank riparian zone was replanted with native herbaceous and woody vegetation. The adjoining landowner did not complete any channel or riparian vegetation improvements on the right bank of the small tributary.

3.1 Stream Assessment Results

This report contains the MY3 survey data and serves as a closeout report summarizing project conditions including channel dimension and profile surveys, pebble counts, hydrologic events documentation, vegetative condition, and site photographs for the Fosson mitigation site. Locations of all fixed survey stations, established for the purpose of post-construction monitoring, are presented in the plan view drawing (Figure 2).

3.1.1 Cross-Section Surveys

Five cross-sections were established on Paint Fork Creek and one on the unnamed tributary following construction. They have been surveyed during each of the three monitoring years (Figure 2; Appendix A Tables A.1-6.). The morphological characteristics summary of all cross-sections combined provides a comparison of mean values of channel dimensions (Exhibit Table 3). The width/depth (mean 13.3) and the entrenchment ratios (mean 3.8) are of particular interest. These values drive the broad level channel classification and are the reasons for the stream maintaining an overall C stream type classification. Additionally, by sloping and reshaping the left channel bank, the flood prone width was increased from approximately 50 ft to ≥100 ft, except at cross-section 1 where the flood prone width was 40.3 ft. The channel banks were not reshaped in the immediate vicinity of cross-section 1 (lower most portion of the project reach) due to poor access to the channel below the Fosson driveway bridge. The moderate entrenchment of cross-section 1 nudges the classification to a Bc stream type at this particular location.

Stream type classification changed from a Cb in the pre-project assessment in 1999 to a C in MY3 (2007). This change can be attributed to the shaping and sloping of the left channel bank that increased the flood prone cross-sectional width. As a result, the entrenchment ratio classification changed from moderately to slightly entrenched.

Bankfull cross-sectional area ranged from a low of 27.8 ft^2 (MY1) to 68.7 ft^2 (MY0). This wide range of values for bankfull cross-sectional area suggests that the elevation of bankfull may have been misinterpreted in the field (i.e., located at a lower elevation on the channel bank for MY1 compared to MY0). The disparity in the identification of bankfull elevation between MY1 and MY0 also influenced the measurement of bankfull width. Mean bankfull width ranged from 20.3 ft in MY1 to 31.5 ft in MY0. Bankfull cross-sectional area and width, for MY3, fell within the range of mean values for previous surveys and were 43.4 ft^2 and 23.8 ft.

The project reach has maintained a moderate to high width/depth ratio (>12). Cross-section 2 was the only location where the width/depth ratio was low (10.5) and fell into the category of an E stream type (<12.0). Moreover, vegetation establishment and the subsequent trapping and accumulation of suspended material during high flow events appear to have contributed to the narrowing of the channel corridor in places.

Morphological characteristics for the six individual cross-sections, cross-section plot overlays, and representative cross-section photos are presented for comparative purposes in Appendix A Tables A.1-6.

Cross-section 1 (Appendix Table A.1.1.).–This cross-section transects a run. There has been little change in this cross-section from 1999 (as-built) through 2007 (MY3). Evidence of lateral channel movement (bank erosion) was not observed along either streambank. The left bank has aggraded slightly, most likely due to suspended sediments being trapped by the riparian vegetation. This aggradation has resulted in the decrease of bankfull width when compared to previous years monitoring values. Unlike the other main stem cross-sections, cross-section 1 was determined to be a Bc stream type. This is due to moderate entrenchment ratio (1.6) present at this cross-section.

Cross-section 2 (Appendix Table A.1.2.).–This cross-section transects a run. The left and right banks of this cross-section have remained stable during the eight years following construction. The planted vegetation on the left bank is well established; the riparian buffer on the right bank, between SR 1530 and the stream channel, is well established with mature trees. The thalweg has experienced little to no change. Unlike the other 4 cross-sections, the width/depth ratio at this cross-section has been <12 during each of the monitoring surveys and is the reason for the E stream type classification at this location.

Cross-section 3 (Appendix Table A.1.3.).–This cross-section transects a pool. The thalweg at cross-section 3 has shown no evidence of change over the eight years since project construction. Aggradation of the left bank has occurred, most likely due to vegetation trapping sediments during high flows, and a stable bench is present. The left and right banks are stable and well vegetated. This cross-section was noted as being a run feature in earlier surveys; however, it now contains characteristics more typical of a pool feature. The cross-section is located in a slight meander and the thalweg would be deeper and located closer to the left bank if not for the bedrock channel bed.

Cross-section 4 (Appendix Table A.1.4.).–This cross-section transects a riffle. The thalweg at cross-section 4 has remained relatively stable following construction with only slight deepening (≈0.5 ft) since MY2, but the right and left channel banks have changed over the 8-year period since construction. The left bank has degraded ≈1.5 ft, whereas the right bank has experienced ≈5.0 ft of aggradation forming a stable bench that defines the bankfull channel. Currently, both the left and right channel banks are stable and well vegetated with woody species.

Cross-section 5 (Appendix Table A.1.5.).–This cross-section transects a run. The thalweg at cross-section 5 is situated near the center line of the channel, very similar to its location when compared with previous surveys. The left channel bank appears to have degraded slightly (≈0.5 ft) since project completion. The right channel bank has aggraded ≈1.0 ft since the as-built survey was conducted in 1999. Both the left and right channel banks appeared well vegetated and stable during the MY3 survey.

Cross-section 6 unnamed tributary (Appendix Table A.1.6.).–This cross section transects a run and is the only cross-section on the unnamed tributary. This tributary is the common boundary between the Fosson property and the adjacent landowner. The channel bed aggraded ≈0.5 ft between the as-built survey and the MY1 survey. The channel bed has remained at its current elevation since MY1. The left and right channel banks show no indication of lateral movement since MY1; however, aggradation did occur on both sides of the channel following the as-built survey. The left bank is stable, and woody vegetation has become established. The right bank is also stable at this location. However, at various other locations along the right bank, the bank is vertical, sloughing, and unstable. Unfortunately, the right bank is outside the project boundary and therefore was not addressed during project construction. A bench was excavated on the left bank at the bankfull elevation during construction and is likely the reason the stream type changed from a G to an E at this cross-section.

3.1.2 Longitudinal Survey

The longitudinal profile of the entire Paint Fork Creek project reach was surveyed (sta. 0+00 to sta. 9+71; Appendix A.2.). Elevations of the stream bed, water surface, bankfull indicators, and top of the low banks were captured. Channel sinuosity was 1.2, and the average water surface slope was 0.006 ft/ft (Exhibit Table 3). The MY3 longitudinal profile survey data revealed the thalweg and both channel banks were stable and had minimal aggradation, degradation, and lateral movement occurring along the entire reach.

Stream structures.–Seven stream structures (2 rock vanes, 1 J-hook vane, and 4 root wads) were installed during construction. The upstream most two root wad structures (sta.0+50) were barely recognizable during the MY3 survey. These two structures have become incorporated into the left bank and surrounded with vegetation. The two root wads installed at sta. 2+50, installed in an area of bank erosion before construction, are stable and performing as designed. The J-hook vane (sta. 4+57) located at cross-section 4 is functioning as designed although most of the length of the arm portion of the structure has been covered with sediment deposits and incorporated into the left bank. The two single arm rock vane structures (sta. 4+65 and 6+00) also have become incorporated into the left channel bank and covered with depositional materials and vegetation, making both of these structures difficult to distinguish in the field.

3.1.3 Pebble Counts

Pebble counts were taken at each cross-section to determine the extent of change, if any, in bed material composition (Appendix A.3.). Mean particle size for each of the particle size classes has fluctuated during the monitoring surveys (Exhibit Table 3). Mean particle sizes of the channel before construction for the D50 and D84 particle size classes were 15.7 mm and 183.0 mm, medium gravel and large cobble. The MY1 D50 (35.6 mm) was coarse gravel, whereas it was small cobble (114.0 mm) for the D84. The mean D50 particle sizes declined following the MY1 survey to very coarse sand (MY2 = 1.3 mm; MY3 = 1.8 mm) as did the mean D84 particle sizes for MY3, very coarse gravel (48.6 mm).

The MY3 pebble counts revealed this site had one of the lowest mean D50s and the lowest mean D84 particle sizes observed since project construction. Over the course of monitoring, the project reach channel substrate has changed from a gravel bed (type 4) to one of sand (type 5). In fact, mean particles size for all categories have generally declined during each of the three monitoring surveys. With the left bank and right bank riparian vegetation well established, one would expect the D50 and D84 particle sizes to increase. The decrease in particle sizes may be influenced by upstream land use practices (development, agricultural), or by the presence of bedrock within the channel bed throughout most of the project reach. Bedrock lined channels are not conducive for bed material accumulation; materials that do settle out on top of bedrock can easily become mobilized during high flow events. The D50 was highest at cross-sections 4 and 5 (2.0 mm and 5.0 mm). These two cross-sections do not have bedrock dominated substrates. Neither mid-channel nor transverse bars were observed within the project reach.

Exhibit Table 3. Morphological Characteristics Summary of all Cross-Sections					
Variable	Pre-construction	As-built 2000	MY1 2003	MY2 2004	MY3 2007
Drainage Area (mi^2)	13.6	13.6	13.6	13.6	13.6
Bankfull Width (ft) (mean)	34.0	31.5	20.3	22.2	23.8
Bankfull Mean Depth (ft) (mean)	2.7	2.2	1.4	1.7	1.8
Width/Depth Ratio (mean)	12.6	14.7	15.0	13.2	13.3
Bankfull Cross Sectional Area (ft^2) (mean)	88.1	68.7	27.8	37.5	43.4
Maximum Bankfull Depth (ft) (mean)	4.0	3.6	2.2	2.6	3.1
Width of Floodprone Area (ft) (mean)	200	90.6	158.4	158.4	88.1
Entrenchment Ratio (mean)	5.9	2.9	5.2	5.2	3.8
Water Surface Slope (ft/ft)	0.006	0.006	0.007	0.007	0.006
Particle Size Class (mean) [a]					
D16 (mm)	0.1		0.1	<0.0062	0.2
D35 (mm)	4.4		1.4	0.2	0.5
D50 (mm)	15.7		25.6	1.3	1.8
D84 (mm)	183.0		114.0	90.0	48.6
D95 (mm)	Bedrock		304.0	664.0	515.0

[a] Particle size class data were not collected during the as-built survey.

3.2 Hydrologic Data and Bankfull Verification

In the absence of a stream gage in the project drainage, the Ivy River stream gage was used as a surrogate (Appendix A.4.). The Ivy River gage is in USGS Hydrologic Unit 06010105, is located at 1,700 ft above mean sea level, and has a drainage area of 158 mi^2. Based on the N.C. Rural Mountain Regional Hydraulic Geometry Curve graph, a discharge of 450-500 cfs at the Ivy River gage correlates to the bankfull flow for the project reach (Mulkey 2003). Between the time construction was completed in September 1999 and September 2007 there have been >30 flow events ≥500 cfs recorded at the Ivy River gage (USGS 2008). Fifteen of these events exceeded 1,000 cfs (Appendix Table A.4.1.). Three bankfull events at the project site between April 2000 and March 2003 were photographically documented (Appendix A.5.). High flow discharges ≥500 cfs recorded on consecutive days were counted as a single bankfull event.

3.3 Fixed Station Photos

Four fixed station photo locations document project site conditions from 1999 (before construction) through 2007 (Appendix A.6.). The planted vegetation along the left bank has become well established over the eight years since installation. Although outside the project extent, the adjoining landowner has allowed the right bank vegetation to mature. Planted woody vegetation is ≥15 ft in height and has enhanced stability of both channel banks. With a protected riparian buffer on each side of the channel corridor, channel banks have stabilized and tree foliage is now blocking direct sun light to the channel, which should help reduce daytime water temperature increases.

