Little Beaver Creek Stream and Wetland Restoration Site

2008 Annual Monitoring Report- (Year 2)

Wake County
EEP Project No. 221
Design Firm: Earth Tech

May 2009

Prepared for:

NCDENR/ Ecosystem Enhancement Program
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I. Executive Summary

The Little Beaver Creek Stream and Wetland Restoration Site consists of 3712 linear feet of stream restoration, 1,913 linear feet of stream preservation, 2.4 acres of wetland restoration, all within a 52 acre conservation easement. Little Beaver Creek is located at the end of Olive Farm Road (SR 1178) in southwest Apex, Wake County, North Carolina. Construction was conducted between July 2005 and November 2005.

The project contains a portion of Little Beaver Creek, a tributary to B. Everett Jordan Lake, which is located within the Cape Fear River Basin. The project watershed is 1.1 square miles. The North Carolina Wetland Restoration Program (NCWRP), now known as the North Carolina Ecosystem Enhancement Program (NCEEP), identified Little Beaver Creek as a potential stream and wetland mitigation site. Prior to restoration, Little Beaver Creek was incised with moderate habitat and an actively migrating unstable pattern. Sand bars were composed of erodible material that migrated frequently during small storm events. Sections of the channel that had been straightened for agricultural purposes contained mid channel bars indicating overwidening. The mid channel bars were deflecting the stream flow into the banks accelerating stream bank erosion.

The stream project is divided into three separate reaches labeled Reach 1, Reach 2, and Reach 3. Reach 1 and 2 consist of Priority 1 and 2 stream restoration. Priority 1 restoration involves the re-establishment of the bankfull stage to the historical floodplain elevation. Priority 2 involves the creation of a new floodplain and stream pattern while keeping the streambed at the present elevation. In order to accomplish this type of restoration, a combination of bedform transformation, channel dimension adjustments, pattern alterations, and the structure installation was performed. Natural meander patterns were restored and grade control rock vanes and rootwads incorporated for aquatic habitat enhancement and bed and bank stability. Tributary 1 of Reach 1, Tributary 2 of Reach 2, and Tributary 3 of Reach 3a was restored using Priority 1 restoration. Natural meander patterns were restored, the bed and banks were stabilized with woody and herbaceous plantings. , The restoration of Reach 3 below the road crossing, now referred to as Reach 3b, was abandoned due to bedrock constraints. Reach 3b is preserved within the permanent conservation easement.

Construction of the restored channel was completed in November 2005. The woody stem material that was available at the time of construction was not suitable for the site, so planting was delayed until the dormant season of 2006/2007 when suitable plant material was available. Tropical storm Alberto passed over the area June 14, 2006 and created heavy precipitation and flooding which eroded many areas and caused some bank failures. Additionally, due to bedrock constraints, no work was performed on Reach 3b downstream of the road crossing. Because of these design changes, wetland restoration potential is less than initially anticipated.

Little Beaver Creek is currently in a degraded state throughout much of the reach. The stream has down-cut in many areas since construction and some of the structures were

placed inappropriately, resulting in some bank stability issues. This is partially due to the damage caused by Tropical Storm Alberto. Pools have shifted into the riffle areas and riffles tend to be short throughout all three stream reaches. Structure type and placement have exacerbated this problem. Tributaries 1 and 2 are in generally good condition exhibiting minimal signs of down-cutting or bank stability issues

When comparing MY-01 to MY-02, the channel and banks do appear to be stabilizing in some areas marked as problems or concerns on the year one plan due to vegetation establishment. None of the streams experience further significant down cutting due to Tropical Storm Hannah in September of 2008 as observed in the comparison of the longitudinal profiles.

Little Beaver Creek was monitored according to the three reaches established for design. Reach 1 extends from the top of the restoration to the confluence with Tributary 1, a total of 991 linear feet. The pool locations are correctly located within the meander bend areas, however for the majority of the stream length, the riffles are too short. Possible riffle construction in conjunction with the existing sill structures may correct the stream profile issues.

Reach 2 extends from the confluence with Tributary 1 to station 33+00, 1,309 linear feet. The longitudinal profile in the upper reach is primarily dominated by riffles and pools that have shifted into inappropriate places within the plan form of the stream, or segments in which structures have caused submerged riffles and long pools. The lower portion of the reach is dominated by a series of structures. These sill structures have influenced the stream profile by creating a sill step followed by a scour pool formation that is not compatible with the stream type or plan form.

Little Beaver Creek Reach 3A is located from 33+00 to the end of the project, 732 linear feet. Aggradation within the longitudinal profile has occurred at the head of this reach as the riffle has extended and filled a pool area in a meander bend. This reach is dominated by riffles that have shifted into the meander bends.

Tributary 1, 381 linear feet, ties into Little Beaver Creek at station 19+25. The tributary has adjusted at the top and bottom of the reach from the year one data; however its overall stability is good. There is evidence that the abandoned roadway within the conservation easement that crosses this tributary is still being used.

Tributary 2, 206 linear feet, ties into Little Beaver Creek at station 29+50. The stream channel is very stable and is entirely covered with thick herbaceous vegetation.

Currently there are eight RDS groundwater gauges (2, 3, 4, 5, 6, 7, 8, & 9) within the conservation easement. By recommendation from EEP, these gauges were installed on June 25, 2008 to replace an older set of gauges. Data was retrievable from three (6, 7 & 9) of the old gauges (Appendix C). Four of the groundwater gauges (Gauge 6, 7, 8, and 9) in the proposed wetland restoration areas of Reach 1 are displaying jurisdictional wetland hydrology (Appendix C). One bankfull event was recorded as a result of

Tropical Storm Hannah passing over the area on September 6, 2008 which created a rain event of greater than four inches. The flooding eroded many areas which were already noted as stream problem areas in the Year 1 monitoring report. Currently there are 354 woody planted stems/acre. Invasive exotics observed throughout the conservation easement include tall fescue (*Schedonurus arundinaceus*), Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and Chinese privet (*Ligustrum sinense*) with tall fescue and Japanese stiltgrass being the most common.

II. Project Background

A. Project Objectives

The project had the goal of accomplishing the following objectives:

1. Restore 3,753 linear feet of Little Beaver Creek and 682 linear feet of unnamed tributaries to Little Beaver Creek and preserve 1,560 linear feet of Little Beaver Creek. Due to bedrock constraints, restoration efforts were abandoned in Reach 3b at the downstream end of the project between station 47+53 and 63+13.29. This area is now under preservation within the permanent conservation easement.
2. Provide a stable stream channel that neither aggrades or degrades while maintaining its dimension, pattern, and profile, with the capacity to transport the watersheds water and sediment loads.
3. Improve water quality and reduce erosion through streambank stabilization techniques.
4. Re-establish connectivity of the stream with its floodplain.
5. Improve aquatic habitat through the implementation of natural structures such as rootwads, rock vanes, woody debris, and the planting of a riparian buffer.
6. Provide aesthetic value, wildlife habitat, and bank stability through the creation or enhancement of a riparian zone.
7. Restore characteristic hydrologic regime to disturb wetlands.
8. Restore characteristic plant communities and wildlife habitat within disturbed wetlands.

B. Project Structure

Prior to restoration, Little Beaver Creek consisted of an incised channel with moderate habitat and an unstable pattern that was actively migrating. Stream banks were steep with areas of active erosion, particularly along the outside of meander bends. Sand bars were composed of easily erodible material that migrated frequently during small storm events. Sections of the stream that had been straightened historically had mid channel bars indicating an overwidened channel that was unable to carry the sediment load. Instead of focusing the flow along the thalweg, the mid channel bars were redirecting the flow into the banks and accelerating bank erosion.

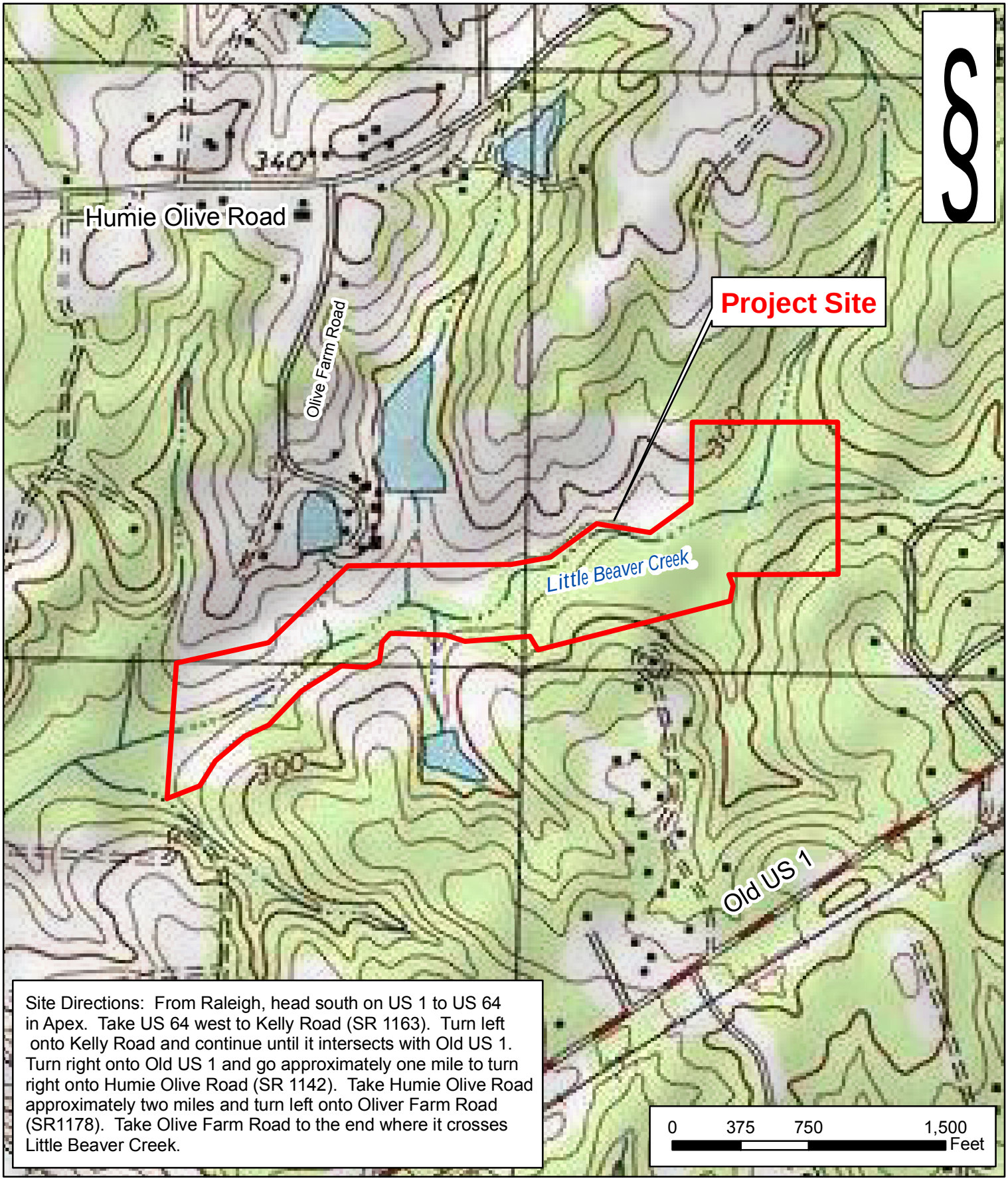
Priority 2 restoration was performed on all streams in an attempt to adjust the stream dimension, pattern, and profiles 1 and 2 to allow for adequate sediment transport. Specific Priority 2 techniques included bedform transformation, channel dimension adjustments, pattern alterations, and the installation of rock vane structures to serve as grade control. The natural meander patterns were restored and channel stabilizing structures such as rootwads and rock vanes installed to not only to serve as bank protection and grade control, but to enhance aquatic habitat. The Priority 2 restoration involved converting the impaired channels into a sinuous channel that meanders for a 3032 linear feet of stream as measured along the centerline of Little Beaver Creek and 680 linear feet of tributaries totaling 3712 linear feet. 2300 linear feet of Little Beaver Creek was preserved in the conservation easement. The conservation easement encompasses 52 acres. The riparian buffer within the permanent conservation easement was planted on January 15-February 9, 2007.

Table I. Mitigation Structure and Objectives

Little Beaver Creek Stream and Wetland Restoration Site Project No. 221					
Project Segment/Reach I.D.	**Mitigation Type**	**Approach**	**Linear Feet/Acreage**	**Stations**	**Comments**
Little Beaver Creek/Reach 1 & 2	Restoration	N/A	2.4 acres	N/A	Wetland Restoration
Little Beaver Creek/Reach 1 & 2	Restoration	Priority 2	2300	10+00 to 19+91 19+91 to 33+00	Instream structures and vegetated buffers
Little Beaver Creek/Reach 3a	Restoration	Priority 2	732	33+00 to 40+32	Instream structures and vegetated buffers
Little Beaver Creek/Reach 3b	Preservation	N/A	1,913	48+00 to 63+13	Preservation of vegetated buffers within permanent conservation easement
Tributary 1	Restoration	Priority 2	381	10+00 to 13+81	Instream structures and vegetated buffers
Tributary 2	Restoration	Priority 2	206	10+00 to 12+06	Instream structures and vegetated buffers
Tributary 3	Restoration	Priority 2	93	10+00 to 10+92	Instream structures and vegetated buffers

C. Location and Settings

The Little Beaver Creek project site is located approximately 3.5 miles southwest of the town of Apex in southeastern Wake County, North Carolina (Figure 1). The headwaters of the project originate approximately 0.75 miles to the east of the restoration site. Little Beaver Creek flows for approximately 4.5 miles before it reaches B. Everett Jordan Lake.



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Little Beaver Creek
Stream and Wetland Restoration Site

Site Location Map

Wake County, North Carolina

USGS 7.5-Minute Topographic Quadrangle Map (Newhill, NC)

EEP Project No. 221

Date: May 20, 2009

Ecosystem Enhancement Program

Figure 1

The watershed is approximately 1.11 square miles (711 acres) and is oriented east to west. The project is established within a conservation easement on private lands. The creek originates west of the Humie Olive Road (SR 1142) and Old US 1 intersection. The project extents are located upstream and downstream of Olive Farm Road (SR 1178) which is a gravel road off of Humie Olive Road.

Site Directions: From Raleigh, head south on US 1 to US 64 in Apex. Take US 64 west to Kelly Road (SR 1163). Turn left onto Kelly Road and continue until it intersects with Old US 1. Turn right onto Old US 1 and go approximately one mile to turn right onto Humie Olive Road. Take Humie Olive Road approximately two miles and turn left onto Olive Farm Road. Take Olive Farm Road to the end where it crosses Little Beaver Creek.

D. History and Background

The North Carolina Wetland Restoration Program (NCWRP, now known as North Carolina Ecosystem Enhancement Program, NCEEP), identified Little Beaver Creek as having potential for stream and wetland restoration.

Little Beaver Creek enters the site as a second order stream before draining into B. Everett Jordan Lake as a third order stream. Little Beaver Creek is located within the Piedmont Physiographic Province of the Cape Fear River Basin (USGS Cataloging Unit 03030002). The watershed is located to the southwest of Apex, North Carolina. The watershed of Little Beaver Creek has an average width of 4,500 feet from the headwaters to its outlet. The topography is gentle sloping with relatively flat floodplains. Land surface elevations range from approximately 270 to 390 feet above mean sea level. Areas of hydric soils are common along the flat, narrow drainageways, however, few intact wetland communities are present due to alterations to accommodate agricultural and residential land use.

Table II. Project Activity and Reporting History

Little Beaver Creek Stream and Wetland Restoration Site-Project No. 221			
Activity or Reporting	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion Date**
Restoration Plan	2003	2003	March 2003
Final Design-90%	2005	2005	2005
Construction	2005	2005	November 2005
Temporary S&E mix applied to entire project area	2005	2005	2005
Permanent seed mix applied to entire project area	2005	2005	2005
Containerized, B&B, and livestake planting	January 2007	February 2007	February 2007
Mitigation Plan/As-built (Year 0 Monitoring-baseline)	July 2006	March 2006	February 2007
Year 1 Monitoring	Fall 2006	February 2007	November 2007

Year 2 Monitoring	December 2008	Summer/Fall 2008	December 2008
Year 3 Monitoring	NA	NA	NA
Year 4 Monitoring	NA	NA	NA
Year 5 Monitoring	NA	NA	NA

Table III. Project Contact Table

Little Beaver Creek Stream and Wetland Restoration Site-Project No. 221	
Designer POC	Earth Tech 701 Corporate Center Drive Suite 475 Raleigh, NC 27607 Bill Jenkins PE (919) 854-6200
Construction Contractor	Envirocon, Inc. 651 Corporate Circle Suite 114 Golden, CO 80401 Verne Musser (303) 215-0187
Planting Contractor POC	Seal Brothers 131 West Cleve St. Mt. Airy, NC 27030 Brain Seal (336) 786-2263
Seeding Contractor POC	Seal Brothers 131 West Cleve St. Mt. Airy, NC 27030 Brain Seal (336) 786-2263
Seed Mix Sources	Evergreen Seeding 4792 Rawls Church Rd. Fuquay-Varina, NC 27526
Nursery Stock Suppliers	Mellow March Farm 1312 Woody Store Rd. Siler City, NC 27344 (919) 742-1200
Monitoring Performers	The Catena Group 410-B Millstone Drive Hillsborough, NC 27278
Stream Monitoring	Ward Consulting Engineers 8386 Six Forks Road, Suite 101 Raleigh, North Carolina 27615-5088
Vegetation Monitoring	The Catena Group 410-B Millstone Dr. Hillsborough, NC 27278
Wetland Monitoring	The Catena Group 410-B Millstone Dr. Hillsborough, NC 27278

Table IV. Project Background Table

Little Beaver Creek Stream and Wetland Restoration Site-Project No. 221	
Project County	Wake
Drainage Area	
Little Beaver Creek	1.1 sq mi
Drainage impervious surface cover estimate (%)	< 5%
Stream Order	
Little Beaver Creek	2nd
Physiographic Region	Piedmont
Ecoregion	Triassic Basin
Rosgen Classification of As-Built	C
Cowardin Classification	Riverine
Dominant Soil Types	Augusta fine sandy loam, Wehadkee silt loam, Worsham sandy loam
Reference Site ID	Richland Creek and Little Beaver Creek
USGS HUC for Project	3030002
USGS HUC for Reference	Richland Creek (03030003) and Little Beaver Creek (03030002)
NCDWQ Sub-basin for Project	030605
NCDWQ Sub-basin for Reference Reach	Richland Creek (030610), Little Beaver Creek (030605)
NCDWQ Classification for Project	Little Beaver Creek (WS-IV, NSW)
NCDWQ Classification for Reference	Richland Creek (B), Little Beaver Creek (WS-IV, NSW)
Is any portion of any project segment 303D listed?	No
Is any portion of any project segment upstream of a 303D listed segment?	Yes
Reasons for 303D listing or stressor	Chlorophyll a
% of project easement fenced	0%

E. Monitoring Plan View

See Figure 2 for the Monitoring Plan View.

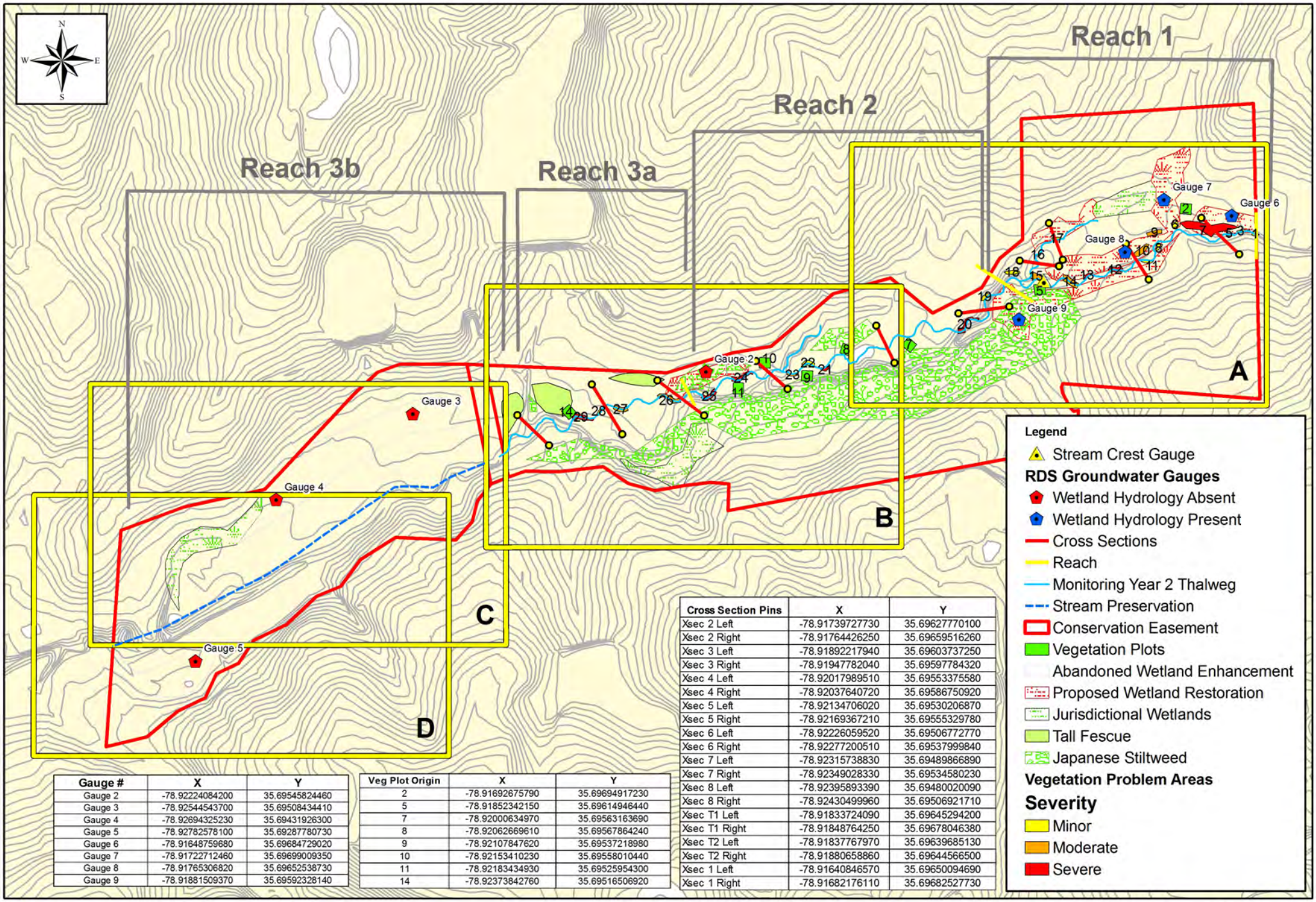
III. Project Condition and Monitoring Results

A. Vegetation Assessment

Monitoring year 1 had a total of 15 vegetation monitoring plots. These plots were not established using the new CVS protocol. By recommendation from EEP, the number of vegetation plots was reduced to eight and seven of the original plots were abandoned. Plots 2, 5, 7, 8, 9, 10, 11, and 14 have been chosen to best represent the vegetative conditions of the project and data collection will follow the new CVS protocol (Version 4.0) for the remainder of the monitoring period.

According to the US Army Corps of Engineers Stream Mitigation Guidelines, the survival of planted woody species should be at least 320 stems/acre through monitoring year (MY) 3. A mortality rate of ten percent will be allowed after MY4 (288 stems/acre), with another ten percent mortality rate allowed after MY5 requiring a minimum of 260

stems/acre by the end of the five year monitoring period. Currently there are 354 planted stems/acre within the conservation easement. This density is barely greater than the monitoring year three success criteria and replanting may need to be considered if survivorship is not met during the MY 3 monitoring period. The successional species dog fennel (*Eupatorium capillifolium*) was ubiquitous throughout the conservation easement along with the less frequent common horseweed (*Conyza canadensis*). Sweetgum (*Liquidambar styraciflua*) saplings were also very common along the stream buffer throughout the conservation easement. Invasive exotics observed throughout the conservation easement include tall fescue (*Schedonurus arundinaceus*), Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and Chinese privet (*Ligustrum sinense*) with tall fescue and Japanese stiltgrass being the most common. According to the NC Native Plant Society (NCNPS) Chinese privet, Japanese honeysuckle, Japanese stiltgrass, and multiflora rose are Rank 1 "Severe Threat" invasive exotic species which is defined as exotic plant species that have invasive characteristics and spread readily into native plant communities, displacing native vegetation. Although these species have been given this rank, the functionality of the project is not expected to be impaired significantly. For additional information relating to vegetation see Appendix A.



