



Monitoring Report
Year 5
Rich Fork Mitigation Site
Davidson County, North Carolina

Yadkin 03040103
Contract #R-9999WM

Submitted to:

North Carolina
Department of Environment and
Natural Resources
Ecosystem Enhancement Program

Submitted by:

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ENVIRONMENTAL TECHNOLOGIES
AND CONSTRUCTION, INC.

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EXECUTIVE SUMMARY

The Rich Fork Mitigation Site restored 21.49 acres of riverine wetland and 3,398 linear feet of stream and preserved an additional 1,972 linear feet of stream in Davidson County in the Yadkin River Basin (HUC 03040103030030). The site will yield 18.59 Wetland Mitigation Units and 3,792 Stream Mitigation Units. The project was initiated in the spring of 2000 and construction was completed in the spring of 2004. The goal of the project is to re-establish an integrated wetland-stream complex that will restore ecosystem processes, structure, and composition to mitigate for wetland functions and values that have been lost as a result of anthropogenic disturbances in this region of the Yadkin River Basin.

Wetland monitoring activities in 2008 looked at the fifth year of monitoring. This report includes analyses of both hydrologic and vegetation monitoring results as well as local climatic conditions throughout the growing season. Monitoring included sampling vegetation survivability at six locations, recording groundwater elevations at six locations, and documenting the general site conditions at six permanent photograph points within the wetland restoration area.

The wetland restoration components of the project were evaluated to determine their compliance with the success criteria established for vegetation and hydrology (the soils did not require success criteria). Climatic on-site data for the 2008 growing season were compared to historical data from Lexington, North Carolina to determine whether 2008 was a normal climatic year. The historical data were collected from the NRCS, "Water and Climate Center, Climate Analysis for Wetlands by County" website. This evaluation concluded that 2008 was an average year for rainfall during the growing season. Rainfall was within the 30th to 70th percentiles for the months of March, April, and November. Rainfall was less than the 30th percentile threshold in May, June, and October. Rainfall was greater than the 70th percentile threshold in July, August, and September.

The site was planted at a density of 680 trees per acre. The target community for the site is bottomland hardwood forest. There were six vegetative monitoring plots established throughout the planting areas. The 2008 vegetation monitoring of the planted areas revealed an average density of 600 trees per acre, which is above the minimum requirement of 260 trees per acre needed to meet the success criteria at the end of the five-year monitoring period.

Wetland hydrology was monitored with groundwater gauges throughout the entire 2008 growing season. The results from the gauges indicated that the water table was within 12 inches of the soil surface for a continuous period of greater than 12.5% of the growing season at all six monitoring gauges. This surpassed the success criteria of saturation for a continuous period of at least 8% of the growing season. The project groundwater gauges also closely mimicked the hydroperiod recorded at the reference wetland gauge.

Soils in the restoration portion of the site were determined to be Wehadkee and Chewacla. Since these soils are already considered hydric, no success criteria or monitoring is required.

For the stream component of the project, fifth year monitoring data were collected in May and June 2008 for cross-sectional area, planform, and profiles in the four monitored reaches. The permanent cross-sections, planform and profile showed minimal deviation from the as-built conditions, indicating that the streams are maintaining a stable form with respect to dimensions and features. Aquatic macroinvertebrates were sampled in October 2008, but the identification results were unavailable before the Monitoring Year 5 report was submitted. These data will be made available as soon as the species identifications are completed.

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1.0 WETLANDS

Wetland hydrology and vegetation were evaluated to determine their compliance with the success criteria established for the site (soils did not require success criteria). Climatic data for the 2008 growing season were compared to historical data to determine whether 2008 was a normal year in terms of climate conditions as a precursor to validating the results of the wetland monitoring. The historical data were collected from the NRCS, Water and Climate Center, "Climate Analysis for Wetlands by County" website. This evaluation concluded that 2008 was an average year for rainfall during the growing season. Rainfall was within the 30th to 70th percentiles for the months of March, April, and November. Rainfall was less than the 30th percentile threshold in May, June, and October. Rainfall was greater than the 70th percentile threshold in July, August, and September (Appendix B).

1.1 Vegetation - The 21.49-acre wetland restoration site was planted at a density of 680 trees per acre. There were six vegetation monitoring plots established throughout the planted areas. The 2008 vegetation monitoring revealed an average density of 600 trees per acre, which is above the minimum requirement of 260 trees per acre (Appendix A). In 2008, Plot 4 experienced approximately 40% vegetation mortality, which is likely due to beaver activity. The rest of the plots have had little to no mortality (Table 1 and 2).

Table 1: Vegetation Monitoring Results

Plot #	Willow Oak	Swamp Chestnut Oak	Laurel Oak	Yellow Poplar	Swamp Blackgum	Black Willow	Silky Dogwood	Overcup Oak	Green Ash	Cherrybark Oak	Total - Year 5	Total (at planting)	Density - Year 5 (Trees/Acre)
1		12		4					2		18	18	720
2		2	6					6		2	16	17	640
3	9	2	1						6		18	18	720
4		1	2			2	1	1	4		11	18	440
5		1							13		14	14	560
6	2	7	1	1					2		13	13	520
Total Year 5 Average												600	

Table 2: Vegetation History (Trees/Acre)

Plot #	Year 1	Year 2	Year 3	Year 4	Year 5
1	720	720	720	720	720
2	560	600*	680*	680	640
3	640	640	720*	720	720
4	680	680	600	600	440
5	520	520	560*	560	560
6	480	480	520*	520	520

* More trees/acre recorded in Year 3 because of either a resprout from a tree that was previously counted as dead or a missed tree from previous monitoring.

1.2 Hydrology - Wetland hydrology was monitored throughout the entire 2008 growing season with groundwater gauges (Appendix B). The results of this monitoring indicated that the water table was within 12 inches of the soil surface for a continuous period of greater than 12.5% of the growing season at all six monitoring gauges (Table 3). In addition, the site gauges closely mimic the hydroperiod measured at the reference wetland. Table 4 presents the hydroperiod history of each well over the course of the monitoring.

Table 3: Hydrologic Monitoring Results

Gauge #	5%	5% - 8%	8% -12.5%	>12.5%	No. of Days	Dates Meeting Success
1				X	65	3/14-5/17
2				X	73	3/14-5/26
3				X	80	3/14-6/02
4				X	74	3/14-5/27
5				X	84	3/14-6/05
6				X	73	3/14-5/25
Ref. Wetland				X	79	3/14-6/01

Table 4. Hydroperiod History

Gauge #	Pre-Restoration	Year 1	Year 2	Year 3	Year 4	Year 5
1	<5%	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%
2	<5%	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%
3	<5%	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%
4	<5%	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%
5	<5%	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%
6	<5%	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%
Ref. Wetland	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%	>12.5%

1.3 Soils - Soils in the restoration portion of the site were determined to be Wehadkee and Chewacla. Wehadkee is a hydric soil on the state and federal hydric soils list and the Chewacla soils have hydric inclusions of poorly drained soils. The overburden and fill associated with the Chewacla soils was removed during construction to restore the hydric characteristics of the soil lost from filling and overbank flooding. As both soils are already considered hydric, no success criteria or monitoring was required.

2.0 STREAMS

The restored streams were monitored to evaluate their compliance with the success criteria established for physical (cross-section, planform and profile) and biological stability.

2.1 Physical - The as-built survey was completed immediately prior to the return of active flow into the channel in June 2004. Fifth year monitoring data were collected in June 2008 for cross-sectional area, planform and profiles in the four monitored reaches and compared to the as-built condition (Appendix C). The permanent cross-sections (Table 5) and planform (Table 6) showed minimal deviation from the as-built conditions. The profile of the main-stem downstream reach shows aggradation throughout the profile, most notably at the end of the reach. This aggradation was due to the presence of a beaver dam just downstream of the reach. Overall, the streams are maintaining a stable form with respect to dimensions and features.

Table 5. Bankfull Cross-Sectional Area

Cross-Section	As-Built	Year 1	Year 2	Year 3	Year 4	Year 5
XS 1 Main Stem Up	7.3	7.3	6.3	6.2	5.4	4.8
XS 2 Main Stem Up	2.1	2.5	1.9	1.6	2.1	1.9
XS 3 Main Stem Down	5.9	5.7	5.2	2.9	2.8	2.8
XS 4 Main Stem Down	4.6	4.9	4.0	5.2	5.5	4.8
XS 1 Tributary Up	1.8	1.6	2.7	1.2	1.1	1.8
XS 2 Tributary Up	1.2	1.1	0.9	1.5	1.2	1.0
XS 3 Tributary Down	2.6	2.7	1.6	1.3	1.2	1.0
XS 4 Tributary Down	1.1	1.2	0.9	0.7	0.5	1.7

Table 6. Planform (Sinuosity/Radius of Curvature)

Reach	As-Built	Year 1	Year 2	Year 3	Year 4	Year 5
Main Stem Up	1.2/13.9	1.2/13.9	1.2/13.5	1.2/13.8	1.2/13.8	1.2/13.8
Main Stem Down	1.2/13.0	1.2/13.1	1.2/14.9	1.2/11.8	1.2/11.8	1.2/13.8
Tributary Up	1.2/7.4	1.2/7.4	1.2/8.7	1.2/7.0	1.2/7.0	1.2/7.0
Tributary Down	1.4/7.3	1.4/7.3	1.4/7.6	1.3/7.0	1.2/7.0	1.3/7.0

Table 7. Profile (Average depth in feet from control elevation)

Reach	As-Built	Year 1	Year 2	Year 3	Year 4	Year 5
Main Stem Up	1.42	1.37	1.28	1.26	1.23	1.27
Main Stem Down*	1.37	1.41	1.33	1.46	1.43	1.25
Tributary Up	0.87	0.82	0.79	0.75	0.76	0.67
Tributary Down	1.15	1.09	0.86	1.20	0.92	0.56

*Values from previous years have been revised following an update of Monitoring Year 3 calculations.

2.2 Biological Monitoring - Aquatic macroinvertebrates were sampled in October 2008, but the identification results were unavailable before the Monitoring Year 5 report was submitted. These data will be made available as soon as the species identifications are completed.

Table 8. Summary Benthic Macroinvertebrate Data

Sampling Location	Total No. of Organisms						Total Number of Taxa						Biotic Index Assigned Values						
	Year	Pre	1	2**	3	4†	5	Pre	1	2**	3	4†	5	Pre	1	2**	3	4†	5
Upstream*		24	33	18	26	-		9	10	4	3	-		6.61	7.47	7.84	8.98	-	
Main Channel		54	52	16	23	-		6	17	7	5	-		6.98	7.63	8.12	7.96	-	
Tributary		N/A	56	N/A	N/A	-		N/A	18	N/A	N/A	-		N/A	7.45	N/A	N/A	-	
Confluence		124	27	50	57	-		16	13	20	14	-		6.44	6.77	7.59	8.10	-	

*Upstream control site monitored pre-restoration; ** Second-year monitoring was not conducted (due to site conditions) and a supplemental sample was completed in 2006.

†Fourth-year monitoring not conducted due to exceptional drought during growing season.

3.0 MAINTENANCE/MANAGEMENT ACTIONS

The flooding of Rich Fork Creek during the 2008 monitoring year caused a debris blockage of the tributary near the confluence with the main stem, backwatering the tributaries. This blockage (deposited sand and silt) was removed and the tributary was reconnected with the main stem as part of the continuing maintenance schedule at the Rich Fork Site.

This year also saw an increase in beaver activity at the downstream section of the site along the main stem. The beavers and the dams were removed, creating a free-flowing stream once again.

4.0 CONCLUSIONS

Findings from this monitoring year indicate that the project site is performing as designed. The survival of the planted species exceeds the density requirement of the success criteria and non-target species were not identified in any of the vegetation monitoring plots. All six groundwater monitoring gauges exceeded the hydrologic success criteria of 8% continuous saturation during the growing season.

Physical monitoring of the streams at four permanent monitoring reaches documented minor changes in the cross-sections and profiles. The observable changes in the profiles and cross-sections were due to minor bed aggradation in both the tributary and the mainstem. This is the result of backwater conditions from beaver dams and deposition from large flood events on Rich Fork Creek. This deposition is primarily limited to the portions of the tributary and mainstem near their confluence just upstream of Rich Fork Creek.

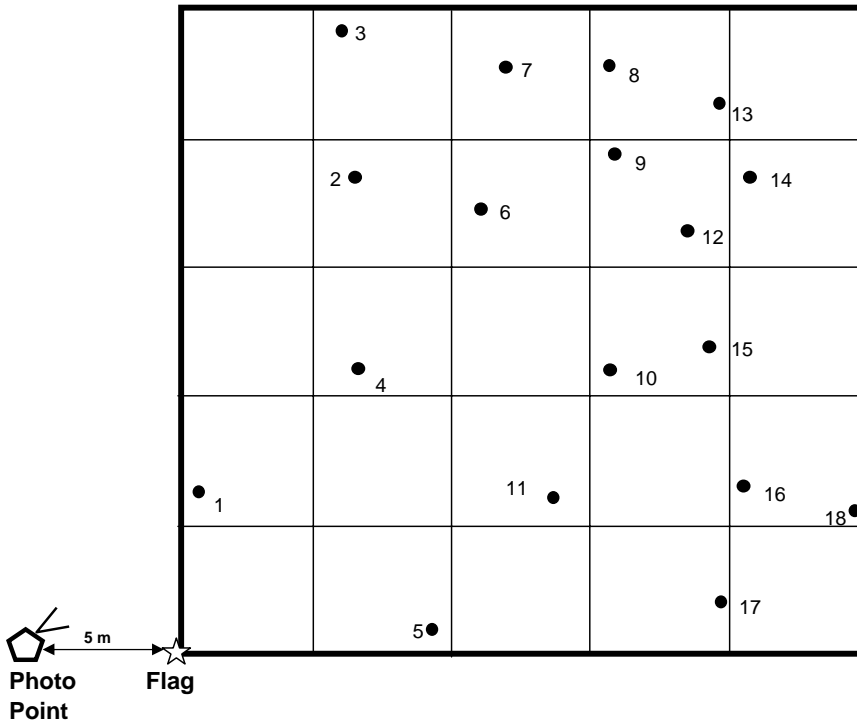
The project streams are maintaining a stable form and are routinely accessing their floodplains. In-stream structures are stable and functioning as designed. Observations of stream bank vegetation indicate that live stake survivability is high and the herbaceous vegetation is well developed on the stream banks. Aquatic macroinvertebrates were sampled in October 2008, but the identification results were unavailable before the Monitoring Year 5 report was submitted. These data will be made available as soon as the species identifications are completed.