3.4 Problem Areas

No problem areas such as scour and erosion or failing stream structures were observed during the MY3 survey. The disturbed areas present during construction, left banks of Paint Fork Creek and the unnamed tributary, have become stabilized with the vegetation plantings and with the natural recruitment of herbaceous and woody vegetation. The channel corridor also is stable.

4.0 Vegetation Assessment

During construction, disturbed areas were seeded with a temporary seed mix (brown top millet *Panicum ramosum* and winter wheat *Triticum* sp.) and a perennial native seed mix consisting of herbaceous and woody species (Exhibit Table 4). Following construction the left bank conservation easement areas adjacent to Paint Fork Creek and the unnamed tributary were planted with a large quantity (no numbers available) of live stakes and bare-rooted shrubs and trees (NCWRC 2000; Exhibit Table 4).

Although woody seed species (11) were sown with herbaceous seed species (14), the contribution of those seeds is unknown. Giving the keen competition for light and water, it is most likely the woody stems planted as live stakes and bare rooted specimens are the dominant woody stems from replanting. The herbaceous layer of sown native seed and wild recruited varieties likely out-competed the woody seed species during the first few years of riparian establishment. Moreover, woody stems ranging from ≥15 ft cover the easement area, and it is unlikely these would have attained this size in only eight years if they had germinated from seed.

Exhibit Table 4. Native Seed Mix and Woody Vegetation Planted		
Type	**Scientific Name**	**Common Name**
Native Seed Mix		
	Acer rubrum	Red maple
	Acer saccharinum	Silver maple
	Aronia arbutifolia	Red chokeberry
	Asclepias incarnata	Swamp milkweed
	Carex lupilina	Hop sedge
	Cephalanthus occidentalis	Button bush
	Cornus amomum	Silky dogwood
	Eleocharis palustris	Creeping spikerush
	Elymus virginicus	Virginia wild rye
	Eupatorium fistulosa	Joe Pye weed
	Fraxinus pennsylvanica	Green ash
	Ilex verticillata	Winterberry
	Juncus effusus	Soft rush
	Leersia oryzoides	Rice cut grass
	Nyssa sylvatica	Black gum
	Onoclea sensibilis	Sensitive fern
	Panicum clandestinum	Deertongue
	Prunus serotina	Black cherry
	Quercus palustris	Pin oak
	Sambucus canadensis	Elderberry
	Scirpus americanus	Three square spikerush
	Scirpus atrovirens	Green bulrush
	Scirpus cyperinus	Woolgrass
	Scirpus validus	Softstem bulrush
	Tripascum dactyloides	Eastern gamagrass
Live Stakes		
	Cornus amomum	Silky dogwood
	Salix nigra	Black willow
	Salix sericea	Silky willow
Bare-Rooted Trees		
	Betula nigra	River birch
	Cornus sericea	Red-osier dogwood
	Fraxinus pennsylvanica	Green ash
	Juglans nigra	Black walnut
	Quercus phellos	Willow oak
	Salix nigra	Black willow
	Sambucus canadensis	Elderberry

4.1 Plot Descriptions, Photographs, and Sampling

In 2003, two large (1,000 ft^2; plots A and B) tree plots and six smaller (10.8 ft^2; plots 1-6) vegetation monitoring plots were established (Mulkey 2003). All plots were used to provide photo reference points of vegetation performance (Appendix B.1.). In both the tree plots and all six vegetation plots, woody stems were tagged, identified to species, and enumerated. All tree and vegetation plots were resurveyed in 2007 (MY3). All counted stems for MY3 included both planted and naturally regenerated stems.

Tree plot A is situated on the left bank upstream of cross-section 5, beginning near station 1+75. Tree plot B is located on the left bank between cross-sections 2 and 3, beginning near station 6+25 (Figure 2). Vegetation plot 1 is located along the left bank of the unnamed tributary, near cross-section 6. Vegetation plot 2 is located within tree plot A. Vegetation Plots 3 (sta. 3+75) and 4 (sta. 5+30) are located between tree plots A and B. Vegetation plot 5 is located within tree plot B, and vegetation plot 6 is located downstream of cross-section 2 (sta. 8+25). The six smaller vegetation plots also were used to assess woody stem density (planted and naturally regenerated).

4.2 Vegetation Monitoring Results

Tree Plot A.–Silky dogwood *Cornus amomum* was the dominant woody species in this tree plot, comprising 64% of the total stems counted (Exhibit Table 5). Eight black locusts *Robinia pseudoacacia* and a bitternut hickory *Carya cordiformis* had naturally regenerated into this plot since 2003. Overall, woody stem density decreased by 15% from MY2 to MY3 due to the loss of 16 elderberry *Sambucus canadensis*. The decline of plants in this plot can probably be attributed to the presence of Japanese knotweed *Reynoutria japonica = Fallopia japonica = Polygonum cuspidatum*. This exotic plant has formed a dense, monotypic canopy in much of tree plot A. Several tagged, dead stems were observed under the canopy of Japanese knotweed. blackberry *Rubus* sp. and reed canary grass *Phalaris arundinacea* were present in the herbaceous layer along the channel margin.

Tree Plot B.–Silky willow *Salix sericea* was the dominant woody species in this plot, comprising 53% of the total stems counted (Exhibit Table 5). Willow oak *Quercus phellos* and silky dogwood (18%) were equally abundant. Total numbers of stems nearly doubled from MY2 to MY3. Most of this increase is attributable to recruitment of silky willow (16 stems); these stems were most likely live stakes that have matured over the past eights years, but were not included as woody stems in earlier counts. A black locust also naturally recruited into the plot following the MY2 survey. The herbaceous layer was dominated by blackberry. Other herbaceous species present included reed canary grass and Japanese knotweed.

Vegetation Plot 1 unnamed tributary.–One black willow and two silky dogwoods were observed during MY3, with one of the silky dogwood recruited since MY2. The herbaceous layer consisted of a goldenrod *Solidago* sp. mixed with tall fescue *Festuca sp*.

Vegetation Plot 2.–Zero woody stems were recorded during MY3; the one elderberry stem reported in MY1 was no longer present. Reed canary grass and blackberry were the dominant herbaceous species present.

Vegetation Plot 3.–Woody stem density was unchanged in Vegetation Plot 3 from MY2 to MY3. One silky dogwood was observed in the plot. The herbaceous layer consisted of goldenrod mixed in with tall fescue.

Vegetation Plot 4.–Woody stem species were absent from this plot. Reed canary grass and black berry were the dominant herbaceous vegetation.

Vegetation Plot 5.–One staghorn sumac *Rhus typhina* naturally recruited into this plot since the MY2 survey. Reed canary grass, goldenrod, and blackberry were observed in the herbaceous layer.

Vegetation Plot 6.–No woody stems were present in this plot. Blackberry and Japanese honeysuckle *Lonicera japonica* were the dominant herbaceous species. Tall fescue also was documented in the plot. It appears to be encroaching from the adjoining field.

A density of 320 planted woody stems per acre is used as the criterion to determine vegetation success for the first three years following installation (USACE 2003). The required density for year-4 is 290 stems per acre, whereas it is 260 stems per acre for year-5. A woody stem density threshold of 260 stems per acre has been met at the project site for both of the larger monitoring plots surveyed in MY3. The mean density of woody stems for both tree plots combined was 1,350 stems per acre (Exhibit Table 5). Stem diversity for the larger tree plots consisted of seven woody species; however, plots were dominated by silky dogwood and silky willow, which comprised 68% of the woody stems. Three woody species recruited into the tree plots since MY2; these were black locust (9), bitternut hickory (1), and tag alder (1).

Woody stem counts for the larger tree plots are of most significance. The smaller vegetation plots were used to count woody stems, but covered such a small area (10.8 ft^2) only a single stem was needed in the plot to meet the minimum criteria.

Exhibit Table 5. Vegetation Monitoring Results

Plots	Black Willow	Silky Willow	Silky Dogwood	Tag Alder	Black Locust	Staghorn Sumac	River Birch	Bitternut Hickory	Willow Oak	Total Stem Count 2003 (MY1)	Total Stem Count 2004 (MY2)	Total Stem Count 2007 (MY3)	Density (Stems/ Acre) 2007 (MY3)
Tree Plots	MY3 Woody Stem Counts												
Plot A (1,000 ft^2)			18		8		1	1		34	33	28	1,220
Plot B (1,000 ft^2)		18	6	1	1		2		6	22	18	34	1,481
											Average Density		**1,350**
Vegetation Plots	MY3 Woody Stem Counts												
Plot 1 (10.8 ft^2)	1		2							2	2	3	12,100
Plot 2 (10.8 ft^2)													
Plot 3 (10.8 ft^2)			1							1	1	1	4,033
Plot 4 (10.8 ft^2)													
Plot 5 (10.8 ft^2)						1						1	4,033
Plot 6 (10.8 ft^2)													
											Average Density		**3,361**

4.3 Invasive Exotic Vegetation Occurrence

Exotic species were present within the project area, with Japanese knotweed, tall fescue, and reed canarygrass being the most prevalent. Japanese knotweed was particularly abundant, forming dense, monotypic stands in several parts of the conservation easement. Japanese knotweed has out competed many of the planted woody stems. Other invasive exotic species present in low densities included multiflora rose *Rosa multiflora*, oriental bittersweet *Celastrus orbiculatus,* and Japanese honeysuckle *Lonicera japonica*.

5.0 Biological Indicators

As a condition of the USACE section 404 permit for the A-10 project, NCDOT was to develop a biological monitoring plan for the mitigation sites. To the best of our knowledge, no fish or aquatic insect sampling was completed.

6.0 Closeout Summary

The Fosson mitigation site on Paint Fork Creek in Madison County, N.C. was monitored for the third time in October 2007, eight years since construction was completed (August 1999). Prior to this effort, monitoring of the project reach occurred in 2003 and 2004 (Mulkey 2003, 2004). Initial project objectives to enhance and protect water quality and riparian vegetation, channel bank stability, and aquatic habitat have been achieved.

Channel Cross-Sections.–Morphometric data from the MY3 survey approximate the range of values expected for the site based on its design, as-built values and the values recorded during MY1 and MY2. Moreover, minimal to no evidence of instability was revealed during the MY3 physical survey of the five individual cross-sections. Although the values for some bankfull parameters have had a wide range over the course of monitoring, this is most likely indicative of variation in survey crews and with the identification of bankfull features in the field. It does not represent instability of the project reach.

Longitudinal Profile.–Channel sinuosity and the water surface slope, representative of a C stream type, have been maintained since project completion. Although sinuosity is on the low end for a C type channel, evidence of the channel attempting to increase its sinuosity (laterally extend) has not been observed. It is unlikely that lateral extension will occur given that the left and right bank vegetation is well established. The presence of a bedrock seam, throughout most of the project reach, provides a natural form of grade control, eliminating the concern of potential head-cutting and resulting change of channel slope. Overall, the channel thalweg has remained stable with little aggradation, degradation, or lateral movement.

Pebble Counts.–Mean particle size for each of the particle size classes generally declined during each of the three monitoring surveys when compared with pre-construction values. With the left bank and right bank riparian vegetation well established, one would expect the particle sizes to increase. The decrease in particle sizes may be influenced by upstream land use practices (development, agricultural) or by the presence of a bedrock channel bed throughout most of the project reach. It is unlikely, given the current stability and condition of the project reach, that this trend is related to on-site scour or erosion.

Hydrologic Data and Bankfull Verification.–The small drainage of Paint Fork Creek has experienced a large number of flashy and sustained bankfull or higher stream flows since project completion. The site has experienced well over the required minimum of two bankfull events within five years and has withstood the forces of high flow events, including record level flooding from two remnant hurricanes, with minimal to no damage reported.

