

**Brown Branch Stream Restoration
2005 Monitoring Report
Monitoring Year Three**

Ecosystem Enhancement Program Project Number 53



Submitted to: NCDENR-Ecosystem Enhancement Program
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Raleigh, NC 27699-1962

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I. Executive Summary/Project Abstract

The North Carolina Wetland Restoration Program conducted a restoration on 5200 feet of Brown Branch stream footage. Brown Branch is located in Caldwell County, North Carolina and within the Yadkin River Basin. The Brown Branch watershed comprises three square miles and is part of the Elk River drainage, eight-digit hydrologic unit code 06010103.

The project site is 3.5 miles east of U.S. Highway 321 at Happy Valley and 3.0 miles north of Olivette, NC. The Brown Branch restoration reach is entirely contained in the Anita-Alata 4H Camp and is the last mile of the creek before its confluence with Mulberry Creek.

The purpose of this restoration project was to improve water quality in Brown Branch by reducing the severe bank erosion. The stream features that motivated the restoration project were an unstable channel configuration, a featureless bed, a lack of riparian cover. These features caused poor water quality and aquatic habitat.

The goals of the Brown Branch restoration project were to establish a stable plan form, create cross-sectional and profile patterns that will enhance in-stream habitat and water quality, and to improve the functional and aesthetic value of the riparian corridor. The design increased the sinuosity of the channel and incorporated rock and log structures to decrease erosive stress on the banks and provide increased aquatic habitat. By creating a range of aquatic niches, the project intends to provide in-stream habitats that may support future trout populations.

A previous monitoring report (May 2004) covered the period from end of construction (September 2002) through the first year post-construction. This report noted extensive channel damage due to heavy rains and high flows that occurred during the first year. Most of these noted problems are still apparent because they were not considered significant enough to result in a critical failure and lack of achieving project goals status. The second monitoring period was conducted by North Carolina State University. EcoLogic obtained some of this data and photographs from NCSU Stream Restoration Institute, but no final report was provided to EcoLogic. Due to lack of information, as noted in Table 11, EcoLogic had little information about the design issues or as-built condition.

Without the past design or monitoring history, it is difficult to judge the performance of this restoration project. EcoLogic ascertained the problem issues with the restoration project, however without the historical information, it is not possible to determine if the problem areas are stable, improving, or declining. A current condition determination would require more time to directly contact the designers and previous monitoring teams and obtain the historical data. This demonstrates the need to maintain continuity of monitoring data. This may be accomplished by consistently using the same environmental firm to conduct the annual monitoring on specific streams and clearly defining the monitoring protocols. This would allow NC EEP to gather coherent data

that is comparable among years and make objective assessment of projects such as Brown Branch.

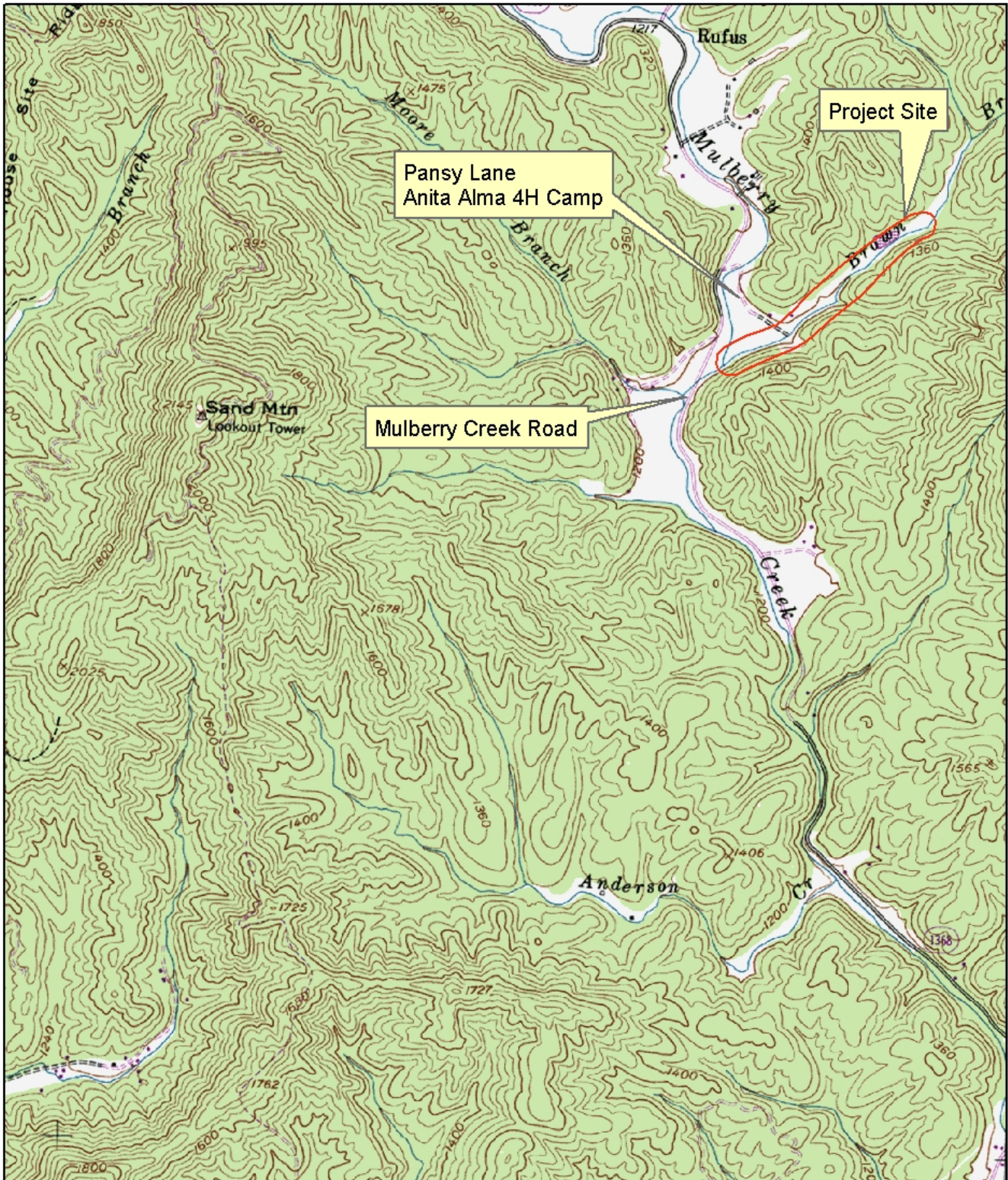
II. Project Background


1. Location and Setting

The North Carolina Wetland Restoration Program conducted a restoration on 5200 feet of Brown Branch stream footage. Brown Branch is located in Caldwell County, North Carolina and is within the Yadkin River Basin. The Brown Branch watershed comprises three square miles and is part of the Elk River drainage, eight-digit hydrologic unit code 06010103.

The project site is 3.5 miles east of Hwy 321 at Happy Valley and 3.0 miles north of Olivette, NC. The Brown Branch restoration reach is entirely contained in the Anita-Alata 4H Camp and is the last mile of the creek before its confluence with Mulberry Creek. The restoration starts immediately downstream from the confluence of two-first order tributaries. The creek flows generally west, along the length of the valley. The restoration reach follows the southern edge of the small valley with a forested hillside along the south bank (river left) and the 4H Campground, a pond and pasture along the north bank (river right).

There is a fence line that separates the grazing pastures in the lower floodplain from the riparian easement. Further up the valley there is no grazing, so no fencing was installed. The camp manager mows the campground, but does not mow the riparian buffer. Except for the difference in vegetation, there are some areas where the easement boundary is not well marked. The camp manager requested that the boundary markers be improved and made easily visible and permanent.



	<p style="text-align: center;">N</p> <p style="text-align: center;">Vicinity Map</p> <p>0 500 1000 2000 Feet</p>	<p style="text-align: right;">EcoLogic Associates, PC April 2006</p> <p style="text-align: center;">Brown Branch Stream Restoration EEP Project # 53, MY 2 (2005) Caldwell County, NC</p> <p>Source: Maptech USGS Topographic Series, Maptech Inc. www.maptech.com/topo Copyright 2002 Maptech</p>
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2. Structure and Objectives

The purpose of this restoration project was to improve water quality in Brown Branch by reducing the severe bank erosion. The stream features that motivated the restoration project were an unstable channel configuration, a featureless bed, a lack of riparian cover. These features caused poor water quality and aquatic habitat.

The goals of the Brown Branch restoration project were to establish a stable plan form, create cross-sectional and profile patterns that will enhance in-stream habitat and water quality, and to improve the functional and aesthetic value of the riparian corridor. The design increased the sinuosity of the channel and incorporated rock and log structures to decrease erosive stress on the banks and provide increased aquatic habitat. By creating a range of aquatic niches, the project intends to provide in-stream habitats that may support future trout populations.

The design increased the sinuosity of the channel and incorporated rock and log structures to decrease erosive stress on the banks and provide increased aquatic habitat.

3. Project History and Background

This stream restoration project was constructed in the summer of 2003 with construction complete in September 2002. At that time an as-built survey was conducted by the design firm Biohabitats, Inc. In October 2003, data was collected by Biohabitats, Inc. and used to produce a one-year monitoring document that is dated May 2004. The first year monitoring document included a list of project performance standards that addressed channel morphology, channel bed substrate and vegetative survival. Due to the heavy rains and resultant high flows during fall 2003, there were problems noted which included erosion behind some structures, and bank failure and erosion on some of the constructed bankfull benches. All of these problems were localized and none were seen as a systemic problem. No repair work was conducted. All of these problem areas were marked as “continue to monitor.”

The present monitoring report collected data during two site visits during summer 2005. This current report is monitoring year number three.

Table I. Project Structure Table	
Project Number and Name: 53 (Brown Branch)	
Segment/Reach ID	Linear Feet or Acreage
Brown Branch	5210 (restored)

Table II. Project Objectives Table			
Project Number and Name: 53 (Brown Branch)			
Segment/Reach ID	Objectives	Linear Feet or Acreage	Comments
Brown Branch	Restoration	5210 feet	Restore Stream Dimension, Pattern and Profile

Table III. Project Activity and Reporting History		
Project Number 53 (Brown Branch)		
Activity or Report	Calendar Year of Completion or Planned Completion	Actual Completion Date
Restoration Plan	2002	2002
Year 1 Monitoring	2003	May 2004
Year 2 Monitoring	2004	October 2005
Year 3 Monitoring	2005	
Year 4 Monitoring	2006	
Year 5 Monitoring	2007	
Year + Monitoring		

Table IV. Project Contact Table	
Project Number: 53 (Brown Branch)	
Designer Biohabitats, Inc. Primary project design POC Ellen McClure	Firm Information / Address 15 West Aylesburg Road Timonium, Maryland, 21093 POC name and phone (800) 220-0919
Construction Contractor NA* Construction contractor POC	Firm Information / Address NA* POC name and phone NA*
Planting Contractor NA* Planting contractor POC	Firm Information / Address NA* POC name and phone NA*
Seeding Contractor NA* Planting contractor point of contact	Company Information / Address NA* POC name and phone NA*
Seed Mix Sources = NA*	Company and Contact Phone NA*
Nursery Stock Suppliers = NA*	Company and Contact Phone NA*
Monitoring Performers EcoLogic Associates, P.C. Stream Monitoring POC Vegetation Monitoring POC Wetland Monitoring POC NA	Firm Information / Address 4321-A South Elm-Eugene St., Greensboro, NC 27406 POC name and phone Kyle Hoover, 336-355-1108 POC name and phone Moni Bates 336-355-1108 POC name and phone NA
* Historical project documents necessary to provide this data were unavailable at the time of this report submission	

Table V. Project Background Table	
Project Number: 53 (Brown Branch)	
Project County	Caldwell
Drainage Area	1.2 square miles
Drainage impervious cover estimate (%) For example	1% or less
Stream Order	2 nd
Physiographic Region	Mountains
Ecoregion	Eastern Blue Ridge Foothills (661)
Rosgen Classification of As-built	C4
Dominant soil types	Colvard
Reference site ID	NA*
USGS HUC for Project and Reference	3050101
NCDWQ Sub-basin for Project and Reference	CTB31 11-38-32-13
NCDWQ classification for Project and Reference	B: Tr
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	NA*
% of project easement fenced	25 (one side, lower portion)
* Historical project documents necessary to provide this data were unavailable at the time of this report submission	

4. Monitoring Plan View

Please see following insert (Figure 3)

III. Project Condition and Monitoring Results

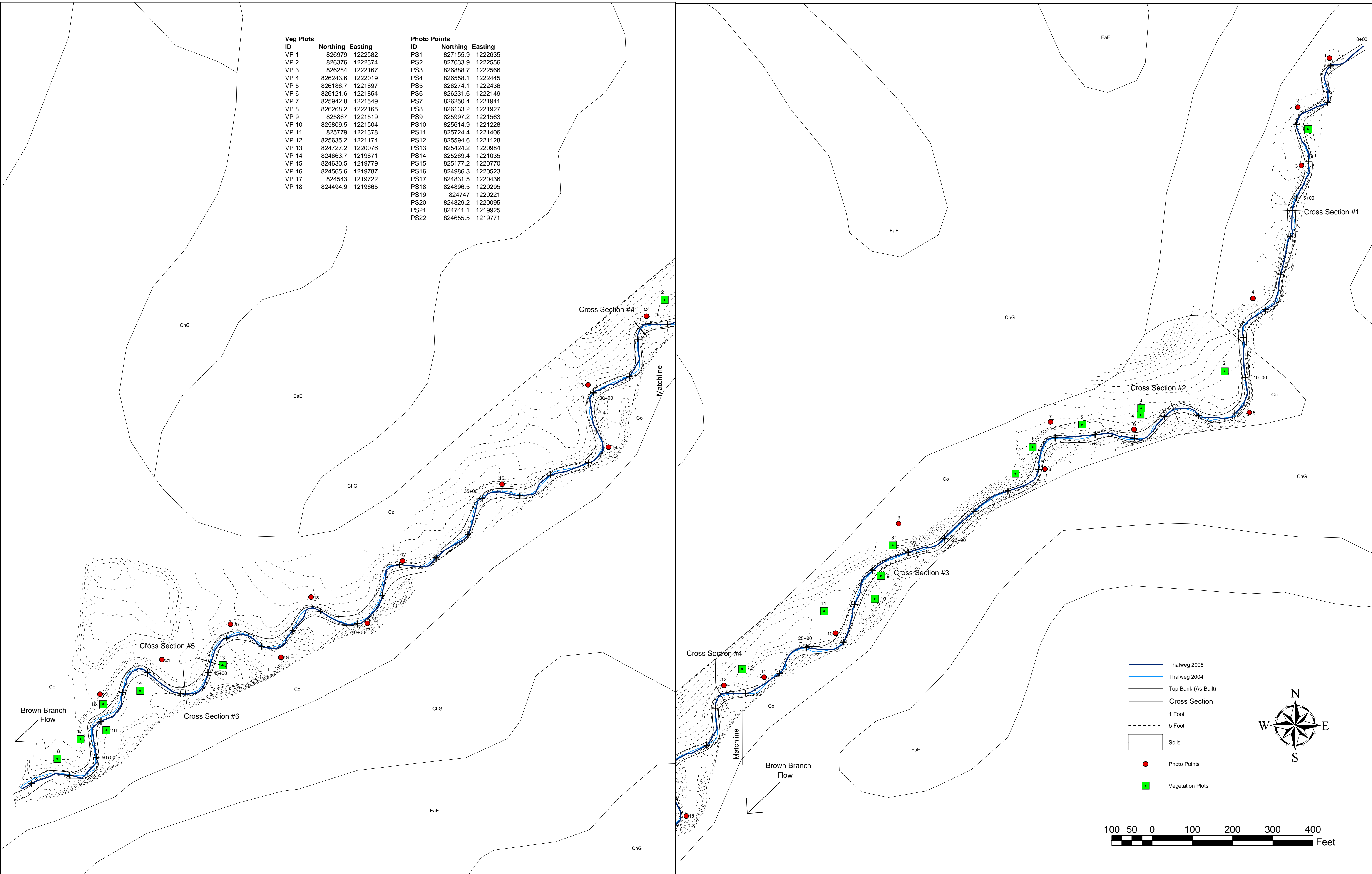
A. Vegetation Assessment

1. Soil Data

The soils along Brown Branch are classified as Cullowhee loam with characteristic very deep profiles, frequent flooding and a slope of less than 3%. These soils have somewhat poor drainage but rapid permeability and a low shrink swell potential. The seasonal high water table appears between 1.5 and 2.0 feet and these soils have very low erosion potential. The surface contains significant amounts of organic material and is typically