Appendix A
Vegetation Monitoring Plot Data Sheets

Vegetation Monitoring Worksheet

Site: Rich Fork Plot: 1 Date: 6/4/2008

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Yellow Poplar (<i>Liriodendron tulipifera</i>)	0.61	1.3	top has died back
2	Yellow Poplar (<i>Liriodendron tulipifera</i>)	0.58	0.8	healthy
3	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.77	1.0	healthy
4	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.08	1.5	healthy
5	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.15	1.4	healthy
6	Yellow Poplar (<i>Liriodendron tulipifera</i>)	0.61	1.2	healthy
7	Yellow Poplar (<i>Liriodendron tulipifera</i>)	0.51	0.8	healthy
8	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.33	0.5	healthy
9	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.52	0.8	healthy
10	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.69	0.9	healthy
11	Green Ash (<i>Fraxinus pennsylvanica</i>)	2.06	2.3	healthy
12	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.59	2.0	healthy
13	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.45	0.6	top has died back
14	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.80	0.9	healthy
15	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.88	1.3	healthy
16	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.98	0.8	healthy
17	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.47	1.3	healthy
18	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.58	2.1	top has died back

Notes - Tree heights smaller than previous years reflect that the top of certain trees have die back
 - Plot map updated annually to more accurately reflect tree locations.

Species	Percent of Total
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	67%
Yellow Poplar (<i>Liriodendron tulipifera</i>)	22%
Green Ash (<i>Fraxinus pennsylvanica</i>)	11%

Density:

Total Number of Trees 18 / 0.025 acres = 720 trees / acre

Survivability:

Total Number of Trees 18 / 18 trees x 100 = 100 % survivability

Number of New Recruits : _____

Note : Flag located N 38° E, 27' from monitoring well



Previous



Current

Species	Percent of Total
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	13%
Cherrybark Oak (<i>Quercus falcata</i>)	13%
Laurel Oak (<i>Quercus laurifolia</i>)	38%
Overcup Oak (<i>Quercus lyrata</i>)	38%

Density:

Total Number of Trees 16 / 0.025 acres = 640 trees / acre

Survivability:

Total Number of Trees 16 / 17 trees x 100 = 94 % survivability

Number of New Recruits : _____

Note : Flag located W 270° N, 126' from monitoring well



Previous



Current

Species	Percent of Total
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	11%
Willow Oak (<i>Quercus phellos</i>)	50%
Green Ash (<i>Fraxinus pennsylvanica</i>)	33%
Laurel Oak (<i>Quercus laurifolia</i>)	6%

Density:

Total Number of Trees 18 / 0.025 acres = 720 trees / acre

Survivability:

Total Number of Trees 18 / 18 trees x 100 = 100 % survivability

Number of New Recruits : _____

Note : Flag located N 38° E, 27' from monitoring well



Previous

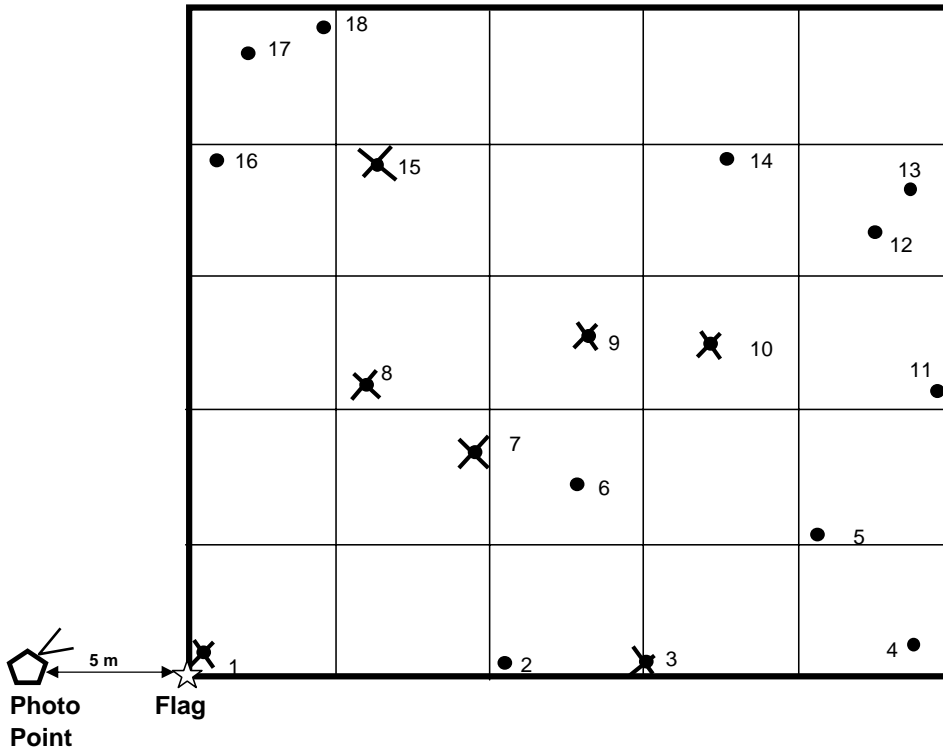


Current

Vegetation Monitoring Worksheet

Site: Rich Fork Plot: 4 Date: 6/4/2008

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Swamp Black Gum (<i>Nyssa sylvatica</i>)			dead
2	Laurel Oak (<i>Quercus laurifolia</i>)	1.16	1.0	sparse leaves
3	Laurel Oak (<i>Quercus laurifolia</i>)			dead
4	Black Willow (<i>Salix nigra</i>)	2.97	4.7	healthy
5	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.28	1.2	healthy
6	Laurel Oak (<i>Quercus laurifolia</i>)	1.20	1.3	healthy
7	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			dead (beaver)
8	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			dead (beaver)
9	Yellow Poplar (<i>Liriodendron tulipifera</i>)			dead
10	Yellow Poplar (<i>Liriodendron tulipifera</i>)			dead
11	Overcup Oak (<i>Quercus lyrata</i>)	0.97	0.7	healthy
12	Silky Dogwood (<i>Cornus amomum</i>)	1.20	1.5	healthy multistem
13	Green Ash (<i>Fraxinus pennsylvanica</i>)	3.80	5.2	healthy
14	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.20	3.5	beaver (resprout ~ 1ft from base)
15	Laurel Oak (<i>Quercus laurifolia</i>)			dead
16	Green Ash (<i>Fraxinus pennsylvanica</i>)	2.82	2.9	healthy
17	Black Willow (<i>Salix nigra</i>)	3.51	4.7	healthy
18	Green Ash (<i>Fraxinus pennsylvanica</i>)	2.48	3.2	healthy

Notes - Tree heights smaller than previous years reflect that the top of certain trees have die back
 - Plot map updated annually to more accurately reflect tree locations

Species	Percent of Total
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	9%
Green Ash (<i>Fraxinus pennsylvanica</i>)	36%
Overcup Oak (<i>Quercus lyrata</i>)	9%
Silky Dogwood (<i>Cornus amomum</i>)	9%
Black Willow (<i>Salix nigra</i>)	18%
Yellow Poplar (<i>Liriodendron tulipifera</i>)	0%
Laurel Oak (<i>Quercus laurifolia</i>)	18%

Density:

$$\text{Total Number of Trees } \underline{11} \quad / \quad 0.025 \text{ acres} \quad = \quad \underline{440} \quad \text{trees / acre}$$

Survivability:

$$\text{Total Number of Trees } \underline{11} \quad / \quad 18 \text{ trees} \quad \times \quad 100 \quad = \quad \underline{61.1} \quad \% \text{ survivability}$$

Number of New Recruits : _____

Note : Flag located E 158° S, 76' from monitoring well



Previous



Current

Species	Percent of Total
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	7%
Green Ash (<i>Fraxinus pennsylvanica</i>)	93%

Density:

Total Number of Trees 14 / 0.025 acres = 560 trees / acre

Survivability:

Total Number of Trees 14 / 14 trees x 100 = 100 % survivability

Number of New Recruits : _____

Note : Flag located N 38° E, 27' from monitoring well



Previous



Current

Species	Percent of Total
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	54%
Green Ash (<i>Fraxinus pennsylvanica</i>)	15%
Yellow Poplar (<i>Liriodendron tulipifera</i>)	8%
Willow Oak (<i>Quercus phellos</i>)	15%
Laurel Oak (<i>Quercus laurifolia</i>)	8%

Density:

Total Number of Trees 13 / 0.025 acres = 520 trees / acre

Survivability:

Total Number of Trees 13 / 13 trees x 100 = 100 % survivability

Number of New Recruits : _____

Note : Flag located N 38° E, 27' from monitoring well



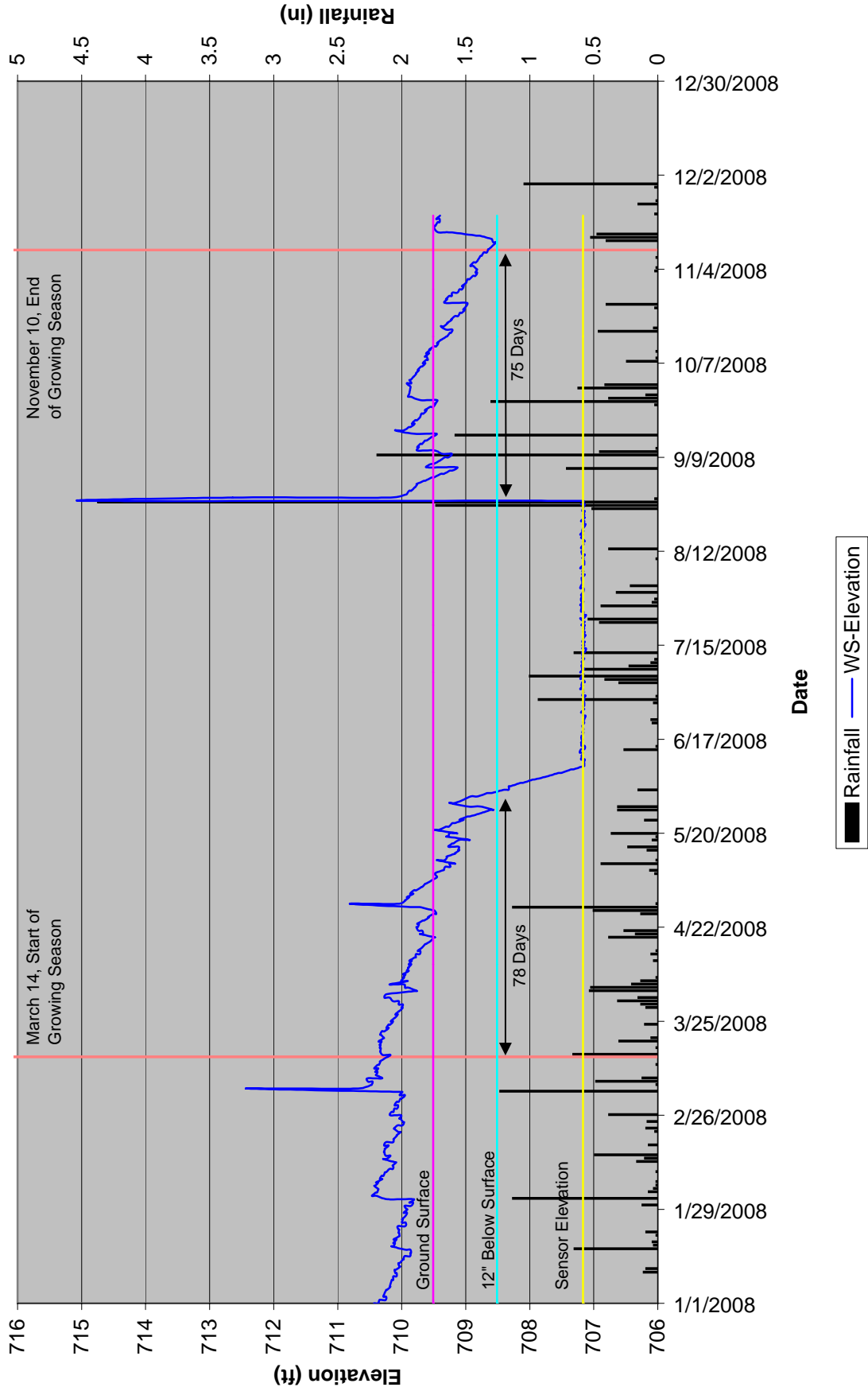
Previous



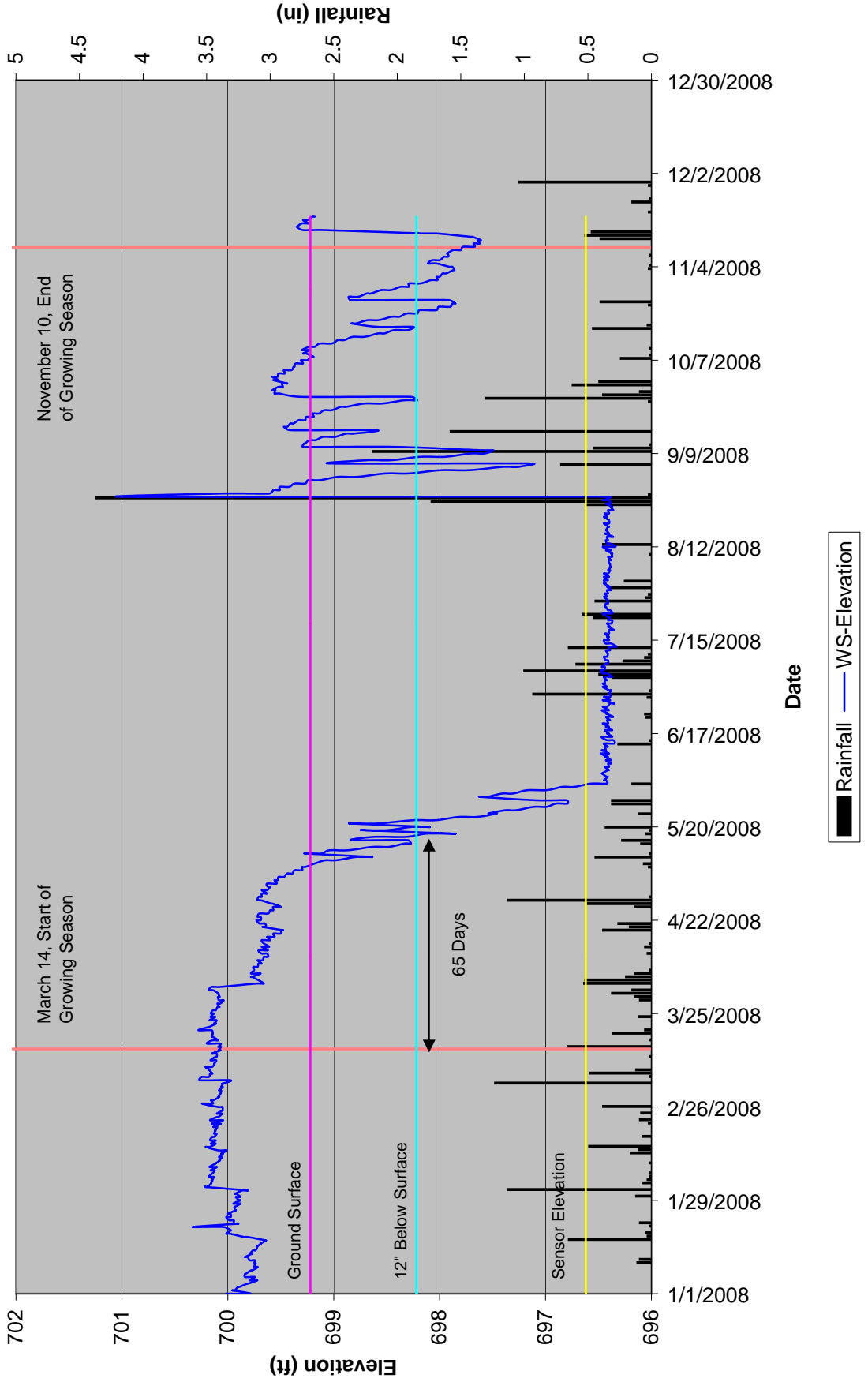
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Appendix B
Hydrologic Monitoring and Hydroperiod