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Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

Cross Section Pins	X	Y
Xsec 2 Left	-78.91739727730	35.69627770100
Xsec 2 Right	-78.91764426250	35.69659516260
Xsec 3 Left	-78.91892217940	35.69603737250
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Xsec 4 Left	-78.92017989510	35.69553375580
Xsec 4 Right	-78.92037640720	35.69586750920
Xsec 5 Left	-78.92134706020	35.69530206870
Xsec 5 Right	-78.92169367210	35.69555329780
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Xsec 6 Right	-78.92277200510	35.69537999840
Xsec 7 Left	-78.92315738830	35.69489866890
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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Monitoring Plan View

Wake County, North Carolina

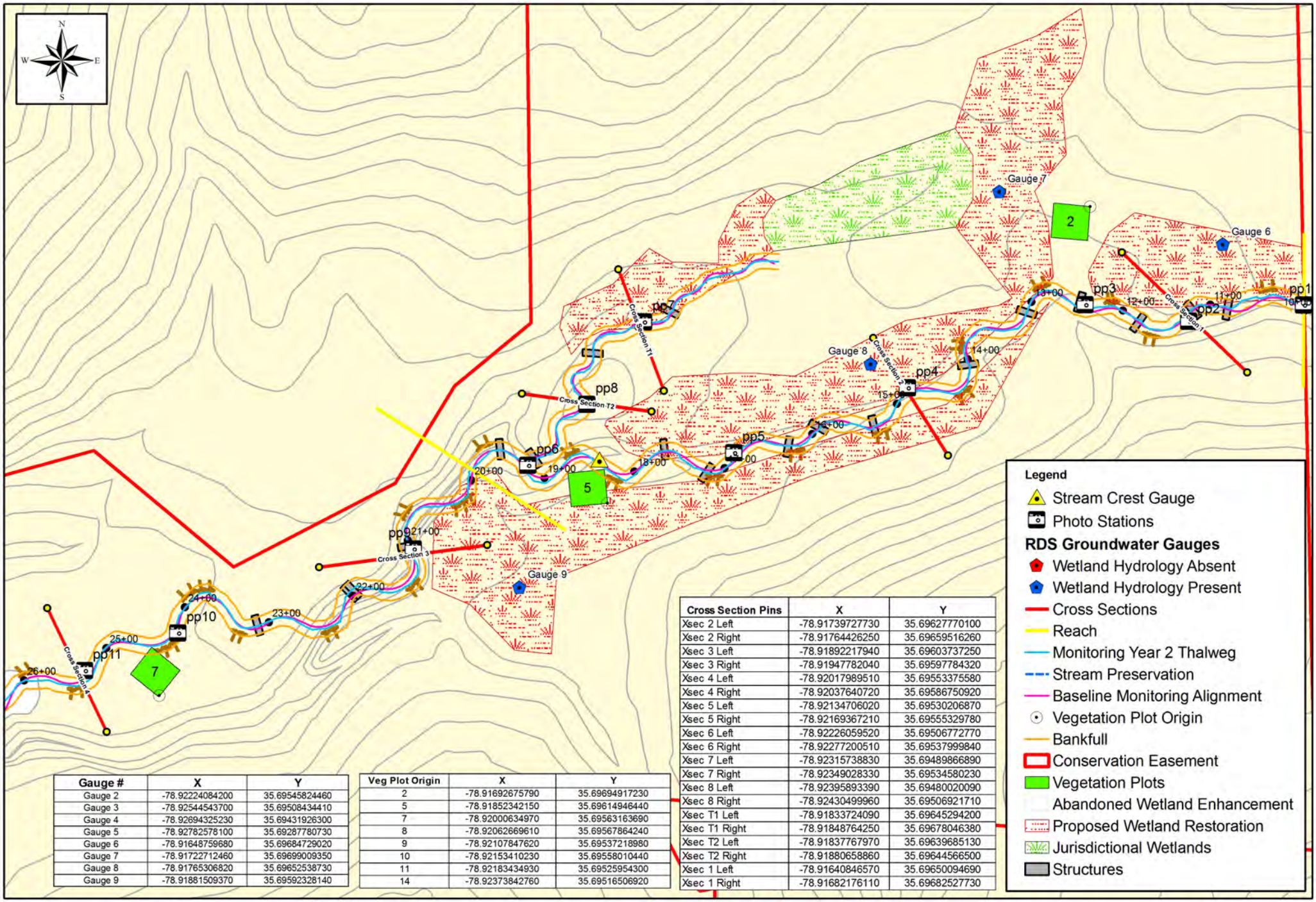
2005 Aerial Orthophotography
(Source: Wake County)

0 125 250 500 Feet

EEP Project No. 221

Date: May 2009

Figure Key



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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Monitoring Plan View

Wake County, North Carolina

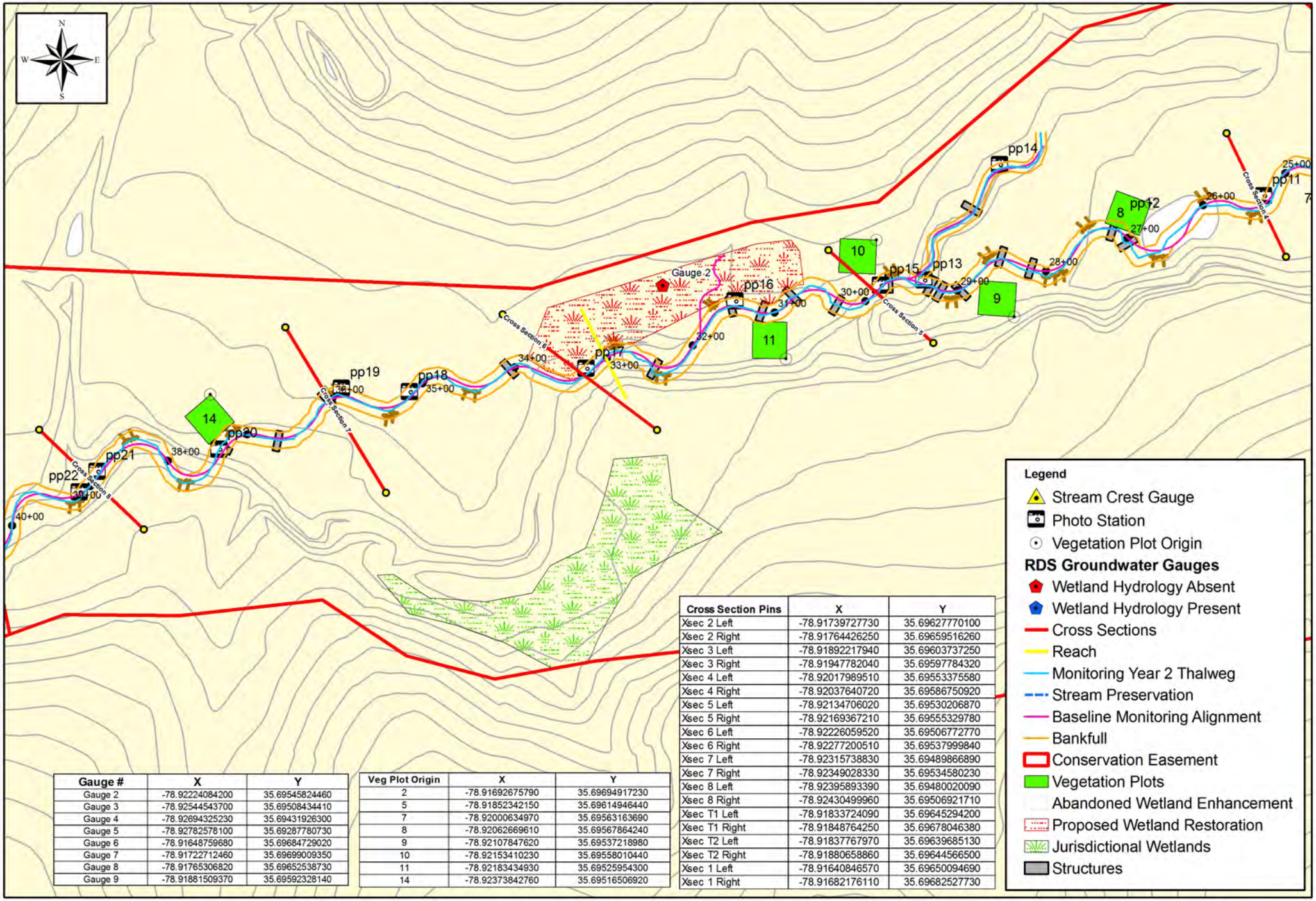
2005 Aerial Orthophotography
(Source: Wake County)

0 37.5 75 150 Feet

EEP Project No. 221

Date: May 2009

Figure A



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The Catena Group

Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration
Monitoring Plan View

Wake County, North Carolina

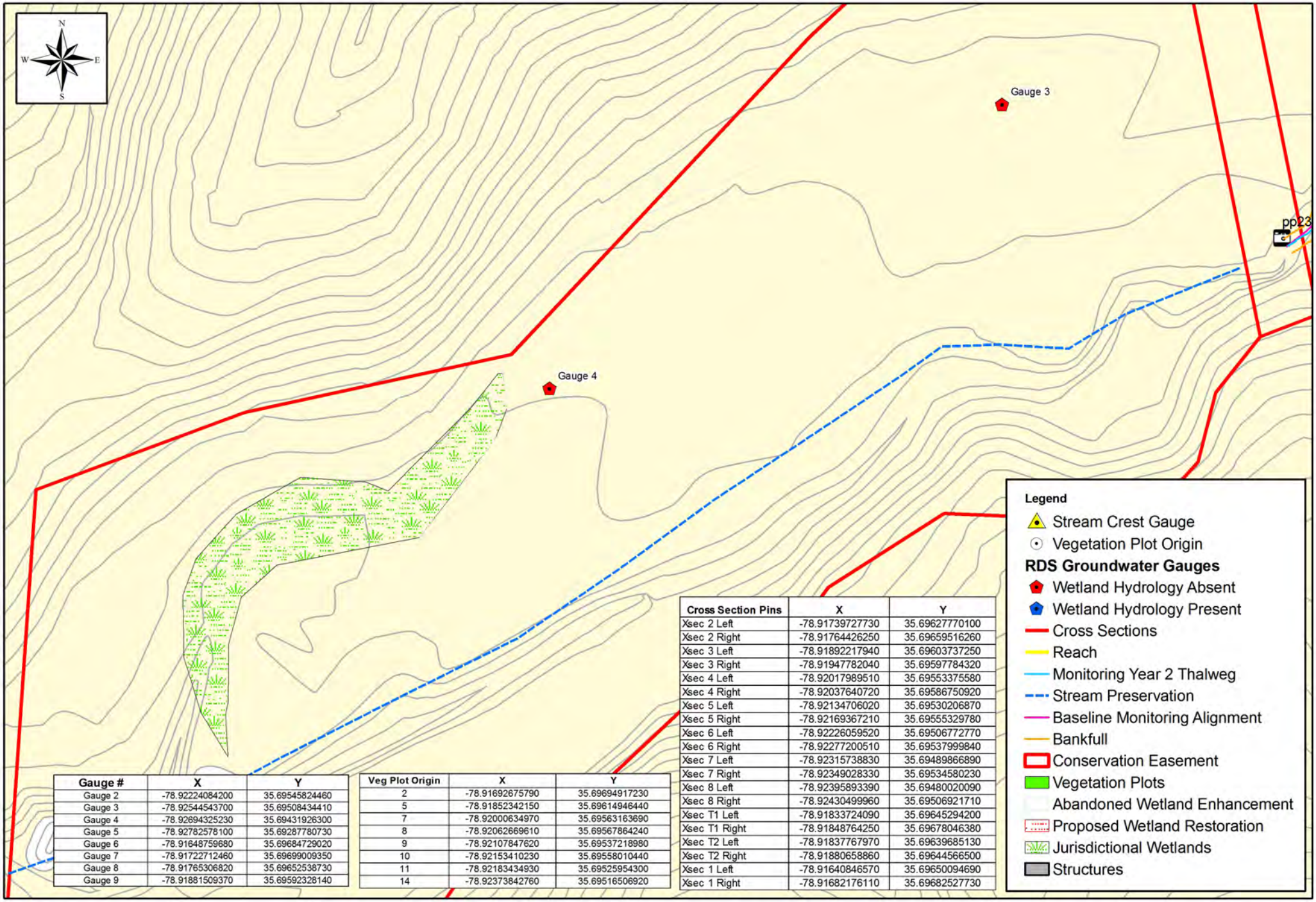
2005 Aerial Orthophotography
(Source: Wake County)

0 37.5 75 150 Feet

EEP Project No. 221

Date: May 2009

Figure B



Gauge #	X	Y
Gauge 2	-78.92224084200	35.69545824460
Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

Cross Section Pins	X	Y
Xsec 2 Left	-78.91739727730	35.69627770100
Xsec 2 Right	-78.91764426250	35.69659516260
Xsec 3 Left	-78.91892217940	35.69603737250
Xsec 3 Right	-78.91947782040	35.69597784320
Xsec 4 Left	-78.92017989510	35.69553375580
Xsec 4 Right	-78.92037640720	35.69586750920
Xsec 5 Left	-78.92134706020	35.69530206870
Xsec 5 Right	-78.92169367210	35.69555329780
Xsec 6 Left	-78.92226059520	35.69506772770
Xsec 6 Right	-78.92277200510	35.69537999840
Xsec 7 Left	-78.92315738830	35.69489866890
Xsec 7 Right	-78.92349028330	35.69534580230
Xsec 8 Left	-78.92395893390	35.69480020090
Xsec 8 Right	-78.92430499960	35.69506921710
Xsec T1 Left	-78.91833724090	35.69645294200
Xsec T1 Right	-78.91848764250	35.69678046380
Xsec T2 Left	-78.91837767970	35.69639685130
Xsec T2 Right	-78.91880658860	35.69644566500
Xsec 1 Left	-78.91640846570	35.69650094690
Xsec 1 Right	-78.91682176110	35.69682527730

The Catena Group

Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Monitoring Plan View

Wake County, North Carolina

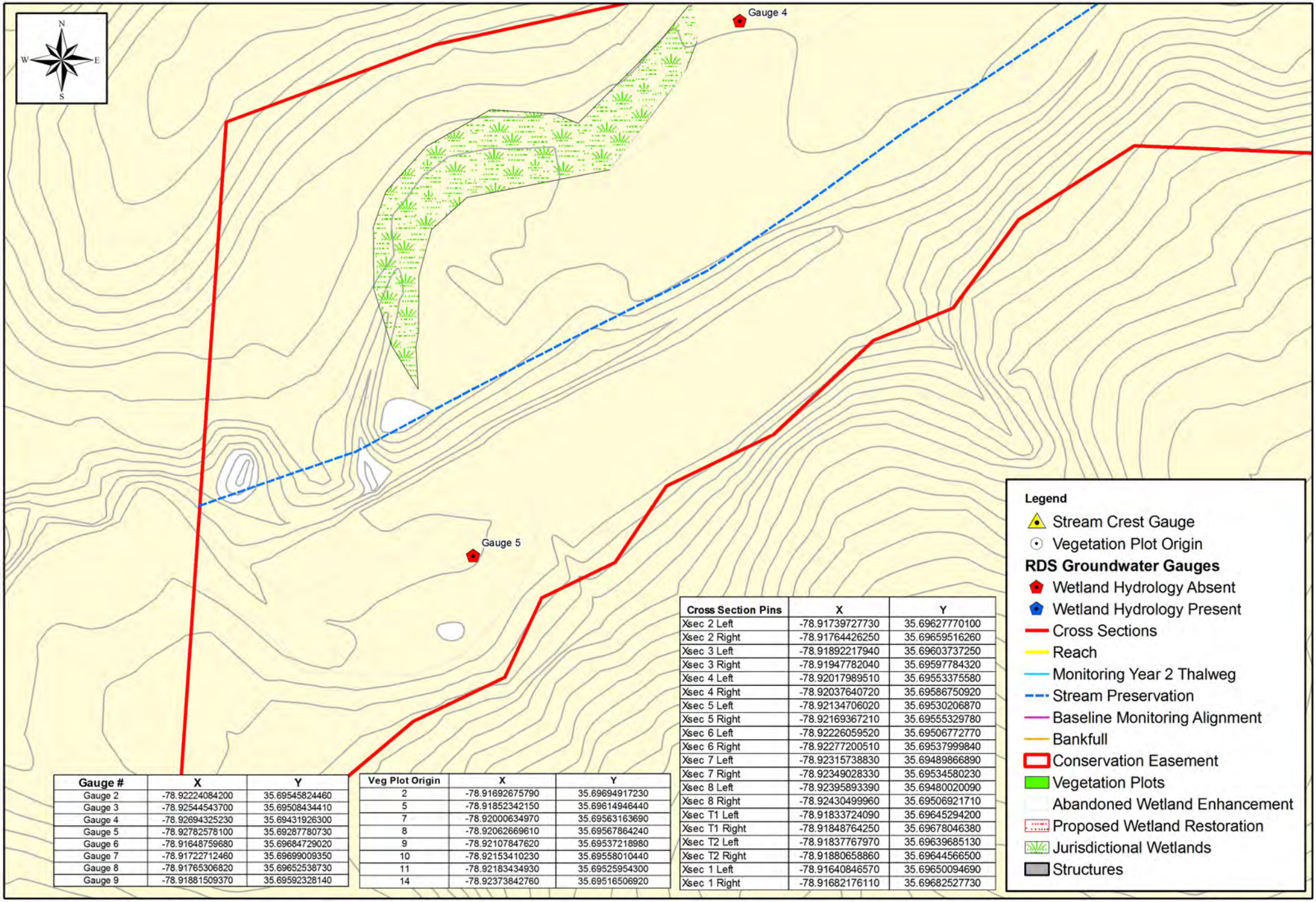
2005 Aerial Orthophotography
(Source: Wake County)

0 37.5 75 150 Feet

EEP Project No. 221

Date: May 2009

Figure C



Gauge #	X	Y
Gauge 2	-78.92224084200	35.69545824460
Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

Cross Section Pins	X	Y
Xsec 2 Left	-78.91739727730	35.69627770100
Xsec 2 Right	-78.91764426250	35.69659516260
Xsec 3 Left	-78.91892217940	35.69603737250
Xsec 3 Right	-78.91947782040	35.69597784320
Xsec 4 Left	-78.92017989510	35.69553375580
Xsec 4 Right	-78.92037640720	35.69586750920
Xsec 5 Left	-78.92134706020	35.69530206870
Xsec 5 Right	-78.92169367210	35.69555329780
Xsec 6 Left	-78.92226059520	35.69506772770
Xsec 6 Right	-78.92277200510	35.69537999840
Xsec 7 Left	-78.92315738830	35.69489866890
Xsec 7 Right	-78.92349028330	35.69534580230
Xsec 8 Left	-78.92395893390	35.69480020090
Xsec 8 Right	-78.92430499960	35.69506921710
Xsec T1 Left	-78.91833724090	35.69645294200
Xsec T1 Right	-78.91848764250	35.69678046380
Xsec T2 Left	-78.91837767970	35.69639685130
Xsec T2 Right	-78.91880658860	35.69644566500
Xsec 1 Left	-78.91640846570	35.69650094690
Xsec 1 Right	-78.91682176110	35.69682527730

The Catena Group

Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Monitoring Plan View

Wake County, North Carolina

2005 Aerial Orthophotography
(Source: Wake County)

0 37.5 75 150 Feet

EEP Project No. 221

Date: May 2009

Figure D

1. Vegetation Problem Areas

Problem areas are defined as either lacking vegetation or containing invasive exotic species and are categorized as Bare Bank, Bare Bench, Eroding Banks, or Invasive Population. See Table 6 in Appendix A for locations of problem areas identified within the conservation easement. See section two of Appendix A for representative photos of the vegetation problem areas observed within the conservation easement of Little Beaver Creek.

2. Vegetation Current Conditions Plan View (CCPV)

The vegetation CCPV provides an overview of all the problem areas in plan view format. The problem areas are color coded to depict the severity of the area of concern and are as follows: red=severe, orange=moderate, yellow=minor (See Appendix A).

B. Stream Assessment

1. Procedural Items

a) Morphological Criteria

The restoration site was surveyed by total station in October 2008. This survey includes a profile of entire length of Little Beaver Creek Reaches 1, 2, and 3a, 3032 feet; Tributary 1, 381 feet; and Tributary 2, 206 feet; and 10 cross-sections. Pebble counts, the visual stability assessment. The problem area assessment was conducted on November 18, 2008. Photographs were taken at all permanent photo points on November 10, 2008.

The cross-sections pins were located and marked with fiberglass poles and flagging tape. Two cross-section pins could not be located and were reset by stakeout using the coordinates provided in the MY-01 monitoring report. These pins were the left pin of cross section 2 and the left pin of tributary cross section 2. The permanent cross section locations are listed below.

Cross Section 1. Little Beaver Creek, Station 11+25, riffle.
Cross Section 2. Little Beaver Creek, Station 14+85, pool.
Cross Section 3. Little Beaver Creek, Station 21+16, riffle.
Cross Section 4. Little Beaver Creek, Station 24+40, pool.
Cross Section 5. Little Beaver Creek, Station 29+86, riffle
Cross Section 6. Little Beaver Creek, Station 33+28, riffle.
Cross Section 7. Little Beaver Creek, Station 36+03, pool.
Cross Section 8. Little Beaver Creek, Station 38+95, riffle.
Cross Section T1. Tributary 1, Station 11+63, pool.
Cross Section T2. Tributary 1, Station 12+89, riffle.

b) Hydrological Criteria

Monitoring requirements state that at least two bankfull events are to be documented within the five year monitoring period. Currently, one crest gauge is present in Reach 1 of Little Beaver Creek. One documented bankfull event occurred on 09/07/08.

Table V. Verification of Bankfull Events

Little Beaver Creek Stream and Wetland Restoration Site Project No. 221			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo #**
2006	June 14, 2006	Visual	N/A
September 18, 2008	September 7, 2008	Visual (i.e. wrack lines)	N/A

c) Bank Stability Assessment

This section along with Table VI will be completed in Year 5 of the monitoring period.

2. Stream Current Conditions Plan View

See Appendix B1.

3. Problem Areas Table Summary

The problem areas found within the restoration primarily consists of failed structures, bank failure and erosion, channel aggradation and degradation, over-widening of the channel, and missing structures. Many of the structures, namely rootwads, which were shown on the MY-01 plan view, were not observed during this year's stream assessment; others were shown in the incorrect location. Areas of concern in Reach 1 primarily involved aggradation of the channel. Aggradation was observed at stations 10+50 to 10+60, 12+50 – 12+70, and 19+00 – 21+90. Bank erosion was also observed in this segment of the stream which totaled approximately 4% of the total bank length. The bank erosion in approximately 50% of the observations was due to scour upstream of root wads. Concerns with installed structures primarily involved two structures with either a submerged or a center gap controlling the water surface elevation instead of the top of the structure. Only one other structure at station 11+75 was a concern in that evidence of overland flow was observed around the right end, which could lead to future additional problems. The majority of the problem areas exist in Reaches 2 & 3 of the stream. The problem areas within these reaches include structure failure due to piping, riffle degradation and root wad erosion from station 27+00 to 36+10 with the majority of the bank erosion occurring from station 27+00 to 30+50. The stream has over widening from station 25+00 to 26+75 and at station 29+00. Erosion is also occurring upstream and downstream of cross section #7 from station 35+00 to 37+00. Photos of the problem areas listed in the table can be seen in Appendix B.

4. Fixed Station Photos

Stream photos from the established photo stations were taken in November 2008 and can be viewed in Appendix B.

5. Stability Assessment

A visual morphological stability assessment was conducted on November 18, 2008. This assessment was broken down into three parts; the main channel and the two tributaries. This separation was not done for the MY-01 monitoring report. Additional discrepancies were found with the as-built quantities listed versus those found in the field and based on post field work analysis, thereby making it difficult to compare the monitoring years.