Fixed Station Photos.–The fixed station photo log for this site reveals that the planted vegetation along the left bank has become well established over the eight years since installation. This vegetation has helped to stabilize the channel banks and provide riparian wildlife habitat. The photo log provides evidence of the progression of a maturing riparian area and also suggests the channel is beginning to narrow in some places.

Problem Areas.–Observations of the riparian floodplain and the stream channel revealed a stable project area that is performing as desired 8 years after construction. No problem areas were identified.

Vegetation.–Density of woody stems, based on the larger tree plots, exceeds the minimum required criterion of 260 stems/acre. Woody plants are abundant throughout the conservation easement and growing as desired. Species diversity within the plots and throughout the riparian area was good, but dominated by silky dogwood and silky willow. Woody species have established extensive root systems that have contributed to stabilizing the stream banks. While not a significant problem, several exotic invasive species are present on the site and should be monitored.

Overall, the Fosson site has benefited from the implementation of the channel and riparian restoration practices set forth in the original construction plan. Establishment of the conservation easement and woody riparian vegetation has contributed to improved channel stability and function. The Fosson site has met the success criteria for mitigation in place at the time of construction. Despite having only been monitored for three years it has been eight years since construction was completed. Given the facts presented in this report, the Fosson site is performing as desired and should be presented for closeout consideration by the regulatory agencies.

7.0 Acknowledgements

Scott Loftis, Jeff Ferguson, Brent Burgess, and Todd Ewing of the NCWRC watershed enhancement group collected and analyzed the field data. Scott Loftis, Jeff Ferguson, and Todd Ewing prepared this report. Jim Borawa with the NCWRC provided comments for improving this report. Mulkey, Inc. collected and analyzed the data and prepared the reports for MY1 and MY2. Russell Blevins with Madison County NRCS office provided administrative assistance during the development and implementation of this project.

7.0 References

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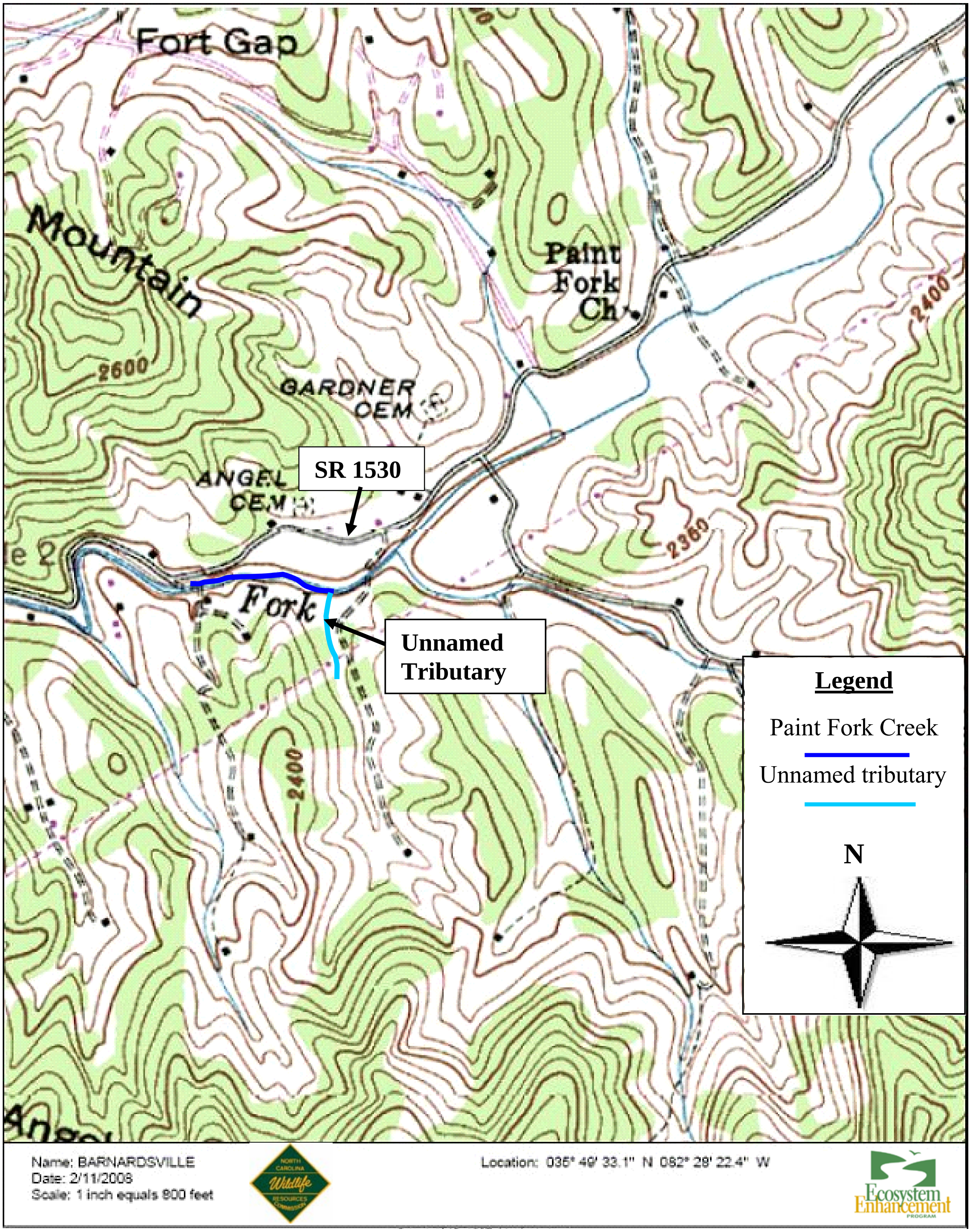


Figure 1.—Fosson mitigation site, Paint Fork Creek, French Broad River basin, Madison County, North Carolina; EEP Project Number 92702.

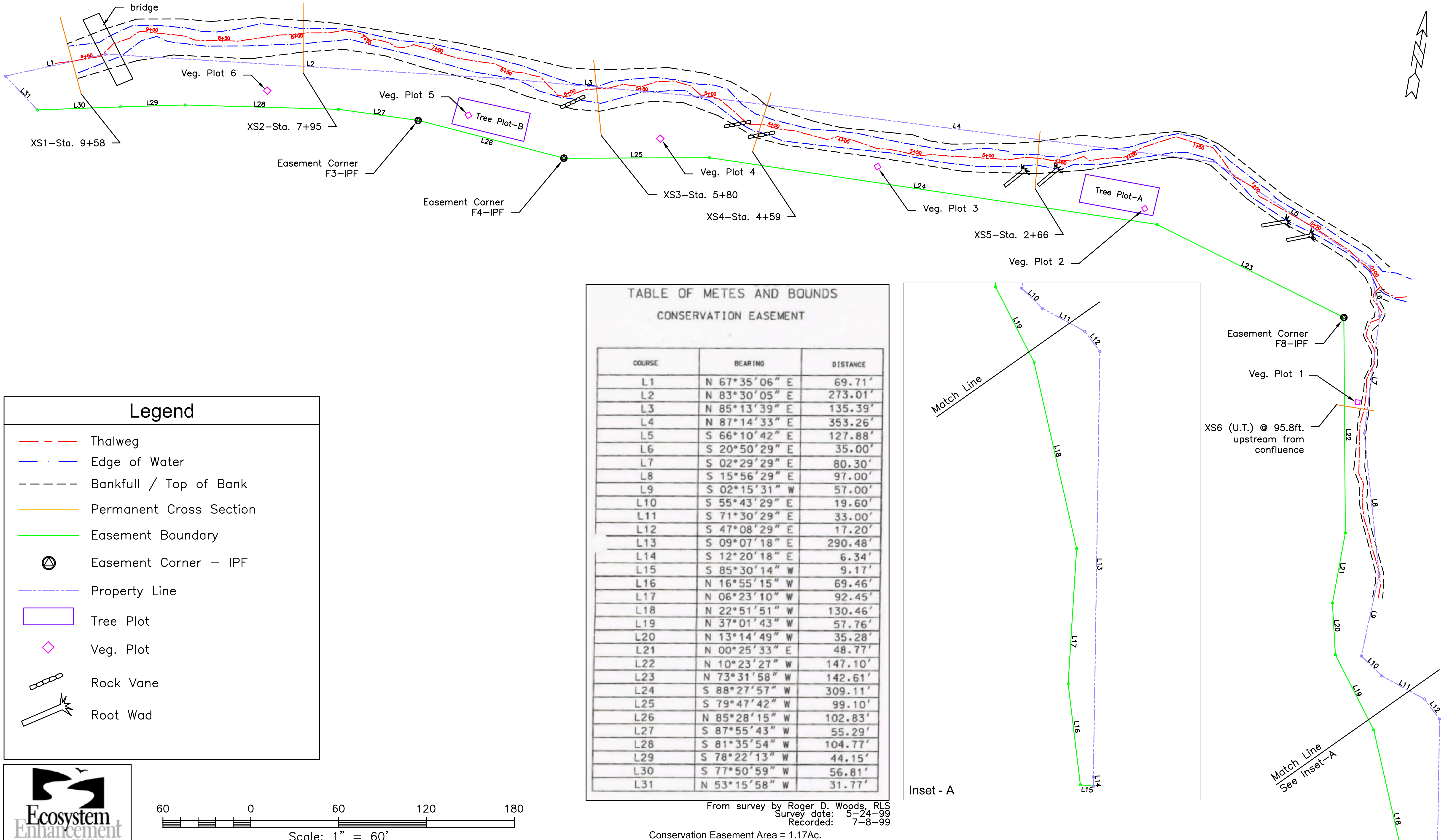


TABLE OF METES AND BOUNDS

CONSERVATION EASEMENT

COURSE	BEARING	DISTANCE
L1	N 67°35'06" E	69.71'
L2	N 83°30'05" E	273.01'
L3	N 85°13'39" E	135.39'
L4	N 87°14'33" E	353.26'
L5	S 66°10'42" E	127.88'
L6	S 20°50'29" E	35.00'
L7	S 02°29'29" E	80.30'
L8	S 15°56'29" E	97.00'
L9	S 02°15'31" W	57.00'
L10	S 55°43'29" E	19.60'
L11	S 71°30'29" E	33.00'
L12	S 47°08'29" E	17.20'
L13	S 09°07'18" E	290.48'
L14	S 12°20'18" E	6.34'
L15	S 85°30'14" W	9.17'
L16	N 16°55'15" W	69.46'
L17	N 06°23'10" W	92.45'
L18	N 22°51'51" W	130.46'
L19	N 37°01'43" W	57.76'
L20	N 13°14'49" W	35.28'
L21	N 00°25'33" E	48.77'
L22	N 10°23'27" W	147.10'
L23	N 73°31'58" W	142.61'
L24	S 88°27'57" W	309.11'
L25	S 79°47'42" W	99.10'
L26	N 85°28'15" W	102.83'
L27	S 87°55'43" W	55.29'
L28	S 81°35'54" W	104.77'
L29	S 78°22'13" W	44.15'
L30	S 77°50'59" W	56.81'
L31	N 53°15'58" W	31.77'

From survey by Roger D. Woods, RLS
Survey date: 5–24–99
Recorded: 7–8–99

Conservation Easement Area = 1.17Ac.