Veg Plots		
ID	Northing	Easting
VP 1	826979	1222582
VP 2	826376	1222374
VP 3	826284	1222167
VP 4	826243.6	1222019
VP 5	826186.7	1221897
VP 6	826121.6	1221854
VP 7	825942.8	1221549
VP 8	826268.2	1221165
VP 9	825867	1221519
VP 10	825809.5	1221504
VP 11	825779	1221378
VP 12	825635.2	1221174
VP 13	824727.2	1220076
VP 14	824663.7	1219871
VP 15	824630.5	1219779
VP 16	824565.6	1219787
VP 17	824543	1219722
VP 18	824494.9	1219665

Photo Points		
ID	Northing	Easting
PS1	827155.9	1222635
PS2	827033.9	1222556
PS3	826888.7	1222566
PS4	826558.1	1222445
PS5	826274.1	1222436
PS6	826231.6	1222149
PS7	826250.4	1221941
PS8	826133.2	1221927
PS9	825997.2	1221563
PS10	825614.9	1221228
PS11	825724.4	1221406
PS12	825594.6	1221128
PS13	825424.2	1220984
PS14	825269.4	1221035
PS15	825177.2	1220770
PS16	824986.3	1220523
PS17	824831.5	1220436
PS18	824896.5	1220295
PS19	824747	1220221
PS20	824829.2	1220095
PS21	824741.1	1219925
PS22	824655.5	1219771



——— Thalweg 2005
 ——— Thalweg 2004
 ——— Top Bank (As-Built)
 ——— Cross Section
 - - - 1 Foot
 - - - 5 Foot
 Soils
 ● Photo Points
 ■ Vegetation Plots

N
 W — + — E
 S

100 50 0 100 200 300 400
 Feet

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Project:
 Brown Branch Stream Restoration
 Caldwell County, NC
Prepared For:
 NC Ecosystem Enhancement Program

Project Number:
 53

Map Title:
 Monitoring
 Plan View

Monitoring Year:
 3 (2005)

Date:
 2/27/06

Figure Number:
 3

2. Problem Areas Table Summary

Table IX. Stream Problem Areas Project Number: 53 Segment Reach: Brown Branch				
Feature Issue	Station	Suspected Cause	Photo	Severity
Bank erosion	3+60	Scour	PA1	Yellow
Bank erosion	5+00	Overland flow	PA2	Yellow
Bank erosion	6+70	Scour	PA3	Yellow
Channel	7+25	Threaded	PA4	Yellow
Bank erosion	7+75	Scour	PA5	Yellow
Bank erosion	9+00	Scour	PA6	Yellow
Channel	10+50	Threaded	PA7	Yellow
Bank erosion	11+00	Scour	PA8	Yellow
Bank erosion	13+90	Overland flow	PA9	Yellow
Bank erosion	22+00	Scour	PA10	Yellow
Structure degradation	24+25	Scour	PA11	Yellow
Bank erosion	29+75	Scour	PA12	Yellow
Channel	40+25	Threaded	PA13	Yellow
Bank erosion	44+00	Scour	PA14	Red
Bank erosion	46+50	Scour	PA15	Red
Bank erosion	48+75	Scour	PA16	Red

3. Numbered Issues Photo Section

Please see Appendix B.2.

4. Fixed Photo Station Points

Please see Appendix B.3.

Table VIII. Stem counts for each species arranged by plot.
Project Number: 00053
Segment Reach: Brown Branch

Species	Plots																		Year 2 Totals	Year 1 Totals	Initial Totals	Survival %	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
Shrubs																							
Cornus amomum					2	7			2										11	NA	NA		
Alnus serrulata				1	2	4			1						4	2			14	NA	NA		
Lindera benzoin		2	3						1	1									7	NA	NA		
Trees																							
Salix nigra									1										1	NA	NA		
Platanus occidentalis				2	4	1		3	2	3							3	20	38	NA	NA		
Prunus sp									3							1			4	NA	NA		
Fraxinus sp																	1	1	2	NA	NA		
Quercus sp.						1	1												2	NA	NA		
Acer rubrum	1				1	3													5	NA	NA		
Liriodendron tulipifera	1	1		1			4	4	2	5	1								19	NA	NA		
Fraxinus americana		1			1	2		1											5	NA	NA		
Betula nigra				1	6		6	1											14	NA	NA		
Nyssa sylvatica	4					4								1					9	NA	NA		
Betula lenta						1		2					2	1	5		1		12	NA	NA		
Fraxinus pennsylvanica										1									1	NA	NA		
Alnus serrulata																		2	2	NA	NA		

NA: Historical project documents necessary to provide this data were unavailable at the time of this report submission.

2. Problem Areas Table Summary

Table IX. Stream Problem Areas				
Project Number: 53				
Segment Reach: Brown Branch				
Feature Issue	Station	Suspected Cause	Photo	Severity
Bank erosion	3+60	Scour	PA1	Yellow
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Channel	7+25	Threaded	PA4	Yellow
Bank erosion	7+75	Scour	PA5	Yellow
Bank erosion	9+00	Scour	PA6	Yellow
Channel	10+50	Threaded	PA7	Yellow
Bank erosion	11+00	Scour	PA8	Yellow
Bank erosion	13+90	Overland flow	PA9	Yellow
Bank erosion	22+00	Scour	PA10	Yellow
Structure degradation	24+25	Scour	PA11	Yellow
Bank erosion	29+75	Scour	PA12	Yellow
Channel	40+25	Threaded	PA13	Yellow
Bank erosion	44+00	Scour	PA14	Red
Bank erosion	46+50	Scour	PA15	Red
Bank erosion	48+75	Scour	PA16	Red

3. Numbered Issues Photo Section

Please see Appendix B.2.

4. Fixed Photo Station Points

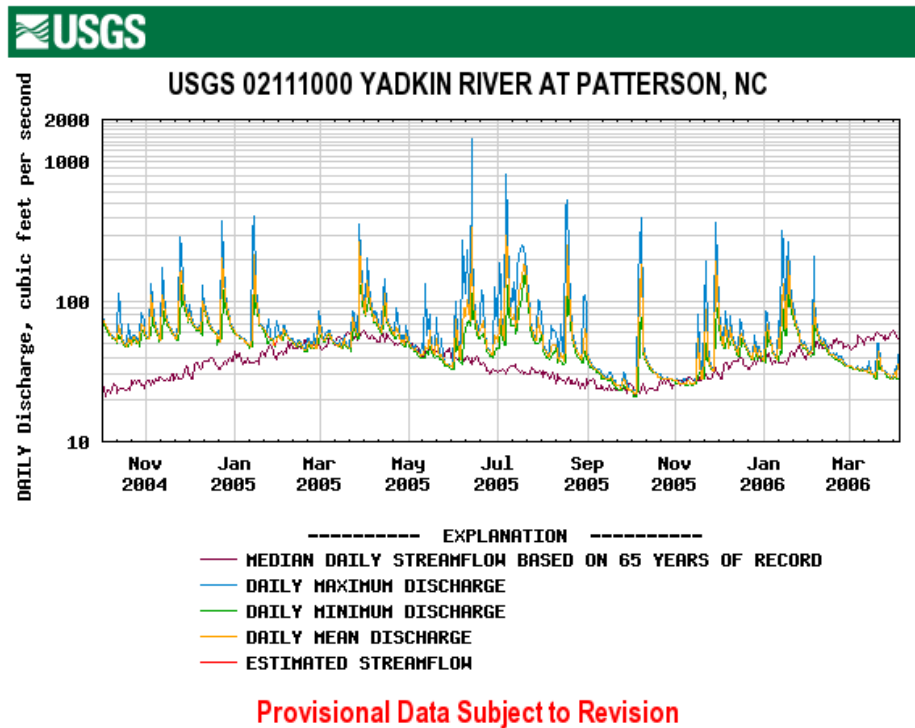
Please see Appendix B.3.

5. Stability Assessment

Table X. Categorical Stream Feature Visual Stability Assessment						
Project Number: 53						
Segment/Reach: Brown Branch						
	2002	2003	2004	2005	2006	2007
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	100%	NA*	NA*	100%		
B. Pools	100%	NA*	NA*	98%		
C. Thalweg	100%	NA*	NA*	96%		
D. Meanders	100%	NA*	NA*	100%		
E. Bed General	100%	NA*	NA*	NA		
F. Channel General	100%	NA*	NA*	NA		
G. Banks	100%	NA*	NA*	NA		
H. Vanes / J Hooks etc.	100%	NA*	NA*	100%		
I. Wads and Boulders	100%	NA*	NA*	NA		
*NA: Historical project documents necessary to provide this data were unavailable at the time of this report submission						

6. Quantitative Morphology

No crest gages are installed at this site to document bankfull events. Therefore, potential occurrence was extrapolated based on USGS stream gage discharge data for the Yadkin River near Patterson, NC. The gage is located about four (4) miles from the project site in a different watershed and has a drainage area of 28.8 square miles. An estimate of the number of bankfull events in 2005 was made by comparing the stream discharges from the USGS data in cubic feet per second (cfs) against the bankfull discharge estimated from the drainage area on the Rural Piedmont Regional Curve. According to the regional curve, a bankfull event occurs on a stream with a 28.8-mi² drainage area when the discharge is about 1,000 cfs. Based on this secondary surrogate USGS data, an estimated one (1) bankfull event occurred in 2005.



Please see pages 11-12 for tables XI and XII.

IV. Methodology Section

The methods used to generate the data in this monitoring report are standard fluvial geomorphology techniques as described in *Applied River Morphology*, 1996, D.L. Rosgen and related publications from US Forest Service and the interagency Stream Mitigation Guidelines, 2003, USACOE, USEPA, NCWRC, NCDENR-DWQ.

EcoLogic's field morphology survey was conducted using a Nikon total station and the data was analyzed and displayed using RiverMorph version 3.1 software. The pebble counts were conducted using Pocket RiverMorph software and a PDA. The vegetation problem areas and structural problem areas were noted in the field on the PDA.

Photographs were taken at medium-high resolution using a Nikon Coolpix 4600 digital camera.

GPS location information was collected using a Trimble Geo XT handheld mapping grade GPS unit. GPS locations were collected on all problem areas, photo points and at least one corner of each vegetation-monitoring plot.

Vegetation monitoring plots were marked in the field by placing a steel conduit with blue flagged at each corner. In addition, the up-stream, outside corner was marked with a three-foot length of white plastic pipe tied with orange flagging. Individual plants in the monitoring plots were tied with white flagging.

Table XI. Baseline Morphology and Hydraulic Summary																		
Project Number: 00053																		
Segment/Reach: Brown Branch																		
Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Floodprone Width (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BF Cross Sectional Area (ft ²)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BF Mean Depth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BF Max Depth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Width/Depth Ratio	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Entrenchment Ratio	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wetted Perimeter(ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydraulic radius (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pattern																		
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meander Wavelength (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meander Width ratio	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Profile																		
Riffle length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Riffle slope (ft/ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pool length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pool spacing (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
d84 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Additional Reach Parameters																		
Valley Length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Channel Length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sinuosity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Water Surface Slope (ft/ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BF slope (ft/ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rosgen Classification	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Number of Bankfull Events	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Extent of BF floodplain (acres)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
*BEHI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
*Habitat Index	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
*Macrobenthos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA = Historical project documents necessary to provide this data were unavailable at the time of this report submission.																		