The performance of the main channel was impacted chiefly by the location of the riffles and pools, which had migrated from the design locations. Riffles tended to be short in length and were found to be accumulating fine bed materials. Bed aggradation and degradation were apparent, but it was difficult to determine whether these occurred between MY-01 and MY-02 or prior to that. The channel length of aggradation and deposition was determined through comparison of the longitudinal profiles between MY-01 and MY-02 data (Appendix B2).

Bank erosion lengths based on the assessment are 103, 333, and 175 feet for Reaches 1,2, and 3a with respective reach lengths of 991, 1309, and 732 feet. When broken by reach, the visual stability assessment found that for Reach 1, 15% (2 of the 13) of the structures had failed and 5% of the banks had erosion issues. Reach 2 had 37.5 % (6 of 16) structural failure and 12.7% of the banks had erosion issues. Reach 3 had 33% (1 of 3) of the structures failures and 12.0% of the banks had erosion issues.

Table VII. Categorical Stream Feature Visual Stability Assessment

Little Beaver Creek Stream and Wetland Restoration Site-Project No. 221						
Reaches 1, 2, 3a: (3032 feet)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	65%	41%			
B. Pools	100%	65%	65%			
C. Thalweg	100%	88%	52%			
D. Meanders	100%	72%	65%			
E. Bed General	100%	98%	94%			
F. Bank Condition	NA	NA	90%			
G. Vanes/J Hooks etc.	100%	82%	73%			
H. Wads and Boulders	100%	83%	70%			
Tributary 1: (381 feet)						
A. Riffles	100%	NA	67%			
B. Pools	100%	NA	76%			
C. Thalweg	100%	NA	64%			
D. Meanders	100%	NA	53%			
E. Bed General	100%	NA	93%			
F. Bank Condition	NA	NA	86%			
G. Vanes/J Hooks etc.	100%	NA	100%			
H. Wads and Boulders	100%	NA	NA			
Tributary 2: (206 feet)						
A. Riffles	100%	NA	100%			
B. Pools	100%	NA	100%			
C. Thalweg	100%	NA	100%			

D. Meanders	100%	NA	100%			
E. Bed General	100%	NA	100%			
F. Bank Condition	NA	NA	100%			
G. Vanes/J Hooks etc.	100%	NA	100%			
H. Wads and Boulders	100%	NA	NA			

*The tributaries were not separated from the main channel in the MY-01 monitoring report.

6. Quantitative Measures Summary Tables Stability Assessment

As stated in the Executive Summary, the MY-01 monitoring did not separate the pattern and profile data based on reach. These parameters remained constant across the three reaches and likely represent the entire length of the main channel; making comparison across monitoring years difficult. Moreover, reaches 2 and 3a both show a change in slope within the reach. These slopes are represented in Table IX and do not correlate with the MY-01 slope. However, when the reach-wide slope was calculated, correlation to MY-01 was found.

Little Beaver Creek was divided into three reaches for monitoring. Reach 1 extends from the top of the restoration to the confluence with Tributary 1, a total of 991 linear feet. One pool and one riffle permanent cross section was located within this reach, both of which show a 10% increase in bankfull width compared to MY-01 data. The permanent riffle section has become shallower and has decreased 10% in cross sectional area. The overall pattern remains very close to the as-built alignment. Approximately 20% of the pool radii of curvature have become smaller due the erosion of the outside bend and the shifting of the pool thalweg. In this reach there is more consistency of the correct pool location within the meander bend areas, however, for the majority of the stream length the riffles are too short. The stream profile is being influenced by structure placement in typical riffle locations that are initiating pool formation. Possible riffle construction in conjunction with the existing sill structures may correct the stream profile issues.

Reach 2 extends from the confluence with Tributary 1 to station 33+00, 1,309 linear feet, and contains two riffles and one pool cross section. Of the two riffle sections, little change was found in section 3 from MY-01. Riffle section 5, however, had insufficient points in MY-01 to make a good comparison. The pool section shows an 11% increase in width and area, however no significant changes were noted in the section and therefore this may be attributed to the bankfull location between years. The longitudinal profile, station 20+00 through 26+50, is dominated by riffles and pools that have shifted into inappropriate places within the plan form of the stream or segments in which structures have caused submerged riffles and long pools. The profile station 27+00 through 32+00 is dominated by a series of structures. These structures placed at riffle locations are forming scour pools at the downstream face. The pools typically extend to the next structure. The sill structures have influenced the stream profile by creating a sill step followed by a scour pool formation that is not compatible with the stream type or plan form. The section of this reach from station 29+50 to 30+50 has riffles migrating into pools due to structure placement.

Reach 3A is located from 33+00 to the end of the project, 732 linear feet. Riffle cross section 6 within this reach is aggrading however riffle section 8 has experienced very little change. The pool cross section shows positive development from the last year monitoring data in that it has narrowed and has developed a deeper pool. This is most likely due to the shifting of the riffle upstream into the pool and the pool shortening due to the confinement of a structure that has been placed just downstream. Aggradation within the longitudinal profile has occurred from 33+25 through 33+75 as the riffle has extended and filled a pool area in a meander bend. Most of the pools throughout the reach have increased in depth from the MY-01data. This reach is dominated by riffles that have shifted into the meander bends. The stream segment from station 37+25 through 39+00, has riffles in the correct plan form location; however, they are typically short.

The 381 linear foot Tributary 1 ties into Little Beaver Creek at station 19+25. The profile comparison indicates that the upper riffles within the first 75 feet of stream length have down-cut. Most of stream length in the middle segment of the tributary has remained very similar to MY-01 data. In the lower segment of the stream just above cross section 2, the pattern has adjusted to a better riffle-pool sequence where, previously, multiple pools were indicated. The tributary transitions to Little Beaver Creek through a long riffle that ties the two streams together in a very shallow floodplain.

Tributary 2 is 206 linear feet and ties into Little Beaver Creek at station 29+50. The stream channel is very stable and is entirely covered with thick herbaceous vegetation. Three pools are evident in the profile at the appropriate locations within the stream pattern. Where the tributary ties into Little Beaver Creek there should be a riffle, however there is a pool instead that has resulted in unstable banks in the creek.
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Table VIII A. Baseline Morphology and Hydraulic Summary

Table VIII. Baseline Morphology and Hydraulic Summary
Little Beaver Creek Stream Mitigation Site/Project No. 221
Reach 1 (991 feet)

Parameter	**USGS 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)				7.1	28	16			11.2	14	16.7	14.4			14.5	13.8	29.7	21.8
BF Cross Sectional Area (ft^2)				11	43	21			8	12.2	15.5	13.7			15	25.1	34.2	29.7
BF Mean Depth (ft)				0.9	2.5	1.7			0.7	0.8	0.9	0.9			1.04	1.2	1.8	1.5
BF Max Depth (ft)									1.2	1.4	2	1.8			2.3	2.3	3.4	2.9
Width/Depth Ratio									15.6	16	18	17.6			14	7.6	25.8	16.7
Entrenchment Ratio									2	3	13.6	6.1			>8	4.3	11.2	7.8
Wetted Perimeter (ft)																16.9	18.2	17.6
Hydraulic radius (ft)																1.1	1.5	1.3
Bank height ratio (ft/ft)									3.7						1	1	1	1
Pattern																		
Channel Beltwidth (ft)							12	16	14	5	40		36	65		37.9	58.2	48.1
Radius of Curvature (ft)							6	12	8.4	11	90		29	44		10.9	26.2	18.59
Meander Wavelength									38	14	67		46	83		68.7	98.5	80.1
Meander Width ratio							1.1	1.4	1.3				2.5	4.5		1.61	2.47	2.04
Profile																		
Riffle length (ft)										4	18					17	68	32
Riffle slope (ft/ft)							0.009	0.067	0.035	0.00083	0.1125		0.007	0.02	0.014	0.001	0.02	0.008
Pool length (ft)										6	41.5					0.0013	0.0035	0.0027
Pool spacing (ft)							4	78	30	14	95.8		36.5	58	46.5	31	43	
Substrate																		
d50 (mm)									5.7	0.5-1.0	45							
d84 (mm)									16	8.0-11.3	125							
Additional Reach Parameters																		
Valley Length (ft)															834			834
Channel Length (ft)																		991
Sinuosity									1	1.2	1.5				1.3			1.81
Water Surface Slope (ft/ft)									0.011	0.0025	0.0133				0.0066			0.0076
BF slope (ft/ft)																		0.0072
Rosgen Classification									E4			C4,C5			C4/5			C4/C5
Habitat Index																		

Table VIII B. Baseline Morphology and Hydraulic Summary

Table VIII. Baseline Morphology and Hydraulic Summary
Little Beaver Creek Stream Mitigation Site/Project No. 221
Reach 2 (1,309 feet)

Parameter	USGS 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)				7.1	16	28	10.5	15.1	12.8	14	16.7	14.4			16.1	15.4	21.1	17.8
BF Cross Sectional Area (ft^2)				11	21	43	14.3	14.8	14.6	12.2	15.5	13.7			18.5	17.9	22.8	20.4
BF Mean Depth (ft)				0.9	1.7	2.5	0.9	1.4	1.2	0.8	0.9	0.9			1.15	0.8	1.3	1.13
BF Max Depth (ft)							1.9	2.5	2.2	1.4	2	1.8			2.5	1.88	2.54	2.29
Width/Depth Ratio							7.4	16	9	16	18	17.6			14	11.69	17.24	16.4
Entrenchment Ratio									1.4	3	13.6	6.1			>11	2.27	8.07	5.8
Wetted Perimeter (ft)																11.6	24.8	16.4
Hydraulic radius (ft)																0.83	1.27	1.11
Bank Height Ratio (ft/ft)									2.8						1	1	1	1
Pattern																		
Channel Beltwidth (ft)							10	37	20	5	40		40	72		32.2	61	45
Radius of Curvature (ft)							6	35	16.5	11	90		32	48		18.3	31.8	24.4
Meander Wavelength							40	95	60	14	67		51	91		76.9		113.3
Meander Width ratio							1	2.9	1.6				2.5	4.5		1.81	3.43	2.53
Profile																		
Riffle length (ft)										4	18					17	68	32
Riffle slope (ft/ft)							0.009	0.045	0.02	0.00083	0.1125		0.005	0.015	0.0095	0.001	0.02	0.008
Pool length (ft)										6	41.5					0.0013	0.0035	0.0027
Pool spacing (ft)							30	86	51	14	95.8		36.5	80.5	55	31	43	
Substrate																		
d50 (mm)									5.7	0.5-1.0	45							
d84 (mm)									16	8.0-11.3	125							
Additional Reach Parameters																		
Valley Length (ft)															3997			828
Channel Length (ft)																		1309
Sinuosity									1.1	1.2	1.5				1.3			1.58
Water Surface Slope (ft/ft)									0.0055	0.0025	0.0133				0.0047			0.0047
BF slope (ft/ft)																		0.0045
Rosgen Classification									F4-G4			C4,C5			C4/5			C4/C5
Habitat Index																		

Table VIII C. Baseline Morphology and Hydraulic Summary

Table VIII. Baseline Morphology and Hydraulic Summary Little Beaver Creek Stream Mitigation Site/Project No. 221 Reach 3A (732 feet)																		
Parameter	**USGS 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)				7.1	16	28	9.5	15.5	12.8	14	16.7	14.4			17.1	16.9	18.8	18.1
BF Cross Sectional Area (ft^2)				11	21	43	19.2	21.9	21	12.2	15.5	13.7			21	20.1	33.6	25.5
BF Mean Depth (ft)				0.9	1.7	2.5	1.4	2	1.7	0.8	0.9	0.9			1.22	1.1	1.8	1.4
BF Max Depth (ft)							2.1	2.6	2.3	1.4	2	1.8			2.7	1.75	3.23	2.41
Width/Depth Ratio							6.8	7.8	7.5	16	18	17.6			14	10.48	17.24	13.41
Entrenchment Ratio									1.6	3	13.6	6.1			3	4.06	4.42	10.17
Wetted Perimeter (ft)																17.95	20.79	19.04
Hydraulic radius (ft)																1.06	1.62	1.32
Bank Height Ratio (ft/ft)									2.3						1	1	1	1
Pattern																		
Channel Beltwidth (ft)							9	79	24	5	40		43	77		19.4	43.2	32.4
Radius of Curvature (ft)							4	33	15	11	90		34	51		15.29	23.3	19.58
Meander Wavelength							19	135	53	14	67		54	97		78.8	123.3	
Meander Width ratio							1	6.2	1.9				2.5	4.5		1.07	2.38	1.79
Profile																		
Riffle length (ft)										4	18					17	68	32
Riffle slope (ft/ft)							0.01	0.07	0.023	0.00083	0.1125		0.005	0.015	0.0098	0.001	0.02	0.008
Pool length (ft)										6	41.5					0.0013	0.0035	0.0027
Pool spacing (ft)							18	122	64	14	95.8		33	84	52	31	43	
Substrate																		
d50 (mm)									5.7	0.5-1.0	45				5.7			
d84 (mm)									16	8.0-11.3	125				16			
Additional Reach Parameters																		
Valley Length (ft)															2855			625
Channel Length (ft)																		732
Sinuosity									1.1	1.2	1.5				1.3			1.17
Water Surface Slope (ft/ft)									0.0067	0.0025	0.0133				0.0057			0.0067
BF slope (ft/ft)																		0.0062
Rosgen Classification									G4			C4,C5			C4/5			C4/C5
Habitat Index																		

Table IX A. Morphology and Hydraulic Monitoring Summary

Little Beaver Creek Stream Mitigation Site/Project No. 221
Reach 1 (991 feet)

Parameter	Cross Section 1 Riffle						Cross Section 2 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+
BF Width (ft)	13.8	15.4					17.4	19.1																
Floodprone Width (ft)	154	154					87	87																
BF Cross Sectional Area (sq.ft)	25.1	22.4					17.2	18.4																
BF Mean Depth (ft)	1.8	1.45					0.99	0.96																
BF Max Depth (ft)	3.4	2.88					2.21	2.24																
Width/Depth Ratio	7.6	10.6					17.5	19.9																
Entrenchment Ratio	11.2	10					5.04	4.55																
Hydraulic Radius (ft)	16.9	17.2					18.2	20.3																
Wetted Perimeter (ft)	1.5	1.31					0.95	0.91																
Bank Height Ratio	1	1					1	1																
Substrate																								
d50 (mm)	0.81	0.36					0.57	N/A																
d84 (mm)	1.6	1.9					7.42	N/A																

Parameter	MY-01 (2007)[1]			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-06 (2012)			MY+ (2013)			MY+ (2014)		
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
Channel Beltwidth (ft)	29	78.1	43	30.3	76.3	48.8																		
Radius of Curvature (ft)	6.84	32.6	17.5	17	49.2	29.5																		
Meander Wavelength (ft)	62.1	126	88.5	63	98	80.5																		
Meander Width Ratio	1.56	4.2	2.31	1.49	3.76	2.4																		
Profile																								
Riffle length (ft)	3.77	109	18.6	3	41	14.9																		
Riffle slope (ft/ft)	0.01	1.7	0.04	0.01	0.41	0.07																		
Pool length (ft)	9.86	93.7	40.9	9	86	30																		
Pool spacing (ft)	3.77	97.6	18.1	17	107	47.3																		
Additional Reach parameters																								
Valley Length (ft)	834			834																				
Channel Length (ft)	991			1033																				
Sinuosity	1.19			1.24																				
Water Surface Slope (ft/ft)	0.0069			0.0065																				
BF Slope (ft/ft)	0.0085			0.0107																				
Rosgen Classification	C4/C5			C4																				
Habitat Index*																								
Macrobenthos*																								

1. MY-01 monitoring did not separate these parameters based on the separate reaches.

Table IX B. Morphology and Hydraulic Monitoring Summary

Little Beaver Creek Stream Mitigation Site/Project No. 221
Reach 2 (1,309 feet)

Parameter	Cross Section 3 Riffle						Cross Section 4 Pool						Cross Section 5 Riffle											
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+
BF Width (ft)	16.4	16.7					19.4	21.6					28.2	30.7										
Floodprone Width (ft)	53	54.5					97	97					126	126										
BF Cross Sectional Area (sq.ft)	19.1	18.5					23.9	26.9					44	39										
BF Mean Depth (ft)	1.16	1.11					1.23	1.24					1.56	1.27										
BF Max Depth (ft)	2.32	2.36					2.71	2.68					3.93	3.78										
Width/Depth Ratio	14.2	15					15.8	17.3					18.1	24.1										
Entrenchment Ratio	3.25	3.27					4.98	4.49					4.47	4.11										
Hydraulic Radius (ft)	17.5	17.5					20.6	22.8					30.3	33.3										
Wetted Perimeter (ft)	1.09	1.06					1.16	1.18					1.45	1.17										
Bank Height Ratio	1	1					1	0.85					1	0.99										
Substrate																								
d50 (mm)	1.31	0.68					0.43	N/A					7.08	8										
d84 (mm)	1.85	2.35					1.55	N/A					14.2	55.5										

Parameter	MY-01 (2007)[1]			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-06 (2012)			MY+ (2013)			MY+ (2014)		
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
Channel Beltwidth (ft)	29	78.1	43	34.3	115	58.3																		
Radius of Curvature (ft)	6.84	32.6	17.5	17.7	63.2	29.7																		
Meander Wavelength (ft)	62.1	126	88.5	69	120	94.3																		
Meander Width Ratio	1.56	4.2	2.31	1.68	5.68	2.87																		
Profile																								
Riffle length (ft)	3.77	109	18.6	2.4	50	15.6																		
Riffle slope (ft/ft)	0.01	1.7	0.04	0.01	0.16	0.04																		
Pool length (ft)	9.86	93.7	40.9	17	97	41																		
Pool spacing (ft)	3.77	97.6	18.1	24	173	77.7																		
Additional Reach parameters																								
Valley Length (ft)	828			828																				
Channel Length (ft)	1309			1398																				
Sinuosity	1.58			1.69																				
Water Surface Slope (ft/ft)	0.0048			0.0012/0.0083[2]																				
BF Slope (ft/ft)	0.0039			0.0019/0.0091[2]																				
Rosgen Classification	C4/C5			C4																				
Habitat Index*																								
Macrobenthos*																								

1. MY-01 monitoring did not separate these parameters based on the separate reaches.
2. This reach has two distinct slopes with the transition at approximate station 27+00.

Table IX C. Morphology and Hydraulic Monitoring Summary

Little Beaver Creek Stream Mitigation Site/Project No. 221
Reach 3A (732 feet)

Parameter	Cross Section 6 Riffle						Cross Section 7 Pool						Cross Section 8 Riffle											
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+
BF Width (ft)	21.7	19.5					19.9	17.7					19.5	19.3										
Floodprone Width (ft)	95	78.5					156	156					75	73.2										
BF Cross Sectional Area (sq.ft)	25.5	20.8					38.1	34.7					23.6	27.6										
BF Mean Depth (ft)	1.18	1.07					1.91	1.96					1.21	1.43										
BF Max Depth (ft)	2.34	1.79					4.29	4.72					2.68	2.67										
Width/Depth Ratio	18.4	18.2					10.4	9.01					16.1	13.5										
Entrenchment Ratio	4.4	4.03					7.86	8.82					3.84	3.79										
Hydraulic Radius (ft)	22.4	19.9					23	21.4					20.6	20.4										
Wetted Perimeter (ft)	1.14	1.04					1.66	1.62					1.15	1.36										
Bank Height Ratio	1	1					1	0.93					1	1										
Substrate																								
d50 (mm)	3.4	7.75					0.2	N/A					0.21	0.88										
d84 (mm)	18	28.3					0.82	N/A					bdrk	8.12										

Parameter	MY-01 (2007)[1]			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-06 (2012)			MY+ (2013)			MY+ (2014)		
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
Channel Beltwidth (ft)	29	78.1	43	40.3	78.3	56.6																		
Radius of Curvature (ft)	6.84	32.6	17.5	19.2	45.2	31																		
Meander Wavelength (ft)	62.1	126	88.5	77	114	95.9																		
Meander Width Ratio	1.56	4.2	2.31	1.98	3.85	2.78																		
Profile																								
Riffle length (ft)	3.77	109	18.6	3	69	13.6																		
Riffle slope (ft/ft)	0.01	1.7	0.04	0	0.13	0.03																		
Pool length (ft)	9.86	93.7	40.9	10	54	27.4																		
Pool spacing (ft)	3.77	97.6	18.1	15	73	37.7																		
Additional Reach parameters																								
Valley Length (ft)	625			625																				
Channel Length (ft)	732			790																				
Sinuosity	1.17			1.26																				
Water Surface Slope (ft/ft)	0.0069			0.002/0.0127[2]																				
BF Slope (ft/ft)	0.0058			0.0027/0.0132[2]																				
Rosgen Classification	C4/C5			C4																				
Habitat Index*																								
Macrobenthos*																								

1. MY-01 monitoring did not separate these parameters based on the separate reaches.
2. This reach has two distinct slopes with the transition at approximate station 36+00.

Table IX D. Morphology and Hydraulic Monitoring Summary

Little Beaver Creek Stream Mitigation Site/Project No. 221
Tributary 1 (381 feet)

Parameter	Cross Section T1 (Tributary) Pool						Cross Section T2 (Tributary) Riffle																	
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+												
BF Width (ft)	12.5	14					9.46	13.8																
Floodprone Width (ft)	42	38.8					53	60.3																
BF Cross Sectional Area (sq.ft)	10.7	8.82					5.96	9.09																
BF Mean Depth (ft)	0.85	0.63					0.63	0.66																
BF Max Depth (ft)	2.04	1.59					1.31	1.82																
Width/Depth Ratio	14.7	22.2					15	21																
Entrenchment Ratio	3.38	2.77					5.61	4.37																
Hydraulic Radius (ft)	14.5	14.8					10	14.6																
Wetted Perimeter (ft)	0.73	0.6					0.6	0.62																
Bank Height Ratio	1	0.97					1	0.98																
Substrate																								
d50 (mm)	0.59	N/A					0.18	N/A																
d84 (mm)	7.11	N/A					0.91	N/A																

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-06 (2012)			MY+ (2013)			MY+ (2014)		
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
Channel Beltwidth (ft)																								
Radius of Curvature (ft)																								
Meander Wavelength (ft)																								
Meander Width Ratio																								
Profile																								
Riffle length (ft)																								
Riffle slope (ft/ft)																								
Pool length (ft)																								
Pool spacing (ft)																								
Additional Reach parameters																								
Valley Length (ft)																								
Channel Length (ft)																								
Sinuosity																								
Water Surface Slope (ft/ft)																								
BF Slope (ft/ft)																								
Rosgen Classification																								
Habitat Index*																								
Macrobenthos*																								

C. Wetland Assessment

Wetland restoration and enhancement was originally proposed for this project to accompany the stream restoration. The March 2003 Restoration Plan proposed 4.4 acres of wetland restoration and 0.7 acre of wetland enhancement. Stream restoration did not occur along Reach 3b below the road crossing and no alteration in the water table levels have been observed to date. The stream bed was not raised to the proposed level along Reach 1 and 2 as proposed in the restoration plan. Presently, there are 2.4 acres of potential wetland restoration along Reach 1 and 2, and no areas are proposed for enhancement. It is still unclear whether hydrology will be restored in the areas proposed for restoration.

The wetland design was created from the reference community along with published descriptions of piedmont bottomland hardwood forests and general observations of characteristic wetland structure and function. Areas that were considered suitable for wetland restoration are those areas that could support planted hydrophytic vegetation and had the groundwater level altered via site construction such that it would remain within 12 inches of the soil surface for at least 5% of the growing season.

Currently there are eight RDS groundwater gauges (2, 3, 4, 5, 6, 7, 8, & 9) within the conservation easement. The gauges record data daily and are downloaded monthly. Gauges were installed according to the specifications of Technical Note HY-1A-3.1 (USACE 1993). By recommendation from EEP, these gauges were installed on June 25, 2008 to replace an older set of gauges. Data was retrievable from three (6, 7 & 9) of the old gauges (Appendix C). Four of the current groundwater gauges (6, 7, 8, and 9) in the proposed wetland restoration areas of Reach 1 and 2, are displaying jurisdictional wetland hydrology (saturation within 12 inches of the soil surface for >5% of the growing season), and the remaining gauges (2, 3, 4, & 5) do not have saturation within 12 inches of the soil surface (See Appendix C). These gauges will be relocated to proposed wetland restoration areas in Reach 1 that currently do not contain gauges. Precipitation data for Apex from December 01, 2007 to November 14, 2008 was provided by the State Climate Office and is provided in the groundwater gauge data tables in Appendix C.