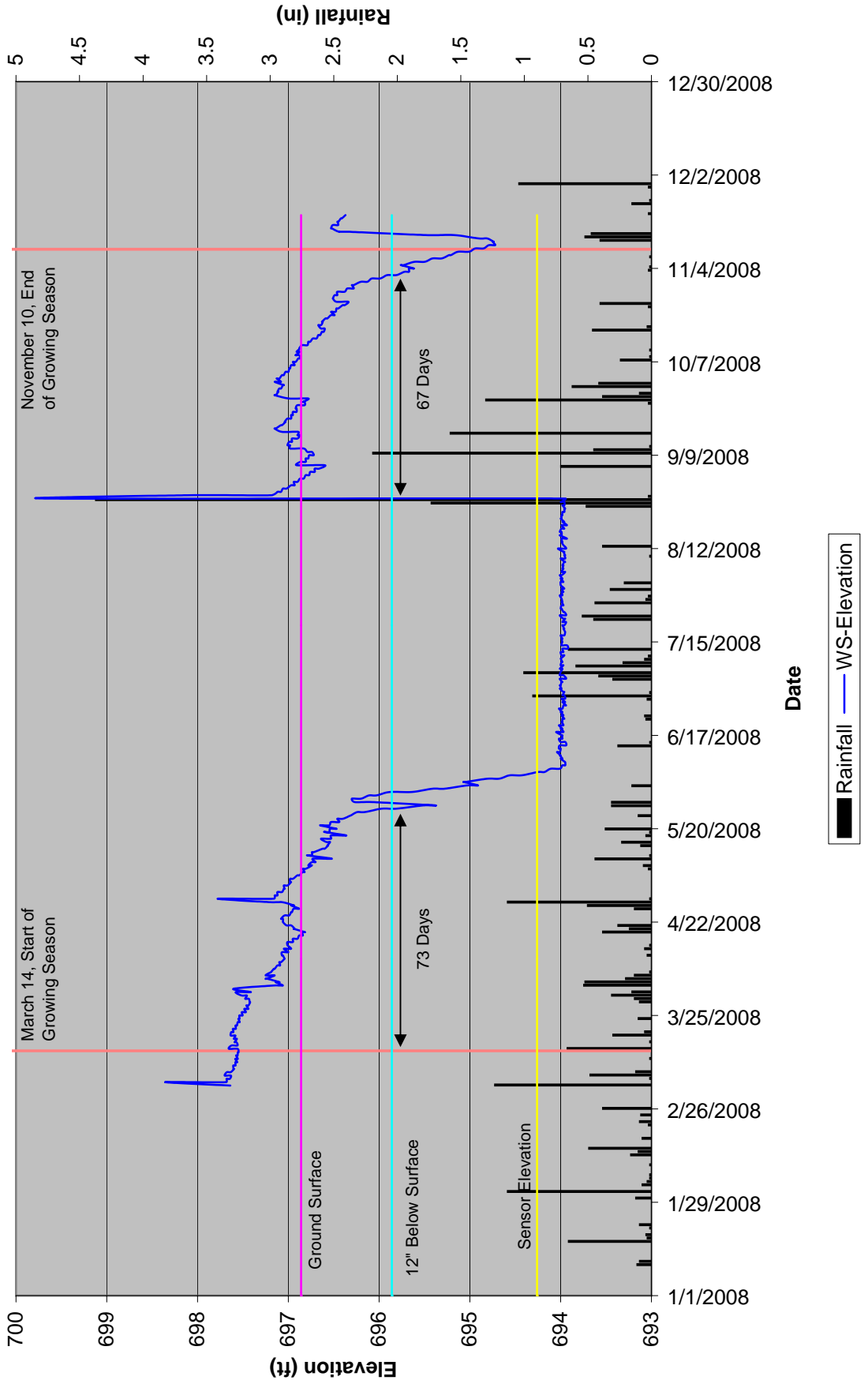
Rich Fork Reference Gauge Hydrograph



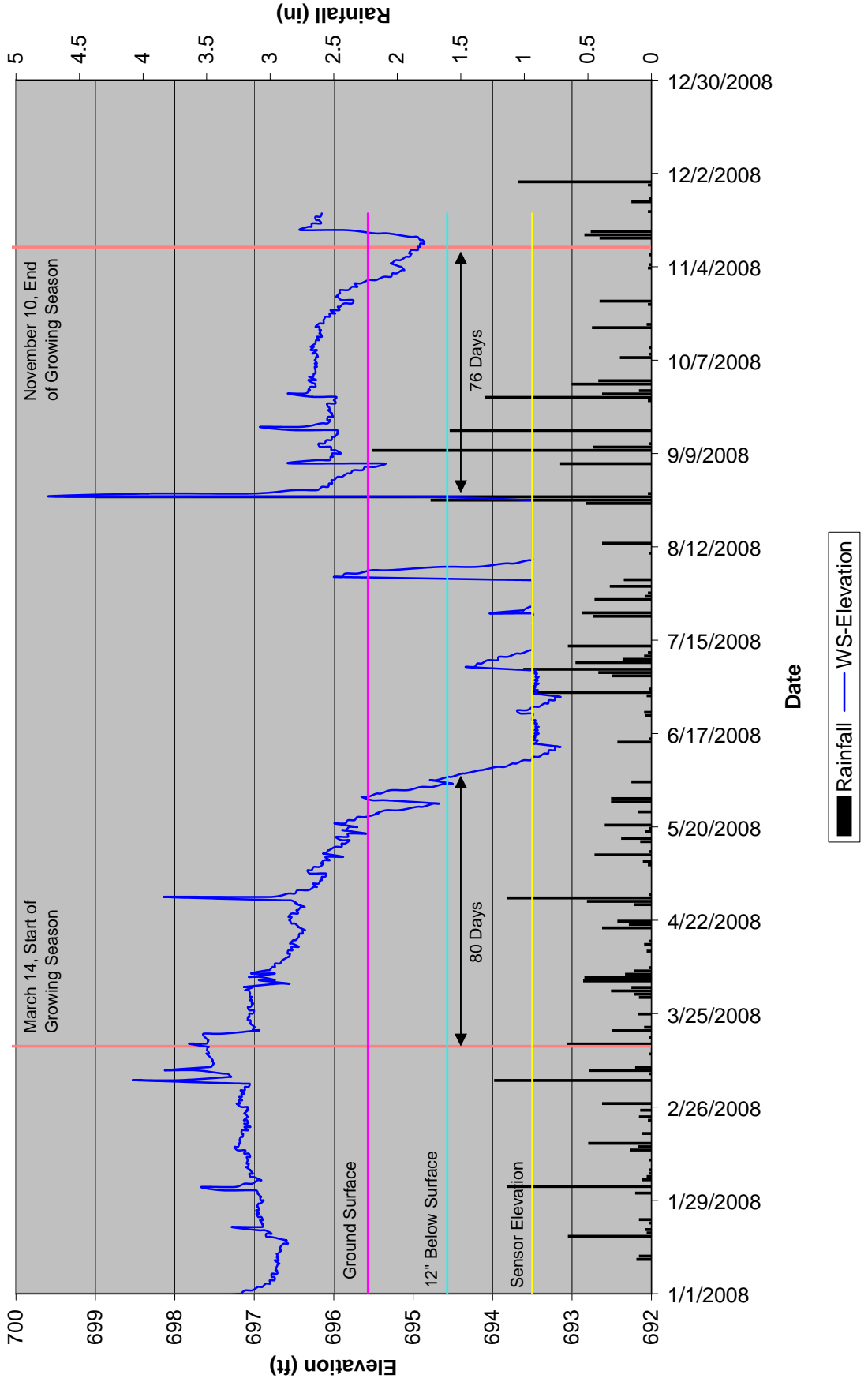
Rich Fork Gauge 1 Hydrograph



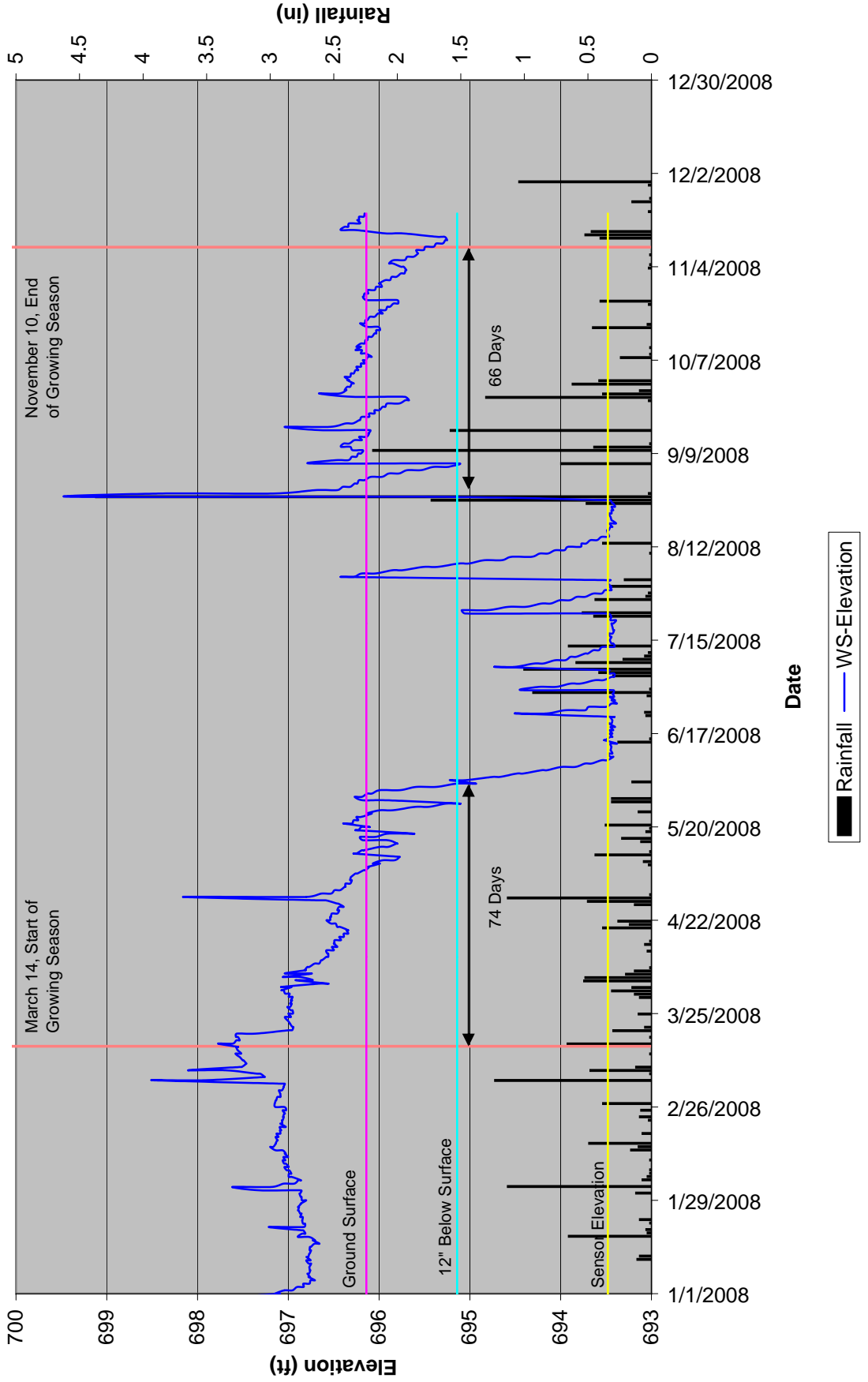
Rich Fork Gauge 2 Hydrograph



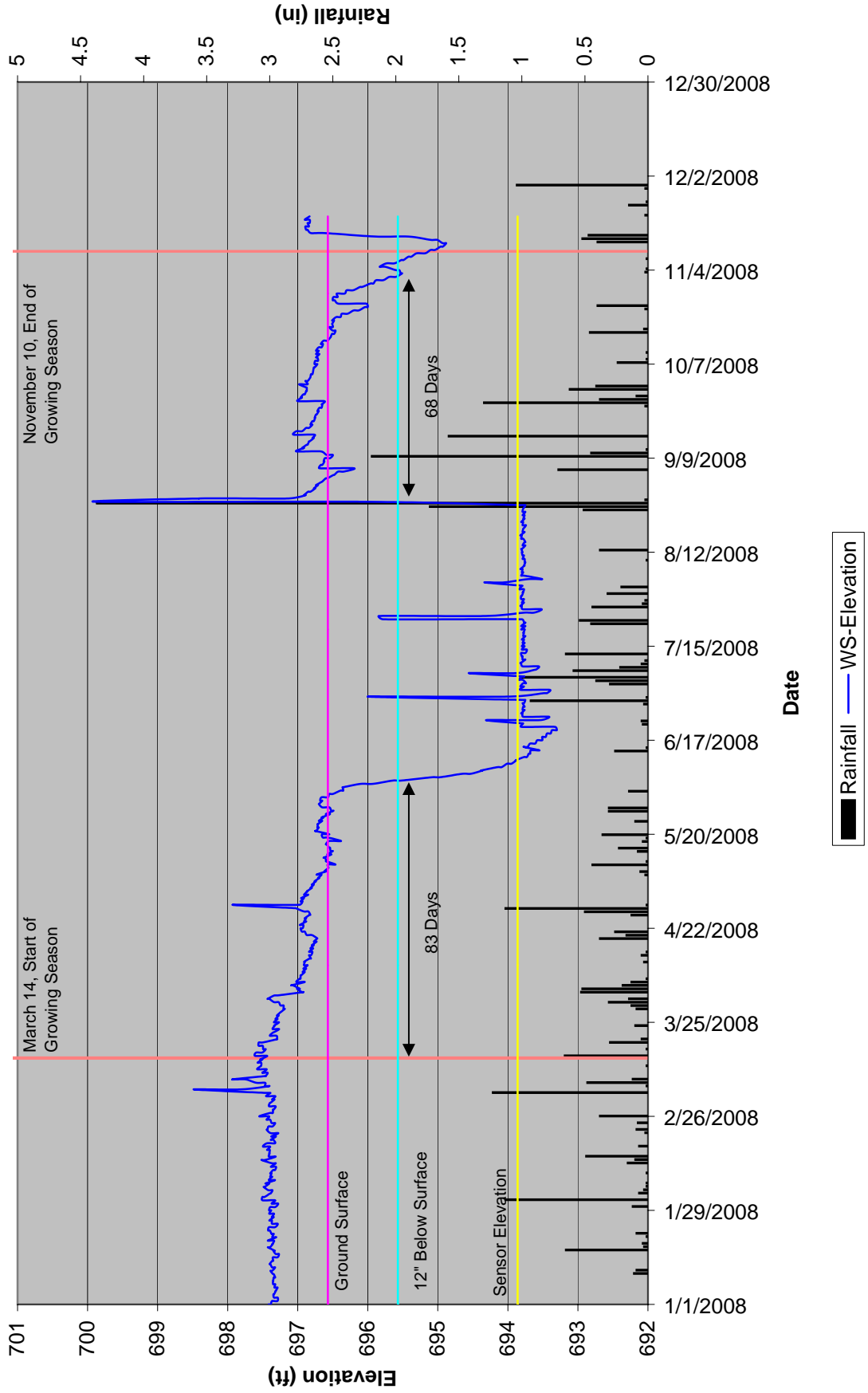
Rich Fork Gauge 3 Hydrograph



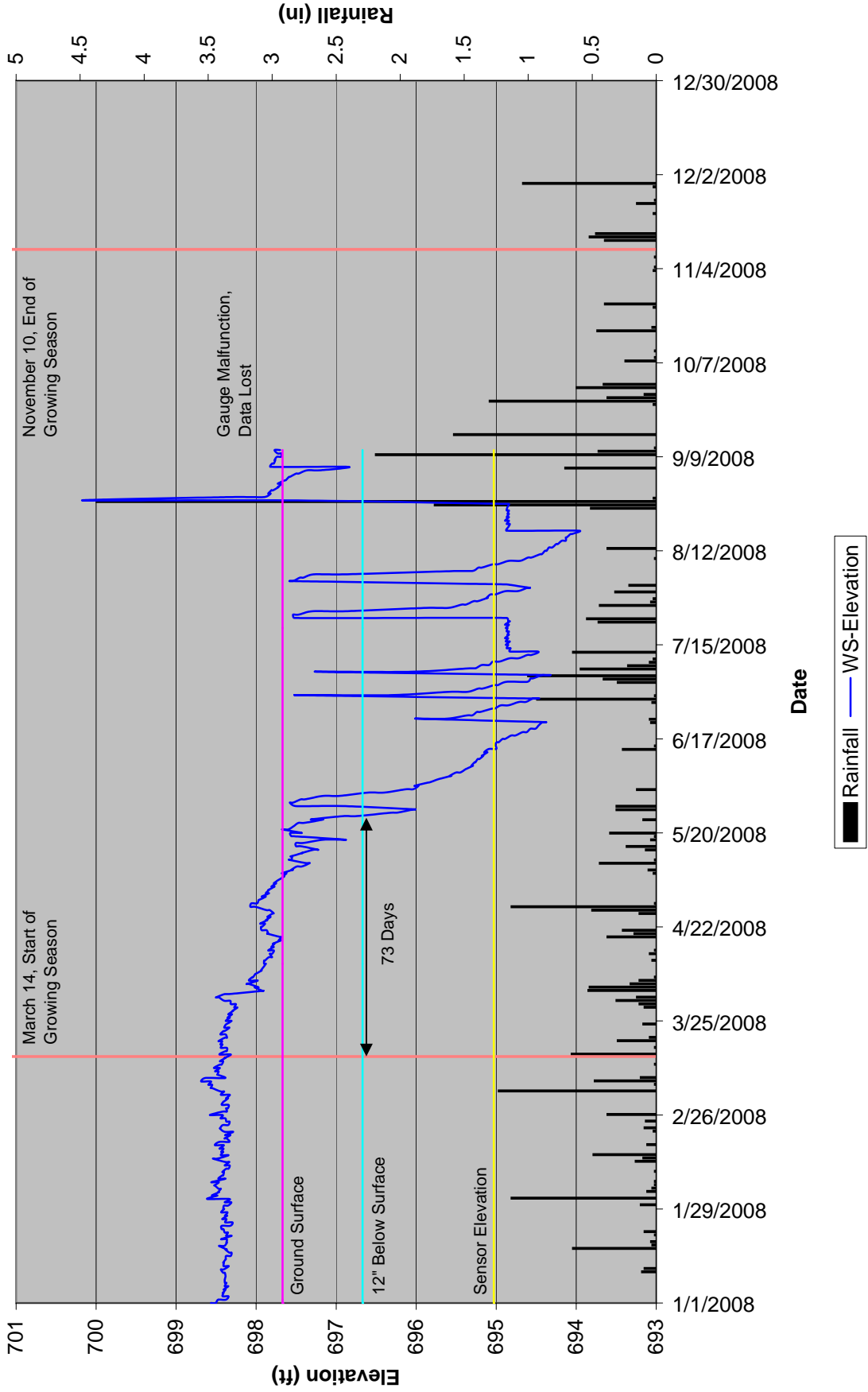
Rich Fork Gauge 4 Hydrograph



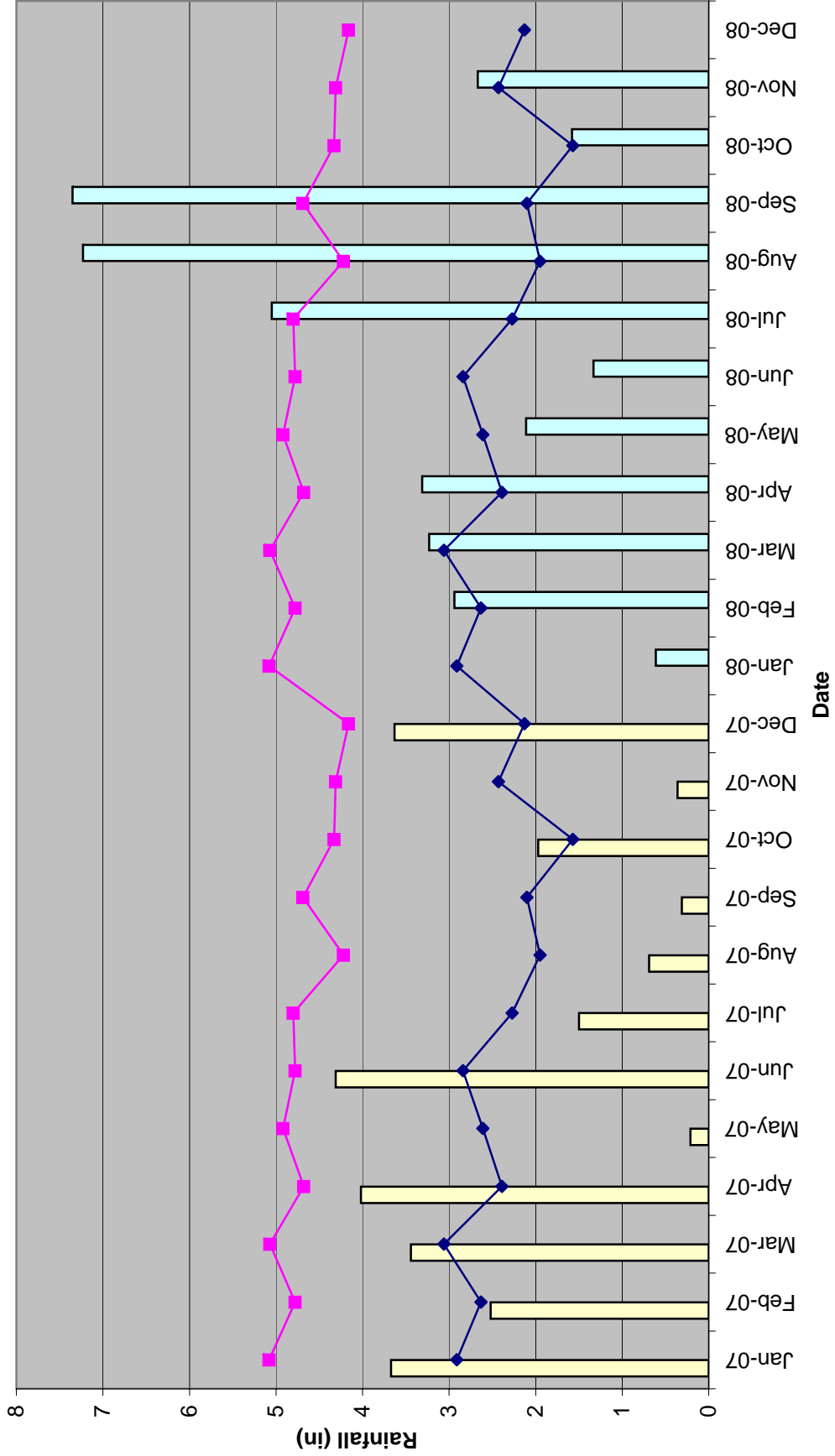
Rich Fork Gauge 5 Hydrograph



Rich Fork Gauge 6 Hydrograph



Rich Fork Site 30-70 Percentile Graph 2007-2008
Lexington, NC Monthly Rainfall



2007 Rainfall 2008 Rainfall 30% Less Than 30% Greater Than

Appendix C
Stream Morphology

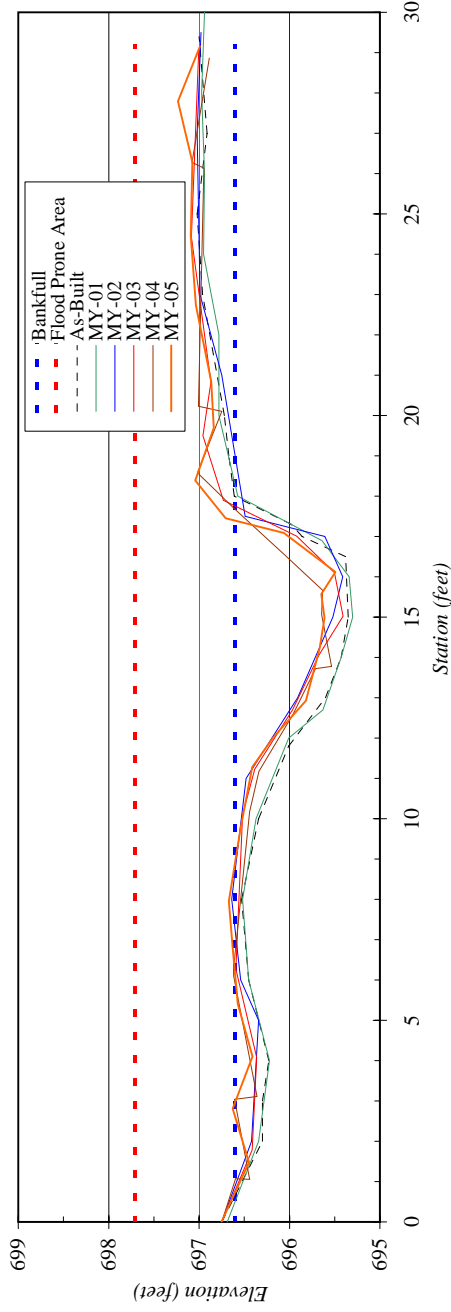
River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Main XS 1, Pool
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	696.75
1.5	696.45
2.8	696.63
4.1	696.41
5.4	696.57
6.8	696.63
8.0	696.67
9.8	696.54
11.3	696.41
12.0	696.18
12.9	695.82
14.2	695.67
15.0	695.61
15.6	695.65
16.1	695.49
17.1	696.06
17.5	696.71
18.4	697.04
19.7	696.84
20.8	696.87
22.7	697.04
24.5	697.09
26.3	697.07
27.8	697.23
29.2	696.99