Table XII. Morphology and Hydraulic Monitoring Summary																																				
Project Number: 00053																																				
Segment/Reach: Brown Branch																																				
Parameter	Cross Section 1						Cross Section 2						Cross Section 3						Cross Section 4						Cross Section 5						Cross Section 6					
	Riffle						Pool						Riffle						Pool						Riffle						Pool					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	14.1	15.2	14.7				22.5	23.1	20				16.6	15.1	17.14				22.9	24.7	22.3				14.6	15.3	17.5				21.6	21.3	18.9			
Floodprone Width (ft)	NA	NA	31.2				NA	NA	33.4				NA	NA	38				NA	NA	35.4				NA	NA	55.9				NA	NA	47			
BF Cross Sectional Area (ft ²)	22.7	19.8	21				12.2	9.5	14.7				14.9	14.9	15.8				22.5	23.2	16.4				14.8	15.1	15.7				24.9	21.7	18.5			
BF Mean Depth (ft)	1.6	1.3	1.5				0.5	0.4	0.74				1.1	1	0.92				1	0.9	0.74				1	1	0.9				1.2	1	1			
BF Max Depth (ft)	2.3	2.1	1.9				1.5	1.6	1.5				1.7	1.8	2.65				2.1	1.9	1.6				1.5	1.4	1.3				1.8	1.8	1.7			
Width/Depth Ratio	8.8	11.6	10.3				41.4	55.8	27.1				13.3	14.7	18.6				23.3	26.2	30.3				14.4	15.4	19.5				18.7	20.8	19.3			
Entrenchment Ratio	NA	NA	2.1				NA	NA	1.7				NA	NA	2.25				NA	NA	1.6				NA	NA	3.19				NA	NA	2.5			
Wetted Perimeter (ft)	NA	NA	15.8				NA	NA	20.8				NA	NA	19.11				NA	NA	22.8				NA	NA	18.1				NA	NA	19.5			
Hydraulic radius (ft)	NA	NA	1.3				NA	NA	0.7				NA	NA	0.83				NA	NA	0.7				NA	NA	0.87				NA	NA	0.95			
Substrate																																				
d50 (mm)	NA	14.4	0.62				NA	0.25	1				NA	17.69	1.24				NA	16	1.44				NA	1.4	1.84				NA	1.4	1.9			
d84 (mm)	NA	48	8.55				NA	11.12	10.6				NA	42	17.3				NA	44	17.47				NA	12.2	23.64				NA	38	11.3			
Parameter	MY-01 (2003)						MY-02 (2004)						MY-03 (2005)						MY-04 (2006)						MY-05 (2007)						MY+ (2008)					
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med			
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA	33	140	70																											
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA	23	147	63																											
Meander Wavelength (ft)	NA	NA	NA	NA	NA	NA	130	350	215																											
Meander Width ratio	NA	NA	NA	NA	NA	NA	1.83	7.7	3.8																											
Profile																																				
Riffle length (ft)	NA	NA	NA	NA	NA	NA	5.4	60.4	28																											
Riffle slope (ft/ft)	NA	NA	NA	NA	NA	NA	0.005	0.079	0.019																											
Pool length (ft)	NA	NA	NA	NA	NA	NA	4.2	122	36																											
Pool spacing (ft)	NA	NA	NA	NA	NA	NA	1.5	198	71																											
Additional Reach Parameters																																				
Valley Length (ft)	NA			NA			3800																													
Channel Length (ft)	NA			NA			5200																													
Sinuosity	NA			NA			1.3																													
Water Surface Slope (ft/ft)	NA			NA			0.009																													
BF slope (ft/ft)	NA			NA			0.008																													
Rosgen Classifier	NA			NA			C																													
Number of Bankfull Events	NA			NA			1 est																													
Extent of BF floodplain (area)	NA			NA			2.5 ac																													
BEHI ⁹	NA			NA			NA																													
Habitat Index ⁸	NA			NA			NA																													
Macrobenthos ⁸	NA			NA			NA																													

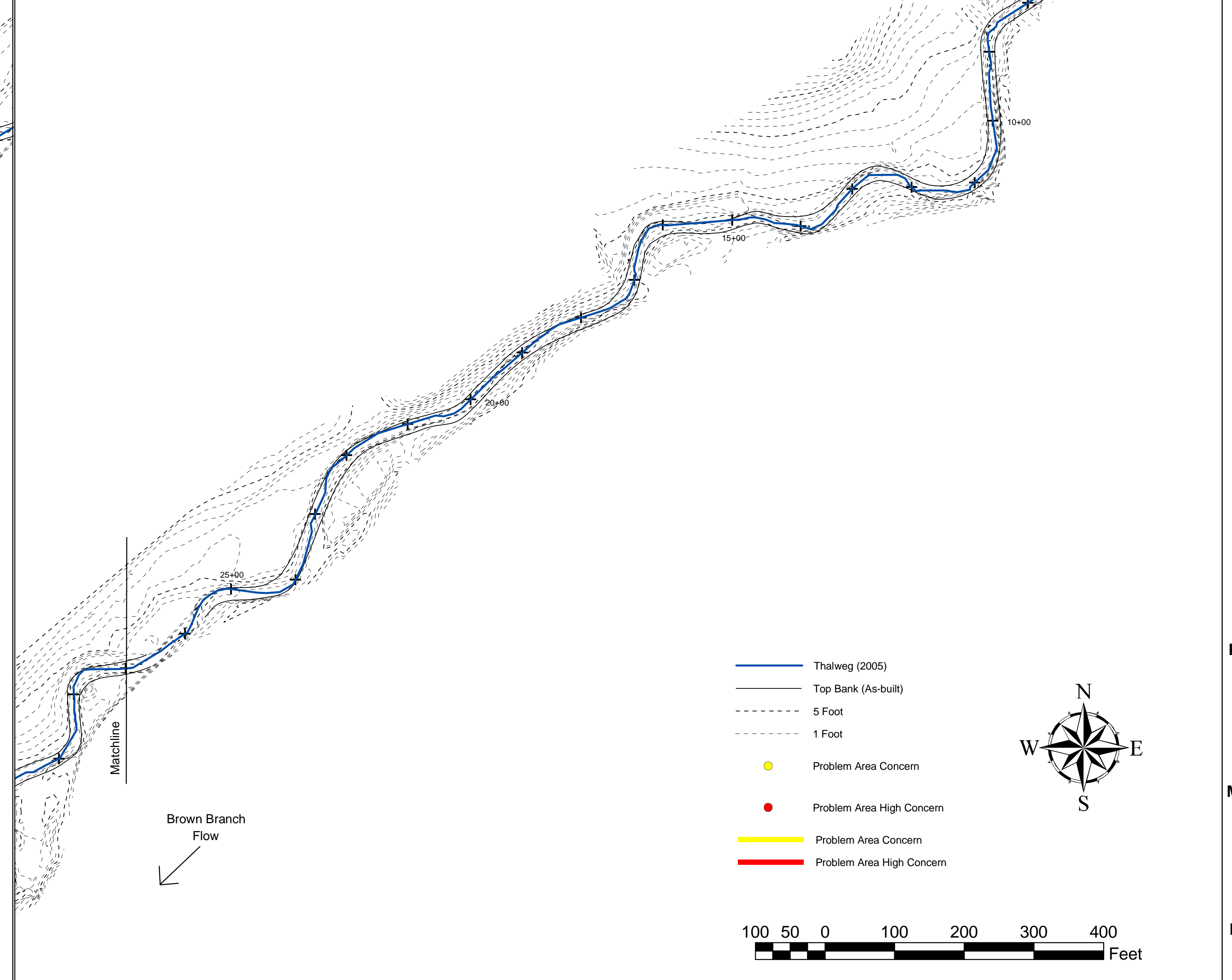
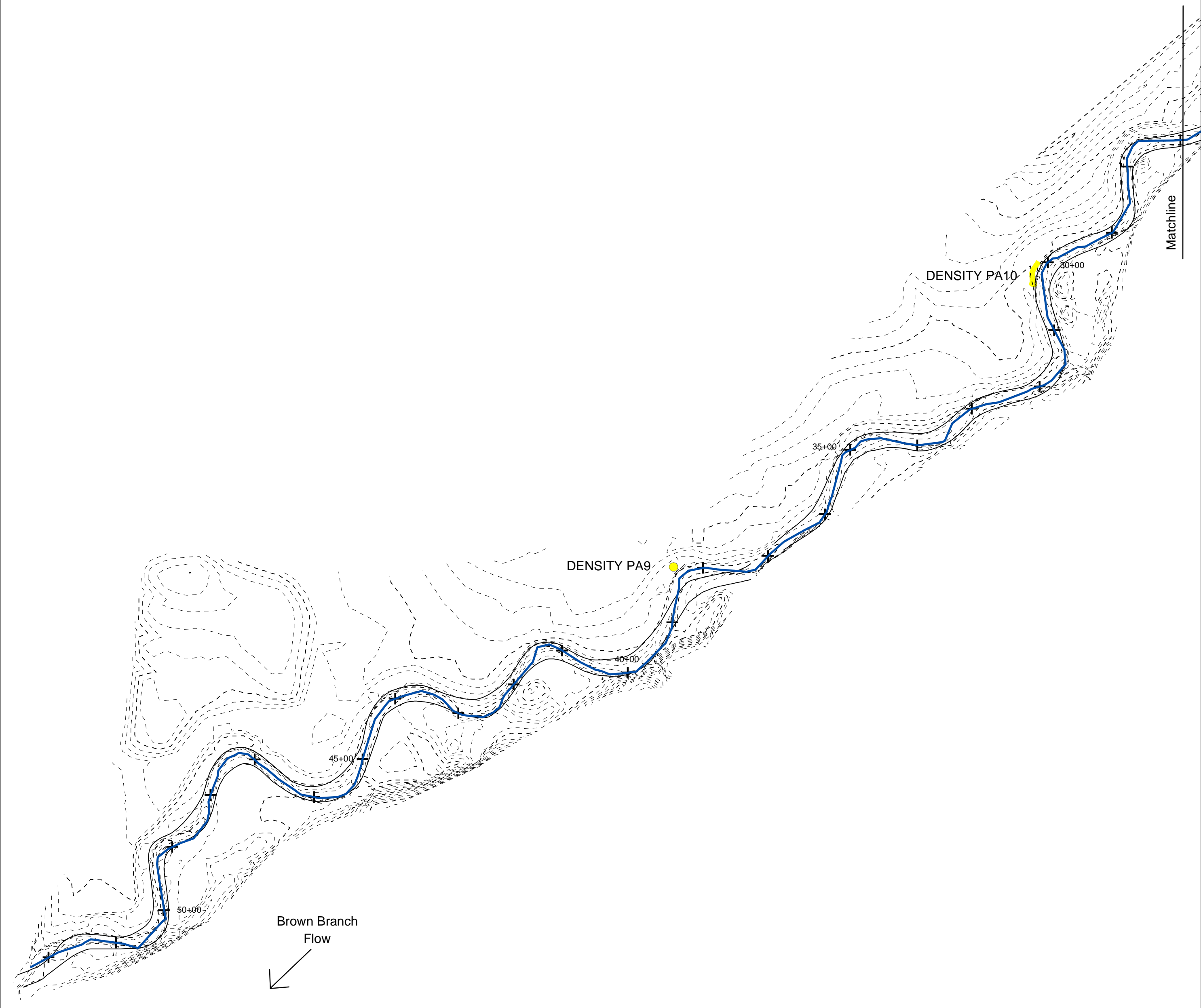
NA = Historical project documents necessary to provide this data were unavailable at the time of this report submission

Appendix A. 1

Appendix A. 1

Vegetation Problem Areas				
Project Number: 53				
Segment Reach: Brown Branch				
Feature Issue	Station	Suspected Cause	Photo	Severity
density	13+90	bank erosion	PA9	yellow
density	22+00	scour	PA10	yellow

Notes:
Vegetation problems were assessed without a species list or planting plan. This limited observable vegetation problems to thin and bare spots that indicate poor seed germination or other vegetation problems and obvious aggressive invasive species.



— Thalweg (2005)
— Top Bank (As-built)
- - - 5 Foot
- - - 1 Foot
● Problem Area Concern
● Problem Area High Concern
— Problem Area Concern
— Problem Area High Concern



Appendix A. 2

Raw Data - Stem Counts	
EEP Project #: 00053	Date: 8/31/2005
Project Name: Brown Branch	Staff Name Moni Bates
Monitoring Contractor: EcoLogic	Staff Name Darrell Timpany
County: Caldwell	Staff Name
8 Digit Catalog Unit: 03030005	Staff Name
Stream/Wetland Name: Brown Branch	Staff Name

Plot Location		
Plot ID	Species	Stem #
1	Liriodendron tulipifera	1
	Acer rubrum	1

Plot Location		
Plot ID	Species	Stem #
2	Lindera benzoin	2
	Liriodendron tulipifera	1
	Fraxinus americana	1

Plot Location		
Plot ID	Species	Stem #
3	Lindera benzoin	3

Plot Location		
Plot ID	Species	Stem #
4	Liriodendron tulipifera	1
	Betula nigra	1
	Alnus serrulata	1
	Platanus occidentalis	2

Plot Location		
Plot ID	Species	Stem #
5	Betula nigra	6
	Alnus serrulata	2
	Platanus occidentalis	4
	Acer rubrum	1
	Fraxinus americana	1
	Cornus amomum	2

Plot Location		
Plot ID	Species	Stem #
6	Alnus serrulata	4
	Platanus occidentalis	1
	Acer rubrum	3
	Fraxinus americana	2
	Cornus amomum	7
	Nyssa sylvatica	4
	Quercus sp.	1

Plot Location		
Plot ID	Species	Stem #
7	Liriodendron tulipifera	4
	Betula nigra	6
	Quercus sp.	1

Plot Location		
Plot ID	Species	Stem #
8	Liriodendron tulipifera	4
	Betula nigra	1
	Betula lenta	2
	Fraxinus americana	1
	Platanus occidentalis	3

Plot Location		
Plot ID	Species	Stem #
9	Alnus serrulata	1
	Platanus occidentalis	2
	Liriodendron tulipifera	2
	Salix nigra	1
	Prunus sp. (?)	3
	Cornus amomum	2
	Lindera benzoin	1

Plot Location		
Plot ID	Species	Stem #
11	Liriodendron tulipifera	1

Plot Location		
Plot ID	Species	Stem #
13	Betula lenta	2
	A lot of volunteers	

Plot Location		
Plot ID	Species	Stem #
15	Betula lenta	5
	Alnus serrulata	4

Plot Location		
Plot ID	Species	Stem #
17	Fraxinus sp	1
	Betula lenta	1
	Platanus occidentalis	3

Plot Location		
Plot ID	Species	Stem #
10	Lindera benzoin	1
	Platanus occidentalis	3
	Liriodendron tulipifera	5
	Fraxinus pennsylvanica	1

Plot Location		
Plot ID	Species	Stem #
12	Liriodendron tulipifera	4
	Alnus serrulata	1
	Prunus sp. (?)	1
	Betula lenta	1
	Platanus occidentalis	11
	A lot of volunteers	

Plot Location		
Plot ID	Species	Stem #
14	Betula lenta	1
	Nyssa sylvatica	1
	A lot of volunteers	

Plot Location		
Plot ID	Species	Stem #
16	Alnus serrulata	2
	Prunus sp. (?)	1
	A lot of volunteers	

Plot Location		
Plot ID	Species	Stem #
18	Platanus occidentalis	20
	Fraxinus sp.	1
	Alnus serrulata	2