Table X. Wetland Criteria Attainment

Little Beaver Creek Stream and Wetland Restoration Site-Project No. 221						
Tract	**Gauge ID**	**Hydrology Threshold Met?**	**Tract Mean**	**Veg Plot ID**	**Veg Survival Threshold Met?**	**Tract Mean**
1	2	No		VP 11	Yes	
	3	No		N/A	N/A	
	4	No		N/A	N/A	
	5	No	50%	N/A	N/A	66%
	6*	Yes		N/A	N/A	
	7*	Yes		VP 2	No	
	8*	Yes		N/A	N/A	
	9*	Yes		VP 5	Yes	

* Meets hydrological threshold for 5% or greater of the growing season

IV. Methodology

Methodologies follow EEP monitoring report template Version 1.2-11/16/06 and guidelines (Lee et al 2006). Photos were taken with a digital camera. A Trimble Geo XT handheld unit with sub-meter accuracy was used to collect groundwater gauge locations, vegetation monitoring plot origins, and problem area locations.

A. Vegetation Methodologies

Eight representative vegetation monitoring plots were chosen out of the original fifteen plots established in Reach 1, 2 and 3 during the as built survey data collection. Level II of the EEP/CVS protocol Version 4.0 was used to collect data for MY-02. Data collected for these plots are in Appendix A.

B. Stream Methodologies

Stream profile and cross-sections were surveyed using total station equipment and methods. The survey data was plotted using AutoCAD Civil3D. The longitudinal profile was generated using the design baseline alignment provided by Earth Tech. This was determined to be the alignment used for the mitigation plan and MY-01 monitoring report.

Cross sectional data was extracted based on a linear alignment between the end pins. The MY-00 and MY-01 data was adjusted such that their surveyed pin locations were as closely aligned to MY-02 as possible. It is unknown which alignments were used to generate the cross-sections for MY-00 and MY-01. Dimensional data was generated using in-house designed spreadsheets based on the Rosgen dimension criteria and equations.

Pattern parameters were calculated by measuring the plotted dimensions of the MY-02 surveyed thalweg. Profile parameters were determined through analysis of a Microsoft Excel generated plot of the profile based on the aforementioned baseline alignment.

C. Wetland Methodologies

Eight RDS groundwater monitoring gauges (2, 3, 4, 5, 6, 7, 8, & 9) were downloaded monthly to ensure proper function throughout the growing season. Data was exported into Excel spreadsheet along with incorporation of local rainfall data provided by the State Climate Office (Appendix C).

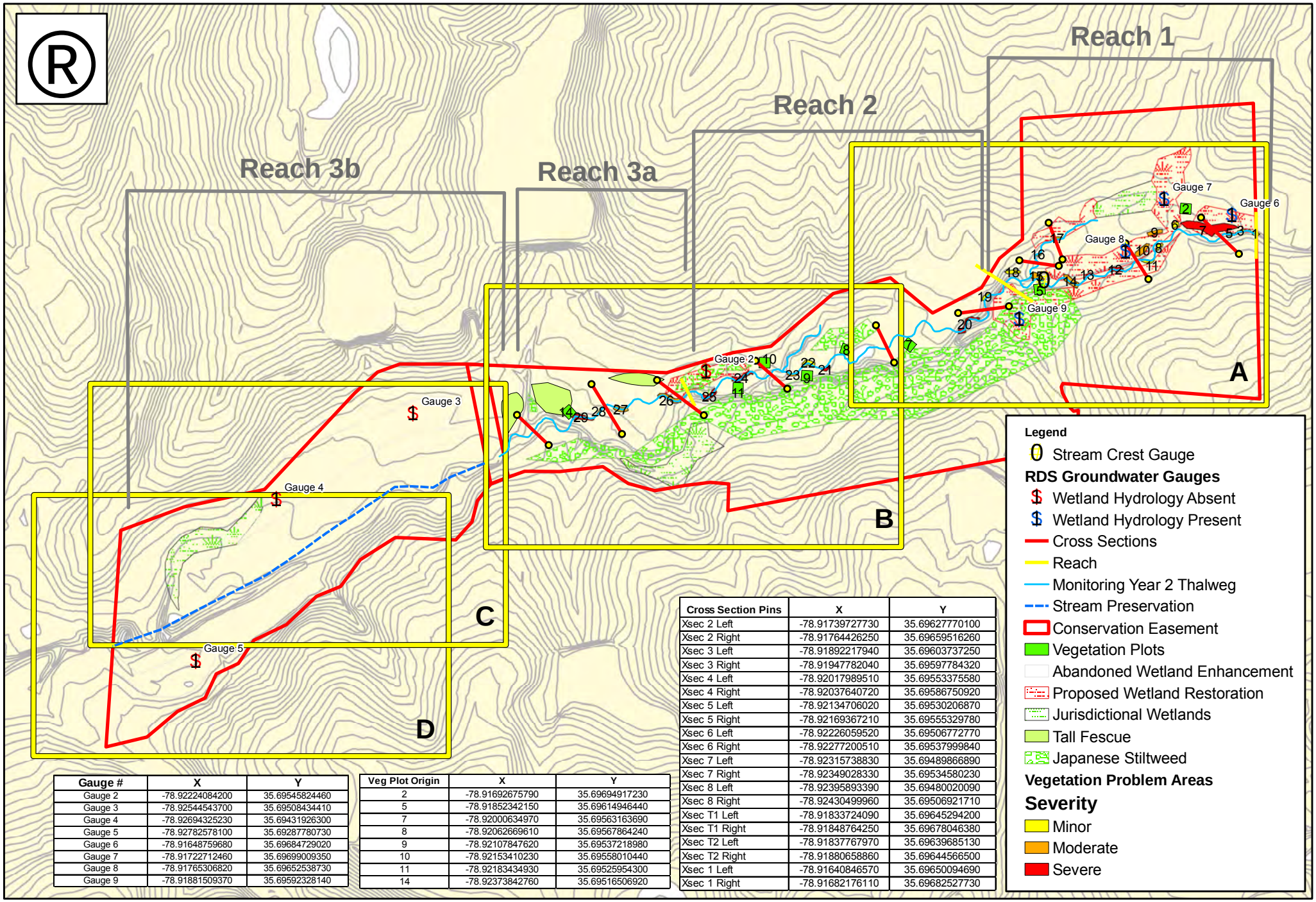
V. References

Lee, Michael T. Peet, Robert K. Roberts, Steven D., Wentworth, Thomas R. (2006). *CVS-EEP Protocol for Recording Vegetation Version 4.0.*

Weakley, Alan (2007). *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas*. http://www.herbarium.unc.edu/flora.htm.

Appendix A.

1. Vegetation Raw Data



Gauge #	X	Y
Gauge 2	-78.92224084200	35.69545824460
Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

Cross Section Pins	X	Y
Xsec 2 Left	-78.91739727730	35.69627770100
Xsec 2 Right	-78.91764426250	35.69659516260
Xsec 3 Left	-78.91892217940	35.69603737250
Xsec 3 Right	-78.91947782040	35.69597784320
Xsec 4 Left	-78.92017989510	35.69553375580
Xsec 4 Right	-78.92037640720	35.69586750920
Xsec 5 Left	-78.92134706020	35.69530206870
Xsec 5 Right	-78.92169367210	35.69555329780
Xsec 6 Left	-78.92226059520	35.69506772770
Xsec 6 Right	-78.92277200510	35.69537999840
Xsec 7 Left	-78.92315738830	35.69489866890
Xsec 7 Right	-78.92349028330	35.69534580230
Xsec 8 Left	-78.92395893390	35.69480020090
Xsec 8 Right	-78.92430499960	35.69506921710
Xsec T1 Left	-78.91833724090	35.69645294200
Xsec T1 Right	-78.91848764250	35.69678046380
Xsec T2 Left	-78.91837767970	35.69639685130
Xsec T2 Right	-78.91880658860	35.69644566500
Xsec 1 Left	-78.91640846570	35.69650094690
Xsec 1 Right	-78.91682176110	35.69682527730

Legend

- Stream Crest Gauge
- **RDS Groundwater Gauges**
- Wetland Hydrology Absent
- Wetland Hydrology Present
- Cross Sections
- Reach
- Monitoring Year 2 Thalweg
- Stream Preservation
- Conservation Easement
- Vegetation Plots
- Abandoned Wetland Enhancement
- Proposed Wetland Restoration
- Jurisdictional Wetlands
- Tall Fescue
- Japanese Stiltweed
- **Vegetation Problem Areas**
- **Severity**
- Minor
- Moderate
- Severe

The Catena Group

Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Vegetation Current Conditions Plan View

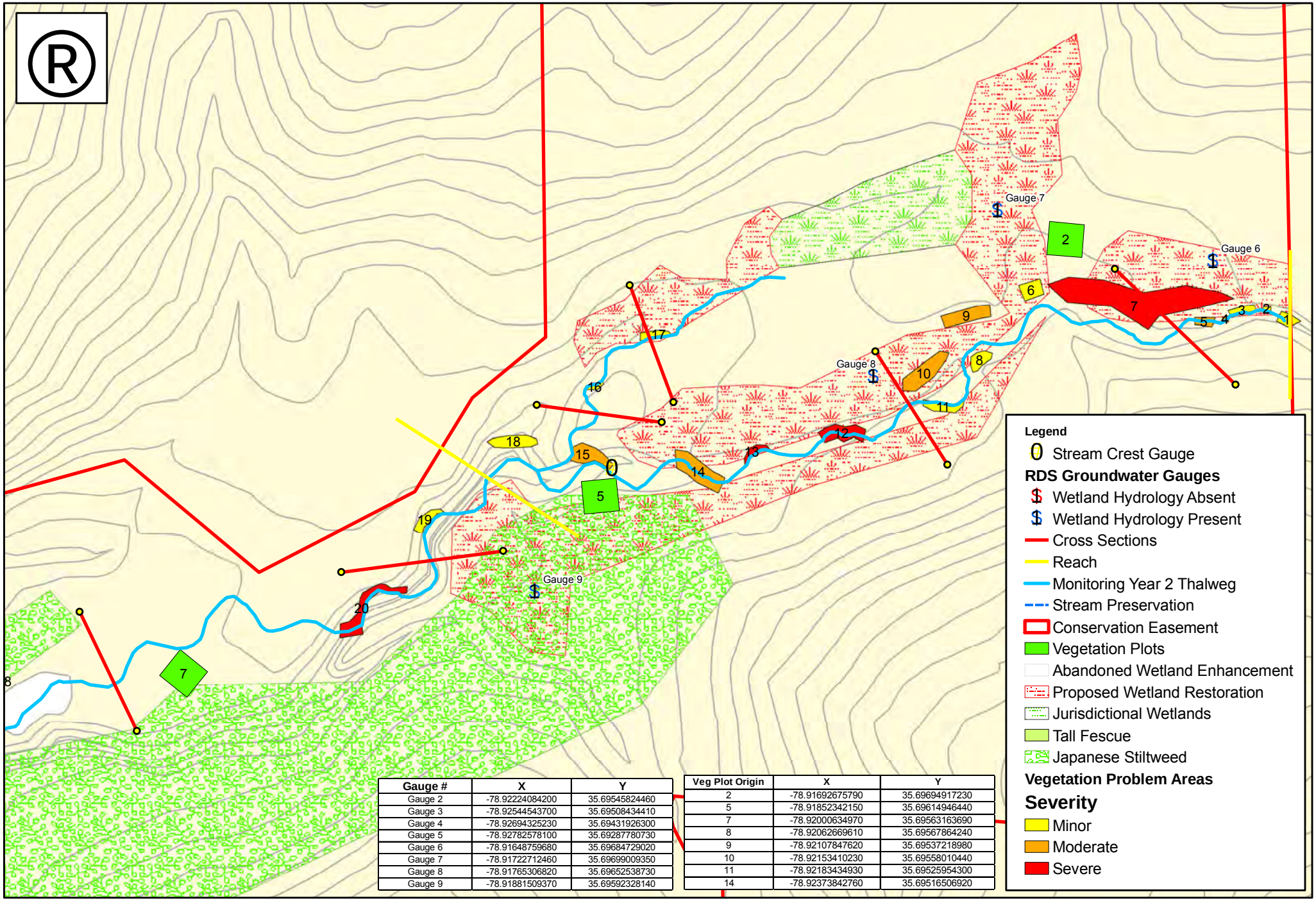
Wake County, North Carolina

0 125 250 500 Feet

EEP Project No. 221

Date: May 2009

Figure Key



Gauge #	X	Y
Gauge 2	-78.92224084200	35.69545824460
Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Vegetation Current Conditions Plan View

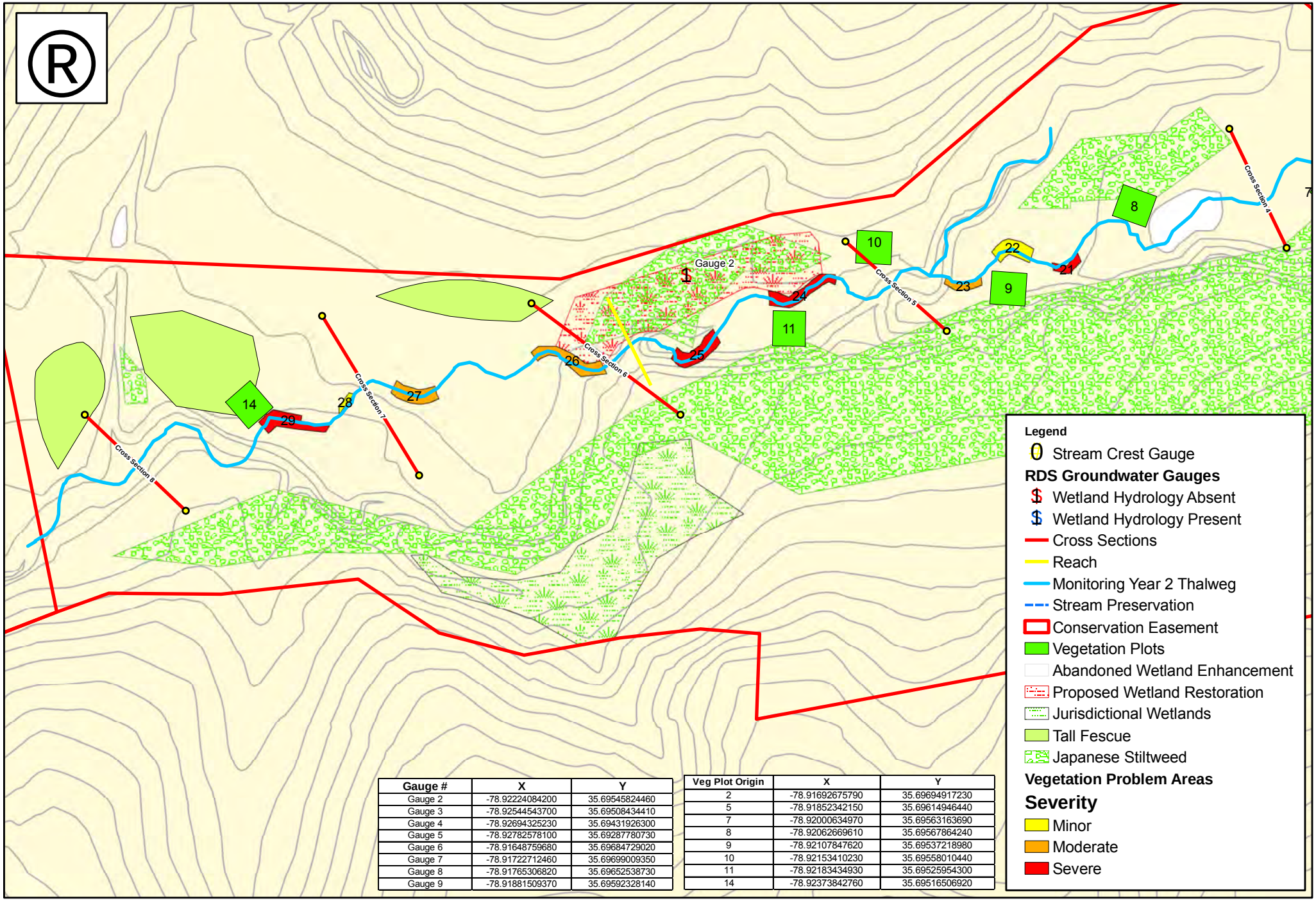
Wake County, North Carolina

0 37.5 75 150 Feet

EEP Project No. 221

Date: May 2009

Figure A



Gauge #	X	Y
Gauge 2	-78.92224084200	35.69545824460
Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Vegetation Current Conditions Plan View

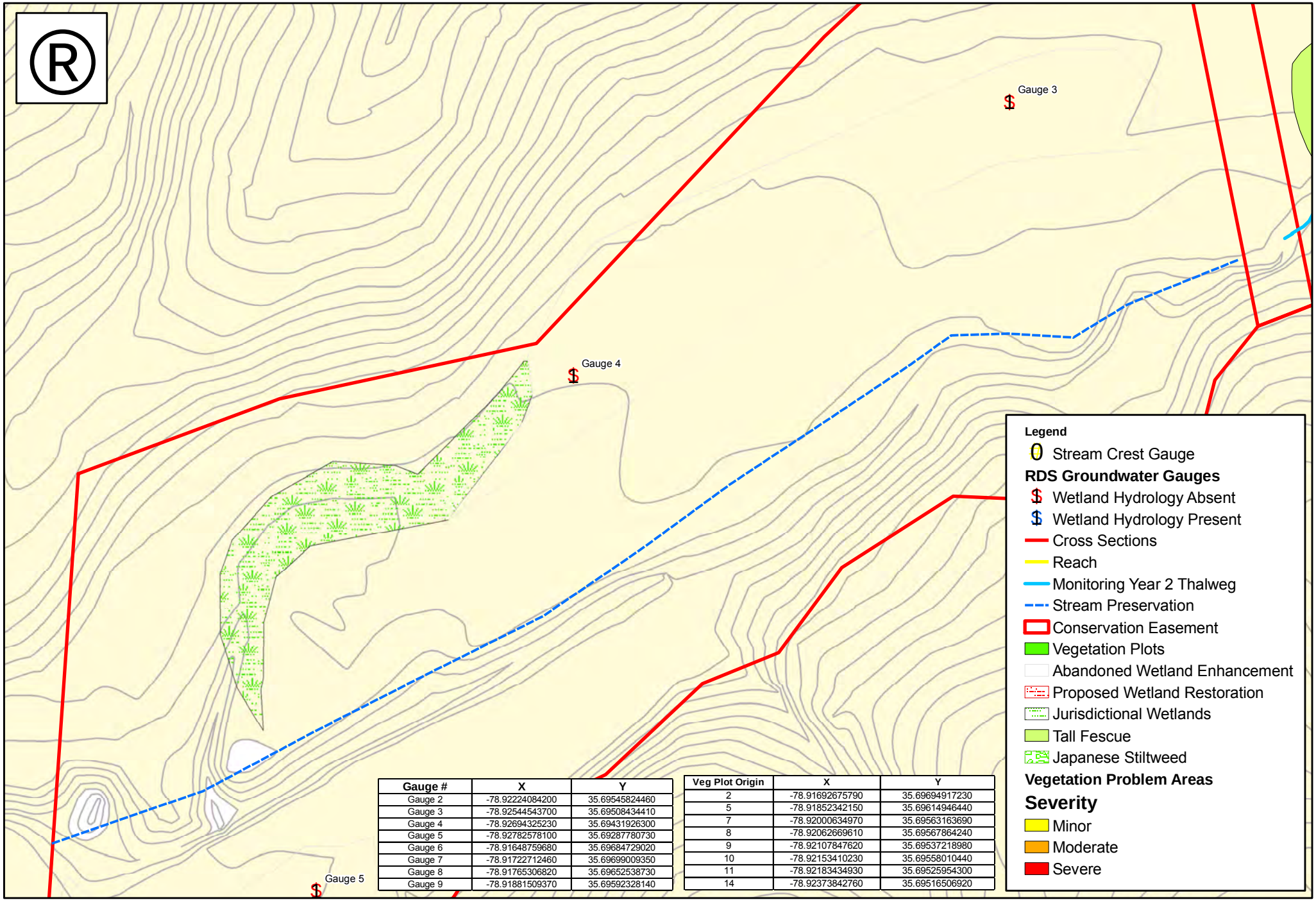
Wake County, North Carolina

0 37.5 75 150 Feet

EEP Project No. 221

Date: March 2009

Figure B



Gauge #	X	Y
Gauge 2	-78.92224084200	35.69545824460
Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Vegetation Current Conditions Plan View

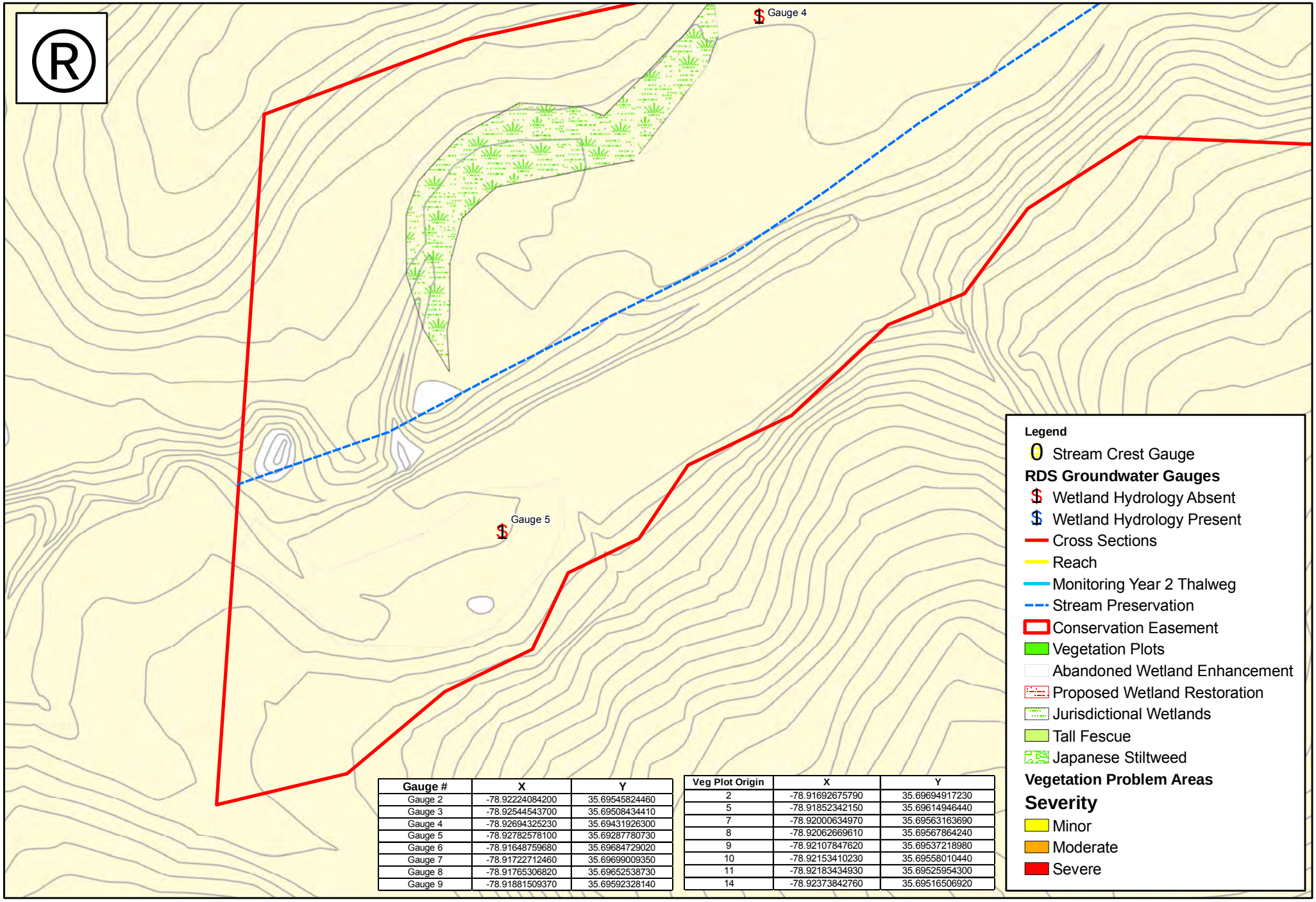
Wake County, North Carolina

0 37.5 75 150 Feet

EEP Project No. 221

Date: May 2009

Figure C



Gauge #	X	Y
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Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
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5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