Ecosystem Enhancement PROGRAM

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION
WATERSHED ENHANCEMENT GROUP
20830 GREAT SMOKY MOUNTAIN EXPRESSWAY
WAYNESVILLE, NORTH CAROLINA 28786
828.452.6191 Ext.26 OFFICE
828.452.7772 FAX

Paint Fork Creek
Madison County Fosson Site
MY3 Plan View

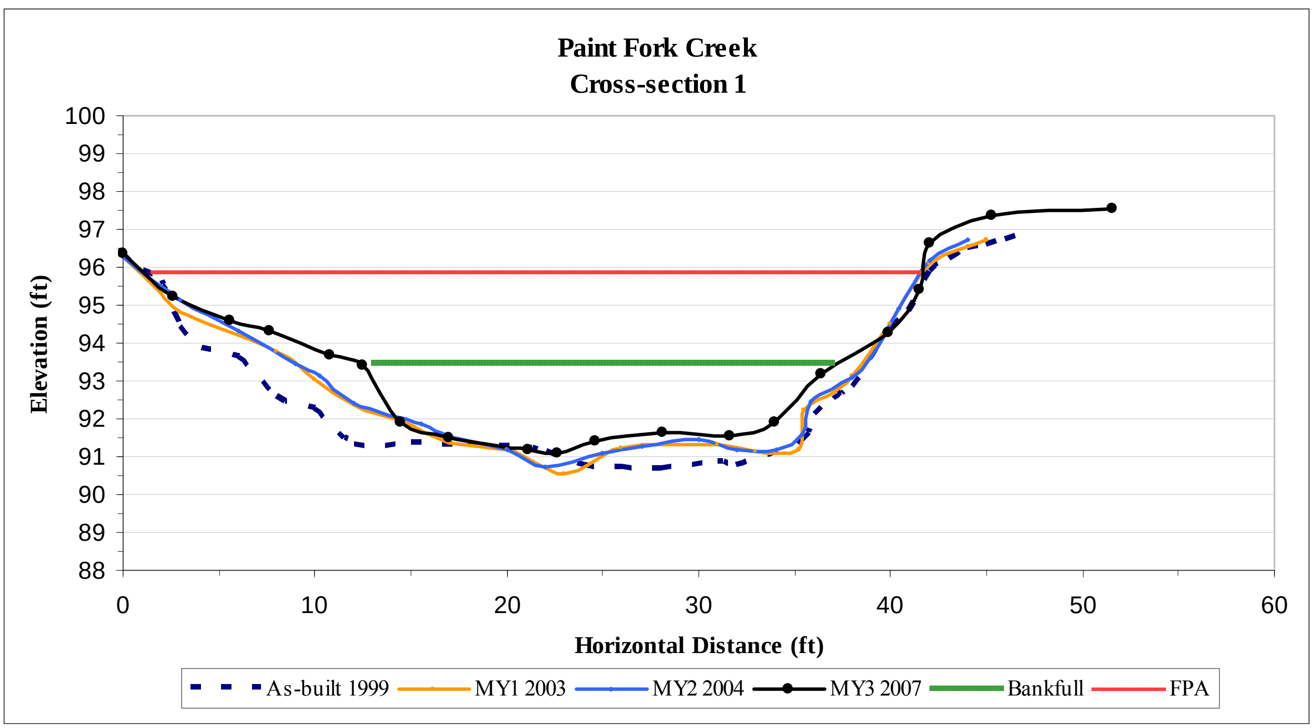
DRAWN BY: JCF	DATE: 05/08
APPROVED:	DATE:
SURVEY BY: JCF, CSL, ABB, TDE	DATE: 10/07
CAD FILE ID: Fosson07.dwg	

SHEET 1 OF 1

APPENDIX A

Appendix A.1. Cross-Sections Plots and Photographs.

Appendix Table A.1.1. Cross-Section 1 Abbreviated Morphological Characteristic Summary			
	Year		
Characteristic	2003	2004	2007
Station (ft)			9+58
Feature			Run
Stream Type			Bc
Bankfull Cross Sectional Area (ft^2)	33.5	43.0	41.5
Maximum Bankfull Depth (ft)	2.2	2.4	2.4
Bankfull Mean Depth (ft)	1.3	1.5	1.7
Width/Depth Ratio	20.1	18.1	14.7
Entrenchment Ratio	1.5	1.4	1.6
Bankfull Width (ft)	26.0	27.9	24.7



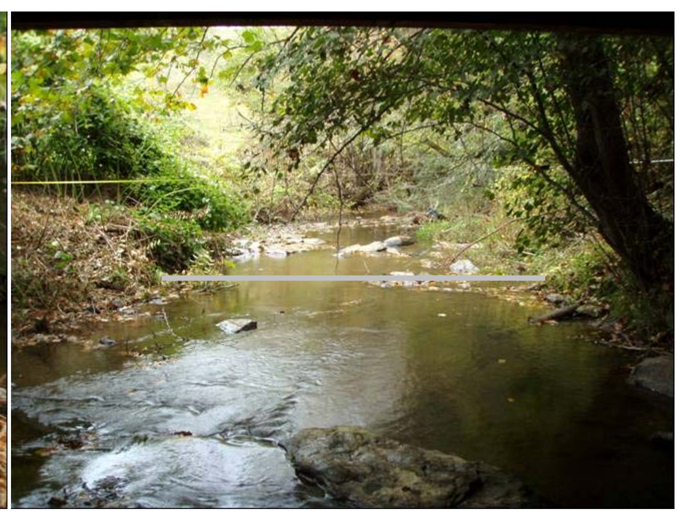
Cross-section 1, left bank to right bank, November 1999.

Cross-section 1, left bank to right bank, February 2001.

Cross-section 1, left bank to right bank, March 2003.

Cross-section 1, left bank to right bank, May 2004.

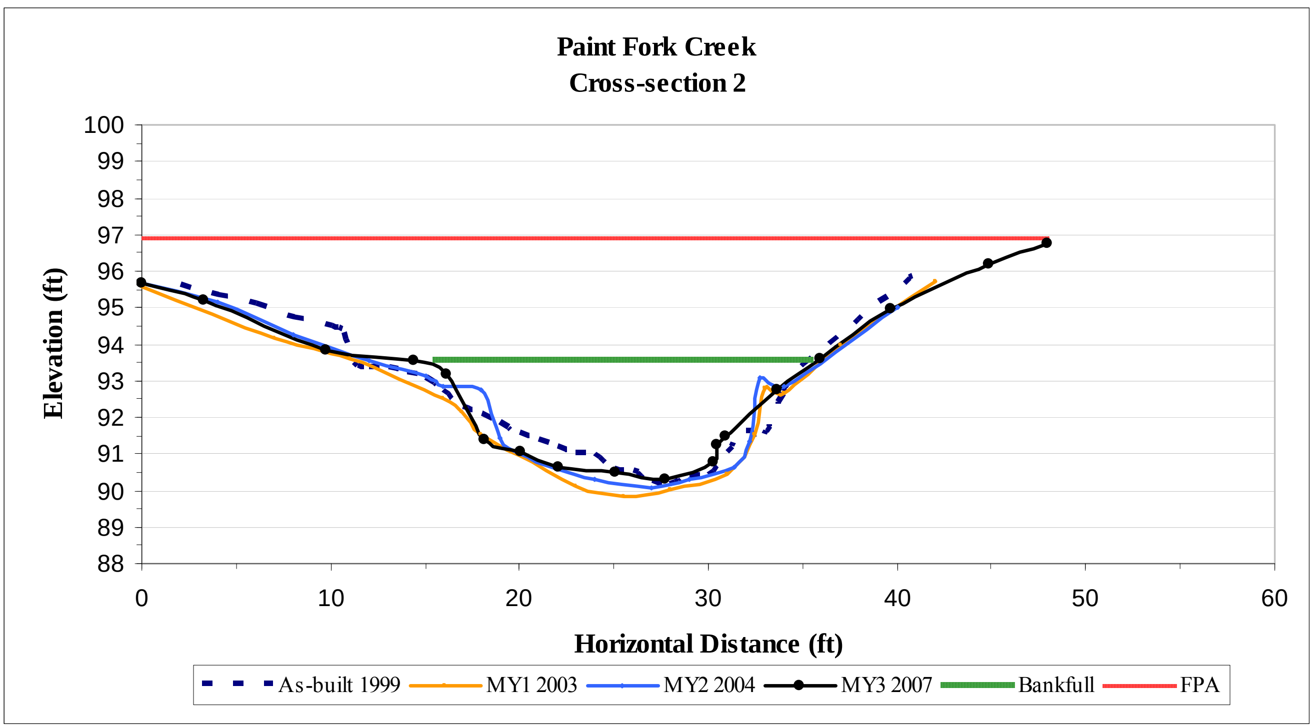
Cross-section 1, left bank to right bank, October 2007.



Cross-section 1, upstream to downstream, October 2007.

Appendix A.1. Continued.

Appendix Table A.1.2. Cross-Section 2 Abbreviated Morphological Characteristic Summary			
	Year		
Characteristic	2003	2004	2007
Station (ft)			7+95
Feature			Run
Stream Type			E
Bankfull Cross Sectional Area (ft^2)	25.5	32.6	44.0
Maximum Bankfull Depth (ft)	2.3	2.8	3.3
Bankfull Mean Depth (ft)	1.6	2.0	2.1
Width/Depth Ratio	9.7	8.6	10.5
Entrenchment Ratio	2.2	2.4	4.7
Bankfull Width (ft)	15.8	16.7	21.4



Cross-section 2, left bank to right bank, November 1999.

Cross-section 2, downstream to upstream, February 2001.

Cross-section 2, left bank to right bank, March 2003.

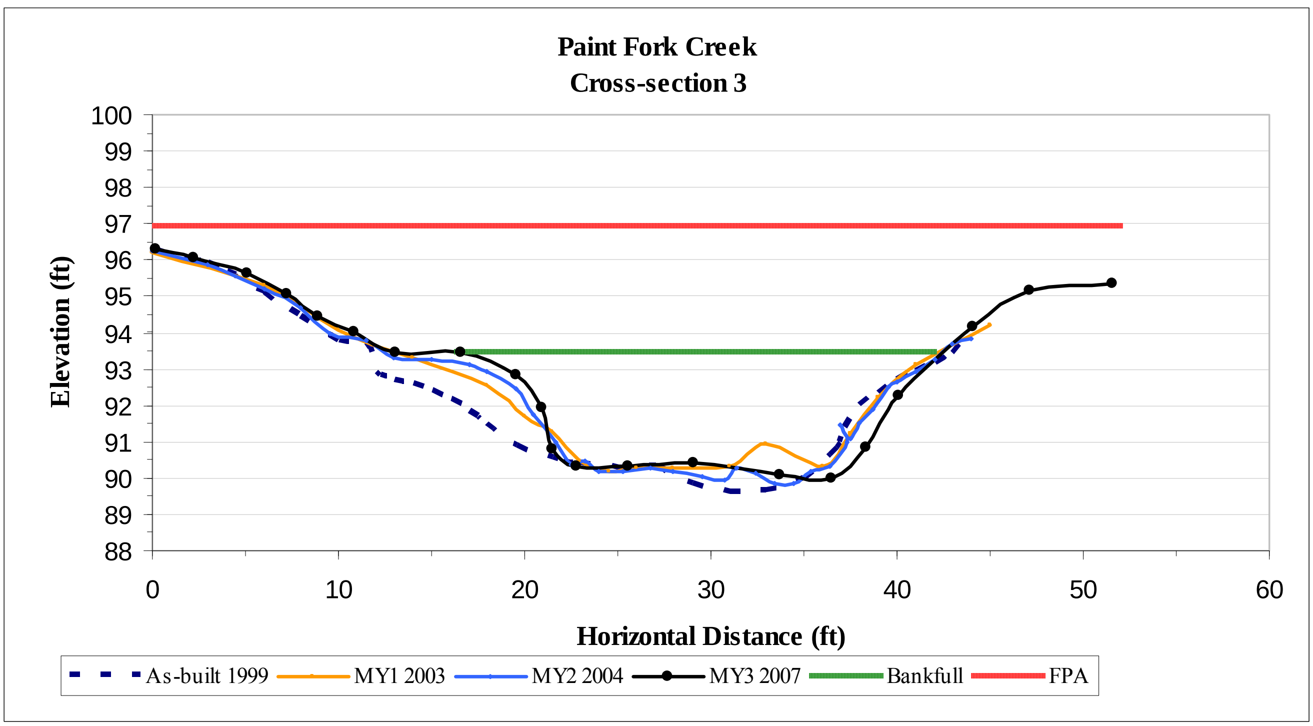
Cross-section 2, left bank to right bank, May 2004.