Appendix A. 3



PA 9



PA 10

Appendix A. 4



VP 5



VP 11



VP 14

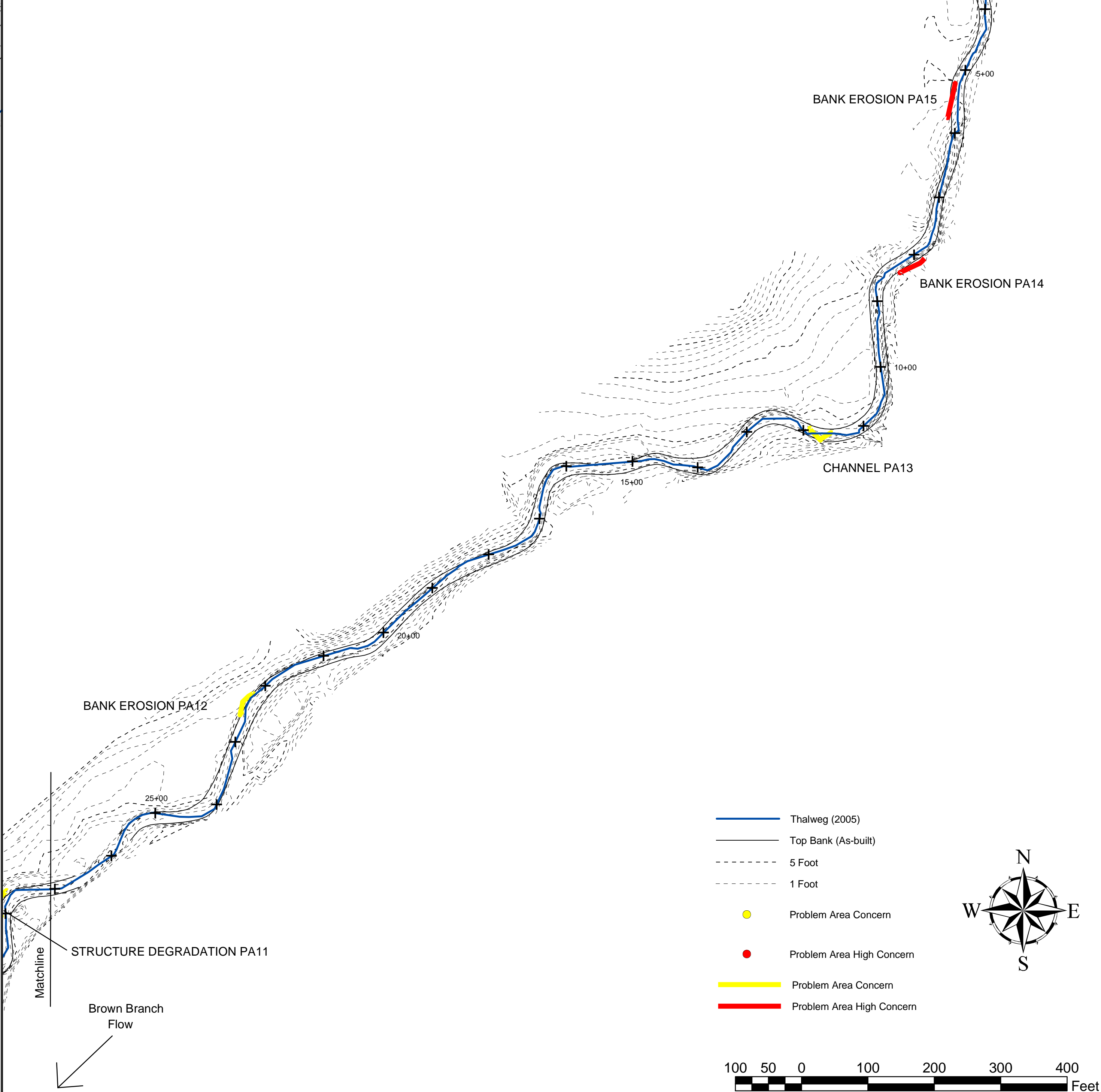
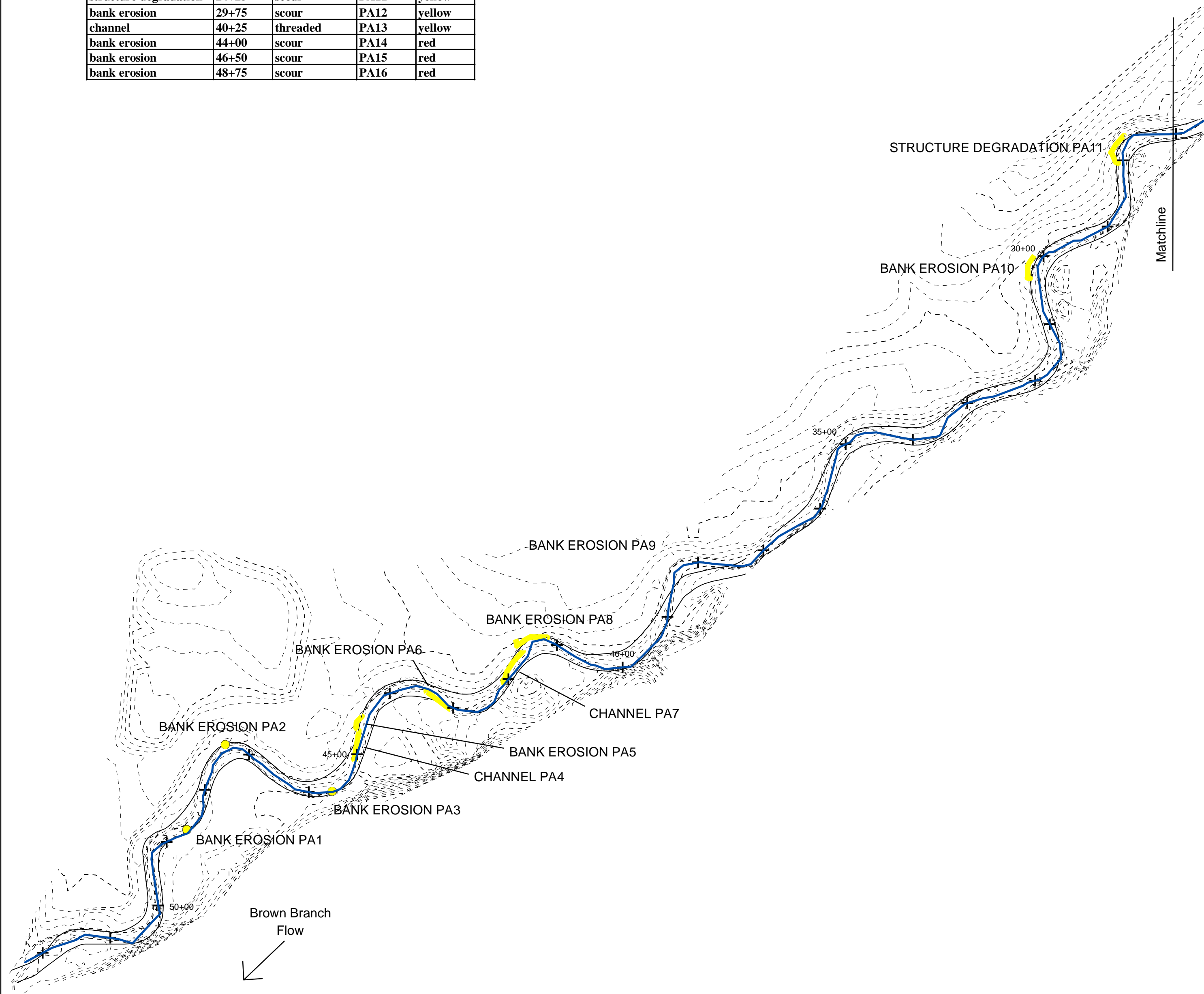


VP 15

Appendix B. 1

Appendix B. 1

Stream Problem Areas				
Project Number: 53				
Segment Reach: Brown Branch				
Feature Issue	Station	Suspected Cause	Photo	Severity
bank erosion	3+60	scour	PA1	yellow
bank erosion	5+00	overland flow	PA2	yellow
bank erosion	6+70	scour	PA3	yellow
channel	7+25	threaded	PA4	yellow
bank erosion	7+75	scour	PA5	yellow
bank erosion	9+00	scour	PA6	yellow
channel	10+50	threaded	PA7	yellow
bank erosion	11+00	scour	PA8	yellow
bank erosion	13+90	overland flow	PA9	yellow
bank erosion	22+00	scour	PA10	yellow
structure degradation	24+25	scour	PA11	yellow
bank erosion	29+75	scour	PA12	yellow
channel	40+25	threaded	PA13	yellow
bank erosion	44+00	scour	PA14	red
bank erosion	46+50	scour	PA15	red
bank erosion	48+75	scour	PA16	red



— Thalweg (2005)
— Top Bank (As-built)
--- 5 Foot
--- 1 Foot
● Problem Area Concern
● Problem Area High Concern
— Problem Area Concern
— Problem Area High Concern



Appendix B.2



PA 1



PA 2



PA 3



PA 4



PA 5



PA 6



PA 7



PA 8



PA 11



PA 12



PA 13



PA 14



PA 15



PA 16

Appendix B.3



PS 1



PS 2



PS 3



PS 4



PS 5



PS 6



PS 7



PS 8



PS 9



PS 10



PS 11



PS 12



PS 13



PS 14



PS 15



PS 16



PS 17



PS 18



PS 19



PS 20



PS 21

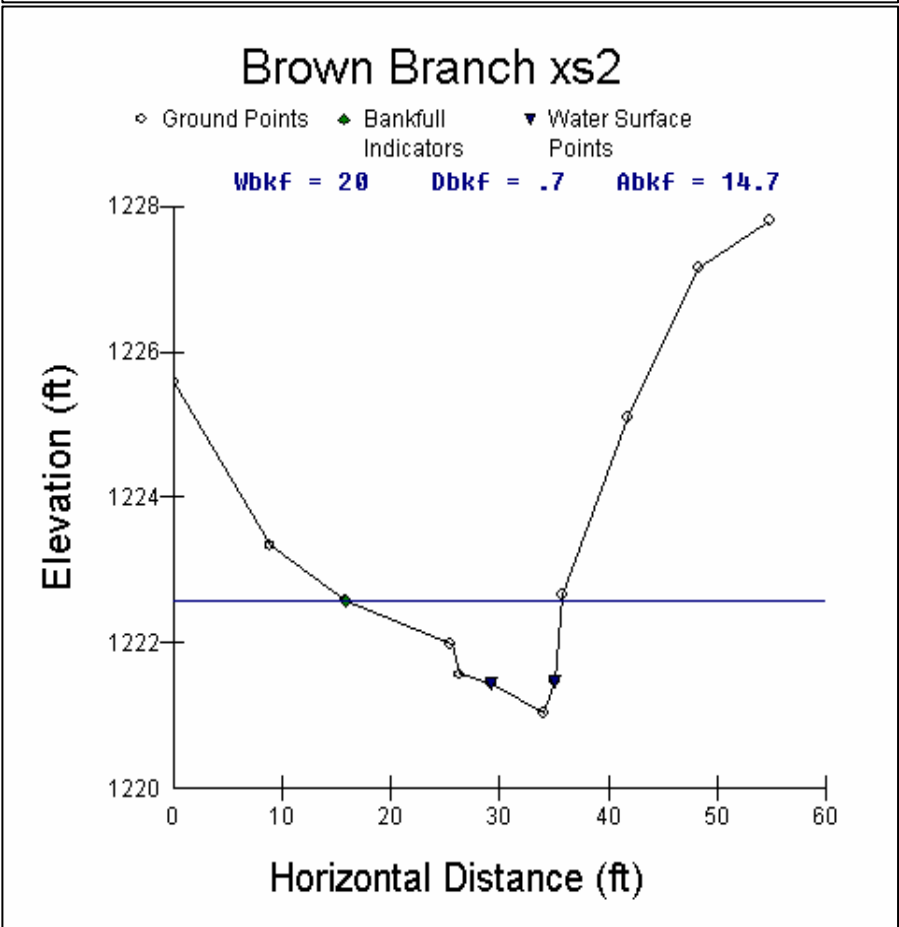
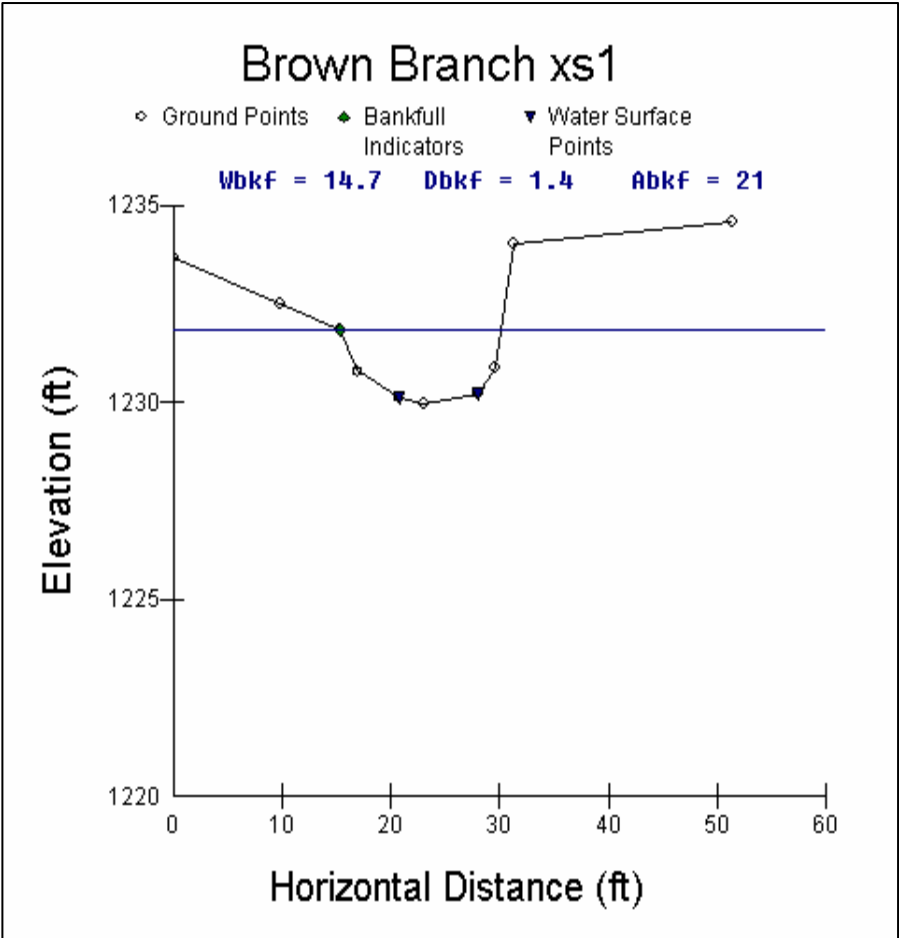


PS 22

Appendix B.4

Table B1. Qualitative Visual Stability Assessment						
Project Number: 00053						
Segment/Reach: Brown Branch						
Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	32	32	0	100	
	2. Armor stable (e.g. no displacement)?	32	32	0	100	
	3. Facet grade appears stable?	32	32	0	100	
	4. Stable interval grade?	32	32	0	100	
	5. Feature spacing appropriate?	32	32	0	100	
	6. Minimal evidence of embedding/fining?	32	32	0	100	
	7. Depth appears appropriate for current discharge?	32	32	0	100	
	8. Length appropriate?	32	32	0	100	
						100
B. Pools	1. Present? (e.g not subject to severe aggradation?) 4	38	38	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	38	38	0	100	
	3. Thalweg located outer bend?	34	38	4/235	89	
	4. Spacing appropriate?	38	38	0	100	
	5. Non-aggrading (not filling)?	38	38	0	100	
	6. Length appropriate?	38	38	0	100	
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	38	38	0	100	
	2. Downstream of meander (glide/inflection) centering?	35	38	2/52	92	
D. Meanders	1. Outer bend in state of limited/controlled erosion?	30	30	0	100	30
	2. Of those eroding, # w/ concomitant point bar formation?	0	NA	0	NA	NA
	3. Apparent Rc within spec?	NA	NA	0	NA	NA
	4. Sufficient floodplain access and relief?	30	30	0	100	30
E. Bed	1. General channel bed aggradation areas (bar formation)	4	NA	0	NA	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	All	NA	None	100	NA
F. Channel Capac./Dimen.	1. Channel width: depth appears out of design/type spec?	All	NA	None	100	NA
G. Banks	1. Apparent scour points from channel processes	Yes	NA	15/155	NA	
	2. Apparent cut points from overland flow	1	NA	0	NA	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	Yes	NA	1/10	NA	NA
	4. Tension cracks	All	NA	None	100	NA
	5. Unstable cantilever blocks (e.g. height/undercut/soil type versus vegetation penetration and extent)	2	NA	0	NA	NA
	6. Bank gradient in excess of 40%?	All	NA	None	100	NA
	7. Collapse/slumping	3	NA	0	NA	NA
	8. Ratio of bank height: bankfull height elevated	All	NA	None	100	NA
H. Vanes	1. Free of back or arm scour?	52	52	1	100	52
	2. Height appropriate?	52	52	0	100	52
	3. Angle and geometry appear appropriate?	52	52	0	100	52
	4. Free of piping or other structural failures?	51	52	1/52	NA	NA
I. Wads/ Boulders	1. Free of scour?	40	44	4	NA	NA
	2. Footing stable?	30	34	4	NA	NA
NA: Historical project documents necessary to provide this data were unavailable at the time of this report submission.						