SUMMARY DATA	
Bankfull Elevation:	696.6
Bankfull Cross-Sectional Area:	4.8
Bankfull Width:	8.5
Flood Prone Area Elevation:	697.7
Flood Prone Width:	>30
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.6
W / D Ratio:	15.1
Entrenchment Ratio:	>3
Bank Height Ratio:	1.0

Yadkin River Basin, Rich Fork, MY05, Main XS 1, Pool



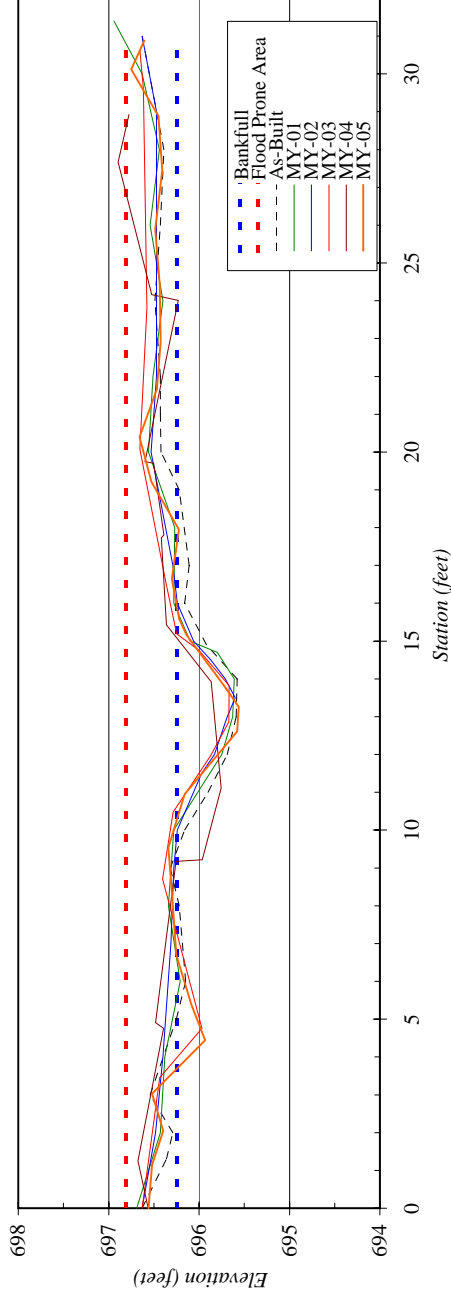
River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Main XS 2, Riffle
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	696.56
1.1	696.52
2.0	696.40
3.0	696.52
4.4	695.93
5.4	696.09
6.7	696.25
8.6	696.31
9.5	696.34
11.0	696.16
12.1	695.74
12.6	695.58
13.3	695.56
13.9	695.74
15.2	696.14
15.6	696.22
16.6	696.30
18.0	696.22
19.2	696.53
20.4	696.66
21.7	696.47
22.9	696.43
24.4	696.44
25.9	696.48
27.5	696.41
28.9	696.45
30.1	696.75
30.9	696.61

SUMMARY DATA	
Bankfull Elevation:	696.24
Bankfull Cross-Sectional Area:	1.9
Bankfull Width:	5.9
Flood Prone Area Elevation:	696.81
Flood Prone Area Width:	>35
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.3
W / D Ratio:	18.8
Entrenchment Ratio:	>6
Bank Height Ratio:	1.0

Yadkin River Basin, Rich Fork, MY05, Main XS 2, Riffle



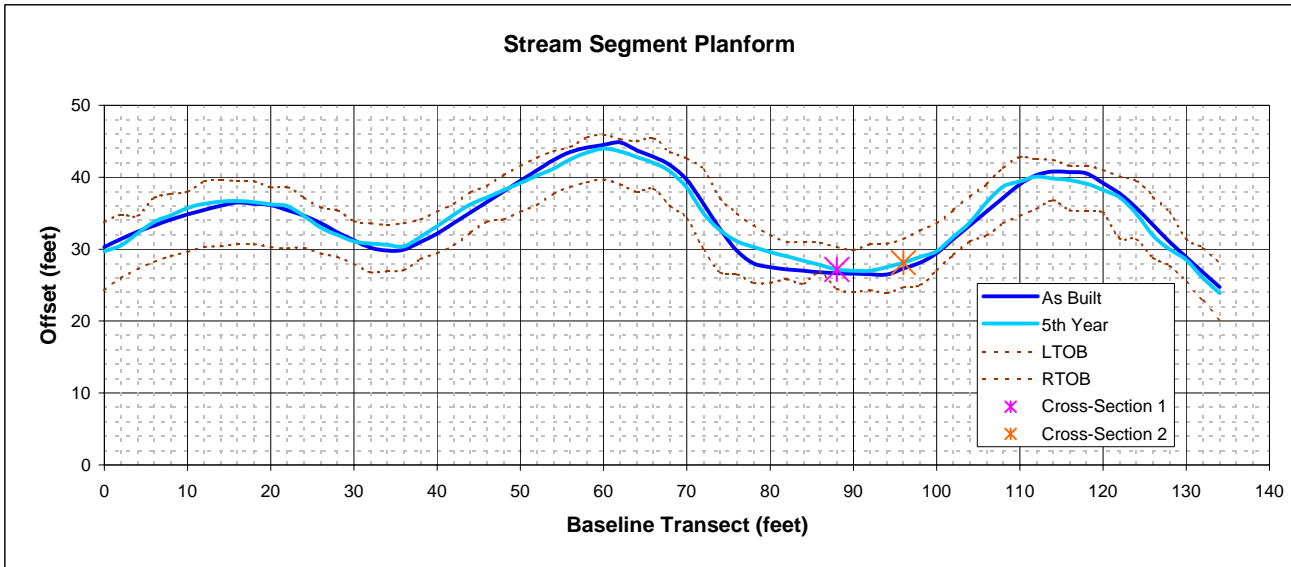
River Basin:	Yadkin
Watershed:	Rich Fork
Planform ID	Main Up
Date:	5/28/2008
Field Crew:	BR, KV



View of mainstem upstream planform looking downstream

SUMMARY DATA	
Stream Segment Length:	160
Distance Between Survey Points:	134
Distance Between Stations:	2
Sinuosity:	1.2
Mean Radius of Curvature:	13.8
Belt Width:	20.1

Stream Type:	E5
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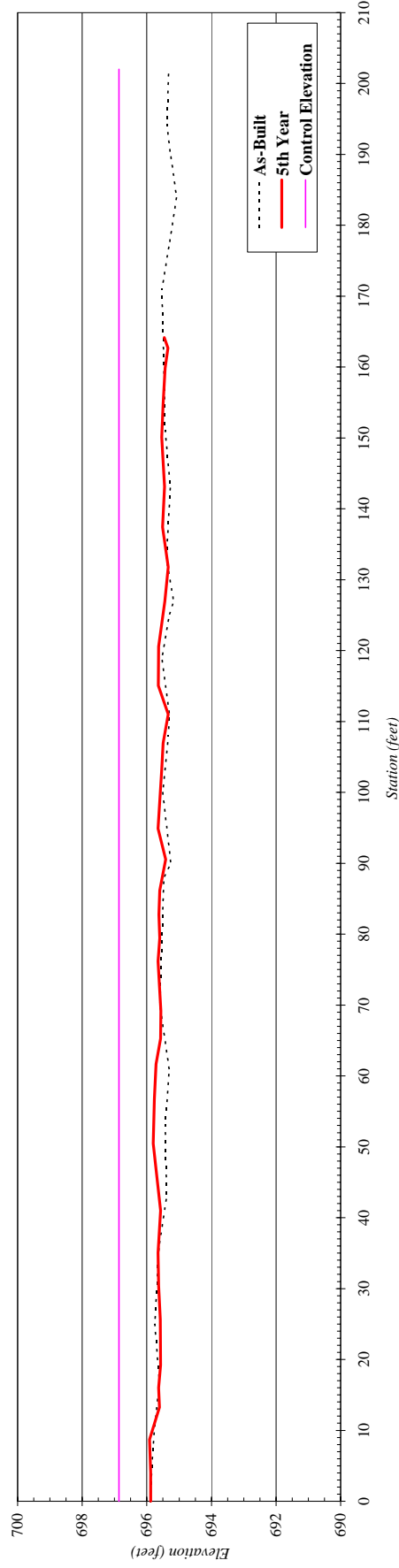


Comments:

River Basin:	Yadkin
Watershed:	Rich Fork Creek
Reach:	Mainstem
Profile ID:	Upstream
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan
Control Elevation:	696.86

Average Slope:	0.002
As-Built Avg. Depth:	1.42
5th Year Avg. Depth:	1.27

Longitudinal Profile

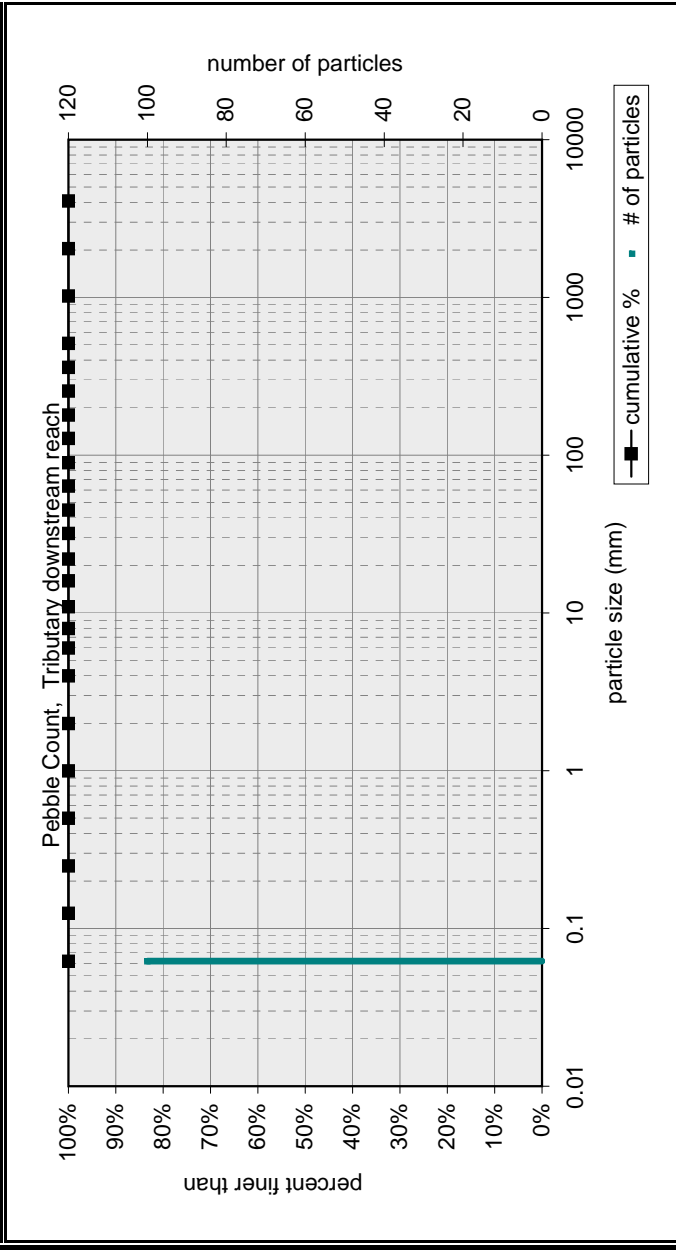


Pebble Count of Channel Reach

Material	Size Range (mm)	Count
silt/clay	0	100
very fine sand	0.062	
fine sand	0.13	
medium sand	0.25	
coarse sand	0.5	
very coarse sand	1	
very fine gravel	2	
fine gravel	4	
fine gravel	6	
fine gravel	8	
medium gravel	11	
medium gravel	16	
coarse gravel	22	
coarse gravel	32	
very coarse gravel	45	
very coarse gravel	64	
small cobble	90	
medium cobble	128	
large cobble	180	
very large cobble	256	
small boulder	362	
small boulder	512	
medium boulder	1024	
large boulder	2048	
very large boulder	4096	
total particle count:		100