The Catena Group

Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Vegetation Current Conditions Plan View

Wake County, North Carolina

0 37.5 75 150 Feet

EEP Project No. 221

Date: May 2009

Figure D

Appendix A. 1. Vegetation Survey Data Tables

Table 1. Vegetation Metadata

Database name	Little Beaver Creek cvs-eep-entrytool-v2.2.5.mdb
Report Prepared By	The Catena Group
Date Prepared	11/25/2008
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Planted Stems	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Total Stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Vegetation Monitoring Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Total Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Total Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	221
project Name	Little Beaver Creek
Description	4435 stream restoration, 1560 preservation, 2.4 acres wetland restoration southwest of Apex, NC. Constructed July-Nov. 2005.
River Basin	Cape Fear
length(ft)	4435
stream-to-edge width (ft)	50
area (sq m)	41198.33
Required Plots (calculated)	11
Sampled Plots	8 (Reduced plot number due to EEP recommendations)

Table 2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing	Unknown
	Aronia arbutifolia	1	1	1				
	Carpinus caroliniana var. *caroliniana*			1				
	Cornus florida		2					
	Fraxinus pennsylvanica	5	23	5		1		
	Hamamelis virginiana var. *virginiana*	1	5					
	Quercus alba	1						
	Quercus lyrata	3	3					
	Quercus phellos		2					
	Viburnum nudum			1		1		
	Morella cerifera	7	3					
	Hamamelis virginiana	5						
TOT:	**11**	**23**	**39**	**8**		**2**		

Table 3. Vegetation Damage By Species

	Species	**All Damage Categories**	**(No Damage)**	**Deer**	**Diseased**	**Insects**
	Aronia arbutifolia	3	2			1
	*Carpinus caroliniana v*ar. *caroliniana*	1		1		
	Cornus florida	2		1	1	
	Fraxinus pennsylvanica	34	16	17		1
	Hamamelis virginiana	5	5			
	Hamamelis virginiana var. *virginiana*	6	2	3		1
	Morella cerifera	10	7			3
	Quercus alba	1				1
	Quercus lyrata	6	3	1		2
	Quercus phellos	2	1	1		
	Viburnum nudum	2	2			
TOT:	**11**	**72**	**38**	**24**	**1**	**9**

Table 4. Vegetation Damage by Plot

	Plot	All Damage Categories	No Damage	Deer	Diseased	Insects
	221-01-0002-year:2	1				1
	221-01-0005-year:2	23	15	5		3
	221-01-0007-year:2	23	11	8		4
	221-01-0008-year:2	4	2	2		
	221-01-0009-year:2	1		1		
	221-01-0010-year:2	3	3			
	221-01-0011-year:2	13	5	6	1	1
	221-01-0014-year:2	4	2	2		
TOT:	**8**	**72**	**38**	**24**	**1**	**9**

Table 5. All Stems by Plot and Species

	Species	Total Stems	# Plots	Avg # Stems	Plot 2	Plot 5	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 14
	Acer rubrum var. *rubrum*	95	6	15.83	4	2	12	1	16		60	
	Aronia arbutifolia	3	2	1.5		2	1					
	Baccharis halimifolia	2	2	1			1				1	
	Betula nigra	6	2	3				5	1			
	Carpinus caroliniana var. *caroliniana*	1	1	1				1				
	Cornus florida	2	1	2							2	
	Diospyros virginiana	4	2	2		2			2			
	Fraxinus pennsylvanica	36	5	7.2		19	5		1		9	2
	Hamamelis virginiana var. *virginiana*	6	2	3			5	1				
	Liquidambar styraciflua	453	8	56.62	12	125	139	35	26	63	46	7
	Liriodendron tulipifera var. t*ulipifera*	11	2	5.5		4	7					
	Nyssa sylvatica	2	1	2						2		
	Pinus taeda	160	8	20	17	20	29	13	4	38	38	1
	Platanus occidentalis var. *occidentalis*	9	3	3	1	3	5					
	Quercus alba	1	1	1							1	
	Quercus lyrata	6	4	1.5	1	2	1	2				
	Quercus nigra	28	1	28						28		
	Quercus phellos	4	3	1.33			2			1	1	
	Rhus copallinum var. *copallinum*	3	2	1.5			2		1			
	Rosa multiflora	1	1	1					1			
	Sambucus canadensis	1	1	1	1							
	Ulmus rubra	2	1	2							2	
	Viburnum nudum	2	1	2							2	
	Morella cerifera	11	1	11			11					
	Carpinus caroliniana	31	3	10.33					1	3	27	
	Quercus	5	1	5					5			
	Hamamelis virginiana	5	2	2.5						3		2
	Hypericum	9	4	2.25	5	1				1	2	
	Liriodendron tulipifera	2	1	2					2			
	Platanus occidentalis	1	1	1					1			
	Prunus serotina	2	1	2		2						
	Acer rubrum	15	1	15						15		
	Ulmus	10	2	5	1	9						
TOT:	**33**	**929**	**33**		**42**	**191**	**220**	**58**	**61**	**154**	**191**	**12**

Table 6. Vegetation Problem Areas				
VPA #	**Station #**	**Probable Cause**	**Severity**	**Photo #**
Bare Banks				
2	10+30	Bare banks/Eroding on left and right descending bank	Minor	None
3	10+50	Bare right descending bank	Minor	None
11	14+50	Bare banks/Eroding on left descending bank	Minor	None
12	15+70	Bare banks/Eroding on left and right descending bank	Severe	None
13	16+70	Bare banks/Eroding on right descending bank	Severe	VPA 13
14	17+50	Bare right descending bank	Moderate	None
16	100ft up UT1	Bare left descending banks/Sweetgums seedlings numerous	Minor	None
19	20+80	Bare right descending bank	Minor	None
26	34+00	Bare right descending bank	Moderate	None
27	35+60	Bare left descending banks	Moderate	VPA 27
29	37+00	Bare banks/Eroding on left and right descending bank	Severe	None
Bare Bench				
4	10+60	Bare bench/plantings absent	Moderate	None
6	12+80	Bare bench/plantings absent	Minor	VPA 6
7	10+80 - 12+80	Plantings absent/area used as an ATV corridor	Severe	VPA 7
8	13+80	Bare bench/plantings absent	Moderate	None
9	13+50	Bare bench/plantings absent	Minor	None
10	14+00	Plantings absent/impacted by ATV's	Moderate	None
15	18+50	Bare bench/impacted by ATV's	Moderate	VPA 15
18	19+60	Bare slope adjacent to bench	Minor	None
Eroding Banks				
1	10+00	Incised stream immediately adjacent upstream	Minor	VPA1
5	11+00	Eroding banks	Moderate	VPA 5
17	200ft up UT1	Eroding right descending banks	Minor	None
20	22+00 - 22+50	Eroding banks along left and right descending banks	Severe	None
21	27+90	Eroding left descending banks	Severe	VPA 21
22	28+60	Eroding left and right descending banks	Minor	None
23	29+00	Eroding left descending banks	Moderate	None
24	31+00	Eroding left and right descending banks	Severe	VPA 24
25	32+40	Eroding left and right descending banks	Severe	VPA 25
28	36+30	Eroding right descending banks	Minor	None
Invasive Exotics				None
30	See CCPV	Tall Fescue encroaching buffer	Severe	VPA 30
31	See CCPV	Japanese Stiltgrass encroaching buffer	Severe	VPA 31

Appendix A
2. Vegetation Problem Area Photos

VPA 1. Left and Right descending banks have eroded bank.

VPA 5. Left and rifght descending banks have eroding banks.

VPA 6. Bare area within the buffer with no vegetation.

VPA 7. Grassy area within buffer with no evidience of planted tree species.

VPA 13. Bare coir matting.

VPA 15. Bare area within buffer.

VPA 16. Bare coir matting with ubiquitous sweetgum saplings (*Liquidambar styraciflua*).

VPA 21. Left descending bank is eroding and is has bare coir matting.

VPA 24. Left descending bank has bare coir matting and eroding banks.

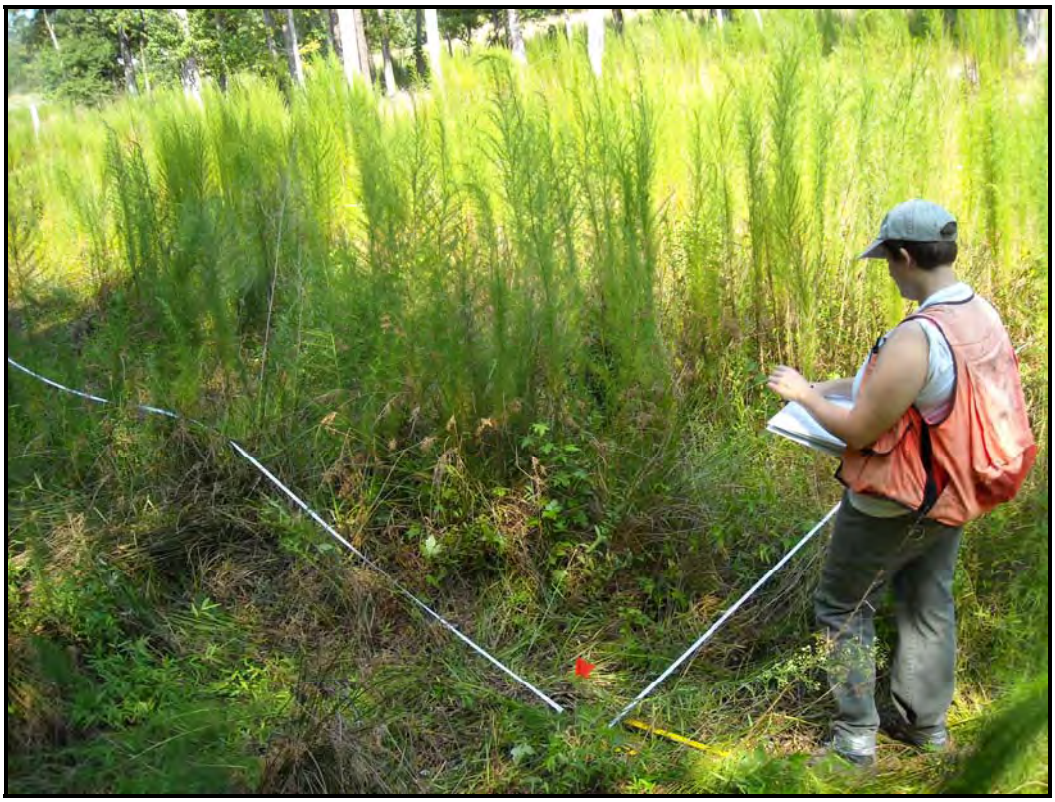
VPA 26. Left and right descending banks are bare of vegetation.

VPA 30. Tall Fescue (*Lolium arundinaceum*) is encroaching into the buffer on the right descending side of the stream.

VPA 31. The invasive exotic Japanese Stiltgrass (*Microstegium vimineum*) encroaching into the buffer.

Appendix A.
3. Vegetation Monitoring Plot Photos

Vegetation Plot 14



Vegetation Plot 11

Vegetation Plot 10

Vegetation Plot 9

Vegetation Plot 8

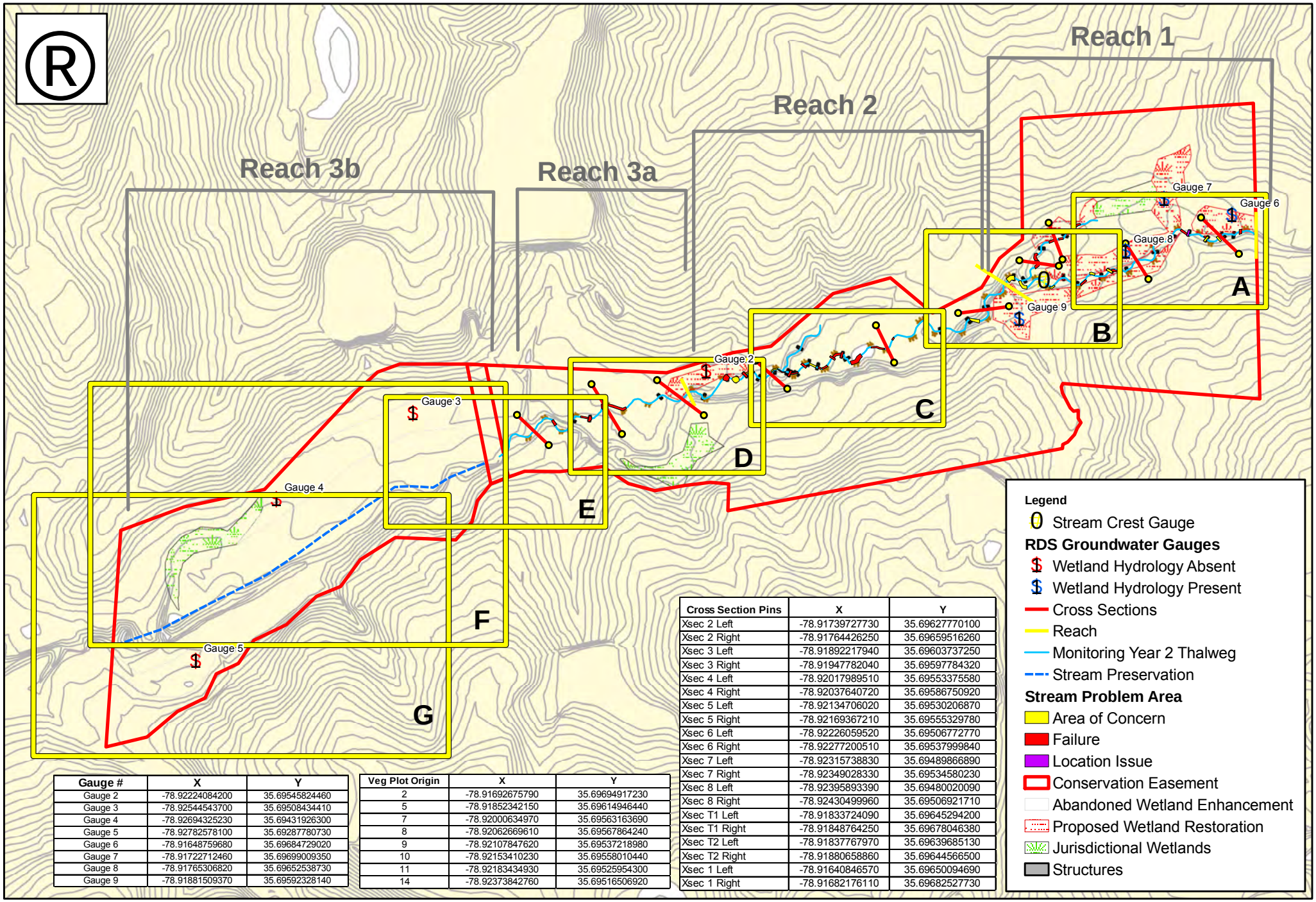
Vegetation Plot 7

Vegetation Plot 5

Vegetation Plot 2

Appendix B.

1. Stream Current Conditions Plan View



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Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
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10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

Cross Section Pins	X	Y
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Xsec T2 Left	-78.91837767970	35.69639685130
Xsec T2 Right	-78.91880658860	35.69644566500
Xsec 1 Left	-78.91640846570	35.69650094690
Xsec 1 Right	-78.91682176110	35.69682527730

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

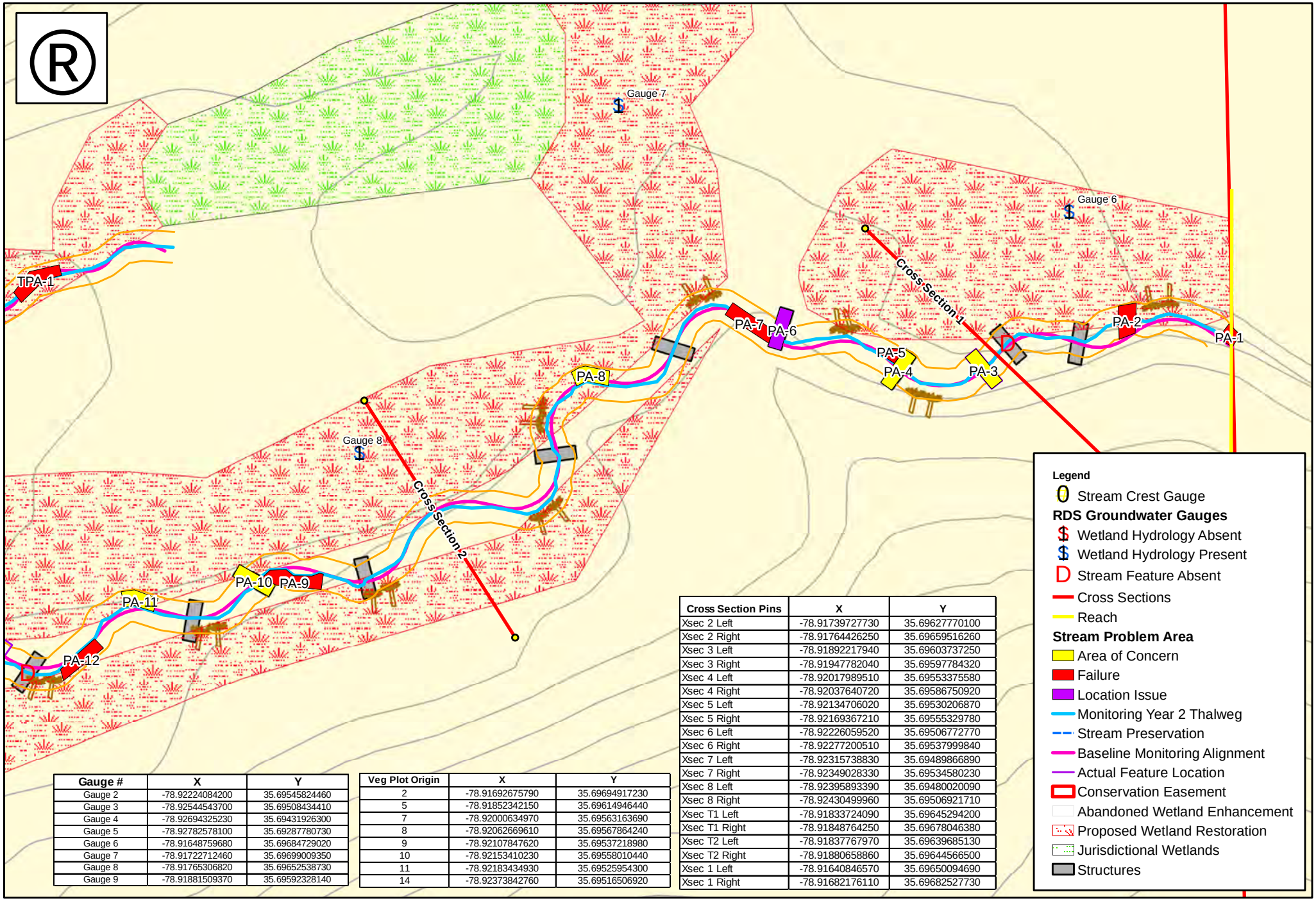
Wake County, North Carolina

0 125 250 500 Feet

EEP Project No. 221

Date: May 2009

Figure Key



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Xsec 1 Right	-78.91682176110	35.69682527730

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

Wake County, North Carolina

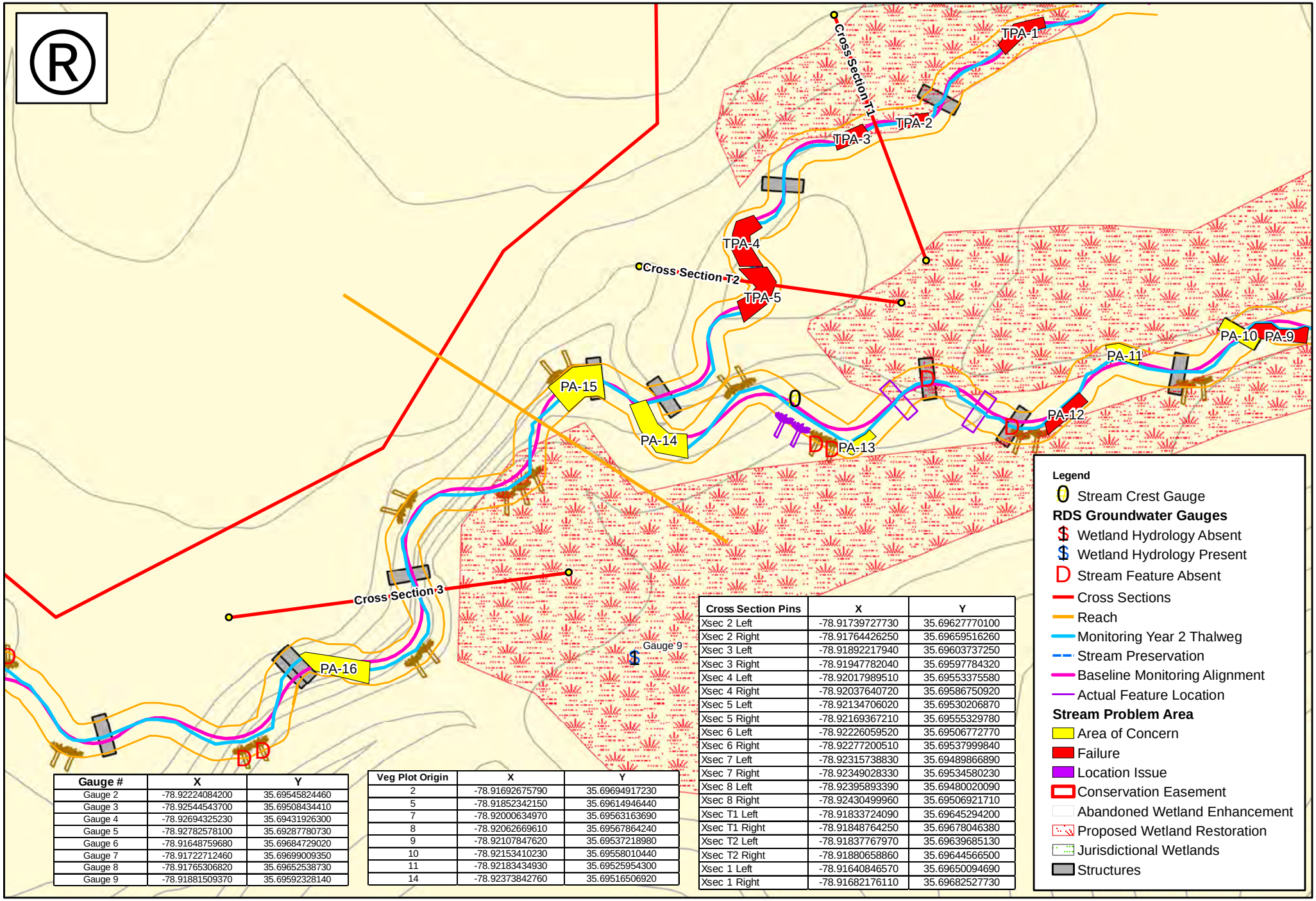
2005 Aerial Orthophotography
(Source: Wake County)