Appendix B.5



River Name: Catawba River
 Reach Name: Brown Branch
 Cross Section Name: Brown xs1
 Survey Date: 09/16/05

River Name: Catawba River
 Reach Name: Brown Branch
 Cross Section Name: Brown xs2
 Survey Date: 09/16/05

Cross Section Data Entry

BM Elevation: 0 ft
 Backsight Rod Reading: 0 ft

Cross Section Data Entry

BM Elevation: 0 ft
 Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1233.663606	LB
9.84	0	1232.494385	
15.37	0	1231.817712	BKF
16.95	0	1230.79517	
20.74	0	1230.09845	LEW
23.08	0	1229.947895	TW
27.99	0	1230.211028	REW
29.54	0	1230.857815	
31.24	0	1234.033434	
51.4	0	1234.592159	RB

TAPE	FS	ELEV	NOTE
0	0	1225.580667	LP
8.9	0	1223.341434	
15.8	0	1222.566587	BKF
25.54	0	1221.985951	
26.3	0	1221.565042	
29.24	0	1221.448453	LEW
34.1	0	1221.040337	TW
35.11	0	1221.468091	REW
35.81	0	1222.666905	
41.75	0	1225.102586	
48.3	0	1227.155082	
54.84	0	1227.810087	RB

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1233.69	1233.69	1233.69
Bankfull Elevation (ft)	1231.82	1231.82	1231.82
Floodprone Width (ft)	31.06	----	----
Bankfull Width (ft)	14.7	4.79	9.92
Entrenchment Ratio	2.11	----	----
Mean Depth (ft)	1.43	1.05	1.61
Maximum Depth (ft)	1.87	1.61	1.87
Width/Depth Ratio	10.29	4.57	6.15
Bankfull Area (sq ft)	21.01	5.02	15.99
Wetted Perimeter (ft)	15.79	6.76	12.25
Hydraulic Radius (ft)	1.33	0.74	1.3
Begin BKF Station	15.35	15.35	20.14
End BKF Station	30.06	20.14	30.06

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1224.1	1224.1	1224.1
Bankfull Elevation (ft)	1222.57	1222.57	1222.57
Floodprone Width (ft)	33.42	----	----
Bankfull Width (ft)	19.98	14.67	5.31
Entrenchment Ratio	1.67	----	----
Mean Depth (ft)	0.74	0.55	1.27
Maximum Depth (ft)	1.53	1.22	1.53
Width/Depth Ratio	27.14	26.91	4.2
Bankfull Area (sq ft)	14.72	8	6.72
Wetted Perimeter (ft)	20.85	16.03	7.27
Hydraulic Radius (ft)	0.71	0.5	0.92
Begin BKF Station	15.77	15.77	30.44
End BKF Station	35.75	30.44	35.75

Entrainment Calculations

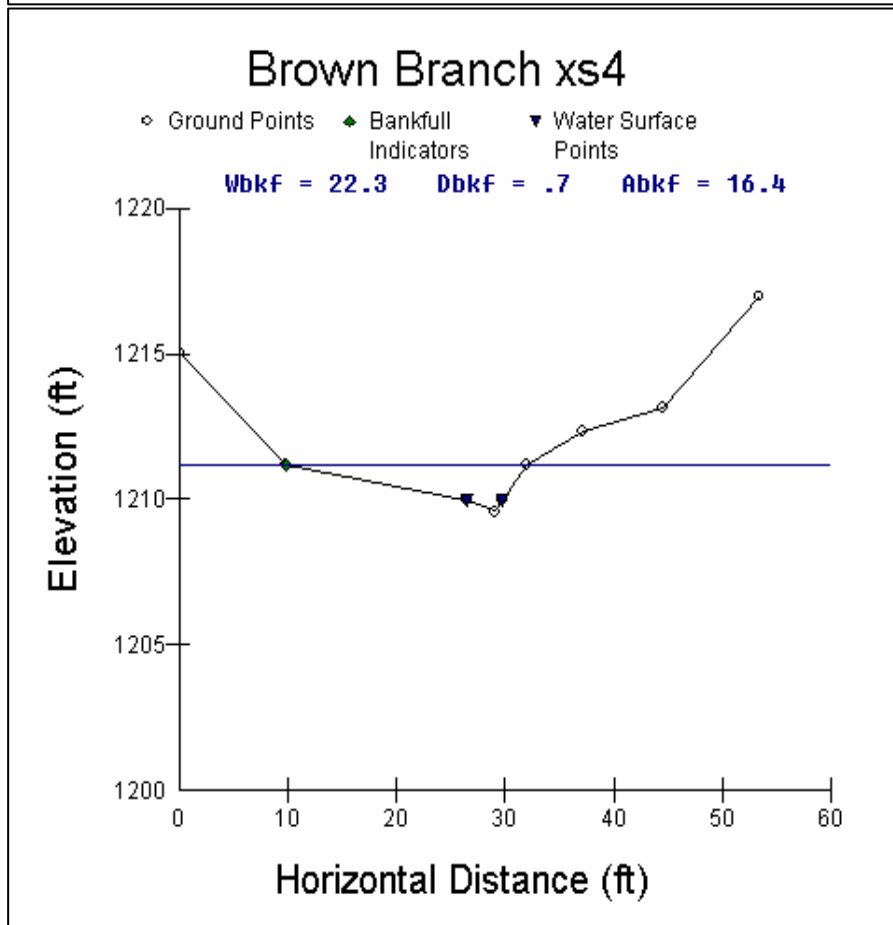
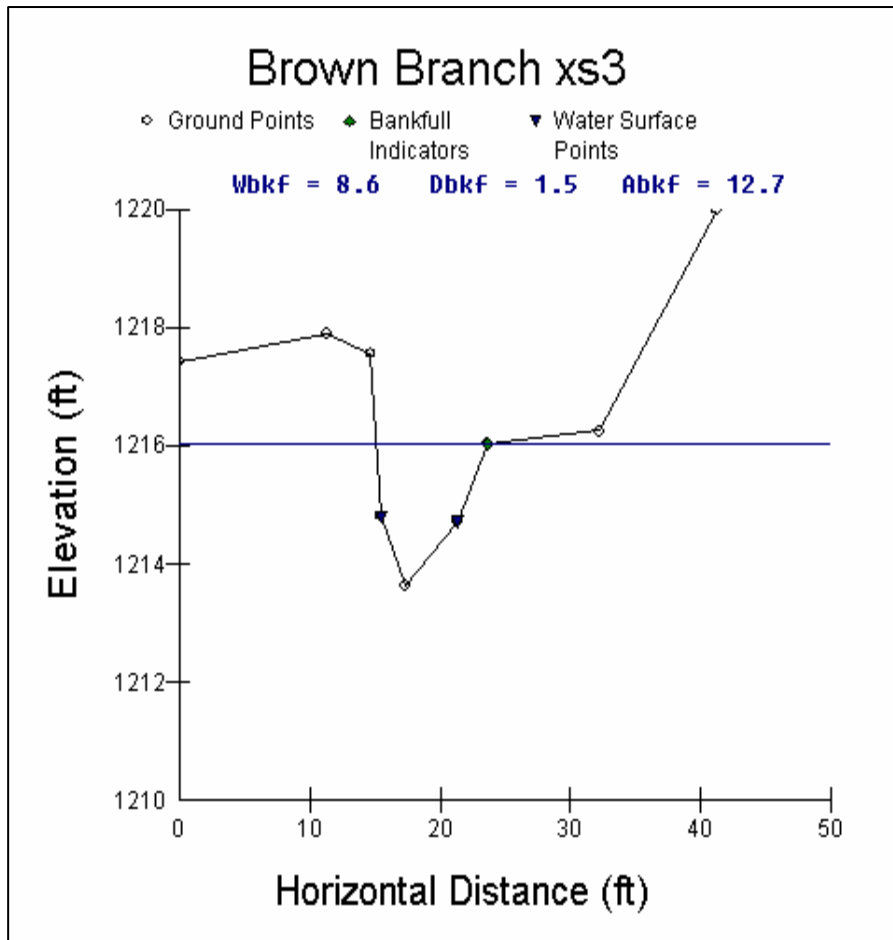
Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			



River Name: Catawba River
 Reach Name: Brown Branch
 Cross Section Name: Brown xs3
 Survey Date: 09/16/05

Cross Section Data Entry

BM Elevation: 0 ft
 Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1217.418434	LB
11.36	0	1217.881995	
14.71	0	1217.550328	
15.46	0	1214.792794	LEW
17.31	0	1213.614857	TW
21.39	0	1214.703292	REW
23.69	0	1216.02326	BKF
32.17	0	1216.245202	
41.2	0	1219.973254	RB

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1218.43	1218.43	1218.43
Bankfull Elevation (ft)	1216.02	1216.02	1216.02
Floodprone Width (ft)	37.45	-----	-----
Bankfull Width (ft)	8.56	8.49	0.06
Entrenchment Ratio	4.38	-----	-----
Mean Depth (ft)	1.48	1.49	0.02
Maximum Depth (ft)	2.41	2.41	0.04
Width/Depth Ratio	5.78	5.7	3.05
Bankfull Area (sq ft)	12.67	12.67	0
Wetted Perimeter (ft)	10.33	10.3	0.11
Hydraulic Radius (ft)	1.23	1.23	0.01
Begin BKF Station	15.13	15.13	23.62
End BKF Station	23.68	23.62	23.68

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

River Name: Catawba River
 Reach Name: Brown Branch
 Cross Section Name: Brown xs4
 Survey Date: 09/16/05

Cross Section Data Entry

BM Elevation: 0 ft
 Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1215.044305	LB
9.81	0	1211.180551	BKF
26.42	0	1209.946448	LEW
29.09	0	1209.581996	TW
29.78	0	1209.949705	REW
32.03	0	1211.162075	
37.11	0	1212.327483	
44.56	0	1213.16045	
53.36	0	1216.975786	RB

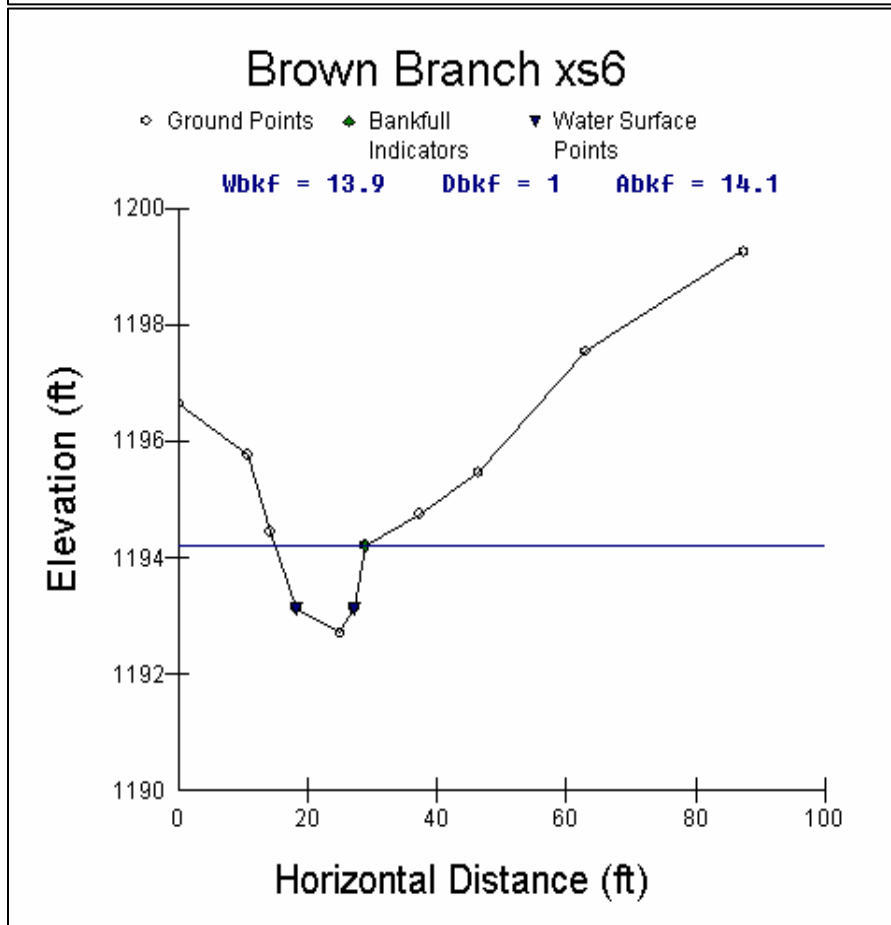
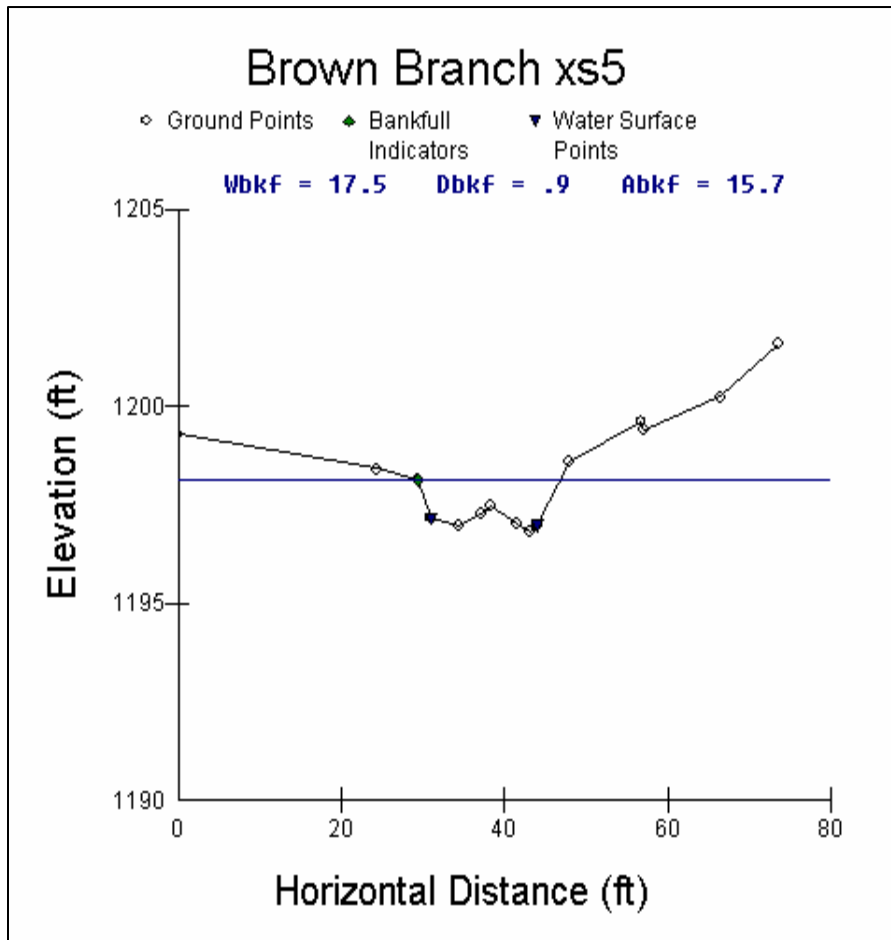
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1212.78	1212.78	1212.78
Bankfull Elevation (ft)	1211.18	1211.18	1211.18
Floodprone Width (ft)	35.39	-----	-----
Bankfull Width (ft)	22.29	11.66	10.63
Entrenchment Ratio	1.59	-----	-----
Mean Depth (ft)	0.74	0.43	1.07
Maximum Depth (ft)	1.6	0.87	1.6
Width/Depth Ratio	30.3	26.92	9.95
Bankfull Area (sq ft)	16.4	5.05	11.35
Wetted Perimeter (ft)	22.76	12.56	11.93
Hydraulic Radius (ft)	0.72	0.4	0.95
Begin BKF Station	9.82	9.82	21.48
End BKF Station	32.11	21.48	32.11