Cross-section 2, left bank to right bank, October 2007.

Cross-section 2, upstream to downstream, October 2007.

Appendix A.1. Continued.

Appendix Table A.1.3. Cross-Section 3 Abbreviated Morphological Characteristic Summary			
	Year		
Characteristic	2003	2004	2007
Station (ft)	Run		Pool
Feature			5+80
Stream Type			C
Bankfull Cross Sectional Area (ft^2)	30.0	39.7	62.0
Maximum Bankfull Depth (ft)	2.0	2.3	3.5
Bankfull Mean Depth (ft)	1.5	1.5	2.2
Width/Depth Ratio	13.7	13.8	13.3
Entrenchment Ratio	1.8	2.3	3.5
Bankfull Width (ft)	20.3	20.2	28.7



Cross-section 3, left bank to right bank, November 1999.

Cross-section 3, left bank to right bank, February 2001.

Cross-section 3, left bank to right bank, March 2003.

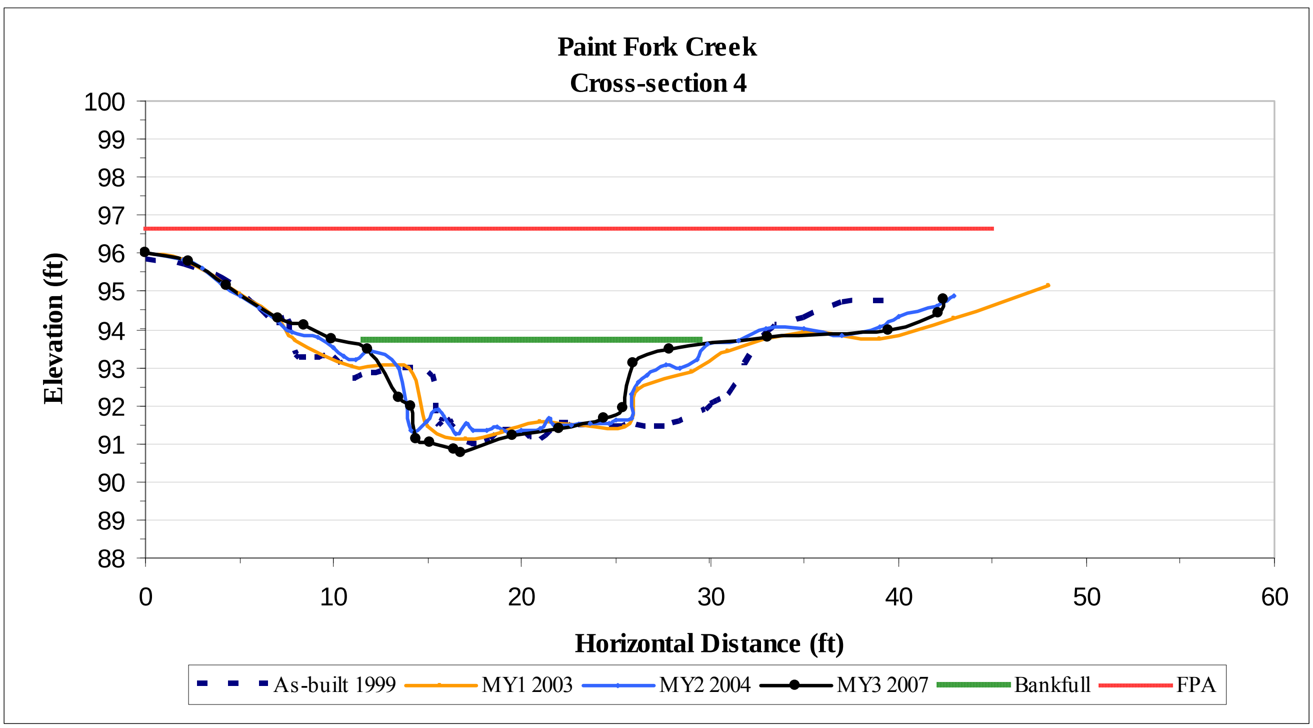
Cross-section 3, left bank to right bank, May 2004.

Cross-section 3, left bank to right bank, October 2007.

Cross-section 3, upstream to downstream, October 2007.

Appendix A.1. Continued.

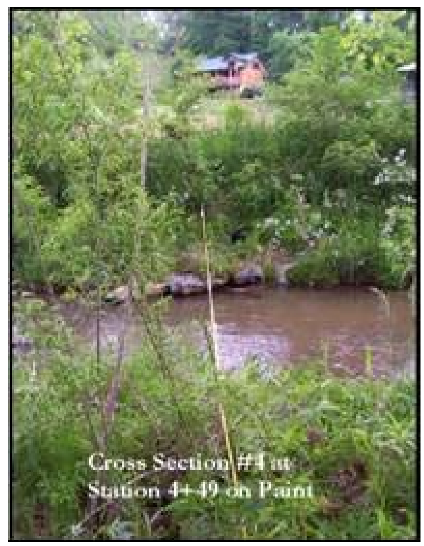
Appendix Table A.1.4. Cross-Section 4 Abbreviated Morphological Characteristic Summary			
	Year		
Characteristic	2003	2004	2007
Station (ft)			4+59
Feature			Riffle
Stream Type			C
Bankfull Cross Sectional Area (ft^2)	27.7	29.5	33.2
Maximum Bankfull Depth (ft)	2.3	2.3	2.9
Bankfull Mean Depth (ft)	1.3	1.5	1.5
Width/Depth Ratio	17.0	13.8	15.2
Entrenchment Ratio	2.7	2.3	4.5
Bankfull Width (ft)	21.7	20.2	22.4



Cross-section 4, left bank to right bank, November 1999.

Cross-section 4, left bank to right bank, February 2001.

Cross-section 4, left bank to right bank, March 2003.



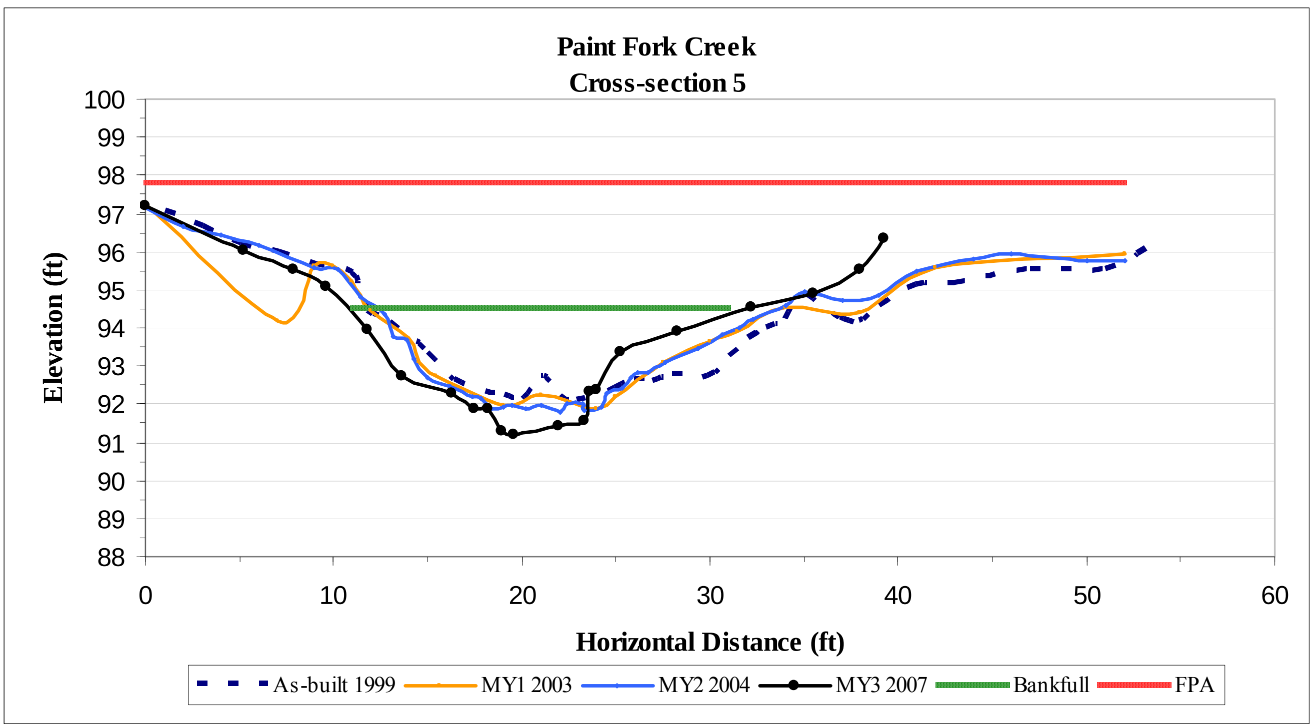
Cross-section 4, right bank to left bank, May 2004.

Cross-section 4, upstream to downstream, May 2004.

Cross-section 4, left bank to right bank, October 2007.

Appendix A.1. Continued.

Appendix Table A.1.5. Cross-Section 5 Abbreviated Morphological Characteristic Summary			
	Year		
Characteristic	2003	2004	2007
Station (ft)			2+66
Feature	Run		
Stream Type			C
Bankfull Cross Sectional Area (ft^2)	22.2	42.8	36.6
Maximum Bankfull Depth (ft)	2.0	3.1	3.3
Bankfull Mean Depth (ft)	1.2	1.7	1.7
Width/Depth Ratio	14.5	15.5	12.7
Entrenchment Ratio	2.8	2.4	4.6
Bankfull Width (ft)	17.9	25.8	21.6



Cross-section 5, left bank to right bank, November 1999.

Cross-section 5, left bank to right bank, February 2001.