0 20 40 80 Feet

EEP Project No. 221

Date: March 2009

Figure A



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The Catena Group

Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

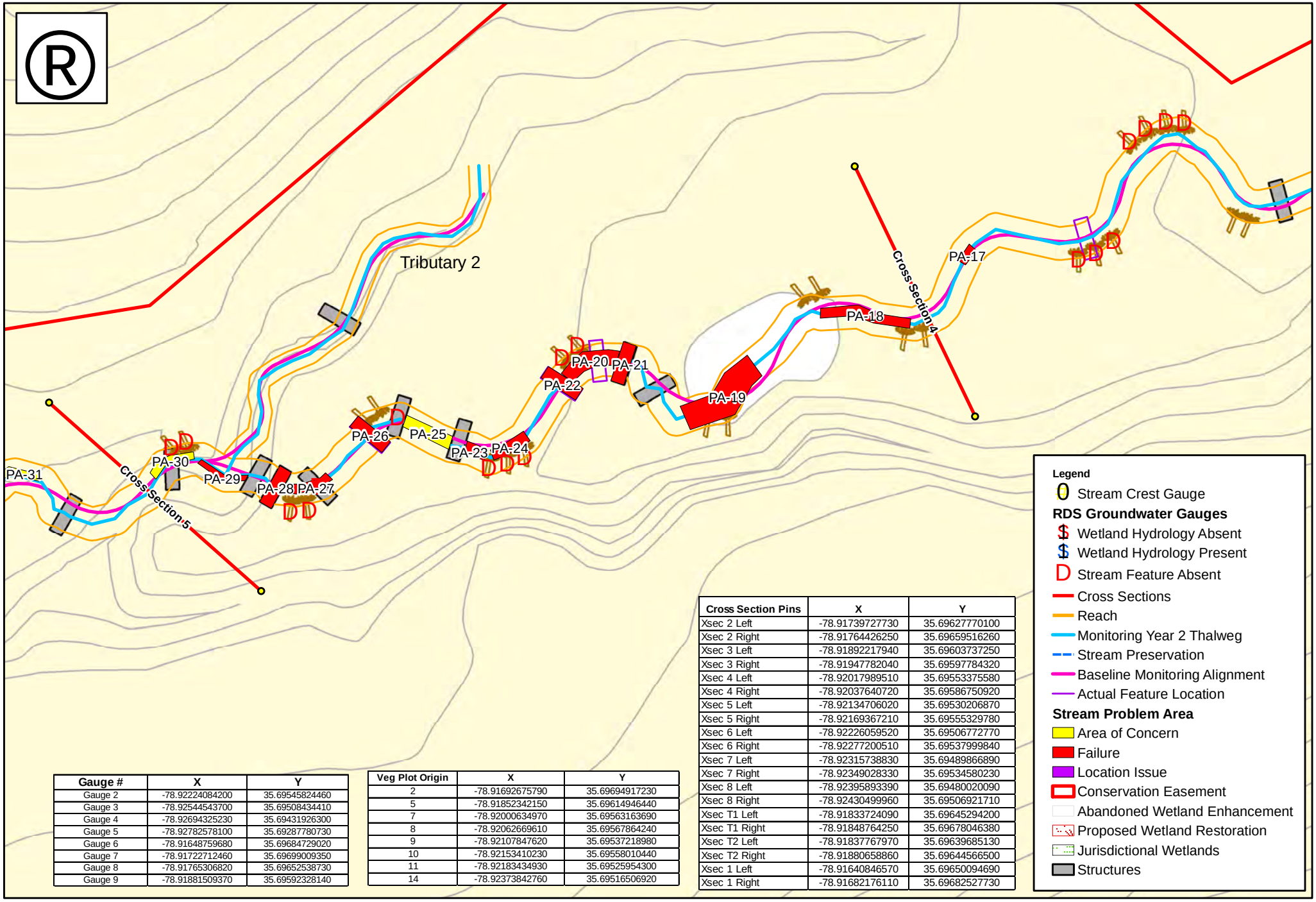
Wake County, North Carolina

0 30 60 Feet

EEP Project No. 221

Date: March 2009

Figure B



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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

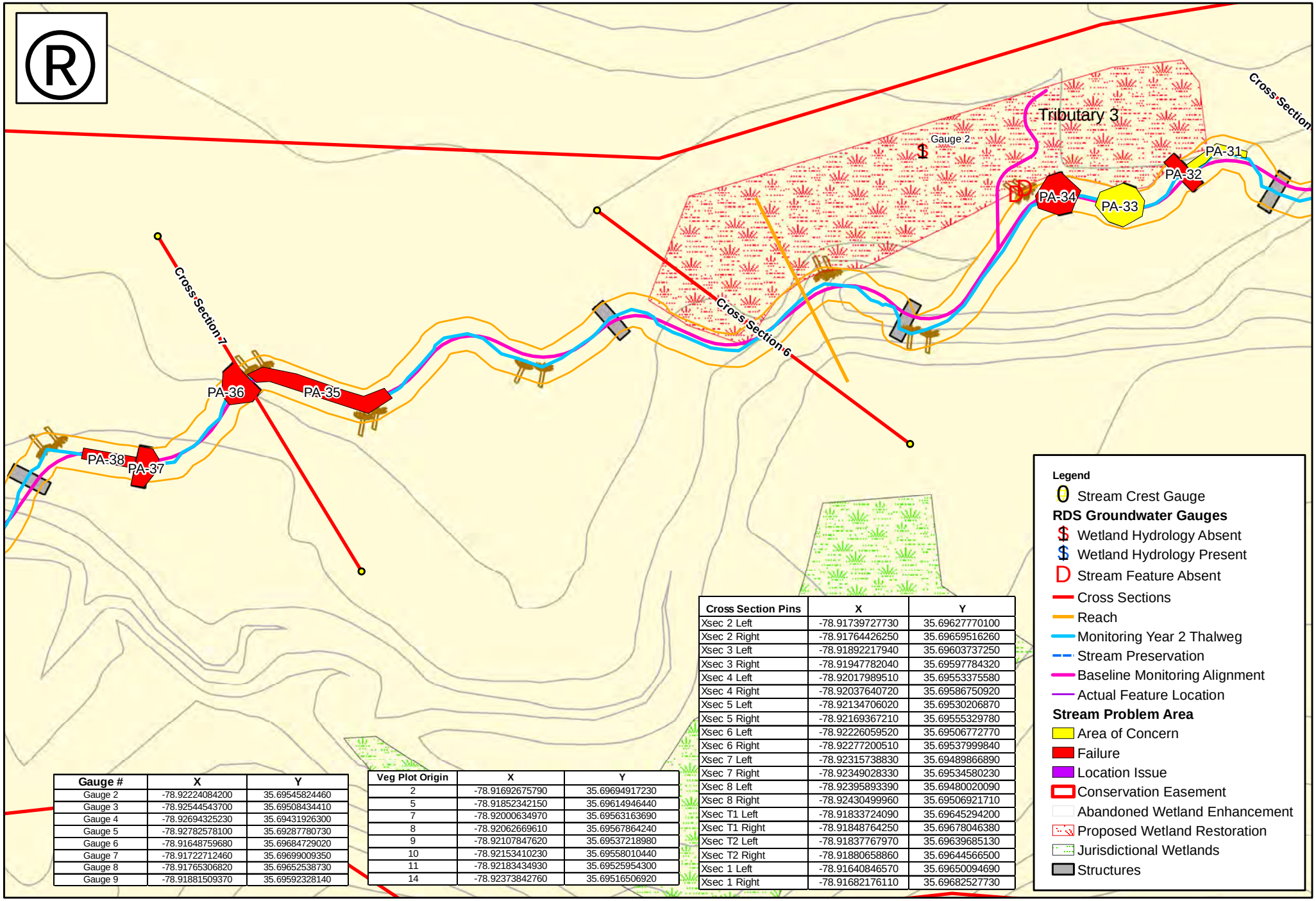
Wake County, North Carolina

0 25 50 Feet

EEP Project No. 221

Date: March 2009

Figure C



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Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

Cross Section Pins	X	Y
Xsec 2 Left	-78.91739727730	35.69627770100
Xsec 2 Right	-78.91764426250	35.69659516260
Xsec 3 Left	-78.91892217940	35.69603737250
Xsec 3 Right	-78.91947782040	35.69597784320
Xsec 4 Left	-78.92017989510	35.69553375580
Xsec 4 Right	-78.92037640720	35.69586750920
Xsec 5 Left	-78.92134706020	35.69530206870
Xsec 5 Right	-78.92169367210	35.69555329780
Xsec 6 Left	-78.92226059520	35.69506772770
Xsec 6 Right	-78.92277200510	35.69537999840
Xsec 7 Left	-78.92315738830	35.69489866890
Xsec 7 Right	-78.92349028330	35.69534580230
Xsec 8 Left	-78.92395893390	35.69480020090
Xsec 8 Right	-78.92430499960	35.69506921710
Xsec T1 Left	-78.91833724090	35.69645294200
Xsec T1 Right	-78.91848764250	35.69678046380
Xsec T2 Left	-78.91837767970	35.69639685130
Xsec T2 Right	-78.91880658860	35.69644566500
Xsec 1 Left	-78.91640846570	35.69650094690
Xsec 1 Right	-78.91682176110	35.69682527730

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

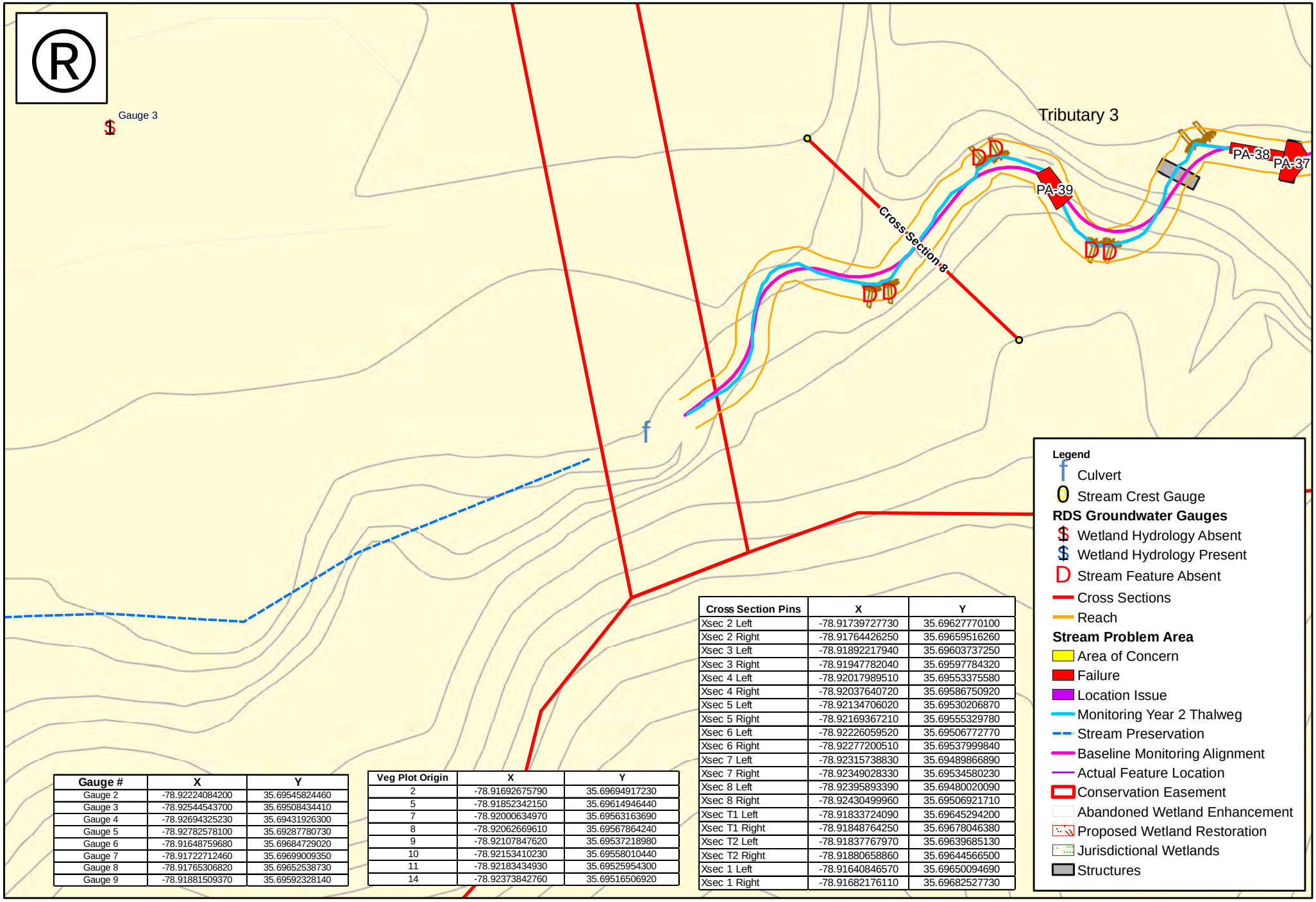
Wake County, North Carolina

0 40 80 Feet

EEP Project No. 221

Date: March 2009

Figure D



Gauge #	X	Y
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Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

Veg Plot Origin	X	Y
2	-78.91692675790	35.69694917230
5	-78.91852342150	35.69614946440
7	-78.92000634970	35.69563163690
8	-78.92062669610	35.69567864240
9	-78.92107847620	35.69537218980
10	-78.92153410230	35.69558010440
11	-78.92183434930	35.69525954300
14	-78.92373842760	35.69516506920

Cross Section Pins	X	Y
Xsec 2 Left	-78.91739727730	35.69627770100
Xsec 2 Right	-78.91764426250	35.69659516260
Xsec 3 Left	-78.91892217940	35.69603737250
Xsec 3 Right	-78.91947782040	35.69597784320
Xsec 4 Left	-78.92017989510	35.69553375580
Xsec 4 Right	-78.92037640720	35.69586750920
Xsec 5 Left	-78.92134706020	35.69530206870
Xsec 5 Right	-78.92169367210	35.69555329780
Xsec 6 Left	-78.92226059520	35.69506772770
Xsec 6 Right	-78.92277200510	35.69537999840
Xsec 7 Left	-78.92315738830	35.69489866890
Xsec 7 Right	-78.92349028330	35.69534580230
Xsec 8 Left	-78.92395893390	35.69480020090
Xsec 8 Right	-78.92430499960	35.69506921710
Xsec T1 Left	-78.91833724090	35.69645294200
Xsec T1 Right	-78.91848764250	35.69678046380
Xsec T2 Left	-78.91837767970	35.69639685130
Xsec T2 Right	-78.91880658860	35.69644566500
Xsec 1 Left	-78.91640846570	35.69650094690
Xsec 1 Right	-78.91682176110	35.69682527730

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

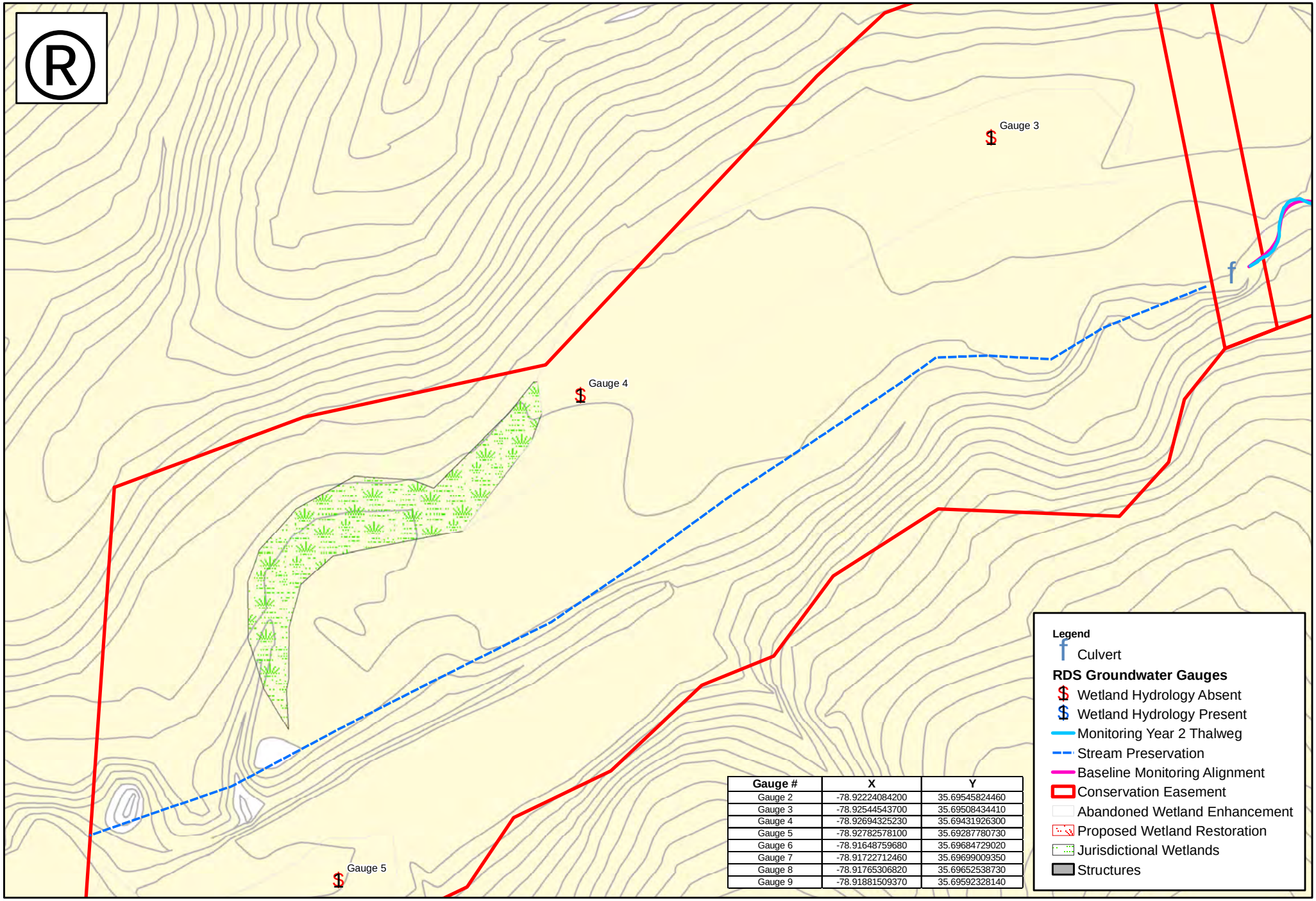
Wake County, North Carolina

0 40 80 Feet

EEP Project No. 221

Date: March 2009

Figure E



Gauge #	X	Y
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Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

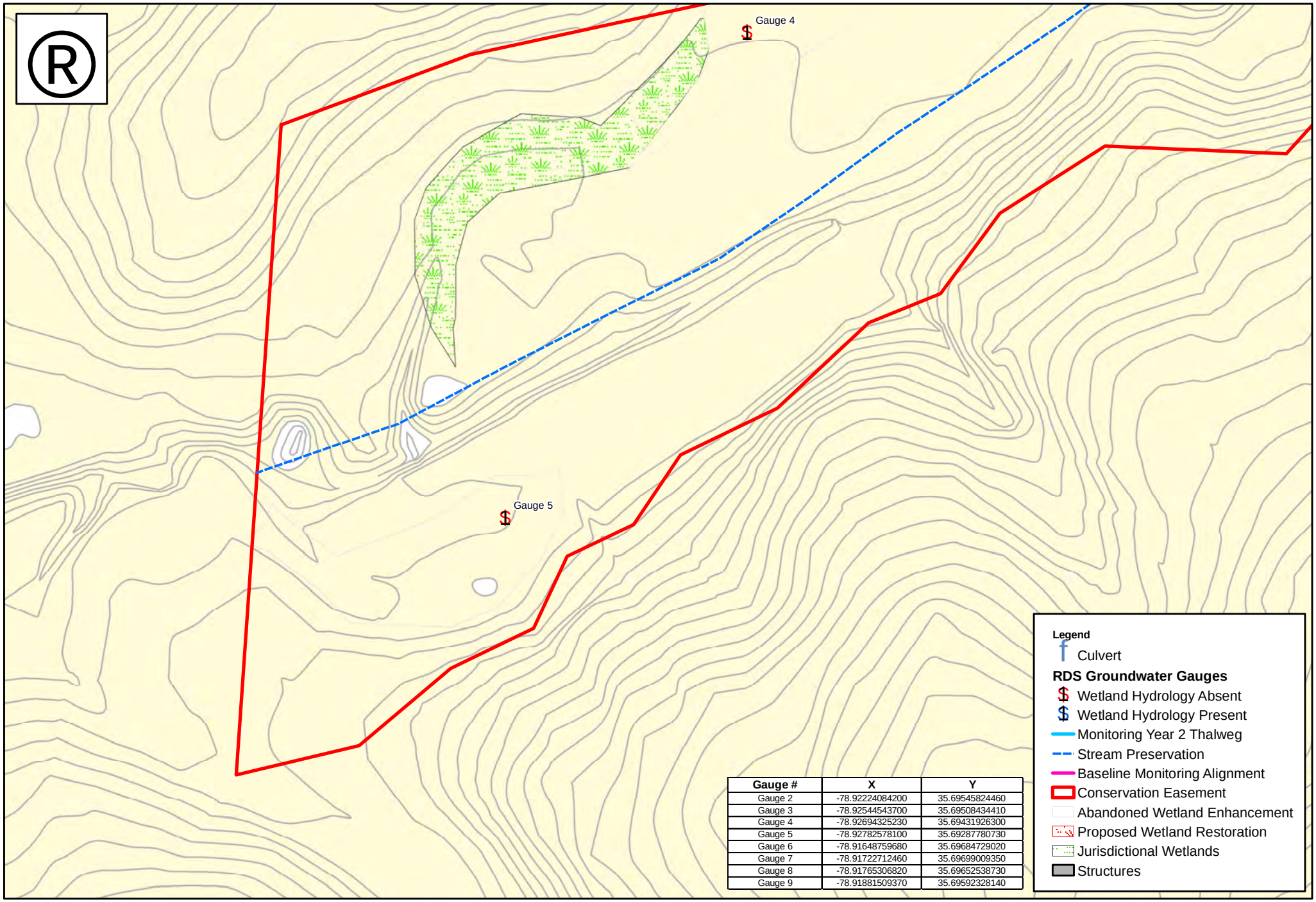
Wake County, North Carolina

0 75 150 Feet

EEP Project No. 221

Date: March 2009

Figure F



Gauge #	X	Y
Gauge 2	-78.92224084200	35.69545824460
Gauge 3	-78.92544543700	35.69508434410
Gauge 4	-78.92694325230	35.69431926300
Gauge 5	-78.92782578100	35.69287780730
Gauge 6	-78.91648759680	35.69684729020
Gauge 7	-78.91722712460	35.69699009350
Gauge 8	-78.91765306820	35.69652538730
Gauge 9	-78.91881509370	35.69592328140

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Ecosystem Enhancement Program

Little Beaver Creek Stream and Wetland Restoration

Stream Current Conditions Plan View

Wake County, North Carolina

0 75 150 Feet

EEP Project No. 221

Date: March 2009

Figure G

Appendix B

2. Stream Problem Area Table

Table B1. Stream Problem Areas
Little Beaver Creek - Project #221

Feature Issue	Station Numbers	Suspected Cause	Photo Number
Right Bank Undercut	10+00 10+08	Upstream- Fallen tree causing 2ft undercut.	PA_1
Pool Filling	10+50 10+60	Incorrect pattern geometry.	PA_2
Structure Concern	11+30 11+30	8" gap in rock structure, channel elevation.	PA_3
Structure Bypass	11+75 11+75	Overland flow around right of structure.	PA_4
Bank Failure	11+75 11+90	Undercut toe due to storm flows.	PA_5
Sill Under Water	12+50 12+50	Wrong location and elevation.	PA_6
Aggradation of Pool	12+50 12+70	Pool filled with sediment from upstream.	PA_7
Riffle in Outside Meander	13+50 13+65	Riffle forming at outside of meander bend due to structure placement, soil failure in root wads present.	PA_8
Bank Failure-Left	15+60 15+90	Left bank failure resulting from high banks.	PA_9
Structure Failure	15+90 16+00	Water going through sill, materials in sill structure are approximately 2" higher than water surface elevation.	PA_10
Bank Erosion	16+60 16+80	Outside bend on the right bank, erosion.	PA_11
Bank Scour	16+95 17+05	Scour upstream of root wads, poor root wads causing erosion.	PA_12
Bank Erosion	18+15 18+25	Erosion upstream of root wads.	PA_13
Channel Narrowing	19+00 19+30	Channel narrowing and getting shallower.	PA_14
Pool Aggraded	19+50 19+60	Pool has aggraded, pushed the channel to the inside of the bend & straightened, rootwad & structure buried in bank.	PA_15
Bank Erosion	21+70 21+90	Aggraded soils causing right bank to blow out.	PA_16