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			



River Name: Catawba River
 Reach Name: Brown Branch
 Cross Section Name: Brown xs5
 Survey Date: 09/16/05

Cross Section Data Entry

BM Elevation: 0 ft
 Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1199.275036	LB
24.37	0	1198.399837	
29.46	0	1198.125222	BKF
31.04	0	1197.141875	LEW
34.47	0	1196.966311	TW
37.13	0	1197.263011	
38.36	0	1197.454224	
41.49	0	1197.012322	
43.09	0	1196.81402	TW2
44.07	0	1196.979695	REW
47.99	0	1198.591833	
56.68	0	1199.604594	RB
57.03	0	1199.405019	
66.43	0	1200.233633	
73.45	0	1201.584153	RB

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1199.45	1199.45	1199.45
Bankfull Elevation (ft)	1198.13	1198.13	1198.13
Floodprone Width (ft)	55.86	-----	-----
Bankfull Width (ft)	17.5	1.17	16.33
Entrenchment Ratio	3.19	-----	-----
Mean Depth (ft)	0.9	0.32	0.94
Maximum Depth (ft)	1.32	0.68	1.32
Width/Depth Ratio	19.5	3.71	17.39
Bankfull Area (sq ft)	15.7	0.37	15.33
Wetted Perimeter (ft)	18.1	2.04	17.41
Hydraulic Radius (ft)	0.87	0.18	0.88
Begin BKF Station	29.37	29.37	30.54
End BKF Station	46.87	30.54	46.87

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

River Name: Catawba River
 Reach Name: Brown Branch
 Cross Section Name: Brown xs6
 Survey Date: 09/16/05

Cross Section Data Entry

BM Elevation: 0 ft
 Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1196.645663	LB
10.75	0	1195.767224	
14.28	0	1194.438585	
18.36	0	1193.108624	LEW
25.07	0	1192.696251	TW
27.14	0	1193.131902	REW
28.85	0	1194.197579	BKF
37.4	0	1194.743956	
46.46	0	1195.443302	
63.13	0	1197.541468	
87.46	0	1199.259221	RB

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1195.7	1195.7	1195.7
Bankfull Elevation (ft)	1194.2	1194.2	1194.2
Floodprone Width (ft)	37.61	-----	-----
Bankfull Width (ft)	13.88	10.4	3.48
Entrenchment Ratio	2.71	-----	-----
Mean Depth (ft)	1.02	1.06	0.89
Maximum Depth (ft)	1.5	1.5	1.43
Width/Depth Ratio	13.64	9.8	3.93
Bankfull Area (sq ft)	14.11	11.03	3.08
Wetted Perimeter (ft)	14.41	12.02	5.25
Hydraulic Radius (ft)	0.98	0.92	0.59
Begin BKF Station	15.01	15.01	25.41
End BKF Station	28.89	25.41	28.89

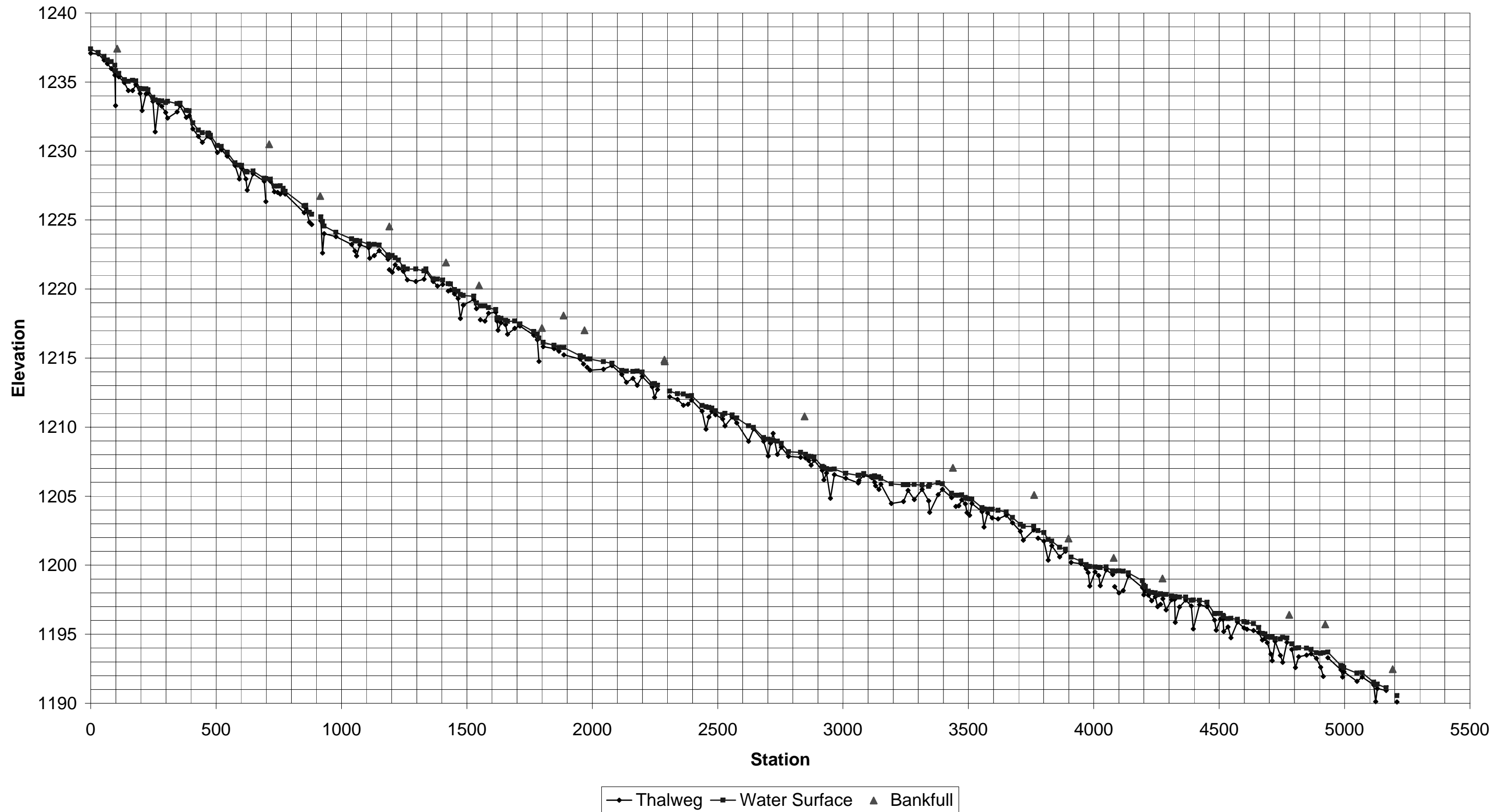
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

Appendix B.6

Brown Branch Long Profile



River Name: Catawba River
 Reach Name: Brown Branch
 Profile Name: Brown Branch Long Profile
 Survey Date: 09/16/05

 Survey Data

STA	Thalweg	Water Surface	Bankfull
0	1237.092	1237.39	
30.089	1237.031	1237.13	
53.36	1236.593	1236.85	
66.21	1236.324	1236.59	
81.742	1235.971	1236.47	
96.578	1235.5	1236.2	
99.793	1233.297	1235.81	
105.511			1237.403
111.951	1235.369	1235.62	
134.587	1234.954	1235.16	
150.768	1234.389	1235.04	
167.543	1234.37	1235.12	
180.754	1234.817	1235.06	
196.994	1234.154	1234.51	
205.388	1232.931	1234.5	
220.847	1234.146	1234.49	
228.638	1234.215	1234.43	
248.413	1233.597	1233.89	
256.836	1231.4	1233.7	
270.257	1233.45	1233.65	
283.666	1233.23	1233.63	
298.831	1232.789	1233.49	
306.659	1232.398	1233.6	
344.966	1232.833	1233.44	
356.931	1233.293	1233.45	
380.971	1232.43	1232.93	
392.638	1232.545	1232.9	
406.86	1231.597	1232.04	
429.685	1231.06	1231.51	
445.559	1230.62	1231.32	
467.9	1231.09	1231.29	
471.66	1231.083	1231.24	
477.985	1230.992	1231.14	
504.734	1229.9	1230.4	
521.229	1230.086	1230.33	
543.869	1229.644	1229.9	
543.921	1229.644	1229.9	
576.014	1228.937	1229.13	
592.309	1227.967	1228.96	
602.074	1228.762	1228.95	
619.202	1227.981	1228.52	
624.716	1227.179	1228.48	
647.351	1228.346	1228.54	
692.608	1227.818	1228.02	
698.839	1226.347	1227.99	
711.67			1230.481

River Name: Catawba River
 Reach Name: Brown Branch
 Profile Name: Brown Branch Long Profile
 Survey Date: 09/16/05

 Survey Data

STA	Thalweg	Water Surface	Bankfull
717.198	1227.81	1227.96	
732.103	1227.05	1227.45	
745.424	1227.006	1227.45	
755.868	1226.873	1227.48	
768.082	1227.095	1227.29	
775.21	1226.887	1227.08	
851.532	1225.54	1226.04	
857.518	1225.856	1226.05	
872.265	1224.832	1225.55	
881.998	1224.676	1225.42	
915.762			1226.738
917.692	1224.937	1225.23	
924.453	1222.619	1224.88	
930.465	1224.019	1224.56	
977.5	1223.809	1224.11	
1041.072	1223.233	1223.64	
1054.366	1222.766	1223.46	
1060.355	1222.41	1223.51	
1073.019	1223.209	1223.46	
1108.765	1222.998	1223.25	
1112.381	1222.241	1223.19	
1131.389	1222.414	1223.22	
1150.39	1222.774	1223.18	
1185.244	1222.16	1222.48	
1190.593		1222.41	1224.525
1190.593	1221.411	1222.34	
1202.909	1221.225	1222.43	
1214.746	1221.754	1222.26	
1226.801	1221.493	1222.1	
1246.822	1221.294	1221.6	
1263.292	1220.675	1221.44	
1296.701	1220.547	1221.44	
1328.834	1220.71	1221.31	
1337.173	1221.288	1221.44	
1365.739	1220.546	1220.74	
1382.85	1220.21	1220.71	
1404.168	1220.34	1220.64	
1416.352			1221.917
1426.15	1219.873	1220.38	
1435.317	1219.943	1220.35	
1450.208	1219.649	1219.95	
1464.983	1219.324	1219.83	
1473.846	1217.867	1219.59	
1485.387	1218.847	1219.54	
1486.203	1218.847	1219.54	
1528.206	1219.246	1219.49	
1538.185	1218.585	1218.99	

River Name: Catawba River
 Reach Name: Brown Branch
 Profile Name: Brown Branch Long Profile
 Survey Date: 09/16/05

 Survey Data

STA	Thalweg	Water Surface	Bankfull
1549.249			1220.268
1554.187	1217.77	1218.77	
1572.762	1217.677	1218.77	
1586.136	1218.257	1218.65	
1615.89	1218.313	1218.51	
1620.277	1217.685	1217.89	
1624.79	1217.021	1217.92	
1635.57	1217.558	1217.86	
1654.27	1217.413	1217.72	
1661.852	1216.737	1217.65	
1690.361	1217.163	1217.67	
1712.078	1217.326	1217.47	
1766.52	1216.653	1216.91	
1781.353	1216.338	1216.74	
1787.593	1214.761	1216.45	
1799.777			1217.183
1804.19	1215.829	1216.13	
1847.432	1215.682	1215.93	
1866.765	1215.501	1215.75	
1886.125			1218.09
1886.943	1215.248	1215.75	
1952.438	1214.917	1215.16	
1964.668	1214.578	1215.06	
1969.323			1217.012
1980.044	1214.331	1214.93	
1991.469	1214.125	1214.94	
2044.71	1214.195	1214.75	
2078.412	1214.454	1214.61	
2118.637	1213.815	1214.11	
2136.85	1213.249	1214.05	
2162.393	1213.537	1214.03	
2178.887	1213.035	1214.04	
2198.996	1213.672	1213.97	
2239.904	1212.919	1213.12	
2247.991	1212.153	1213.16	
2260.039	1212.724	1213.04	
2287.762			1214.887
2288.841			1214.767
2308.686	1212.198	1212.6	
2340.393	1212.017	1212.41	
2363.064	1211.587	1212.38	
2382.351	1211.653	1212.26	
2396.044	1211.969	1212.27	
2438.372	1211.164	1211.57	
2453.177	1209.862	1211.46	
2465.749	1210.725	1211.43	
2477.047	1211.13	1211.38	