Pebble Count,

Tributary downstream reach
Rich Fork Creek
High Point, NC
Note:



based on sediment particles only	size percent less than (mm)					particle size distribution			
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.062	0.06	0.1	0	0	0	1.0	0.1	1.0
based on total count	percent by substrate type					bedrock	hardpan	wood/det	artificial
	100%	0%	0%	0%	0%	0%	0%	0%	0%

bedrock	
clay hardpan	
debris/wood	
artificial	
total count:	100

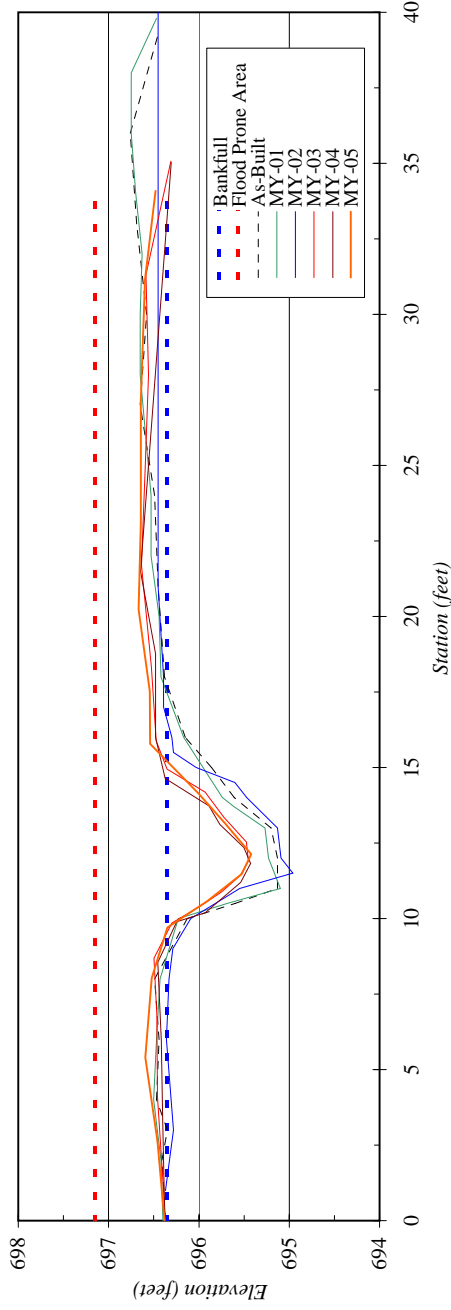
River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Main XS 3, Pool
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	695.95
2.0	695.95
4.0	695.85
6.4	695.88
8.0	695.78
9.6	695.32
11.6	695.64
13.8	695.87
15.0	695.93
16.0	695.99
17.1	696.04
18.6	696.06
19.9	696.04
21.2	695.92
27.1	696.64
31.2	696.60
34.1	696.48

SUMMARY DATA	
Bankfull Elevation:	696.35
Bankfull Cross-Sectional Area:	2.8
Bankfull Width:	5.5
Flood Prone Area Elevation:	697.15
Flood Prone Width:	>40
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.5
W / D Ratio:	10.8
Entrenchment Ratio:	>7
Bank Height Ratio:	1.0

Yadkin River Basin, Rich Fork, MY05, Main XS 3, Pool



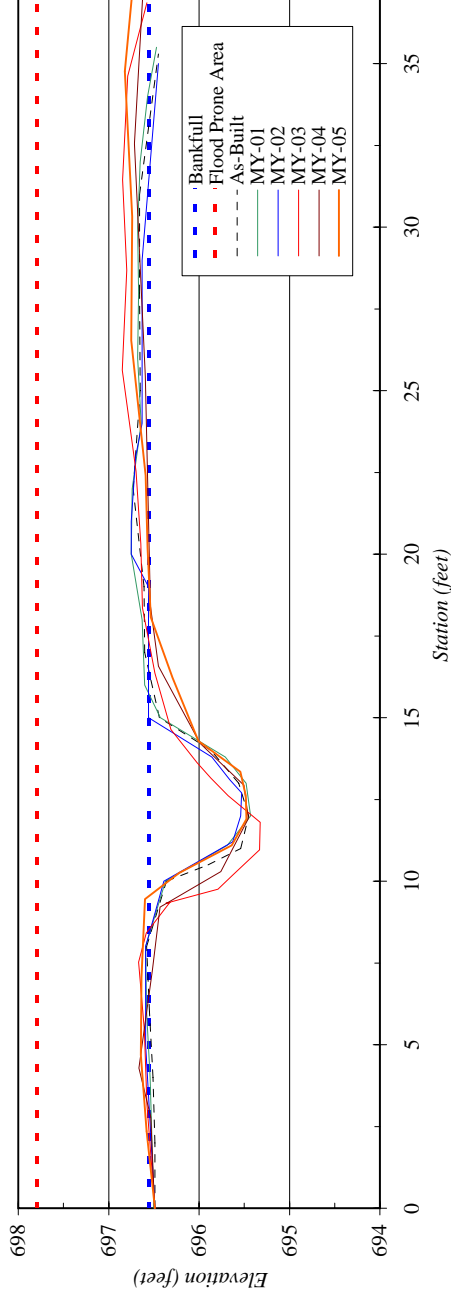
River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Main XS 4, Riffle
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	696.49
2.4	696.58
4.7	696.65
7.1	696.64
9.5	696.60
10.3	696.22
11.1	695.64
11.9	695.47
12.6	695.48
13.4	695.54
14.3	696.01
16.2	696.29
18.1	696.53
20.2	696.57
22.4	696.59
26.5	696.75
30.3	696.74
34.8	696.82
38.1	696.71
39.5	696.61

SUMMARY DATA	
Bankfull Elevation:	696.56
Bankfull Cross-Sectional Area:	4.8
Bankfull Width:	10.0
Flood Prone Area Elevation:	697.8
Flood Prone Width:	>50
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.5
W / D Ratio:	20.8
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0

Yadkin River Basin, Rich Fork, MY05, Main XS 4, Riffle



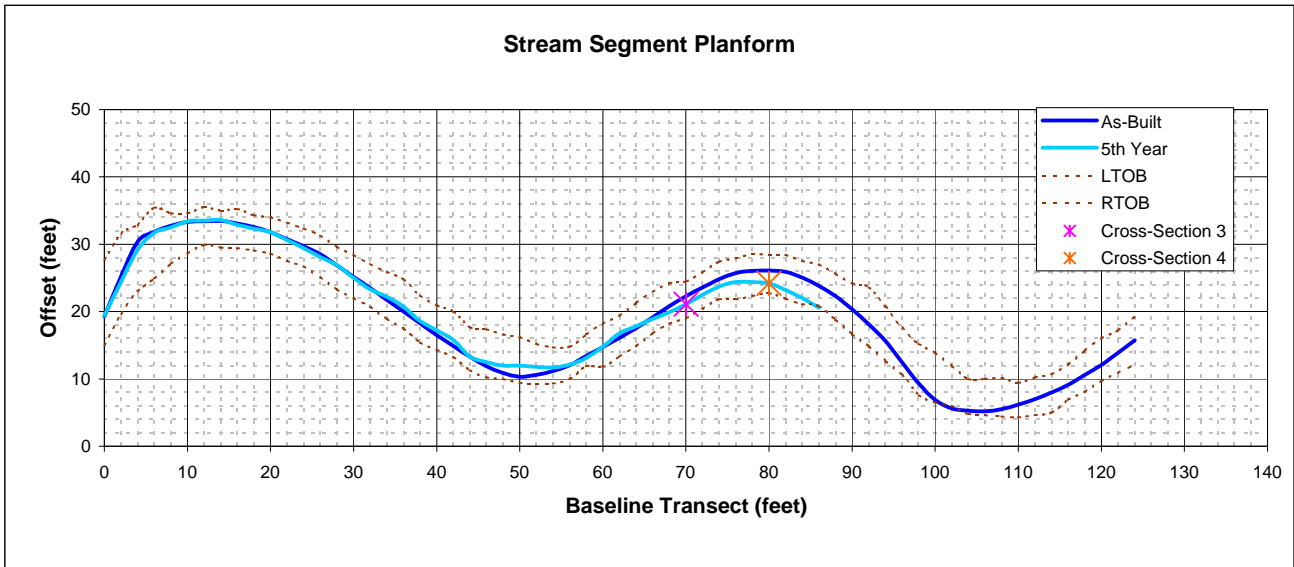
River Basin:	Yadkin
Watershed:	Rich Fork
Planform ID	Main Down
Date:	5/28/2008
Field Crew:	BR, KV



View of mainstem upstream planform looking downstream

SUMMARY DATA	
Stream Segment Length:	150
Distance Between Survey Points:	124
Distance Between Stations:	2
Sinuosity:	1.2
Mean Radius of Curvature:	11.8
Belt Width:	21.9

Stream Type:	E5
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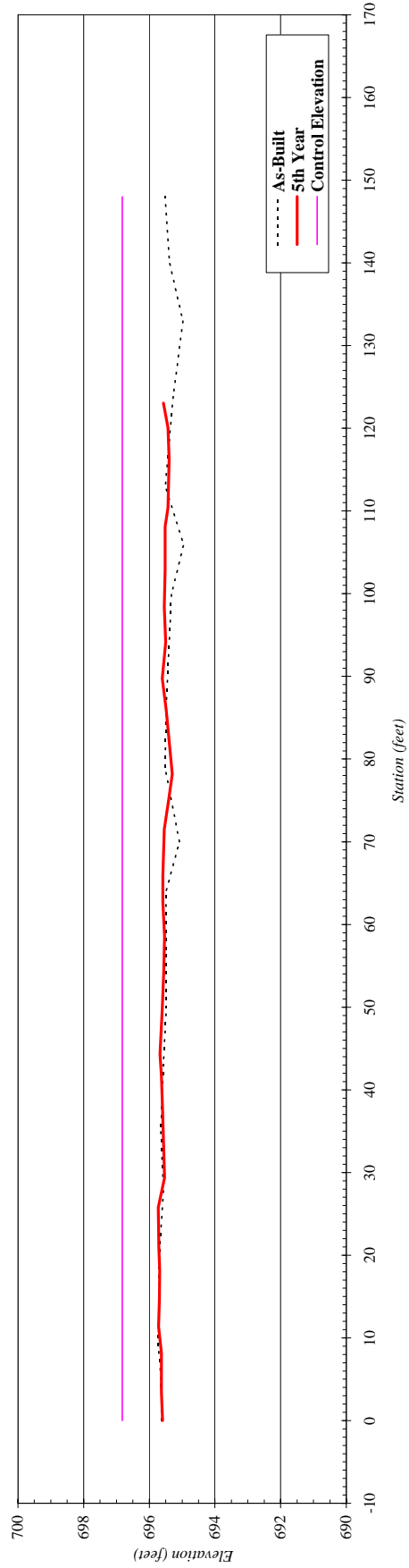


Comments:

River Basin:	Yadkin
Watershed:	Rich Fork Creek
Reach:	Mainstem
Profile ID:	Downstream
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan
Control Elevation:	696.82

Average Slope:	0.002
As-Built Avg. Depth:	1.37
5th Year Avg. Depth:	1.25

Longitudinal Profile

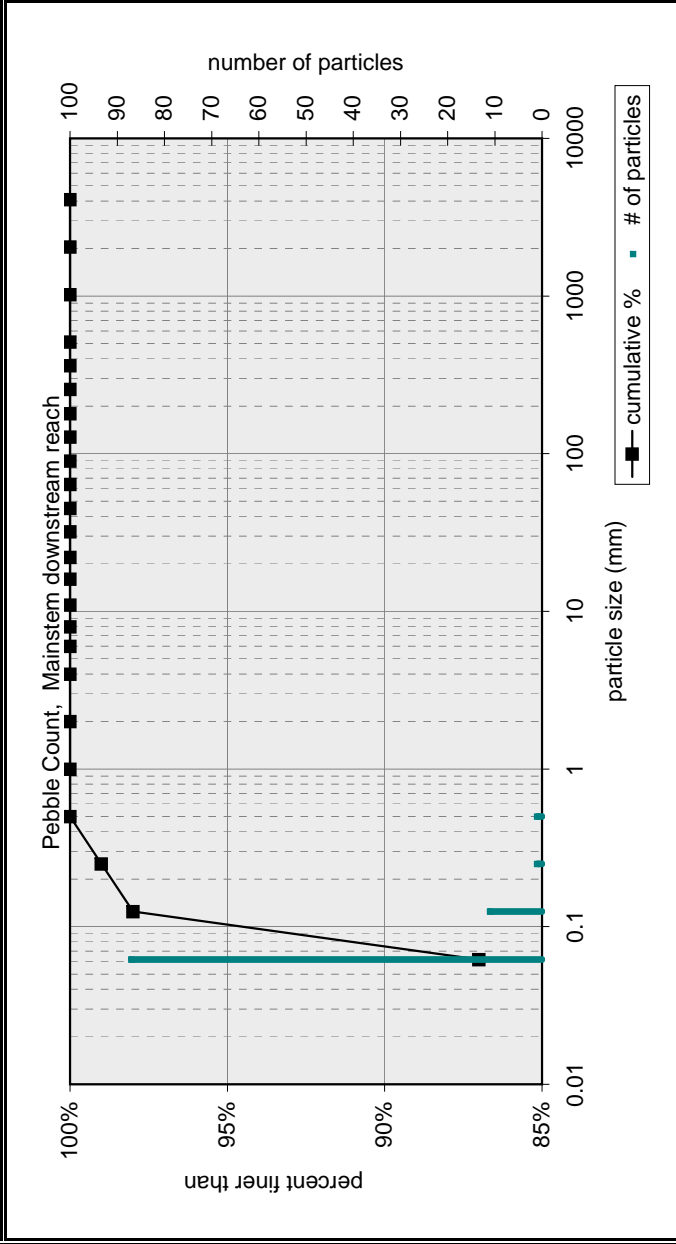


Pebble Count of Channel Reach

Material	Size Range (mm)	Count
silt/clay	0	87
very fine sand	0.062	11
fine sand	0.13	1
medium sand	0.25	1
coarse sand	0.5	1
very coarse sand	1	2
very fine gravel	2	4
fine gravel	4	6
fine gravel	6	8
medium gravel	8	11
medium gravel	11	16
coarse gravel	16	22
coarse gravel	22	32
very coarse gravel	32	45
very coarse gravel	45	64
small cobble	64	90
medium cobble	90	128
large cobble	128	180
very large cobble	180	256
small boulder	256	362
small boulder	362	512
medium boulder	512	1024
large boulder	1024	2048
very large boulder	2048	4096
total particle count:		100