Bank Erosion	25+00 25+08	Erosion on right bank due to scour hole formation.	PA_17
Over-widening	25+50 25+90	Over-widening as a result of depositional aggradation.	PA_18
Over-widening	26+25 26+75	Over-widening as a result of depositional aggradation and unstable banks.	PA_19
Bank Failure and Widening	27+00 27+50	Unstable bank erosion and channel widening.	PA_20
Structure Failure	27+00 27+00	Piping of structure, flow bypassing on right bank.	PA_21
Structure Failure	27+30 27+50	Structure has gaps and piping due to improper construction erosion due to bypassing on right bank, no root wads at this location.	PA_22
Degrading Riffle	28+00 28+00	Riffle is degrading, no root wads before or after riffle as indicated.	PA_23
Unstable Bank	28+00 28+25	No root wads at this location, vertical unstable banks, scouring due to no bank protection or stabilization.	PA_24
Degradation	28+25 28+45	Firm structure, scour hole formation causing riffle to degrade degrading riffle material has migrated to banks, structure beginning to pipe.	PA_25
Structure Failure	28+50 28+50	Rootwad placement too high, no footer present piping resulting, erosion is resulting as well.	PA_26
Bank Erosion	28+95 29+10	No root wads or structure at this location, channel is widening with vertical eroding bank walls.	PA_27
Structure Failure	29+25 29+25	Structure is piping due to boulder gapping and no chinking.	PA_28
Bank Erosion	29+30 29+50	Banks are beginning to erode at toe.	PA_29
Bank Erosion	29+75 29+80	Right bank is eroding, no root wads at this location.	PA_30
Bank Erosion	30+50 30+70	Steep banks in tight meander, no point bar formation.	PA_31
Structure Failure	30+60 30+60	Structure is piping due to boulder gapping and no chinking.	PA_32
Structure Erosion	31+10 31+20	Structure causing backwater, scour at upstream bank against structure no sill visible.	PA_33
Structure and Bank Failure	31+50 31+70	Boulders too large, chinking failed because of joint gapping no root wads present at location, piping, scour on left and right banks.	PA_34

Channel Widening	35+25 36+10	Erosion on right and left banks, root wads beginning to scour upstream.	PA_35
Degradation, Erosion, Structure Failure	36+10 36+10	Erosion and degradation resulting because of structure failure due to piping. Possible loss of riffle.	PA_36
Bank Erosion & Scour	36+70 36+75	Erosion and scour possibly resulting from backwater due to structure.	PA_37
Scour Hole	36+75 37+00	Scour resulting from upstream degradation and channel widening possible loss of upstream structure could result in the future.	PA_38
Aggradation	38+00 38+15	Aggradation in pool.	PA_39
Bank Erosion	10+60 10+80	Bank erosion left and right banks possibly due to steep upstream riffle transition to pool and ending into bench.	TPA_1
Bank Erosion	11+40 11+60	Bank eroding on left bank at bench, channel is beginning to straighten due to upstream riffle.	TPA_2
Bank Erosion	11+70 11+95	Channel widening in bend erosion and bank failures resulting	TPA_3
Bank Erosion	12+50 12+25	Bank erosion	TPA_4
Easment Violation	12+75 13+00	Vehicular/ATV crossing of stream, rutting resulting causing stream bank destabilization and disruption of the channel.	TPA_5

Appendix B

3. Representative Stream Problem Area Photos

Photo 1: PA_1

Photo 2: PA_2

Photo 3: PA_3

Photo 4: PA_4

Photo 5: PA_5

Photo 6: PA_6

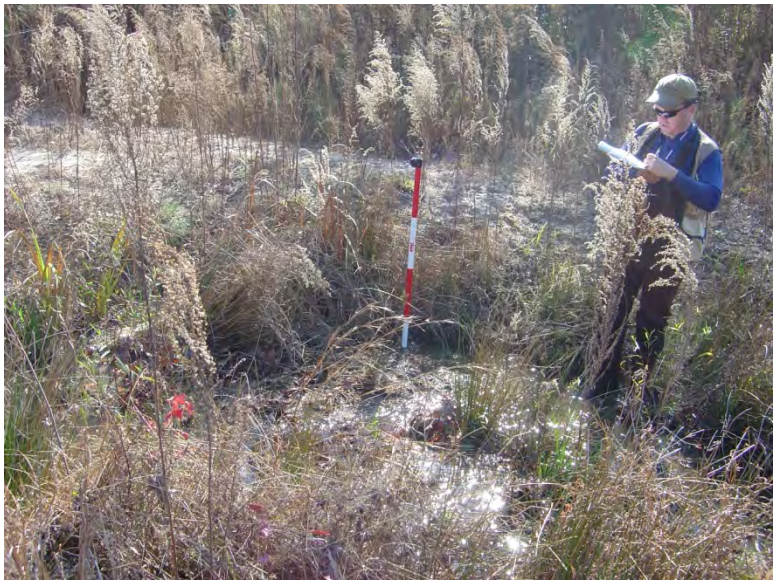


Photo 7: PA_7

Photo 8: PA_8

Photo 9: PA_9

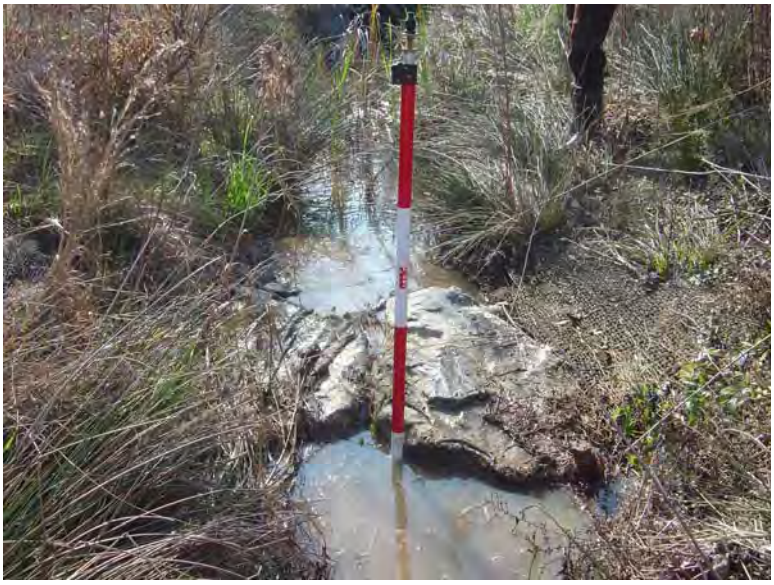


Photo 10: PA_10

Photo 11: PA_11

Photo 12: PA_12

Photo 13: PA_13

Photo 14: PA_14

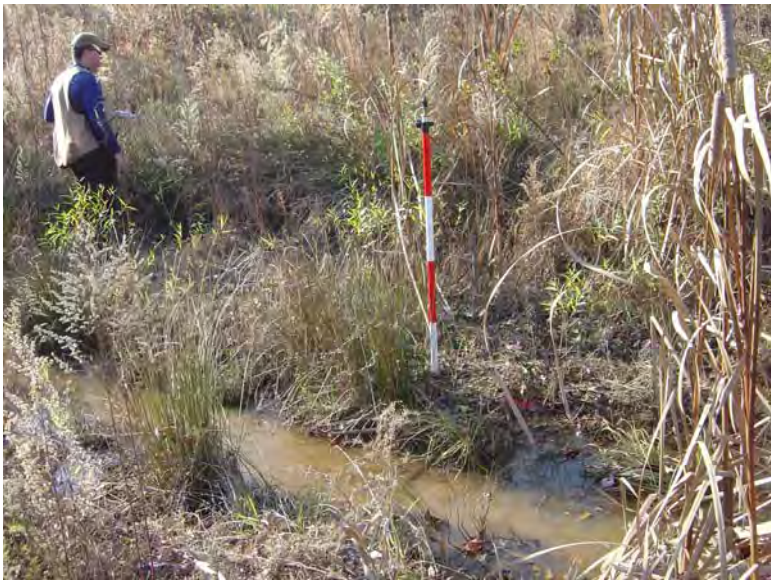


Photo 15: PA_15

Photo 16: PA_16

Photo 17: PA_17

Photo 18: PA_18

Photo 19: PA_19

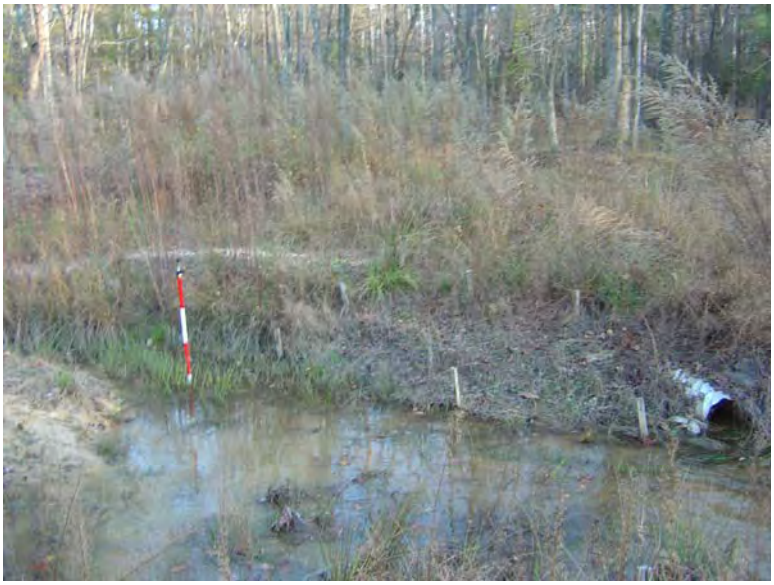


Photo 20: PA_20

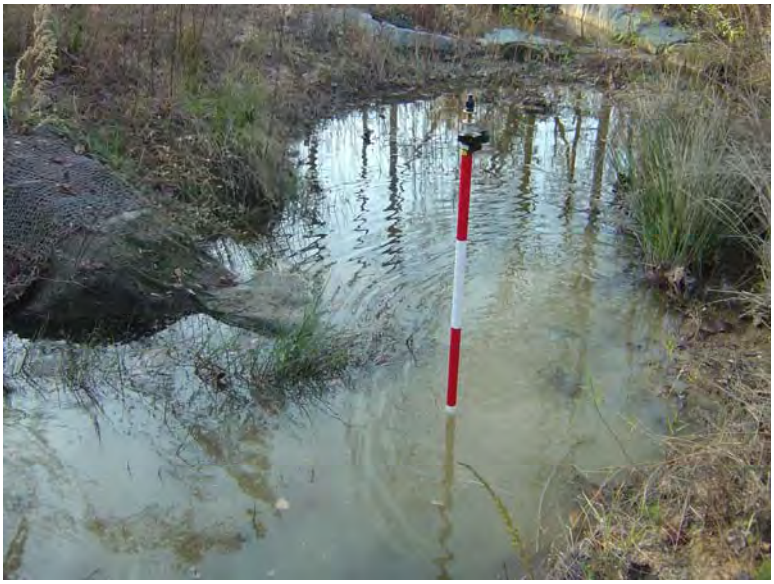


Photo 21: PA_21

Photo 1: PA_22

Photo 2: PA_23

Photo 3: PA_24

Photo 4: PA_25

Photo 5: PA_26

Photo 6: PA_27

Photo 7: PA_28

Photo 8: PA_29

Photo 9: PA_30

Photo 10: PA_31

Photo 11: PA_32

Photo 12: PA_33

Photo 1: PA_34

Photo 2: PA_35

Photo 3: PA_36

Photo 4: PA_37

Photo 5: PA_38

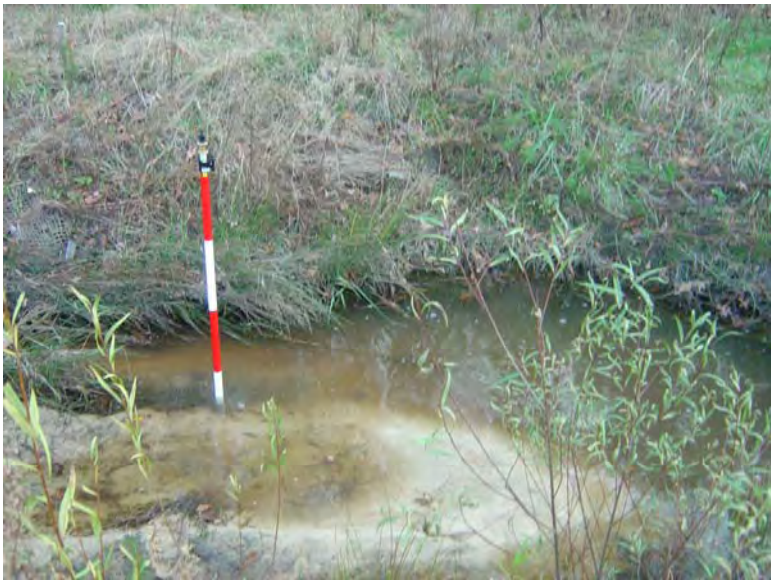


Photo 6: PA_39

Tributary 1

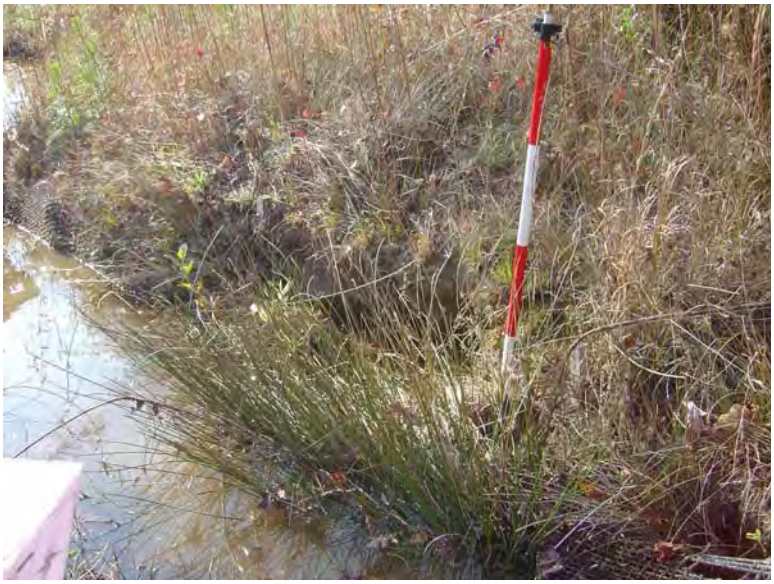


Photo 7: TPA_1

Photo 8: TPA_2

Photo 9: TPA_3

Photo 10: TPA_4

Photo 11: TPA_5

Appendix B

4. Stream Photo-Station Photos

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B

Photo Point 1. Downstream view from Station 10+00.

Photo Point 3. Upstream view.

Photo Point 2. Upstream view from Cross Section #1.

Photo Point 3. Downstream view.

Photo Point 2. Downstream of Cross Section #1.

Photo Point 4. Upstream view from Cross Section #2.

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B

Photo Point 4. Downstream View from Cross Section #2.

Photo Point 6. Downstream view from confluence of Tributary 1.

Photo Point 5. Upstream view.

Photo Point 6. Upstream view from confluence of Tributary 1.

Photo Point 5. Downstream view.

Photo Point 7. Downstream view from Cross Section #T1.

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B


Photo Point 7. Upstream view from Cross Section #T1.


Photo Point 9. Downstream view from Cross Section #3.


Photo Point 8. Downstream view from Cross Section #T2.


Photo Point 9. Upstream view from Cross Section #3.


Photo Point 8. Upstream view from Cross Section #T2.


Photo Point 10. Downstream view.

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B


Photo Point 10. Upstream view.


Photo Point 12. Downstream view.


Photo Point 11. Downstream view from Cross Section #4.


Photo Point 12. Upstream view.


Photo Point 11. Upstream view from Cross Section #4.


Photo Point 13. Downstream view. gravel road stream crossing.

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B


Photo Point 13. Upstream view.


Photo Point 15. Downstream view from Cross Section #5.


Photo Point 14. Downstream view of Tributary 2.


Photo Point 15. Upstream view from Cross Section #5.


Photo Point 14. Upstream view of Tributary 2.


Photo Point 16. Downstream view.

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B


Photo Point 16. Upstream view.


Photo Point 18. Downstream view.


Photo Point 17. Downstream view from Cross Section #6.


Photo Point 18. Upstream view.


Photo Point 17. Upstream view from Cross Section #6.


Photo Point 19. Downstream view from Cross Section #7.

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B


Photo Point 19. Upstream view from Cross Section #7.


Photo Point 21. Downstream view of Cross Section #8.


Photo Point 20. Downstream view.


Photo Point 21. Upstream view.


Photo Point 20. Upstream view.


Photo Point 22. Downstream view.

Little Beaver Creek Stream and Wetland Restoration Site
Monitoring Year 2 Report
Established Photo-Point Photos
Photo Date: November 11, 2008
Appendix B

Photo Point 22. Upstream view of Cross Section 8.

Photo Point 23. Upstream view from the gravel road stream crossing.

Appendix B

5. Table B.2 Qualitative Visual Stability Assessment

Table B2. Visual Morphological Stability Assessment
Little Beaver Creek Stream Restoration/Project 221
Reaches 1, 2, 3a,: (3032 feet)

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built [1]	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	49	64	NA	77%	
	2. Armor stable (e.g.no displacement?)	23	64	NA	36%	
	3. Facet grade appears stable?	27	64	NA	42%	
	4. Minimal evidence of embedding/fining?	15	64	NA	23%	
	5. Length appropriate?	16	64	NA	25%	**41%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	53	64	NA	83%	
	2. Sufficiently deep (Max. Pool D:Mean Bkf>1.6?)	42	64	NA	66%	
	3. Length appropriate?	30	64	NA	47%	**65%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	35	64	NA	55%	
	2. Downstream of meander (glide/inflection) centering?	31	64	NA	48%	**52%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	47	64	NA	73%	
	2. Of those eroding, # w/concomitant point bar formation?	9	17	NA	53%	
	3. Apparent Rc within spec?	47	64	NA	73%	
	4. Sufficient floodplain access and relief?	39	64	NA	61%	**65%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	7/150 [2]	95%	
	2. Channel bed degradation-areas of increasing downcutting of head cutting?	NA	NA	3/186 [2]	94%	**94%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	NA	NA	9/225	96%	**96%**
G. Cross vanes, sills, single wing vanes	1. Free of back or arm scour?	30	34	NA	88%	
	2. Height appropriate?	15	34	NA	44%	
	3. Angle and geometry appear appropriate?	27	34	NA	79%	
	4. Free of piping or other structural failures?	27	34	NA	79%	**73%**
H. Wads/ Boulders	1. Free of scour?	16	25	NA	64%	
	2. Footing stable?	19	25	NA	76%	**70%**

1. The tributaries were not separated from the main channel in the MY-01 monitoring report.

2. Taken from a comparison of the longitudinal profiles of MY-01 and MY-02

Table B2. Visual Morphological Stability Assessment
Little Beaver Creek Stream Restoration/Project 221
Tributary 1: (381 feet)

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built [1]	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	8	11	NA	73%	
	2. Armor stable (e.g.no displacement?)	8	11	NA	73%	
	3. Facet grade appears stable?	8	11	NA	73%	
	4. Minimal evidence of embedding/fining?	6	11	NA	55%	
	5. Length appropriate?	7	11	NA	64%	**67%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	10	11	NA	91%	
	2. Sufficiently deep (Max. Pool D:Mean Bkf>1.6?)	7	11	NA	64%	
	3. Length appropriate?	8	11	NA	73%	**76%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	7	11	NA	64%	
	2. Downstream of meander (glide/inflection) centering?	7	11	NA	64%	**64%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	6	11	NA	55%	
	2. Of those eroding, # w/concomitant point bar formation?	1	5	NA	20%	
	3. Apparent Rc within spec?	7	11	NA	64%	
	4. Sufficient floodplain access and relief?	8	11	NA	73%	**53%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation-areas of increasing downcutting of head cutting?	NA	NA	1/52 [2]	86%	**93%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	NA	NA	3/110	86%	**86%**
G. Cross vanes, sills, single wing vanes	1. Free of back or arm scour?	2	2	NA	100%	
	2. Height appropriate?	2	2	NA	100%	
	3. Angle and geometry appear appropriate?	2	2	NA	100%	
	4. Free of piping or other structural failures?	2	2	NA	100%	**100%**
H. Wads/ Boulders	1. Free of scour?	0	0	NA	NA	
	2. Footing stable?	0	0	NA	NA	**NA**

1. The tributaries were not separated from the main channel in the MY-01 monitoring report.

2. Taken from a comparison of the longitudinal profiles of MY-01 and MY-02

Table B2. Visual Morphological Stability Assessment
Little Beaver Creek Stream Restoration/Project 221
Tributary 2: (206 feet)

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built [1]	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	5	5	NA	100%	
	2. Armor stable (e.g.no displacement?)	5	5	NA	100%	
	3. Facet grade appears stable?	5	5	NA	100%	
	4. Minimal evidence of embedding/fining?	5	5	NA	100%	
	5. Length appropriate?	5	5	NA	100%	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	5	5	NA	100%	
	2. Sufficiently deep (Max. Pool D:Mean Bkf>1.6?)	5	5	NA	100%	
	3. Length appropriate?	5	5	NA	100%	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	5	5	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	5	5	NA	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	5	5	NA	100%	
	2. Of those eroding, # w/concomitant point bar formation?	0	0	NA	100%	
	3. Apparent Rc within spec?	5	5	NA	100%	
	4. Sufficient floodplain access and relief?	5	5	NA	100%	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	0%	
	2. Channel bed degradation-areas of increasing downcutting of head cutting?	NA	NA	0	0%	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	NA	NA	0	0%	**100%**
G. Cross vanes, sills, single wing vanes	1. Free of back or arm scour?	1	1	NA	100%	
	2. Height appropriate?	1	1	NA	100%	
	3. Angle and geometry appear appropriate?	1	1	NA	100%	
	4. Free of piping or other structural failures?	1	1	NA	100%	**100%**
H. Wads/ Boulders	1. Free of scour?	0	0	NA	NA	
	2. Footing stable?	0	0	NA	NA	**NA**

1. The tributaries were not separated from the main channel in the MY-01 monitoring report.

Appendix B

6. Cross Section Plots

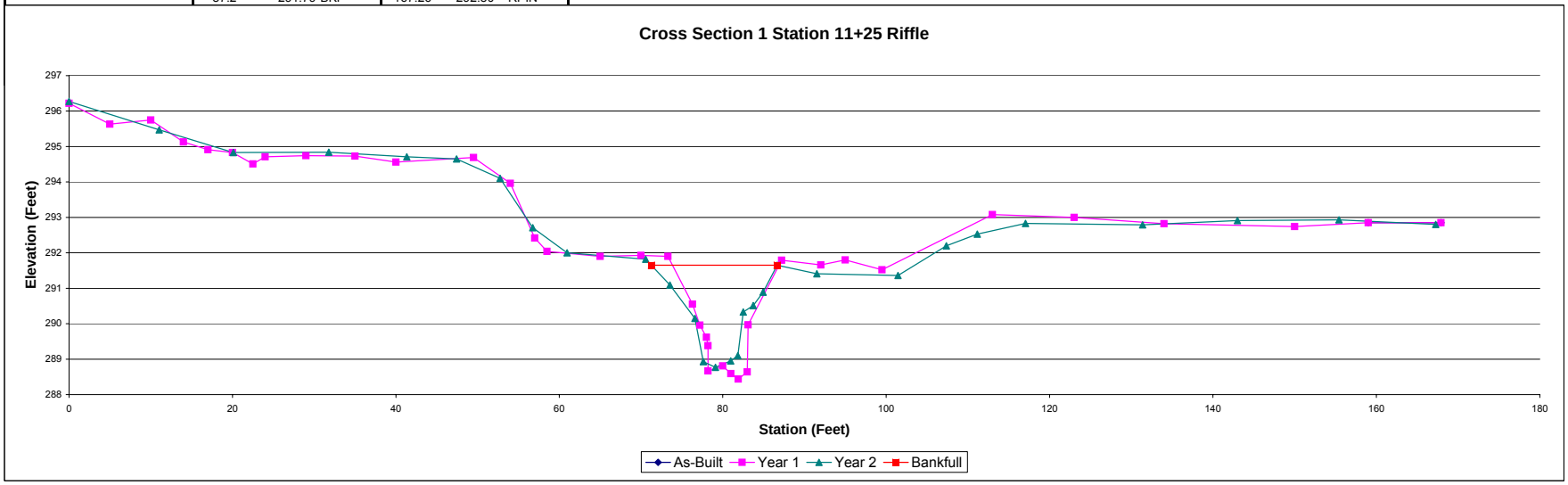
Project:	Litte Beaver Creek
Cross Section:	Cross Section 1
Feature	Riffle
Station:	11+25
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	N/A	25.1	22.4
W (BKF)	N/A	13.8	15.4
Max d	N/A	3.4	2.9
Mean d	N/A	1.8	1.5
W/D	N/A	7.6	10.6

MY0-2006*			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
			0	296.22		0.00	296.27	LPIN
			5	295.63		11.04	295.47	
			10	295.75		20.11	294.83	
			14	295.13		31.79	294.84	
			17	294.91		41.33	294.71	
			20	294.83		47.43	294.65	
			22.5	294.51		52.75	294.10	
			24	294.71		56.75	292.71	
			29	294.74		60.95	292.00	
			35	294.73		70.58	291.82	BKF L
			40	294.56		73.54	291.09	
			49.5	294.69		76.60	290.15	Toe L
			54	293.96		77.63	288.93	
			57	292.42		79.11	288.77	TW
			58.5	292.04		80.98	288.95	
			65	291.9		81.84	289.10	
			70	291.93		82.52	290.33	TOE R
			73.3	291.9	BKF	83.73	290.51	
			76.3	290.55		84.94	290.89	
			77.2	289.96		86.67	291.65	BKF R
			78	289.62		91.51	291.41	
			78.2	289.38	lew	101.45	291.36	
			78.2	288.67		107.37	292.20	
			80	288.81		111.16	292.53	
			81	288.59		117.06	292.83	
			81.9	288.44	TW	131.38	292.79	
			83	288.64		142.99	292.91	
			83.1	289.97		155.43	292.93	
			87.2	291.79	BKF	167.26	292.80	RPIN

Photo of XS-1, Sta 11+25 looking in the upstream direction

*This cross section was moved after MY0 , therefore MY0 is not represented on this plot.