River Name: Catawba River
 Reach Name: Brown Branch
 Profile Name: Brown Branch Long Profile
 Survey Date: 09/16/05

 Survey Data

STA	Thalweg	Water Surface	Bankfull
2491.28	1210.886	1211.18	
2520.824	1210.583	1210.89	
2529.147	1210.091	1210.99	
2557.442	1210.723	1210.88	
2576.272	1210.308	1210.66	
2623.021	1208.985	1210.09	
2643.146	1209.882	1209.98	
2683.288	1208.984	1209.24	
2702.113	1207.917	1209.11	
2710.658	1208.828	1209.07	
2721.131	1209.543	1209.03	
2738.668	1208.02	1208.97	
2753.734	1208.552	1208.8	
2783.279	1207.895	1208.21	
2830.376	1207.805	1208.16	
2847.112			1210.784
2850.82	1207.774	1208.03	
2863.813	1207.583	1207.89	
2873.318	1207.251	1207.85	
2883.883	1207.609	1207.81	
2916.813	1206.862	1207.16	
2923.527	1206.18	1207.08	
2934.227	1206.683	1206.99	
2949.533	1204.842	1206.94	
2965.452	1206.564	1206.97	
3011.736	1206.294	1206.65	
3061.185	1205.955	1206.52	
3061.247	1205.956	1206.52	
3063.294	1206.124	1206.52	
3083.403	1206.519	1206.63	
3113.872	1206.35	1206.41	
3125.668	1206.02	1206.47	
3130.203	1205.758	1206.36	
3143.695	1205.489	1206.39	
3151.412	1205.878	1206.28	
3192.812	1204.477	1205.89	
3241.375	1204.611	1205.81	
3259.042	1205.411	1205.81	
3283.978	1204.747	1205.84	
3314.771	1205.483	1205.79	
3341.496	1204.655	1205.7	
3345.923	1203.823	1205.82	
3379.026	1205.116	1205.96	
3395.979	1205.48	1205.88	
3432.553	1204.895	1205.21	
3438.141			1207.049
3449.453	1204.265	1205.06	

River Name: Catawba River
 Reach Name: Brown Branch
 Profile Name: Brown Branch Long Profile
 Survey Date: 09/16/05

 Survey Data

STA	Thalweg	Water Surface	Bankfull
3461.171	1204.304	1205.06	
3473.54	1204.723	1205.08	
3488.005	1204.45	1204.9	
3494.112	1203.815	1204.82	
3504.369	1203.604	1204.81	
3514.198	1204.465	1204.77	
3553.778	1203.871	1204.17	
3561.598	1202.768	1204.07	
3576.101	1203.782	1204.03	
3594.503	1203.431	1204.03	
3617.858	1203.36	1203.96	
3650.885	1203.608	1203.86	
3675.631	1203.058	1203.46	
3706.618	1202.454	1202.96	
3719.052	1201.813	1202.82	
3760.366	1202.548	1202.8	
3762.059			1205.076
3778.196	1201.953	1202.51	
3801.309	1201.748	1202.35	
3817.745	1200.355	1201.86	
3832.41	1201.402	1201.75	
3864	1200.599	1201.3	
3887.85	1201	1201.15	
3898.897			1201.935
3910.192	1200.188	1200.59	
3949.269	1200.103	1200.3	
3969.407	1199.74	1200.04	
3976.969	1199.466	1199.91	
3984.101	1198.485	1199.9	
4005.012	1199.51	1199.86	
4019.196	1199.252	1199.85	
4026.347	1198.504	1199.81	
4049.796	1199.653	1199.86	
4075.137	1199.33	1199.58	
4079.465			1200.532
4083.348	1198.453	1199.56	
4100.312	1197.985	1199.59	
4117.179	1198.17	1199.57	
4138.44	1199.229	1199.43	
4193.799	1198.378	1198.88	
4199.631	1197.849	1198.55	
4206.536	1198.14	1198.44	
4218.278	1197.825	1198.12	
4230.425	1197.42	1198.02	
4244.961	1197.701	1198	
4254.365	1197.008	1197.86	
4265.724	1197.172	1197.92	

River Name: Catawba River
 Reach Name: Brown Branch
 Profile Name: Brown Branch Long Profile
 Survey Date: 09/16/05

 Survey Data

STA	Thalweg	Water Surface	Bankfull
4274.317			1199.042
4274.871	1197.575	1197.87	
4288.196	1196.769	1197.87	
4310.067	1197.505	1197.76	
4321.595	1197.526	1197.72	
4325.036	1195.864	1197.72	
4342.044	1196.974	1197.68	
4367.084	1197.481	1197.68	
4389.055	1197.05	1197.45	
4396.077	1195.373	1197.48	
4421.872	1197.135	1197.44	
4451.313	1196.995	1197.31	
4481.988	1196.014	1196.47	
4488.265	1195.293	1196.5	
4504.855	1196.088	1196.49	
4515.905	1196.061	1196.36	
4518.24	1195.197	1196.29	
4535.319	1195.516	1196.11	
4547.086	1194.748	1196.15	
4573.431	1195.873	1196.08	
4599.545	1195.461	1195.91	
4610.748	1195.37	1195.87	
4636.584	1195.26	1195.76	
4658.135	1195.122	1195.47	
4671.692	1194.567	1195.06	
4682.342	1194.702	1195	
4682.422	1194.702	1195	
4692.255	1194.396	1194.79	
4705.508	1193.569	1194.77	
4711.713	1193.092	1194.79	
4722.886	1194.472	1194.67	
4743.971	1193.457	1194.65	
4752.491	1192.964	1194.77	
4770.275	1194.419	1194.72	
4778.66			1196.403
4790.011	1193.883	1194.29	
4803.411	1192.596	1193.99	
4817.542	1193.358	1194.01	
4848.304	1193.478	1193.98	
4866.656	1193.592	1193.89	
4887.36	1193.245	1193.66	
4905.055	1192.611	1193.61	
4914.598	1191.954	1193.66	
4922.596			1195.72
4932.935	1193.298	1193.7	
4985.671	1192.413	1192.72	
4992.307	1191.886	1192.68	

River Name: Catawba River
 Reach Name: Brown Branch
 Profile Name: Brown Branch Long Profile
 Survey Date: 09/16/05

Survey Data

STA	Thalweg	Water Surface	Bankfull
4997.655	1192.275	1192.57	
5048.922	1191.581	1192.18	
5070.485	1191.908	1192.21	
5116.356	1191.322	1191.52	
5124.498	1190.13	1191.33	
5130.403	1191.07	1191.37	
5165.685	1190.92	1191.12	
5191.624			1192.477
5208.233	1190.093	1190.55	

Cross Section Locations

Cross Section Name	Type	Profile Station
xs1	Riffle	0
xs2	Pool	0
xs3	Riffle	0
xs4	Pool	0
xs5	Riffle	0
xs6	Riffle	0

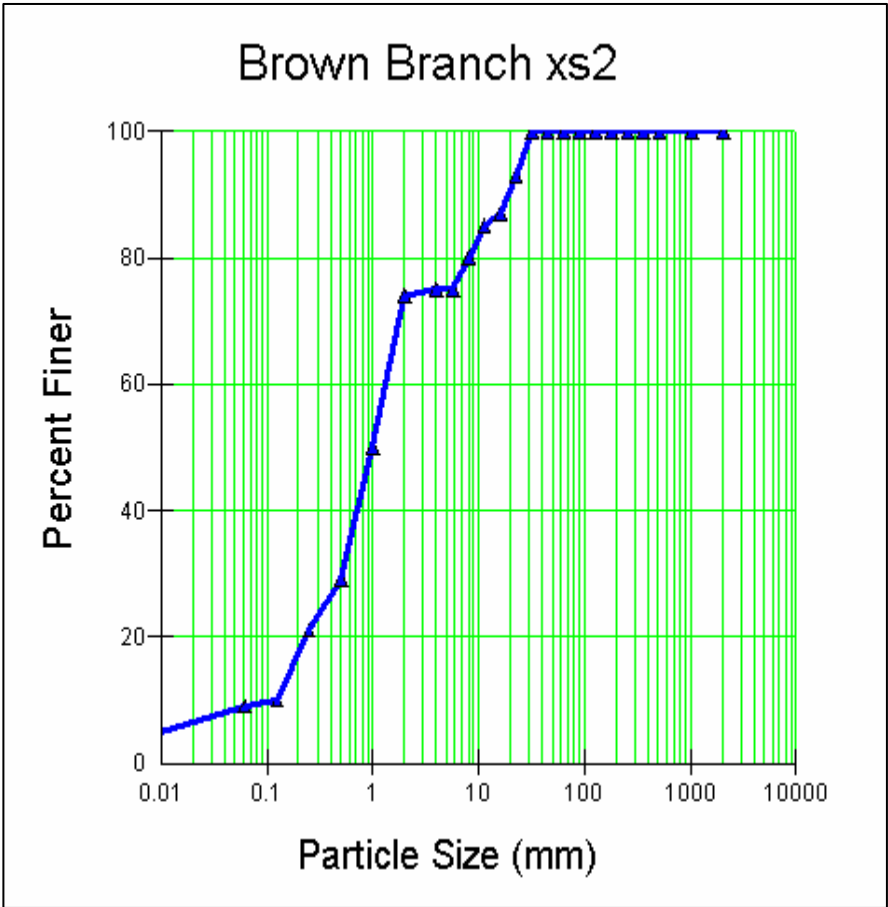
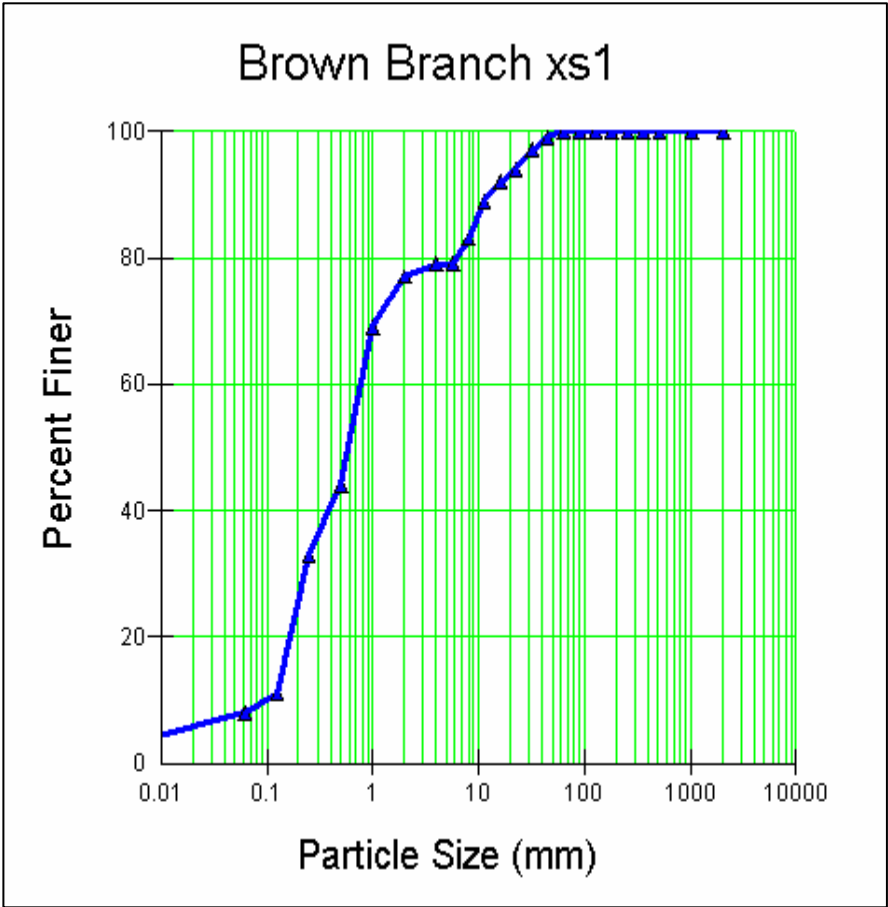
Measurements from Graph

Bankfull Slope: 0.00822

Variable	Min	Avg	Max
S riffle	0.00503	0.01939	0.07904
S pool	0	0.00305	0.01491
S run	0	0	0
S glide	0	0	0
P - P	0	71.11	198.61
P length	4.2	36.09	122.37
Dmax riffle	0	0	0
Dmax pool	0	0	0
Dmax run	0	0	0
Dmax glide	0	0	0
Low Bank Ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

Appendix B.7



River Name: Catawba River
 Reach Name: Brown Branch
 Sample Name: PC1
 Survey Date: 10/13/05

River Name: Catawba River
 Reach Name: Brown Branch
 Sample Name: PC2
 Survey Date: 10/13/05

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	8	8.00	8.00
0.062 - 0.125	3	3.00	11.00
0.125 - 0.25	22	22.00	33.00
0.25 - 0.50	11	11.00	44.00
0.50 - 1.0	25	25.00	69.00
1.0 - 2.0	8	8.00	77.00
2.0 - 4.0	2	2.00	79.00
4.0 - 5.7	0	0.00	79.00
5.7 - 8.0	4	4.00	83.00
8.0 - 11.3	6	6.00	89.00
11.3 - 16.0	3	3.00	92.00
16.0 - 22.6	2	2.00	94.00
22.6 - 32.0	3	3.00	97.00
32 - 45	2	2.00	99.00
45 - 64	1	1.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