Pebble Count

Mainstem downstream reach
Rich Fork Creek
High Point, NC
Note:



based on sediment particles only	size percent less than (mm)					particle size distribution			
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.062	0.06	0.1	0	0	0	1.0	0.1	1.0
based on total count	percent by substrate type					bedrock	hardpan	wood/det	artificial
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	87%	13%	0%	0%	0%	0%	0%	0%	0%

bedrock	
clay hardpan	
debris/wood	
artificial	
total count:	100

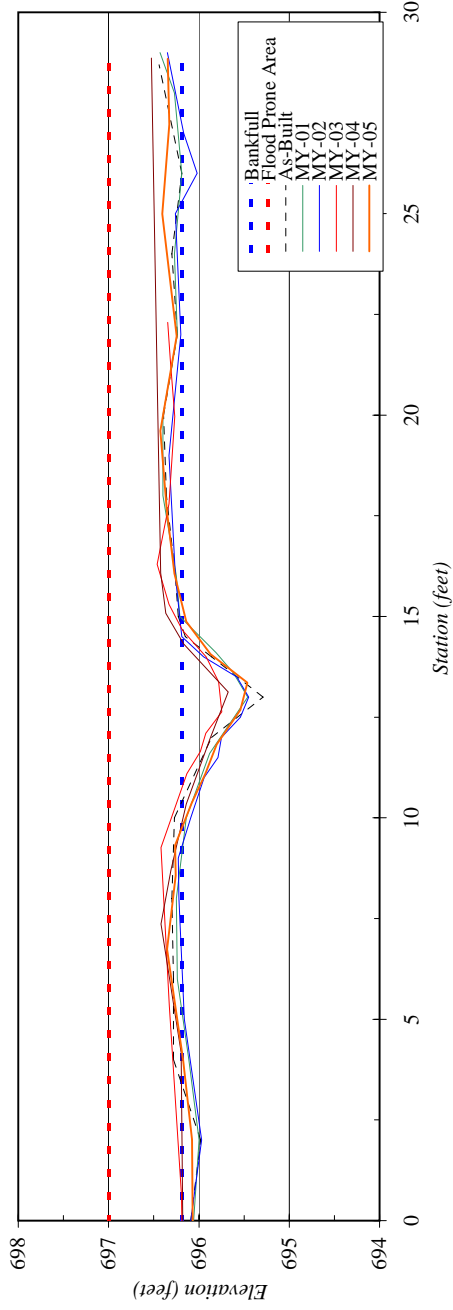
River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Trib XS 1, Pool
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	696.07
2.0	696.07
4.0	696.17
6.7	696.35
8.6	696.26
9.3	696.27
10.4	696.08
11.1	695.93
11.8	695.80
12.7	695.54
13.4	695.46
14.1	695.87
14.9	696.14
16.1	696.27
17.7	696.36
19.6	696.43
22.0	696.25
25.0	696.41
27.2	696.33
28.8	696.35

SUMMARY DATA	
Bankfull Elevation:	696.19
Bankfull Cross-Sectional Area:	1.8
Bankfull Width:	5.6
Flood Prone Area Elevation:	697.0
Flood Prone Width:	>30
Max Depth at Bankfull:	0.5
Mean Depth at Bankfull:	0.3
W / D Ratio:	16.9
Entrenchment Ratio:	>5
Bank Height Ratio:	1.5

Yadkin River Basin, Rich Fork, MY05, Trib XS 1, Pool

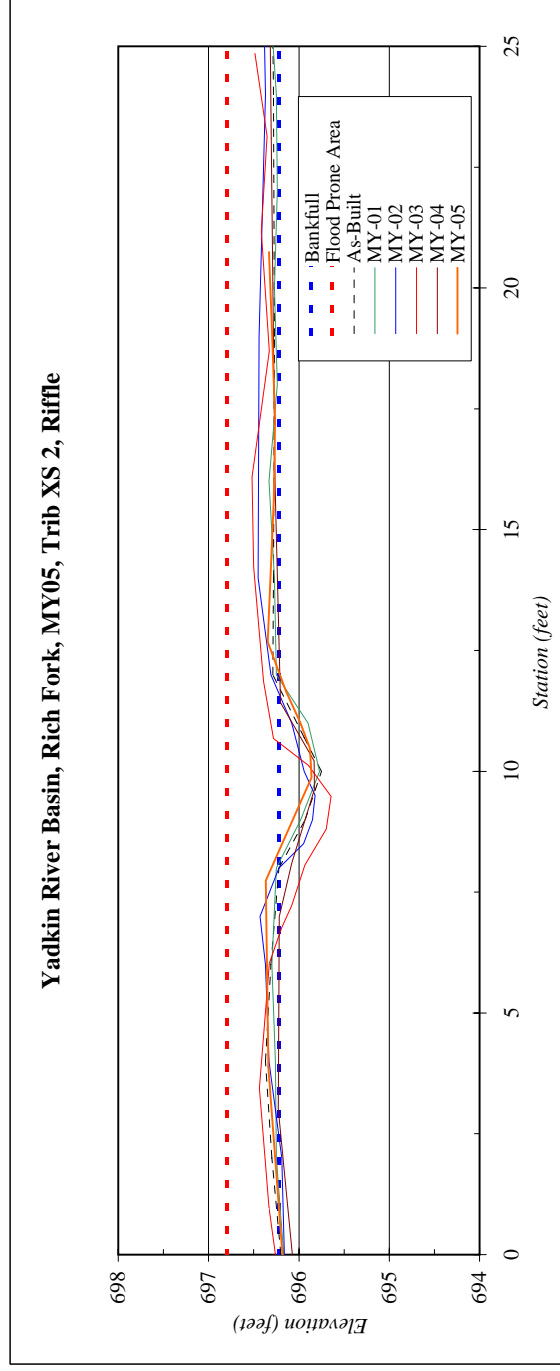


River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Trib XS 2, Riffle
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	696.07
2.0	696.07
4.0	696.17
6.7	696.35
8.6	696.26
9.3	696.27
10.4	696.08
11.1	695.93
11.8	695.80
12.7	695.54
13.4	695.46
14.1	695.87
14.9	696.14
16.1	696.27
17.7	696.36
19.6	696.43
22.0	696.25
25.0	696.41
27.2	696.33
28.8	696.35

SUMMARY DATA	
Bankfull Elevation:	696.22
Bankfull Cross-Sectional Area:	1.0
Bankfull Width:	4.1
Flood Prone Area Elevation:	696.8
Flood Prone Width:	>25
Max Depth at Bankfull:	0.4
Mean Depth at Bankfull:	0.2
W / D Ratio:	17.6
Entrenchment Ratio:	>6
Bank Height Ratio:	1.9



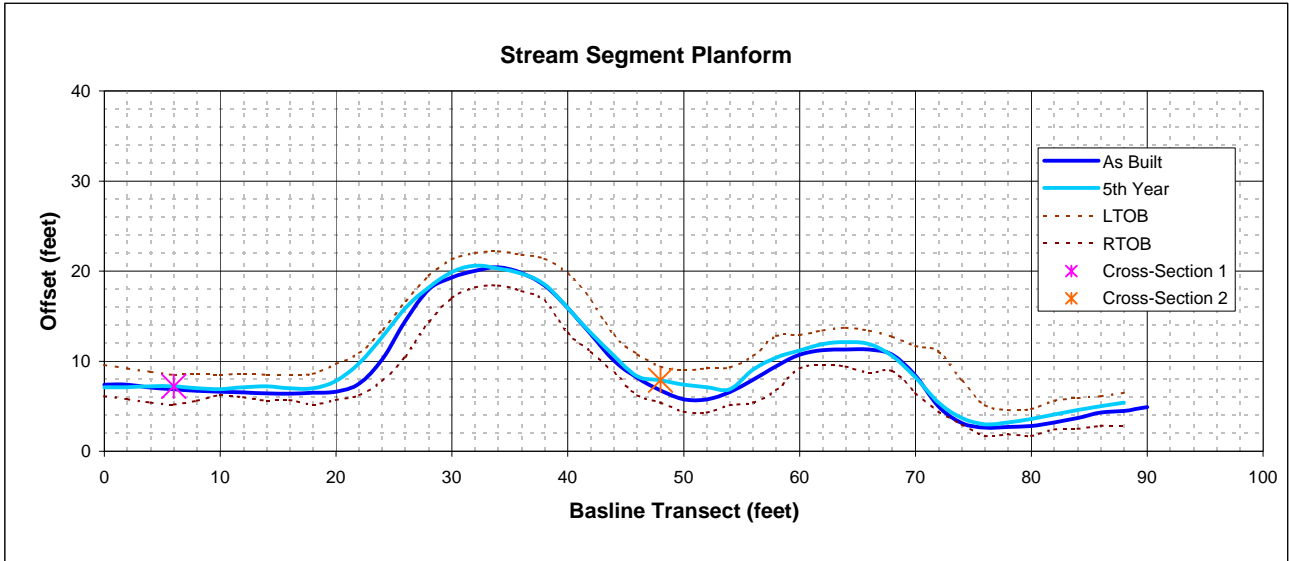
River Basin:	Yadkin
Watershed:	Rich Fork
Planform ID	Trib Up
Date:	5/28/2008
Field Crew:	BR, KV

SUMMARY DATA	
Stream Segment Length:	107
Distance Between Survey Points:	88
Distance Between Stations:	2
Sinuosity:	1.2
Mean Radius of Curvature:	7.0
Belt Width:	17.6



View of tributary upstream planform looking downstream

Stream Type:	E5
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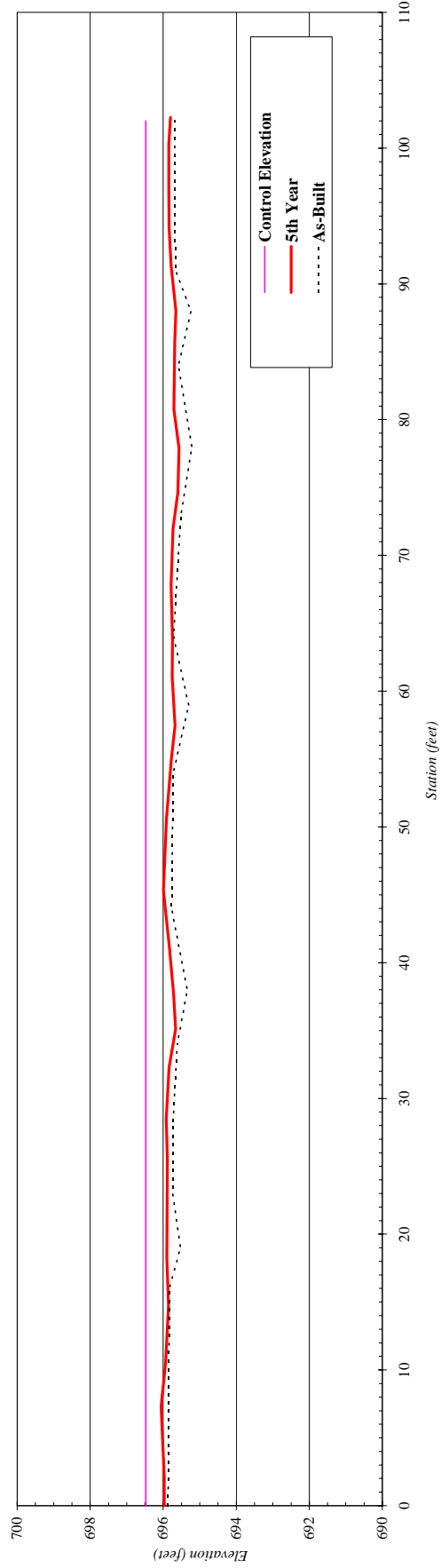


Comments:

River Basin:	Yadkin
Watershed:	Rich Fork Creek
Reach:	Tributary
Profile ID:	Upstream
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan
Control Elevation:	696.48

Average Slope:	0.002
As-Built Avg. Depth:	0.87
5th Year Avg. Depth:	0.67

Longitudinal Profile

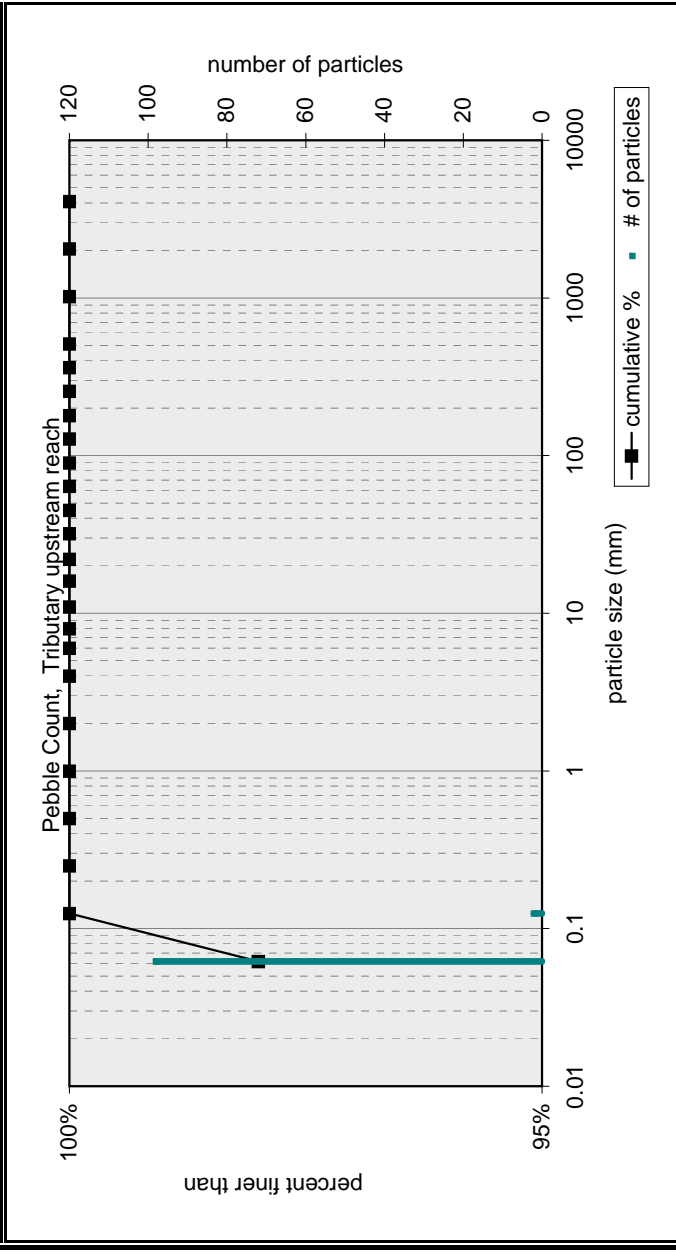


Pebble Count of Channel Reach

Material	Size Range (mm)	Count
silt/clay	0	98
very fine sand	0.062	2
fine sand	0.13	
medium sand	0.25	
coarse sand	0.5	
very coarse sand	1	
very fine gravel	2	
fine gravel	4	
fine gravel	6	
fine gravel	8	
medium gravel	11	
medium gravel	16	
coarse gravel	22	
coarse gravel	32	
very coarse gravel	45	
very coarse gravel	64	
small cobble	90	
medium cobble	128	
large cobble	180	
very large cobble	256	
small boulder	362	
small boulder	512	
medium boulder	1024	
large boulder	2048	
very large boulder	4096	
total particle count:		100