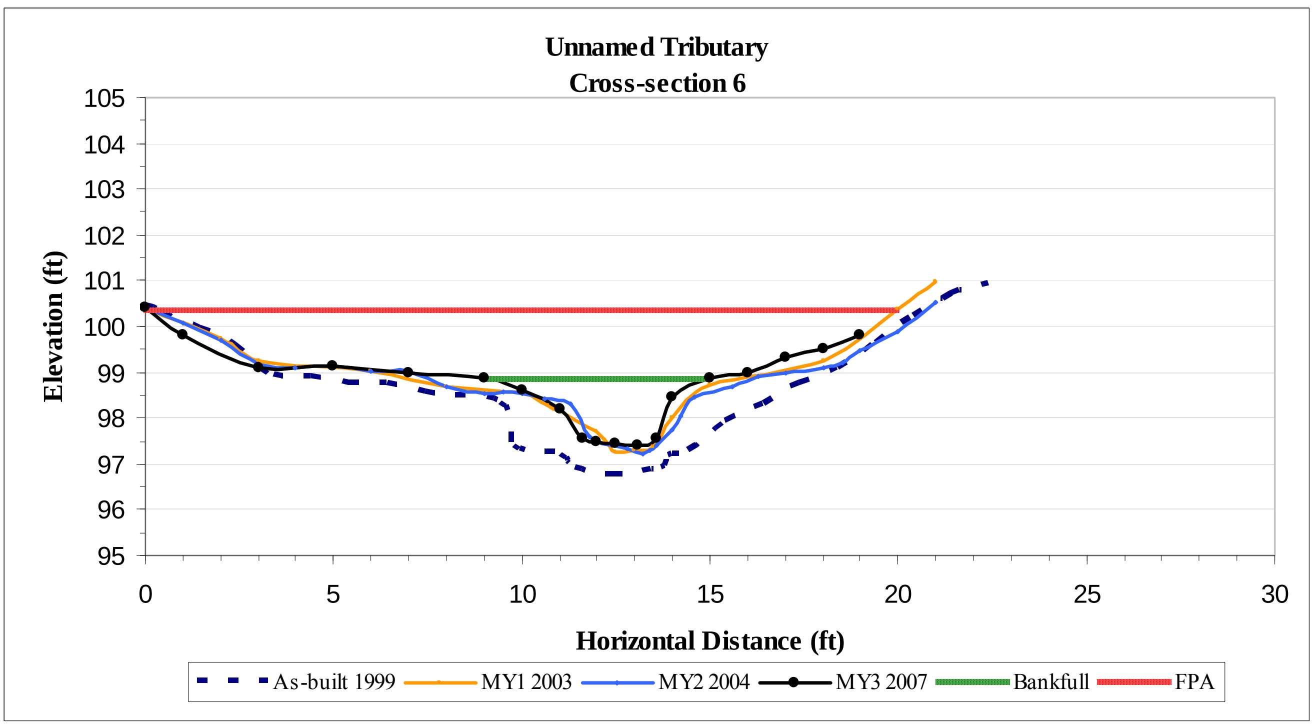
Cross-section 5, left bank to right bank, March 2003.

Cross-section 5, left bank to right bank, October 2007.

Cross-section 5, looking downstream, October 2007.

Appendix A.1. Continued.

Appendix Table A.1.6. Cross-Section 6 Abbreviated Morphological Characteristic Summary			
	Year		
Characteristic	2003	2004	2007
Station (ft)	0+95		
Feature	Run		
Stream Type			E
Bankfull Cross Sectional Area (ft^2)	2.1	2.8	4.6
Maximum Bankfull Depth (ft)	1.0	1.2	1.5
Bankfull Mean Depth (ft)	0.6	0.7	0.8
Width/Depth Ratio	6.5	6.4	7.8
Entrenchment Ratio	4.1	4.2	3.8
Bankfull Width (ft)	3.7	4.3	6.0



Cross-section 6, downstream to upstream, November 1999.

Cross-section 6, downstream to upstream, February 2001.

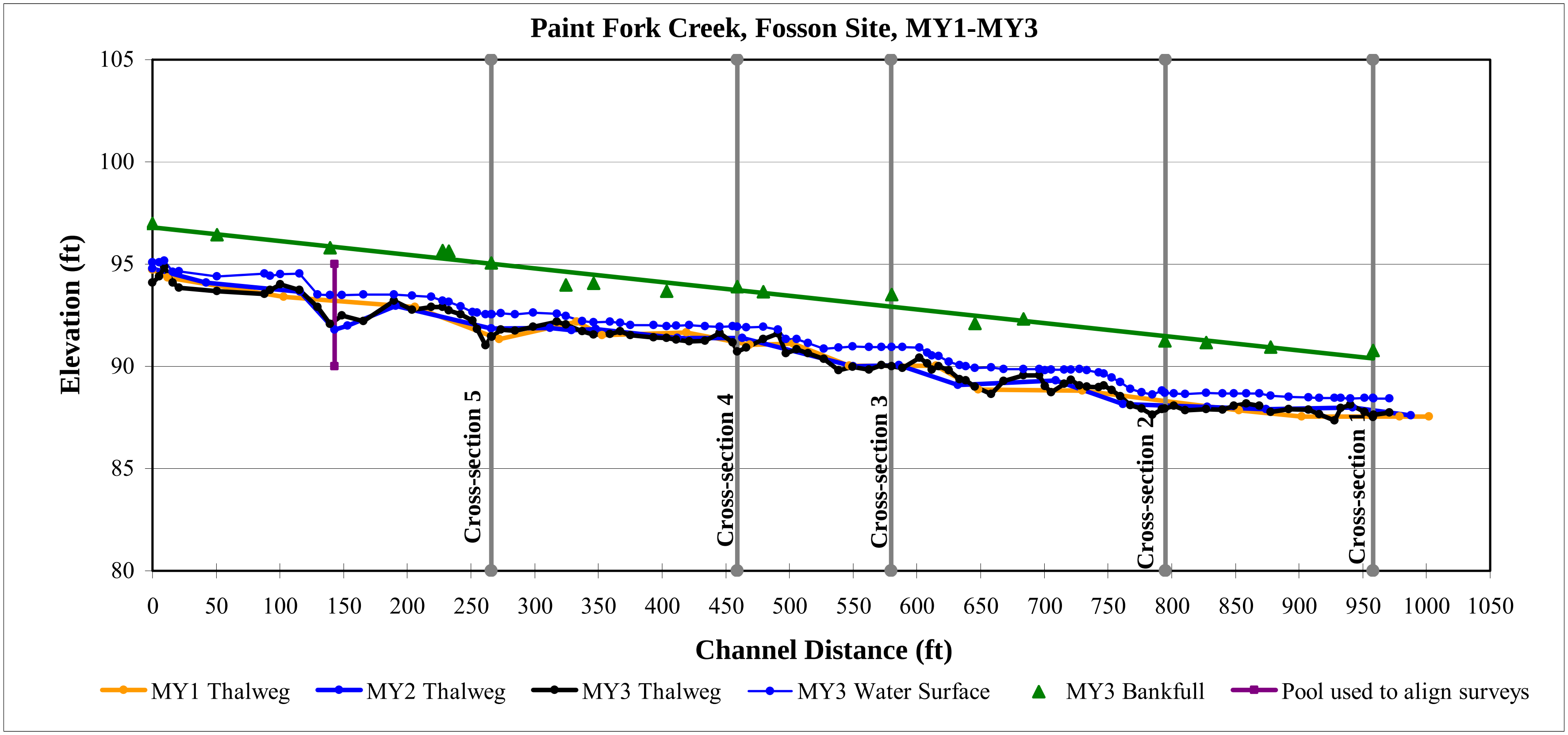
Cross-section 6, left bank to right bank, March 2003.

Cross-section 6, left bank to right bank, May 2004.

Cross-section 6, left bank to right bank, October 2007.

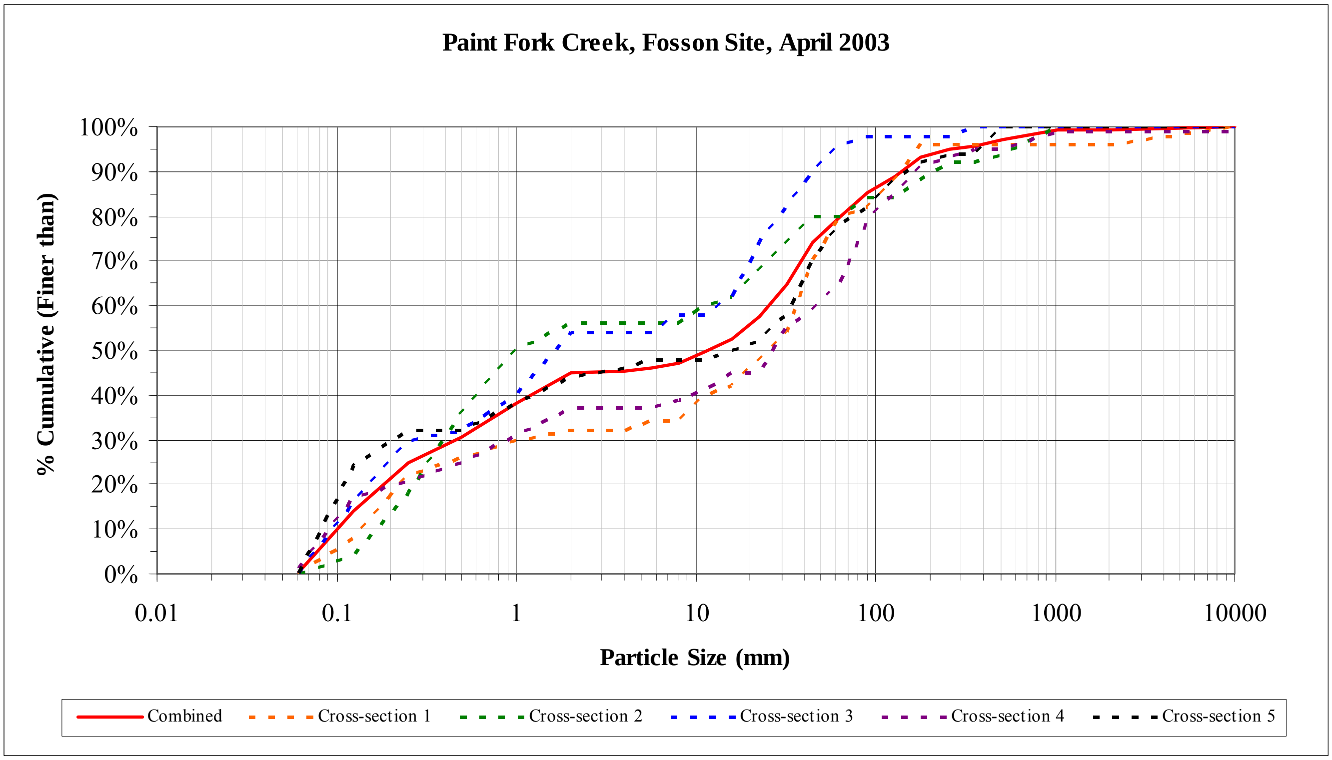
Cross-section 6, upstream to downstream, October 2007.

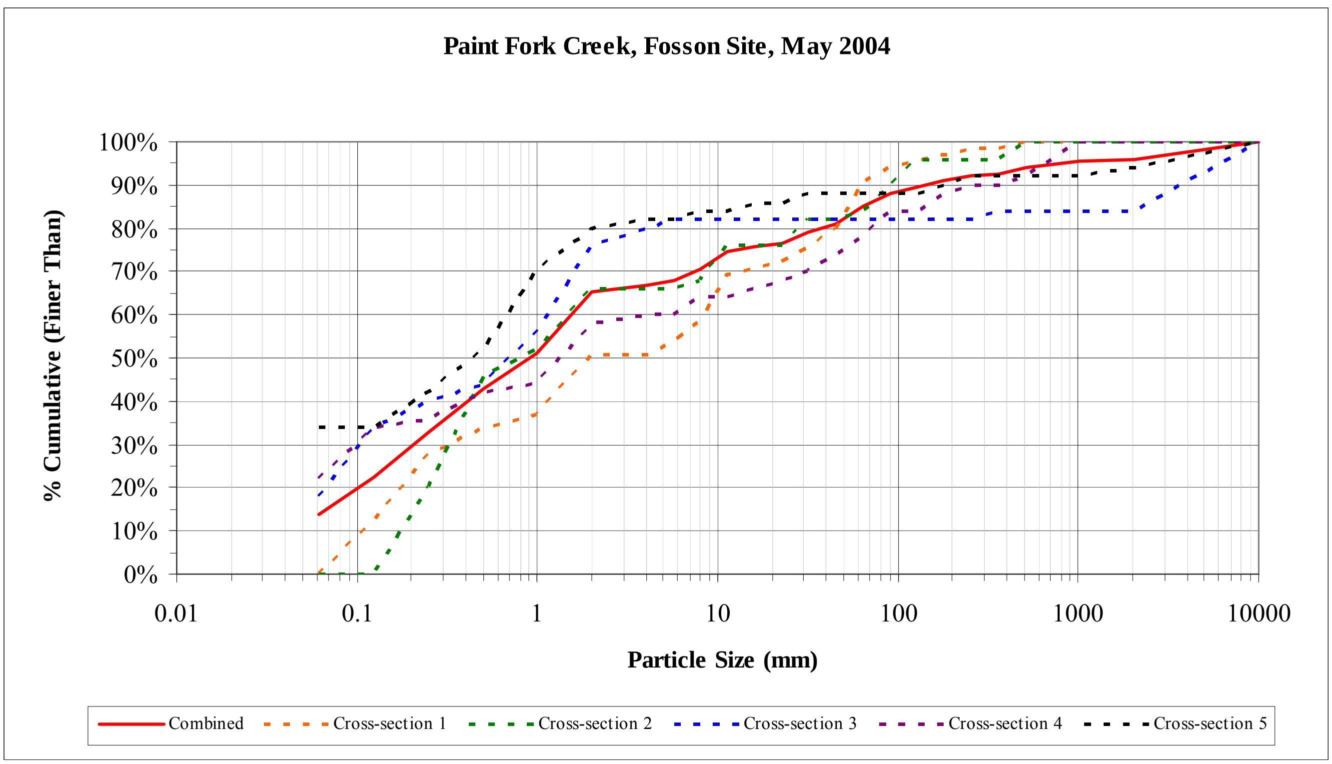
Appendix A.2. Longitudinal Profile Plots.