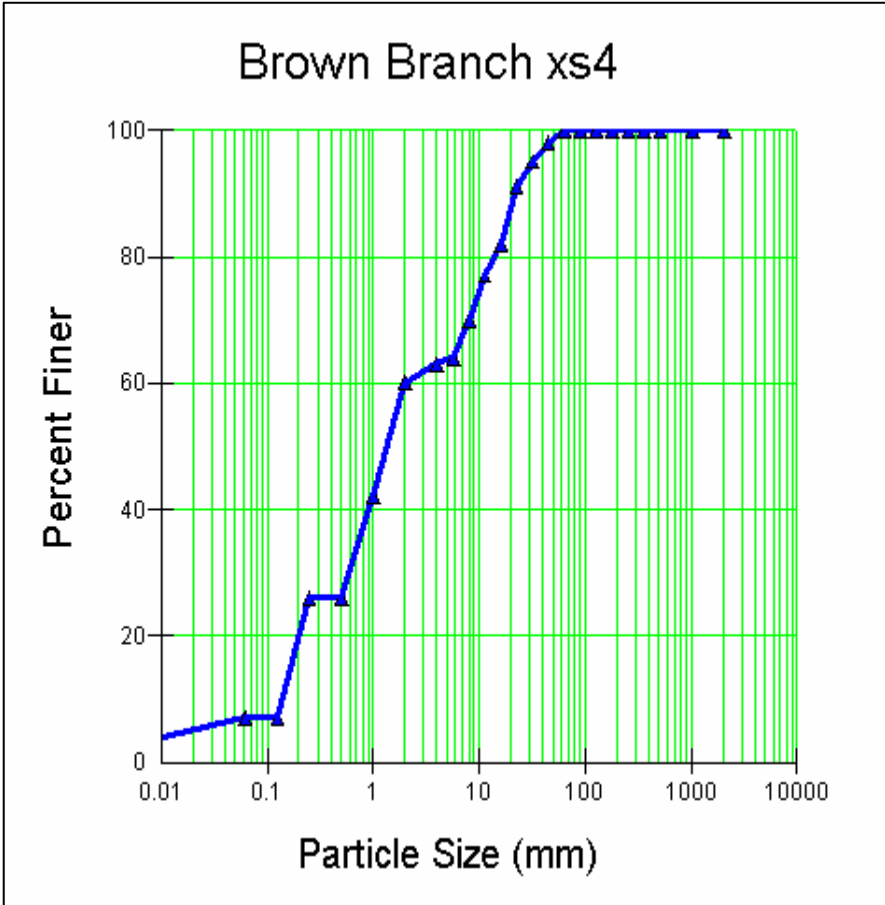
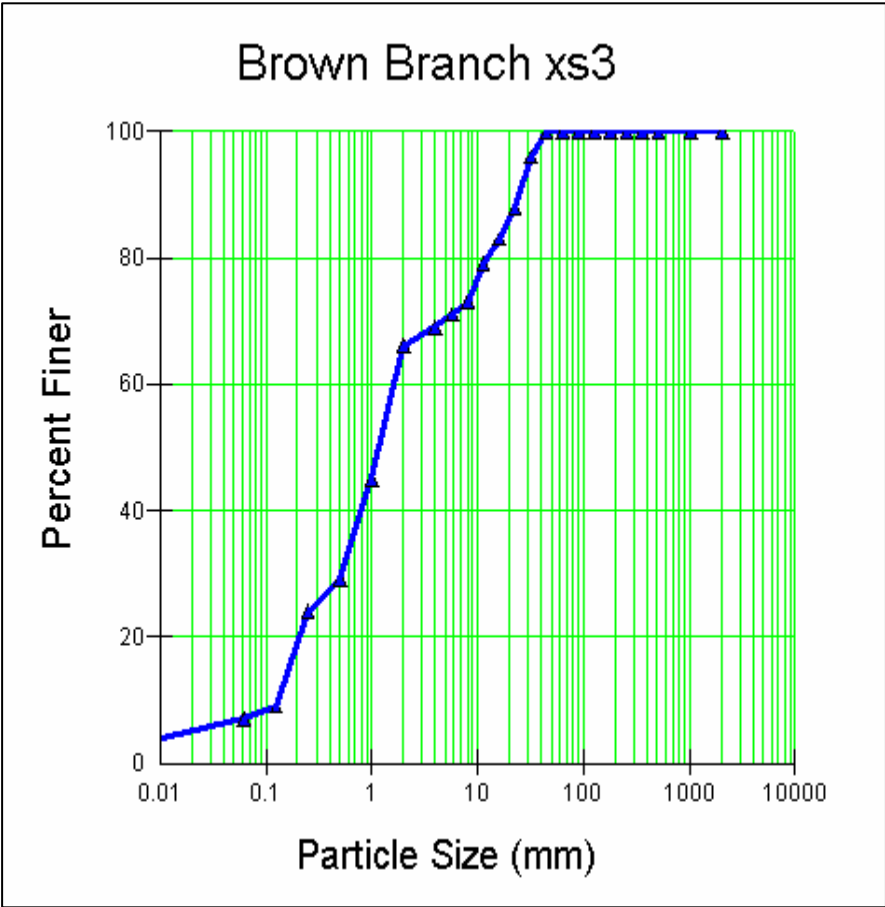
Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	9	9.00	9.00
0.062 - 0.125	1	1.00	10.00
0.125 - 0.25	11	11.00	21.00
0.25 - 0.50	8	8.00	29.00
0.50 - 1.0	21	21.00	50.00
1.0 - 2.0	24	24.00	74.00
2.0 - 4.0	1	1.00	75.00
4.0 - 5.7	0	0.00	75.00
5.7 - 8.0	5	5.00	80.00
8.0 - 11.3	5	5.00	85.00
11.3 - 16.0	2	2.00	87.00
16.0 - 22.6	6	6.00	93.00
22.6 - 32.0	7	7.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.15
D35 (mm)	0.3
D50 (mm)	0.62
D84 (mm)	8.55
D95 (mm)	25.73
D100 (mm)	64
Silt/Clay (%)	8
Sand (%)	69
Gravel (%)	23
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

D16 (mm)	0.19
D35 (mm)	0.64
D50 (mm)	1
D84 (mm)	10.64
D95 (mm)	25.29
D100 (mm)	32
Silt/Clay (%)	9
Sand (%)	65
Gravel (%)	26
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

Total Particles = 100.



River Name: Catawba River
 Reach Name: Brown Branch
 Sample Name: PC3
 Survey Date: 09/16/05

River Name: Catawba River
 Reach Name: Brown Branch
 Sample Name: PC4
 Survey Date: 10/13/05

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	7	7.00	7.00
0.062 - 0.125	2	2.00	9.00
0.125 - 0.25	15	15.00	4.00
0.25 - 0.50	5	5.00	29.00
0.50 - 1.0	16	16.00	45.00
1.0 - 2.0	21	21.00	66.00
2.0 - 4.0	3	3.00	69.00
4.0 - 5.7	2	2.00	71.00
5.7 - 8.0	2	2.00	73.00
8.0 - 11.3	6	6.00	79.00
11.3 - 16.0	4	4.00	83.00
16.0 - 22.6	5	5.00	88.00
22.6 - 32.0	8	8.00	96.00
32 - 45	4	4.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

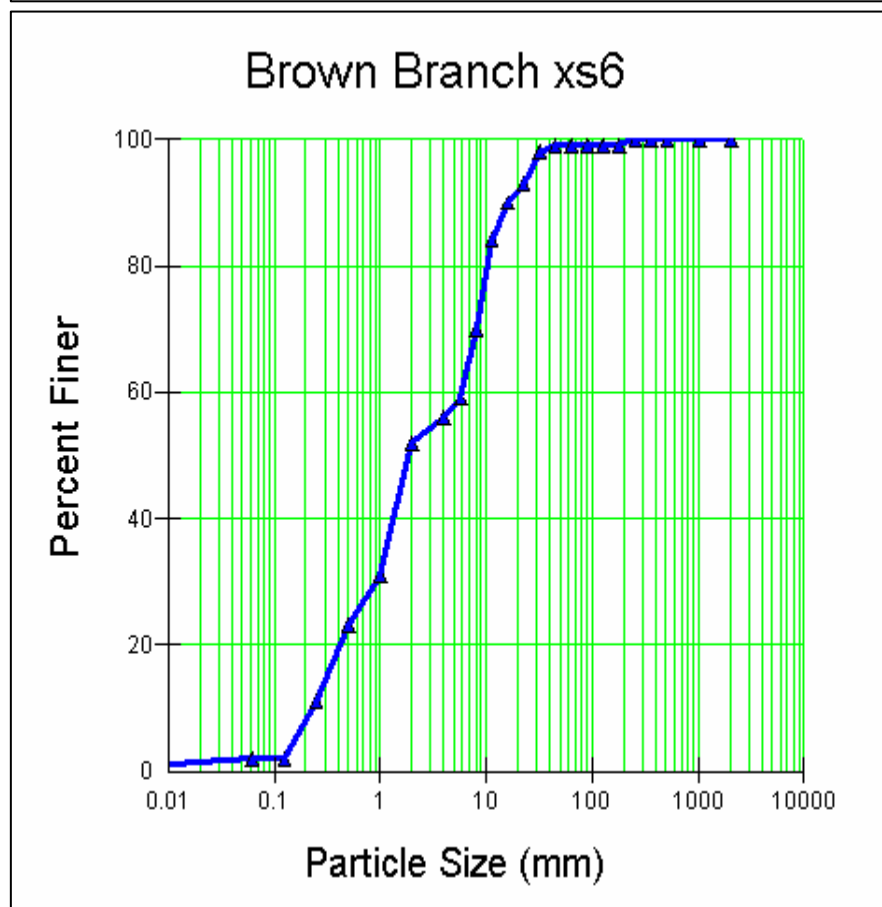
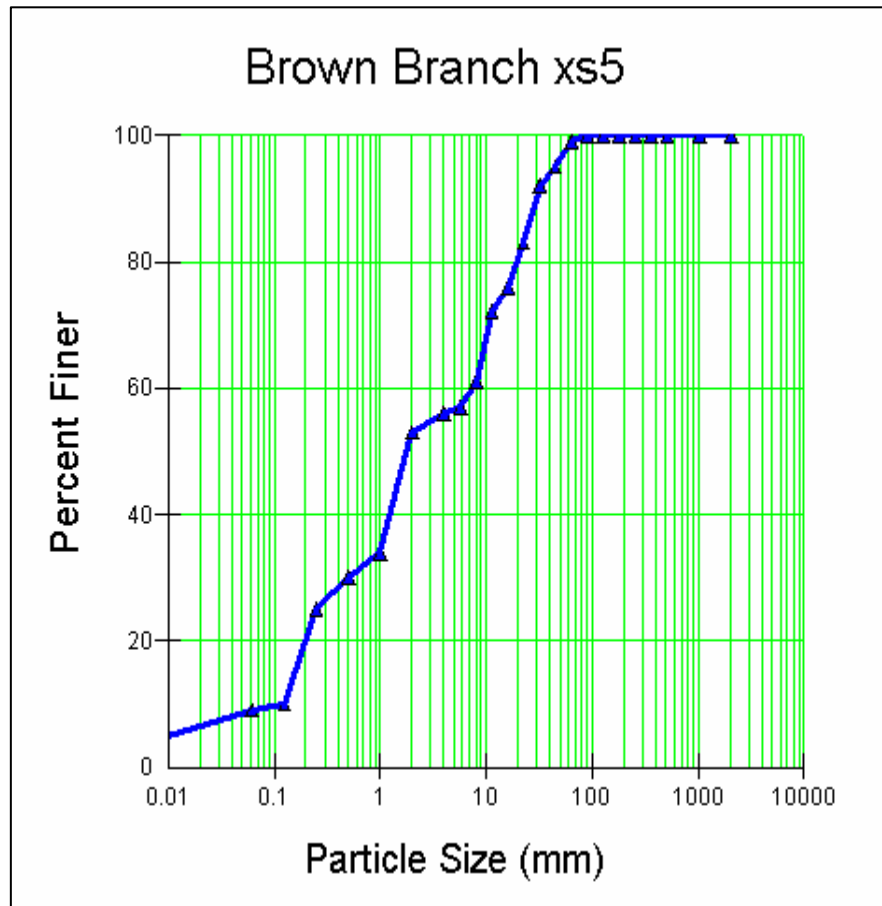
D16 (mm)	0.18
D35 (mm)	0.69
D50 (mm)	1.24
D84 (mm)	17.32
D95 (mm)	30.83
D100 (mm)	45
Silt/Clay (%)	7
Sand (%)	59
Gravel (%)	34
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	7	7.00	7.00
0.062 - 0.125	0	0.00	7.00
0.125 - 0.25	19	19.00	26.00
0.25 - 0.50	0	0.00	26.00
0.50 - 1.0	16	16.00	42.00
1.0 - 2.0	18	18.00	60.00
2.0 - 4.0	3	3.00	63.00
4.0 - 5.7	1	1.00	64.00
5.7 - 8.0	6	6.00	70.00
8.0 - 11.3	7	7.00	77.00
11.3 - 16.0	5	5.00	82.00
16.0 - 22.6	9	9.00	91.00
22.6 - 32.0	4	4.00	95.00
32 - 45	3	3.00	98.00
45 - 64	2	2.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.18
D35 (mm)	0.78
D50 (mm)	1.44
D84 (mm)	17.47
D95 (mm)	32
D100 (mm)	64
Silt/Clay (%)	7
Sand (%)	53
Gravel (%)	40
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.



River Name: Catawba River
 Reach Name: Brown Branch
 Sample Name: PC5
 Survey Date: 09/19/05

River Name: Catawba River
 Reach Name: Brown Branch
 Sample Name: PC6
 Survey Date: 09/19/05

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	9	9.00	9.00
0.062 - 0.125	1	1.00	10.00
0.125 - 0.25	15	15.00	25.00
0.25 - 0.50	5	5.00	30.00
0.50 - 1.0	4	4.00	34.00
1.0 - 2.0	19	19.00	53.00
2.0 - 4.0	3	3.00	56.00
4.0 - 5.7	1	1.00	57.00
5.7 - 8.0	4	4.00	61.00
8.0 - 11.3	11	11.00	72.00
11.3 - 16.0	4	4.00	76.00
16.0 - 22.6	7	7.00	83.00
22.6 - 32.0	9	9.00	92.00
32 - 45	3	3.00	95.00
45 - 64	4	4.00	99.00
64 - 90	1	1.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.18
D35 (mm)	1.05
D50 (mm)	1.84
D84 (mm)	23.64
D95 (mm)	45
D100 (mm)	90
Silt/Clay (%)	9
Sand (%)	44
Gravel (%)	46
Cobble (%)	1
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	2	2.00	2.00
0.062 - 0.125	0	0.00	2.00
0.125 - 0.25	9	9.00	11.00
0.25 - 0.50	12	12.00	23.00
0.50 - 1.0	8	8.00	31.00
1.0 - 2.0	21	21.00	52.00
2.0 - 4.0	4	4.00	56.00
4.0 - 5.7	3	3.00	59.00
5.7 - 8.0	11	11.00	70.00
8.0 - 11.3	14	14.00	84.00
11.3 - 16.0	6	6.00	90.00
16.0 - 22.6	3	3.00	93.00
22.6 - 32.0	5	5.00	98.00
32 - 45	1	1.00	99.00
45 - 64	0	0.00	99.00
64 - 90	0	0.00	99.00
90 - 128	0	0.00	99.00
128 - 180	0	0.00	99.00
180 - 256	1	1.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.35
D35 (mm)	1.19
D50 (mm)	1.9
D84 (mm)	11.3
D95 (mm)	26.36
D100 (mm)	255.99
Silt/Clay (%)	2
Sand (%)	50
Gravel (%)	47
Cobble (%)	1
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.