Pebble Count:

Tributary upstream reach
Rich Fork Creek
High Point, NC
Note:



based on sediment particles only	size percent less than (mm)					particle size distribution			
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.062	0.06	0.1	0	0	0	1.0	0.1	1.0
based on total count	percent by substrate type					bedrock	hardpan	wood/det	artificial
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	98%	2%	0%	0%	0%	0%	0%	0%	0%

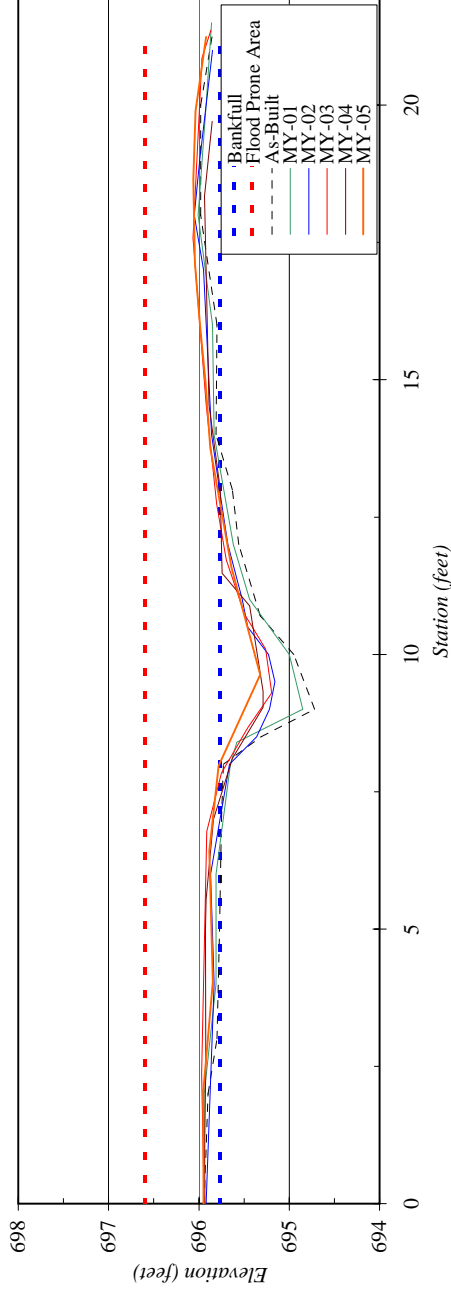
River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Trib XS 3, Pool
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	695.95
2.0	695.95
4.0	695.85
6.4	695.88
8.0	695.78
9.6	695.32
11.6	695.64
13.8	695.87
15.0	695.93
16.0	695.99
17.1	696.04
18.6	696.06
19.9	696.04
21.2	695.92

SUMMARY DATA	
Bankfull Elevation:	695.77
Bankfull Cross-Sectional Area:	1.0
Bankfull Width:	4.8
Flood Prone Area Elevation:	696.6
Flood Prone Width:	>30
Max Depth at Bankfull:	0.4
Mean Depth at Bankfull:	0.2
W / D Ratio:	22.7
Entrenchment Ratio:	>6
Bank Height Ratio:	1.0

Yadkin River Basin, Rich Fork, MY05, Trib XS 3, Pool



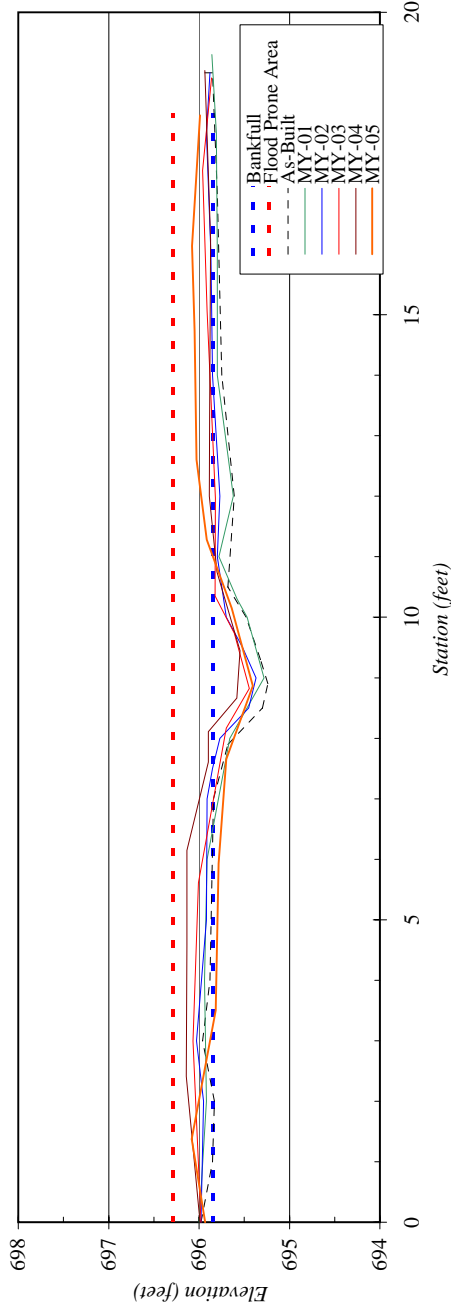
River Basin:	Yadkin
Watershed:	Rich Fork, MY05
XS ID	Trib XS 4, Riffle
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan



Station	Elevation
0.0	695.93
1.4	696.08
3.5	695.82
5.9	695.78
7.7	695.70
8.9	695.41
10.2	695.64
11.3	695.91
12.6	696.03
14.7	696.05
16.1	696.08
18.3	695.99

SUMMARY DATA	
Bankfull Elevation:	695.85
Bankfull Cross-Sectional Area:	1.6
Bankfull Width:	6.2
Flood Prone Area Elevation:	696.29
Flood Prone Width:	>20
Max Depth at Bankfull:	0.4
Mean Depth at Bankfull:	0.3
W / D Ratio:	23.9
Entrenchment Ratio:	>3
Bank Height Ratio:	1.0

Yadkin River Basin, Rich Fork, MY05, Trib XS 4, Riffle



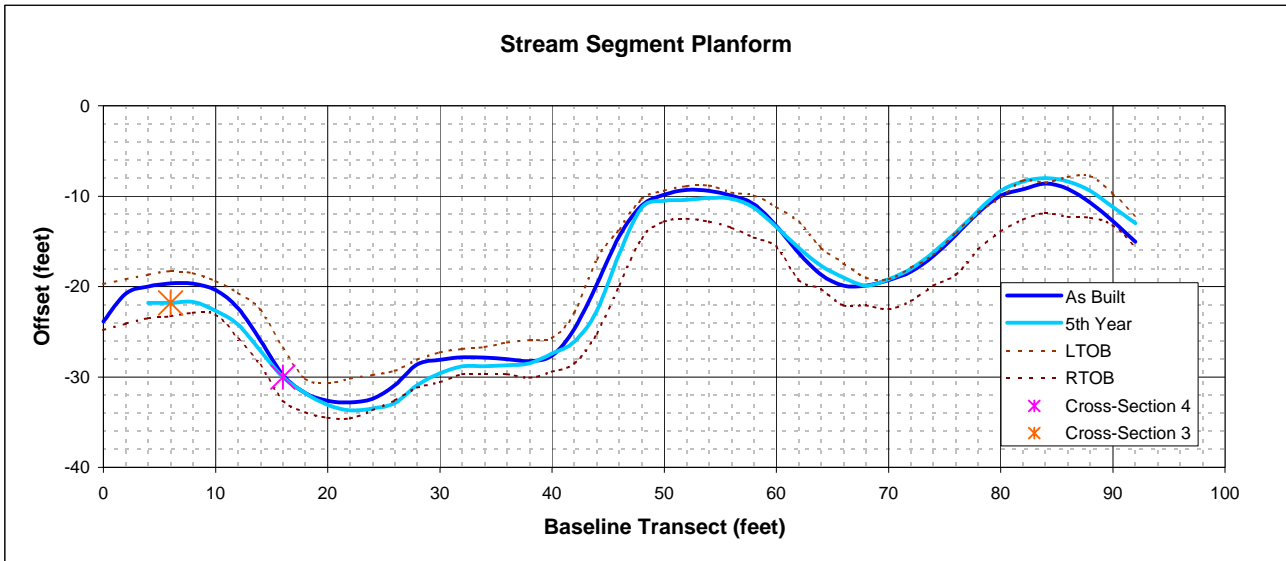
River Basin:	Yadkin
Watershed:	Rich Fork
Planform ID	Trib Down
Date:	5/28/2008
Field Crew:	BR, KV

SUMMARY DATA	
Stream Segment Length:	123
Distance Between Survey Points:	92
Distance Between Stations:	2
Sinuosity:	1.3
Mean Radius of Curvature:	7.0
Belt Width:	25.7



View of tributary downstream planform looking downstream

Stream Type:	E5
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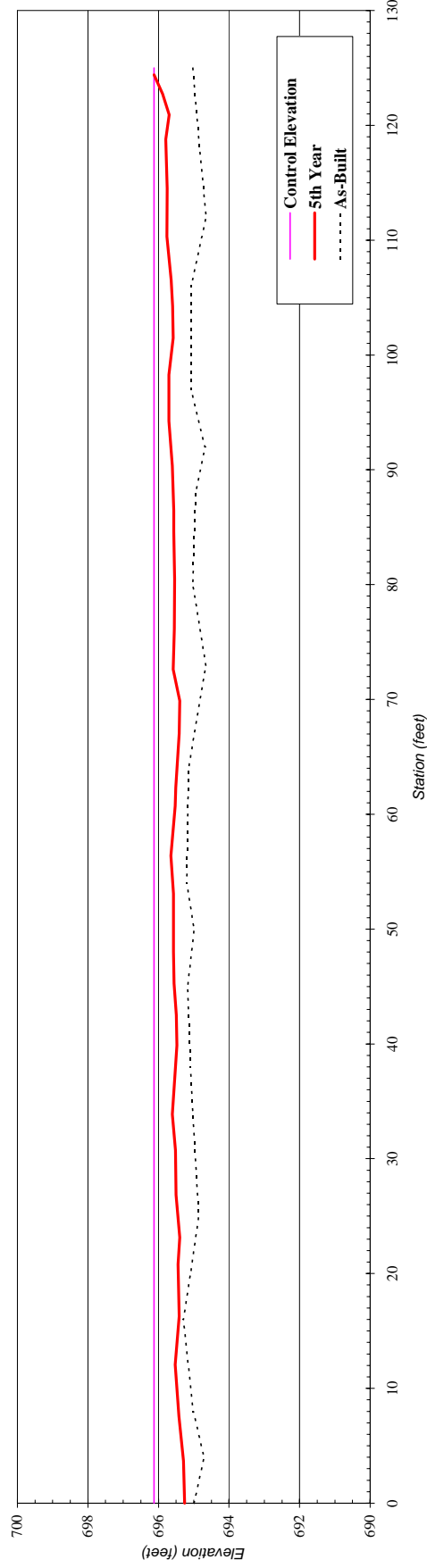


Comments:

River Basin:	Yadkin
Watershed:	Rich Fork Creek
Reach:	Tributary
Profile ID:	Downstream
Date:	5/28/2008
Field Crew:	B. Roberts, K. Vaughan
Control Elevation:	696.13

Average Slope:	0.003
As-Built Avg. Depth:	1.15
4th Year Avg. Depth:	0.56

Longitudinal Profile



Appendix D
Permanent Photo Documentation Points



Photo Location 2, Photo 2: View looking east. 6/4/08 MY05



Photo Location 3: View looking east at the wetland preservation area. 6/4/08 MY05



Photo Location 1: View looking toward large cedar and restored channel at confluence with Rich Fork Creek. 6/4/08 MY05



Photo Location 2, Photo 1: View looking south toward large cedar. 6/4/08 MY05



Photo Location 4: View looking east. 6/4/08 MY05



Photo Location 5: View looking north toward tree line of wetland preservation area. 6/4/08 MY05



Photo Location 6, Photo 1: View looking west. 6/4/08 MY05



Photo Location 6, Photo 2: View looking northwest from Rich Fork. 6/4/08 MY05