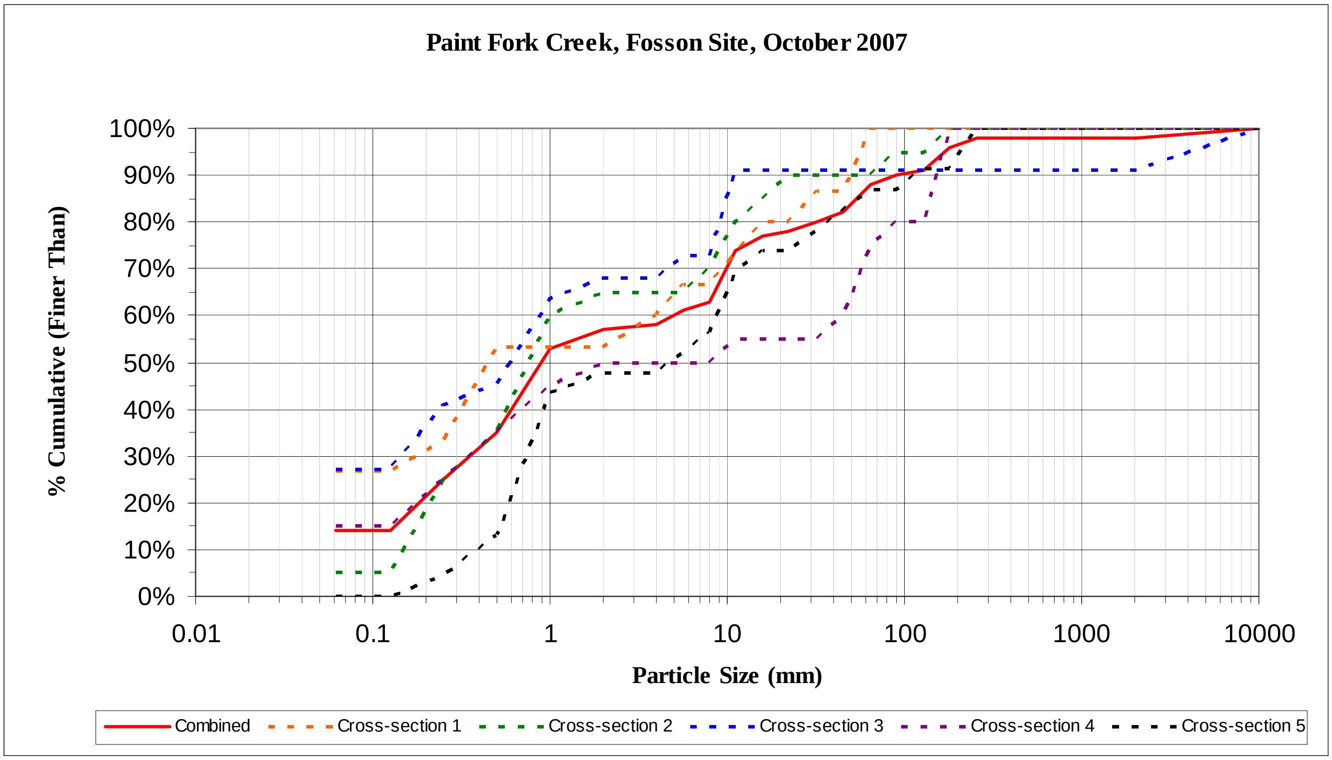
Note: A pool located at approximately station 0+150 was used to align longitudinal survey data among years.

Appendix A.3. Pebble Count Cumulative Frequency Distributions Plots.





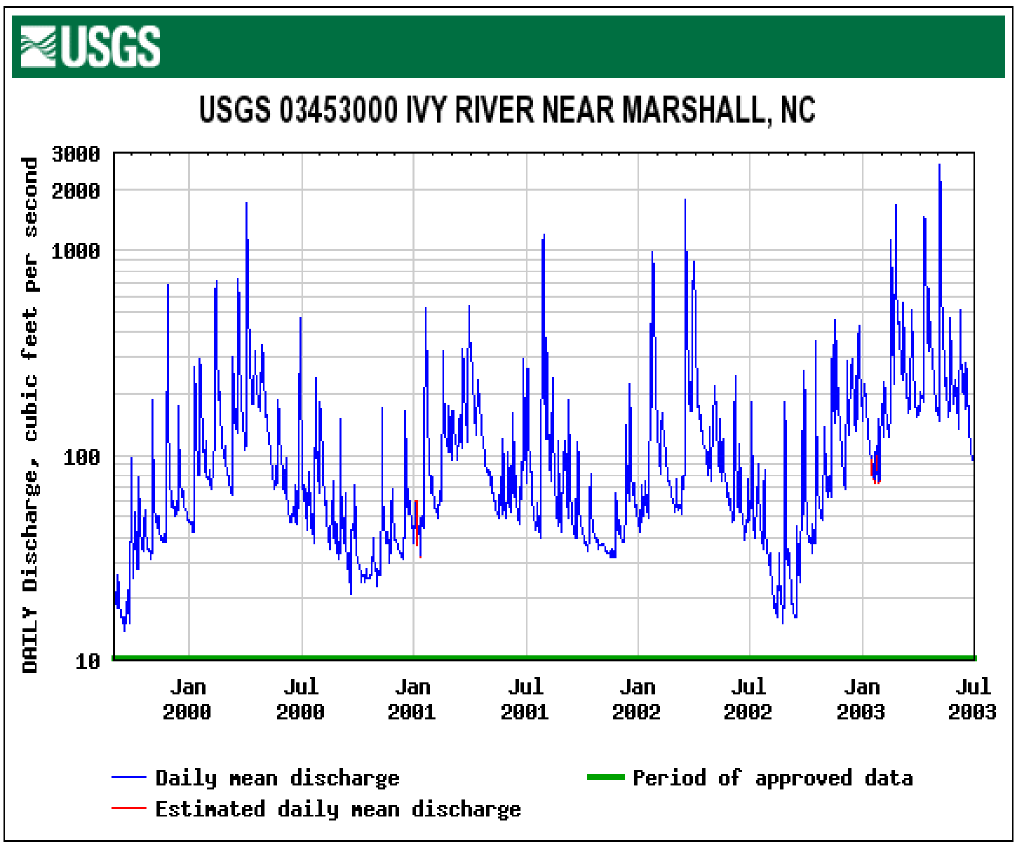
Appendix A.3. Continued.

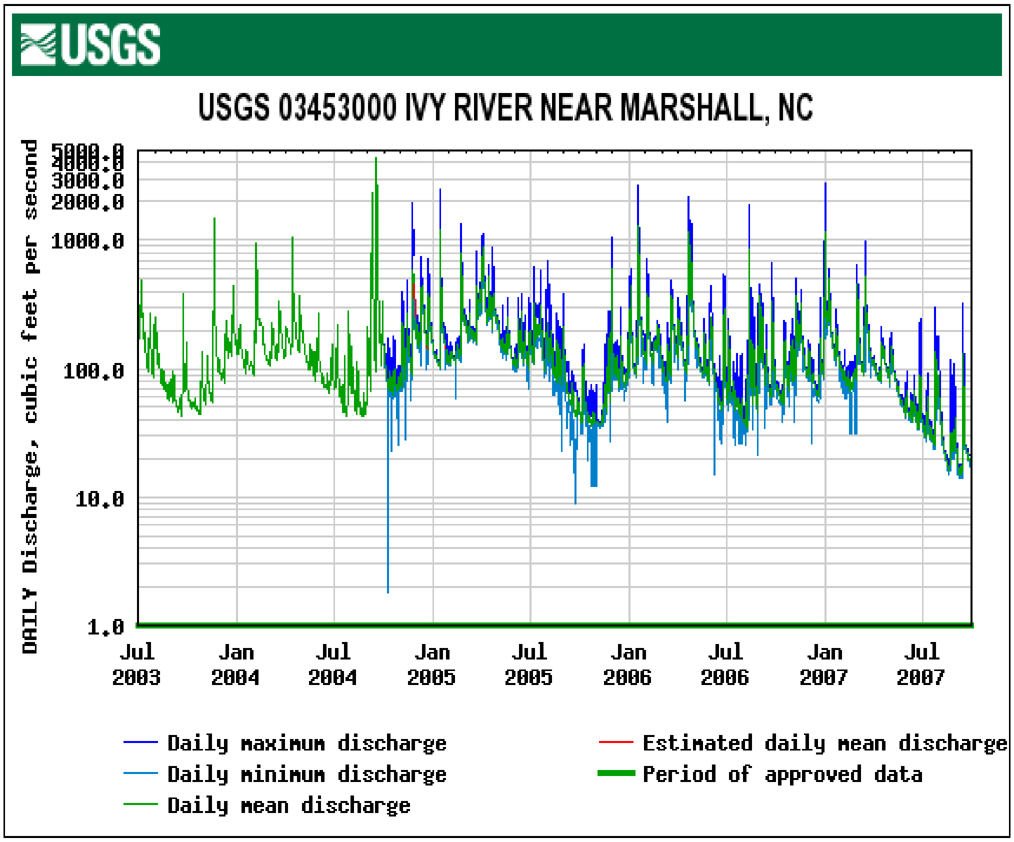


Appendix A.4. Surrogate gage hydrograph data table.

Appendix Table A.4.1. USGS gage 03453000, Ivy River , near Marshall, N.C.			
Date	**Flow (ft^3/s)**	**Gage height (ft)**	**Comments**
4/4/2000	1,720	6.89	Photo verification
7/29-30/2001	1,135	5.44	Photo verification
3/17-18/2002	1,580	6.40	Bankfull event
2/15/2003	1,120	5.62	Bankfull event
2/22-23/2003	1,535	6.37	Photo verification
4/10-11/2003	1,435	6.19	Bankfull event
5/06-07/2003	2,195	8.83	Bankfull event
11/19/2003	1,500	5.81	Bankfull event
4/13/2003	1,050	5.29	Bankfull event
9/08/2004	2,330	7.59	Bankfull event
9/17-18/2004	3,030	8.12	Bankfull event
1/14/2005	1,200	5.68	Bankfull event
1/18/2006	1,290	5.82	Bankfull event
4/22/2006	1,160	5.60	Bankfull event
1/01/2007	1,150	5.51	Bankfull event

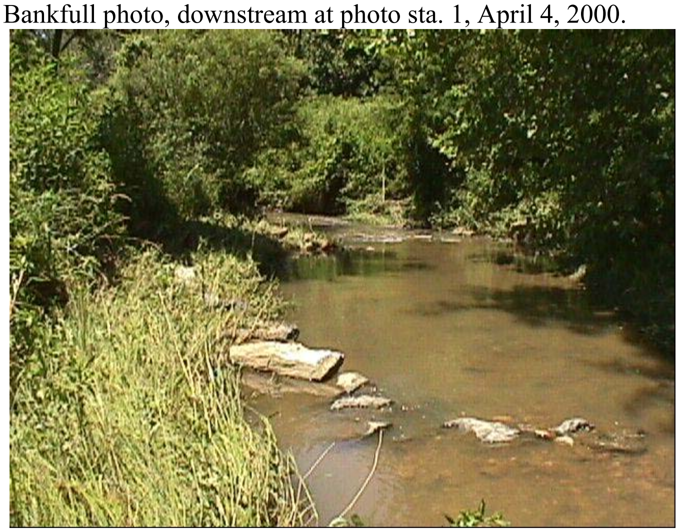
[a]Flow and gage height were averaged for high flow events occurring on consecutive days and counted as one event.




USGS
USGS 03453000 IVY RIVER NEAR MARSHALL, NC
DAILY Discharge, cubic feet per second
5000.0
4000.0
3000.0
2000.0
1000.0
100.0
10.0
1.0
Jul 2003
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006
Jul 2006
Jan 2007
Jul 2007
Daily maximum discharge
Daily minimum discharge
Daily mean discharge
Estimated daily mean discharge
Period of approved data

Appendix A.5. Bankfull Event Verification Photos.

Bankfull photo, downstream at photo sta. 1, April 4, 2000.



Bankfull photo, downstream at cross-section 4, July 29-30, 2001.

Bankfull photo, wrack line in trees, February 22-23, 2003.

Appendix A.6. Fixed Station Photo Log.

Photo sta. 1, existing condition, looking downstream, 1999.

Photo sta. 1, looking downstream, November 1999.

Photo sta. 1, looking downstream, March 2003.

Photo sta. 1, looking downstream, May 2004.

Photo sta. 1, looking downstream, March 2008.

Appendix A.6.

Photo sta. 2, existing condition, looking downstream, 1999.

Photo sta. 2, looking downstream, November 1999.

Photo sta. 2, looking downstream, March 2003.

Photo sta. 2, looking downstream, October 2007.

Photo sta. 2, looking downstream, March 2008.

Appendix A.6.

Photo sta. 3, existing conditon, looking downstream, 1999.

Photo sta. 3, looking downstream, November 1999.

Photo sta. 3, looking upstream, March 2003.

Photo sta. 3, looking upstream, May 2004.

Photo sta. 3, looking upstream, October 2007.

Photo sta. 3, looking downstream, March 2008.

Appendix A.6.

Photo sta. 4, existing condition, looking upstream, 1999.

Photo sta. 4, looking upstream, November 1999.

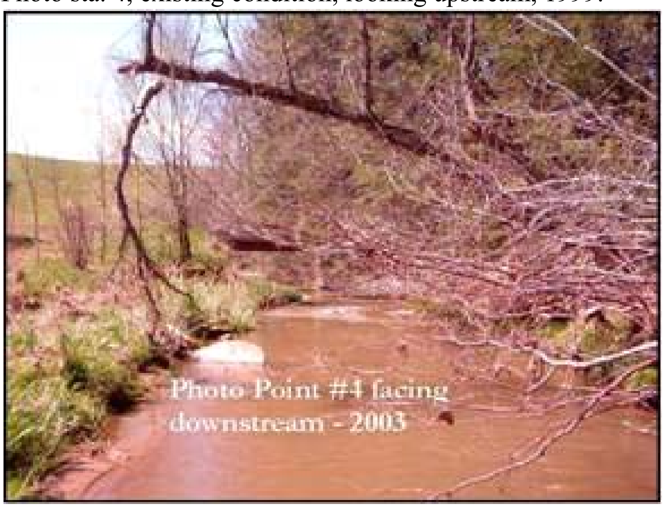


Photo sta. 4, looking downstream, March 2003.

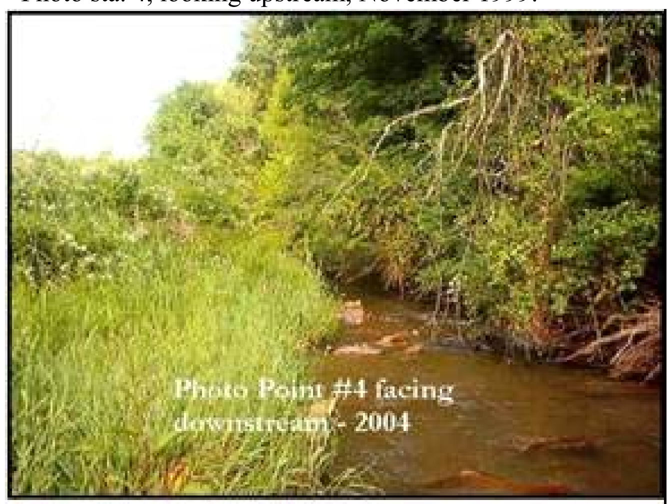


Photo sta. 4, looking downstream, May 2004.

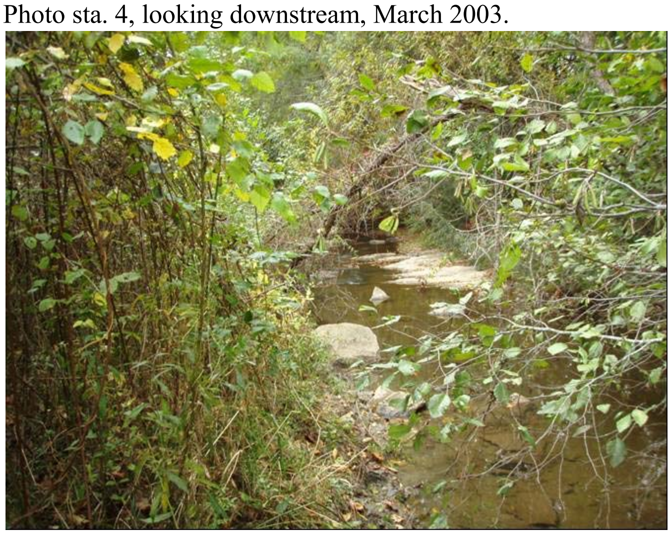


Photo sta. 4, looking downstream, October 2007.

Photo sta. 4, looking upstream, March 2008.

APPENDIX B

Appendix B.1. Vegetation Plot Photographs.

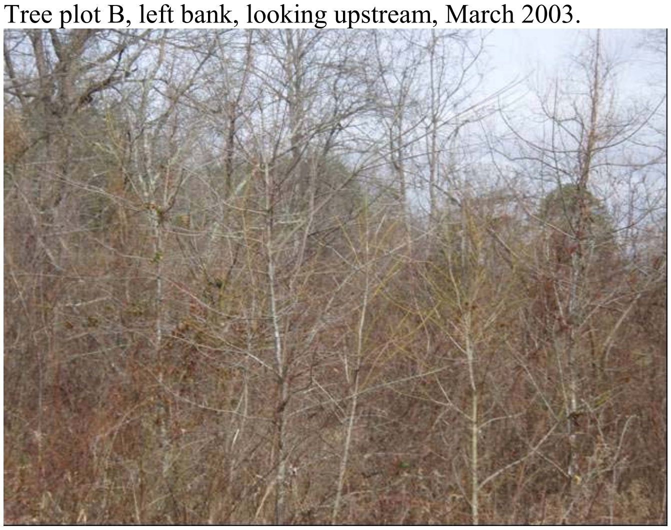
Tree plot A, left bank, looking upstream, March 2003.

Tree plot A, bottom, field side, looking upstream 2007.

Tree plot A, top of plot looking downstream, March 2008.

Appendix B.1. Continued.

Tree plot B, left bank, looking upstream, March 2003.


Tree plot B, left bank, looking upstream, January 2008.


Tree plot B, left bank, looking upstream, January 2008.

Appendix B.1. Continued.

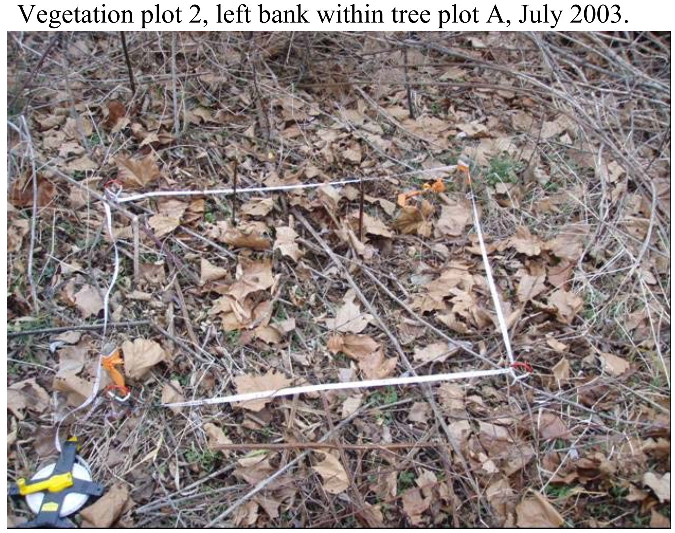
Vegetation plot 1, unnamed trib, left bank, March 2003.

Vegetation plot 1, unnamed trib, left bank, May 2004.

Vegetation plot 1, unnamed tributary, left bank, January 2008.

Vegetation plot 2, left bank within tree plot A, July 2003.

Vegetation plot 2, left bank, May 2004.



Vegetation plot 2, left bank, January 2008.

Appendix B.1. Continued.

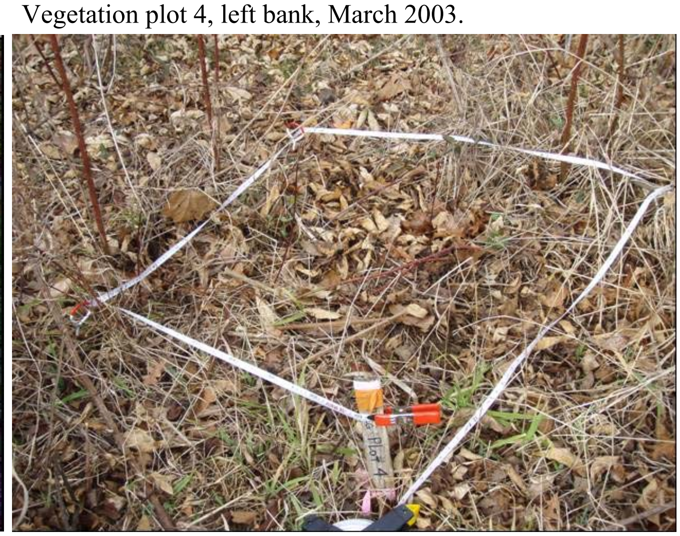
Vegetation plot 3, left bank, March 2003.

Vegetation [lot 3, left bank, May 2004.

Vegetation plot 3, left bank, January 2008.

Vegetation plot 4, left bank, March 2003.

Vegetation plot 4, left bank, May 2004.



Vegetation plot 4, left bank, January 2008.

Appendix B.1. Continued.

Vegetation plot 5, left bank, March 2003.

Vegetation plot 5, left bank, May 2004.

Vegetation plot 5, left bank, January 2008.

Vegetation plot 6, left bank, May 2004.

Vegetation plot 6, left bank, January 2008.