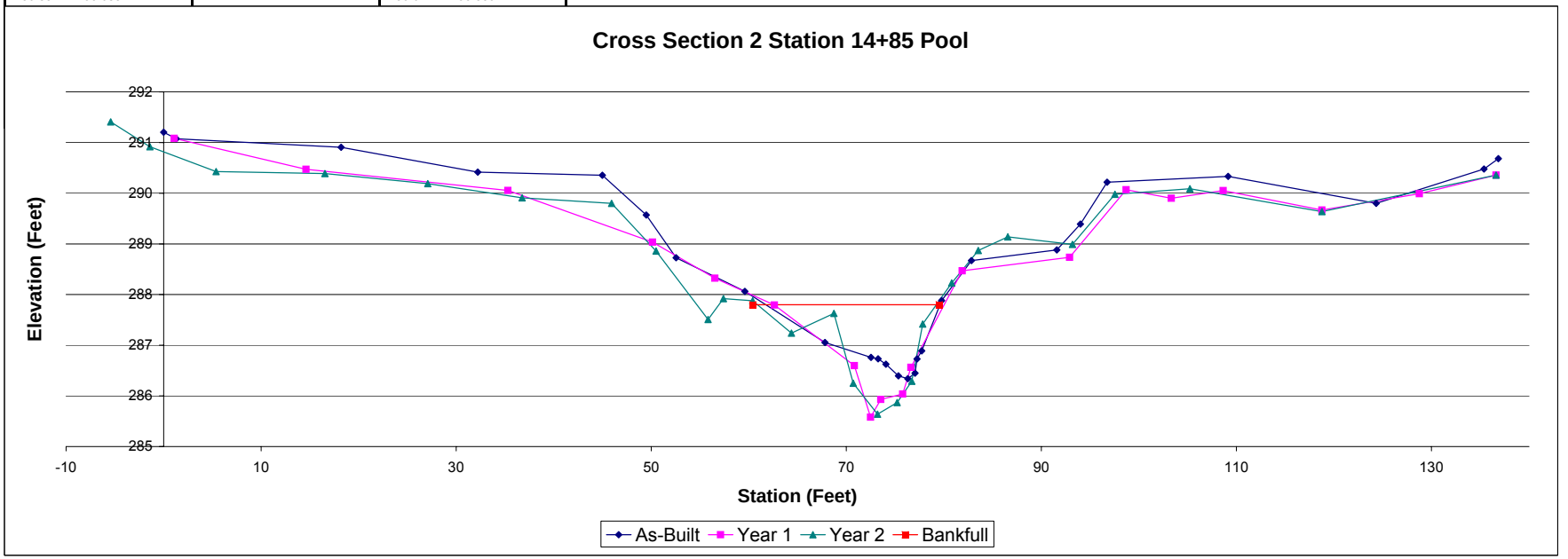


Project:	Litte Beaver Creek
Cross Section:	Cross Section 2
Feature	Pool
Station:	14+85
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	34.2	17.2	18.4
W (BKF)	29.7	17.4	19.1
Max d	2.3	2.2	2.2
Mean d	1.2	1.0	1.0
W/D	25.7	17.5	19.9

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	291.205	RPIN2	1.088	291.083	X2	-5.433	291.409	LP
1.303	291.076		14.6	290.474	X2	-1.413	290.919	
18.202	290.908		35.299	290.055	X2	5.387	290.429	
32.218	290.418		50.125	289.036	X2	16.537	290.389	
44.981	290.355		56.522	288.323	X2	27.087	290.189	
49.489	289.571		62.625	287.794	X2BKF	36.757	289.909	
52.543	288.728		70.82	286.597	X2EOW	45.937	289.799	
59.602	288.063		72.483	285.579	X2TW	50.487	288.859	
67.811	287.053		73.532	285.931	X2	55.827	287.509	
72.534	286.759		75.785	286.036	X2TW	57.397	287.919	
73.264	286.731	LEW	76.618	286.564	X2EOW	60.397	287.879	BKF L
74.06	286.624		81.881	288.468	X2BKF	64.377	287.239	
75.34	286.396		92.898	288.735	X2	68.727	287.629	
76.303	286.339		98.697	290.068	X2	70.717	286.249	TOE L
77.043	286.45		103.321	289.902	X2	73.207	285.639	TW
77.252	286.729		108.642	290.052	X2	75.217	285.869	
77.726	286.89		118.767	289.669	X2	76.707	286.289	TOE R
79.776	287.88		128.755	289.992	X2	77.827	287.419	
82.832	288.671	BKF	136.617	290.359	X2RPIN	80.807	288.229	
91.588	288.88					83.527	288.869	BKFL R
93.997	289.39					86.557	289.139	
96.737	290.219					93.187	288.989	
109.152	290.332					97.547	289.979	
124.326	289.799					105.227	290.089	
135.388	290.479					118.767	289.639	
136.857	290.683					136.617	290.359	RP

Photo of XS-2, Sta 14+85 looking in the downstream direction



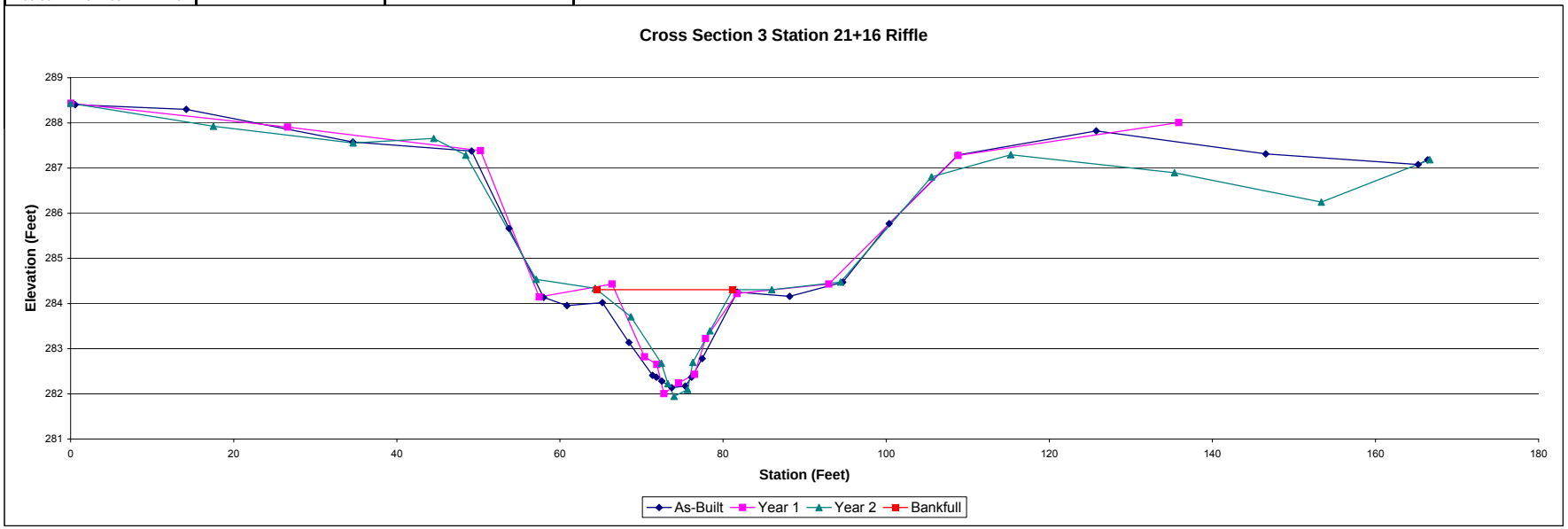
Project:	Litte Beaver Creek
Cross Section:	Cross Section 3
Feature	Riffle
Station:	21+16
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)

	MY0	MY1	MY2
A (BKF)	17.9	19.1	18.5
W (BKF)	21.1	16.4	16.7
Max d	1.9	2.3	2.4
Mean d	0.8	1.2	1.1
W/D	25.0	14.1	15.0

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	288.436	LPIN3	0.043	288.436	X3L	0.00	288.44	RP
0.552	288.402		26.603	287.908	XS3	17.50	287.93	
14.186	288.3		50.259	287.387	XS3	34.63	287.56	
34.61	287.578		57.458	284.146	XS3	44.52	287.66	
49.17	287.377		66.395	284.432	XS3	48.45	287.29	
53.757	285.662		70.363	282.821	XS3BKF	57.10	284.54	
57.993	284.138		71.88	282.652	XS3EOW	64.33	284.34	BKF L
60.861	283.955		72.745	282.006	XS3TW	68.70	283.71	
65.206	284.021	BKF	74.544	282.239	XS3	72.44	282.68	TOE L
68.451	283.139		76.507	282.433	XS3EOW	73.24	282.23	
71.361	282.409		77.864	283.225	XS3BKF	74.01	281.95	TW
71.825	282.37	LEW	81.703	284.22	XS3	75.66	282.10	
72.485	282.281		92.955	284.433	XS3	76.30	282.70	TOE R
73.698	282.138		108.805	287.28	XS3	78.40	283.40	
75.364	282.172		135.877	288.007	XS3	81.19	284.31	BKF R
76.146	282.369	REW				85.97	284.31	
77.44	282.781					94.40	284.48	
81.729	284.254					105.56	286.81	
88.159	284.159					115.27	287.30	
94.688	284.474					135.36	286.90	
100.359	285.769					153.35	286.25	
108.792	287.29					166.66	287.19	RP
125.757	287.824							
146.546	287.314							
165.219	287.08							
166.394	287.183	RPIN3						

Photo of XS-3, Sta 21+16 looking in the downstream direction



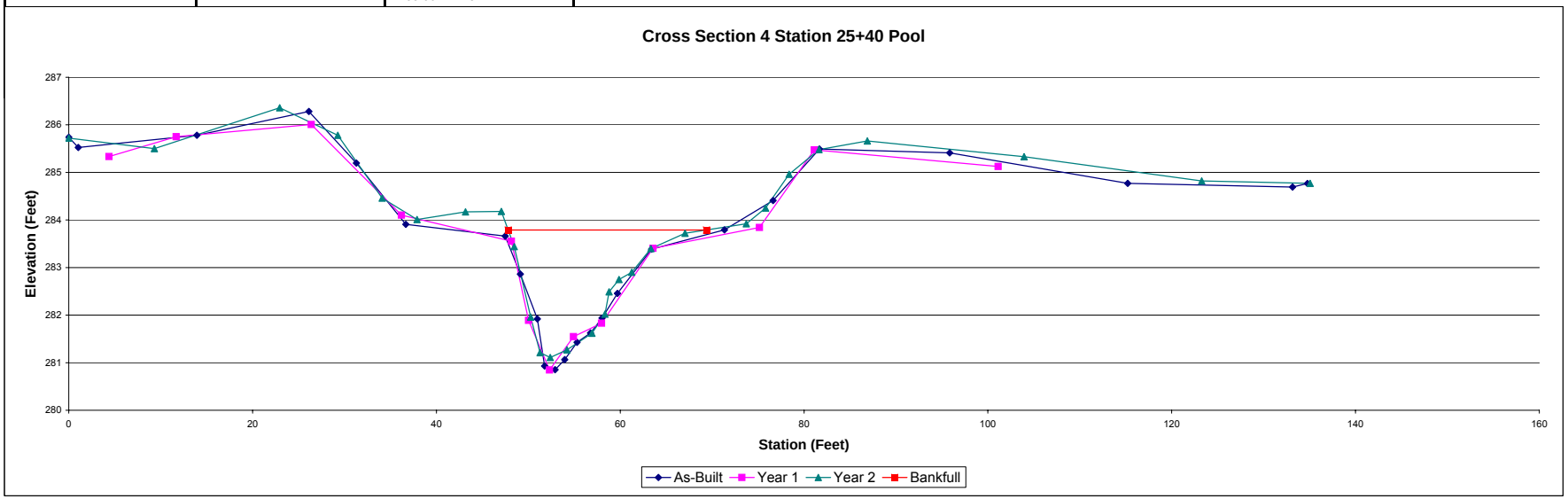
Project:	Litte Beaver Creek
Cross Section:	Cross Section 4
Feature	Pool
Station:	25+40
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)

	MY0	MY1	MY2
A (BKF)	20.4	23.9	26.9
W (BKF)	15.4	19.4	21.6
Max d	2.5	2.7	2.7
Mean d	1.3	1.2	1.2
W/D	11.6	15.8	17.3

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	285.74	RPIN4	4.378	285.334	XS4	0.00	285.72	LP
1.03	285.523		11.69	285.752	XS4	9.32	285.50	
13.942	285.782		26.393	286.008	XS4	22.94	286.36	
26.119	286.281		36.189	284.101	XS4	29.27	285.78	
31.294	285.196		48.166	283.553	XS4BKF	34.09	284.46	
36.678	283.908		50.03	281.889	XS4EOW	37.89	284.01	
47.48	283.661		52.311	280.847	XS4TW	43.16	284.17	
49.135	282.863		54.913	281.546	XS4TW	47.07	284.18	BKF L
50.989	281.92	LEW	57.971	281.831	XS4EOW	48.47	283.44	
51.769	280.929		63.563	283.404	XS4BKF	50.26	281.96	TOE L
52.914	280.853		75.146	283.843	XS4	51.28	281.21	
53.967	281.064		81.117	285.473	XS4	52.39	281.11	TW
55.306	281.429		101.114	285.125	XS4	54.21	281.27	
56.765	281.626					56.92	281.62	
58.016	281.937	REW				58.34	282.02	TOE R
59.701	282.458					58.79	282.49	
63.409	283.387	BKF				59.87	282.75	
71.339	283.791					61.26	282.90	
76.628	284.409					63.34	283.40	BKF R
81.67	285.491					67.06	283.72	
95.841	285.412					73.71	283.92	
115.208	284.77					75.81	284.25	
133.154	284.693					78.38	284.96	
134.767	284.766	LPIN4				81.63	285.48	
						86.89	285.66	
						103.94	285.33	
						123.27	284.82	
						135.06	284.77	RP

Photo of XS-4, Sta 25+40 looking in the downstream direction

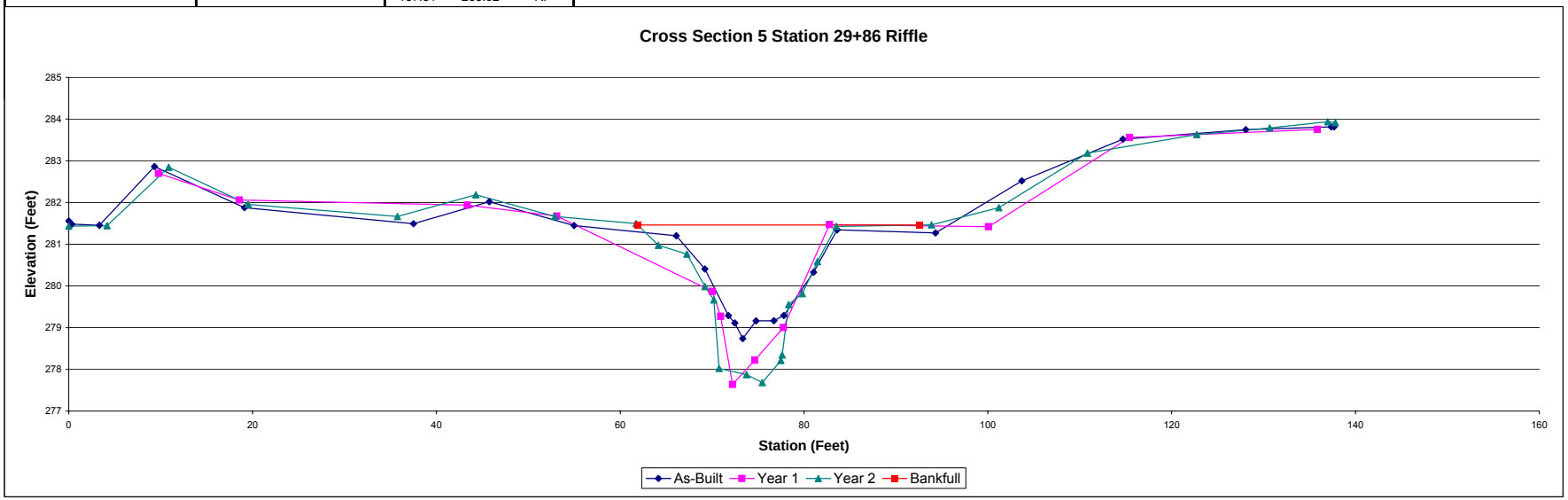


Project:	Litte Beaver Creek
Cross Section:	Cross Section 5
Feature	Riffle
Station:	29+86
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	22.8	44.0	39.0
W (BKF)	17.1	28.2	30.7
Max d	2.5	3.9	3.8
Mean d	1.3	1.6	1.3
W/D	12.8	18.1	24.1

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	281.556	LPIN5	9.759	282.698	XS5	0.00	281.44	LP
0.327	281.481		18.551	282.059	XS5	4.16	281.45	
3.333	281.453		43.367	281.937	XS5	10.87	282.85	
9.332	282.862		53.092	281.674	XS5	19.52	281.96	
19.117	281.877		70.014	279.871	XS5BKF	35.77	281.67	
37.5	281.491		70.928	279.271	XS5	44.29	282.19	
45.756	282.018		72.217	277.638	XS5	52.89	281.67	
54.979	281.447		74.647	278.22	XS5	61.74	281.50	BKF L
66.104	281.203	BKF	77.751	279.004	XS5EOW	64.15	280.98	
69.211	280.408		82.766	281.471	XS5BKF	67.25	280.77	
71.773	279.288	LEW	100.074	281.419	XS5	69.23	279.99	
72.465	279.11	REW	115.409	283.557	XS5	70.18	279.67	
73.33	278.738		135.854	283.753	XS5	70.75	278.03	TOE L
74.775	279.163					73.75	277.88	
76.724	279.165	REW				75.46	277.69	TW
77.807	279.293					77.48	278.22	
81.037	280.33	BKF				77.61	278.35	TOER
83.598	281.345					78.32	279.56	
94.31	281.269					79.80	279.82	
103.696	282.517					81.46	280.59	
114.686	283.517					83.50	281.43	BKF R
128.068	283.746					93.87	281.47	
137.36	283.815					101.20	281.88	
137.671	283.814	LPIN4				110.84	283.19	
						122.73	283.63	
						130.67	283.79	
						136.98	283.94	
						137.81	283.92	RP

Photo of XS-5, Sta 29+86 looking in the downstream direction



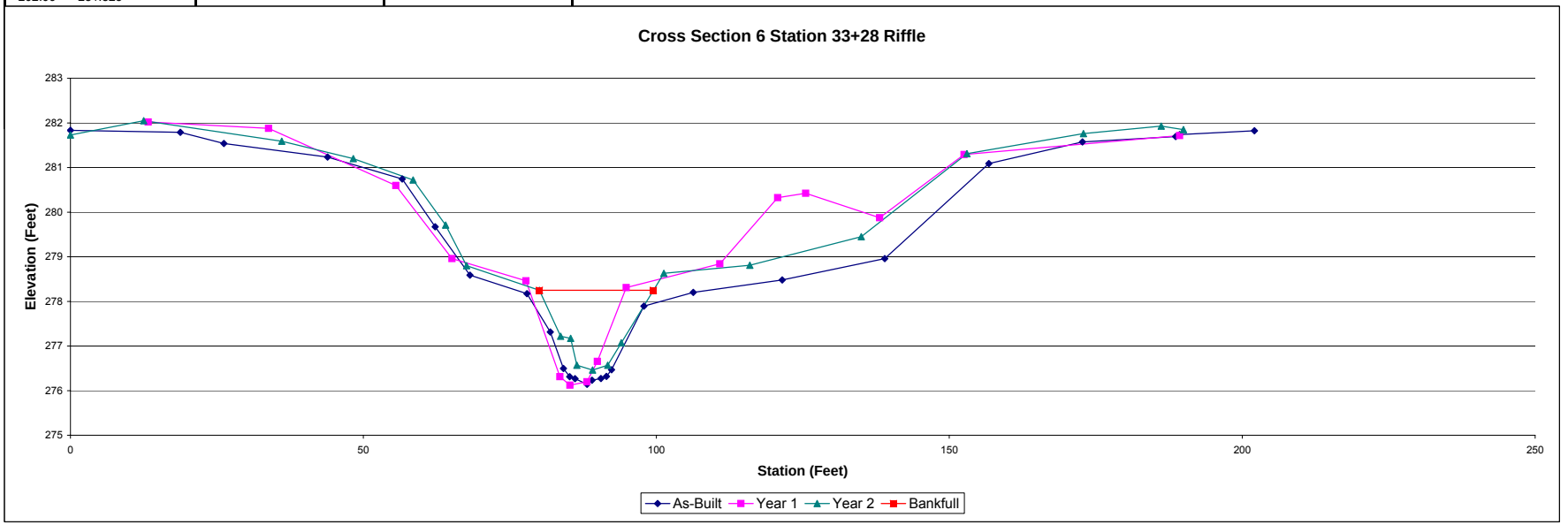
Project:	Litte Beaver Creek
Cross Section:	Cross Section 6
Feature	Riffle
Station:	33+28
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)

	MY0	MY1	MY2
A (BKF)	20.1	25.5	20.8
W (BKF)	18.6	21.7	19.5
Max d	1.8	2.3	1.8
Mean d	1.1	1.2	1.1
W/D	17.2	18.4	18.2

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	281.835	RPIN6	13.282	282.021	X6	0.00	281.73	LP
18.749	281.789		33.812	281.877	X6	12.51	282.05	
26.189	281.538		55.538	280.599	X6	36.06	281.59	
43.891	281.233		65.114	278.96	X6BKF	48.28	281.20	
56.638	280.743		77.748	278.462	X6	58.49	280.72	
62.252	279.672		83.532	276.312	X6	64.05	279.71	
68.183	278.588		85.261	276.122	X6TW	67.61	278.80	
77.929	278.173		88.145	276.199	X6	80.05	278.25	BKF L
81.899	277.315		89.949	276.653	X6EOW	83.66	277.22	
84.148	276.495		94.858	278.308	X6	85.37	277.17	
85.214	276.313	LEW	110.838	278.842	X6	86.43	276.57	TOEL
86.119	276.267		120.705	280.324	X6	89.13	276.46	TW
88.173	276.141		125.496	280.422	X6	91.70	276.57	TOE R
89.024	276.232		138.128	279.874	X6	94.01	277.07	
90.553	276.272		152.535	281.293	X6	101.28	278.63	
91.476	276.32		189.328	281.717	X6RPIN	115.97	278.81	
92.361	276.466					134.98	279.45	
97.869	277.894	BKF				153.02	281.31	
106.299	278.202					172.91	281.76	
121.493	278.481					186.18	281.93	
138.981	278.958					189.98	281.85	RP
156.76	281.088							
172.73	281.573							
188.632	281.694							
189.315	281.738							
202.09	281.825							

Photo of XS-6, Sta 33+28 looking in the downstream direction



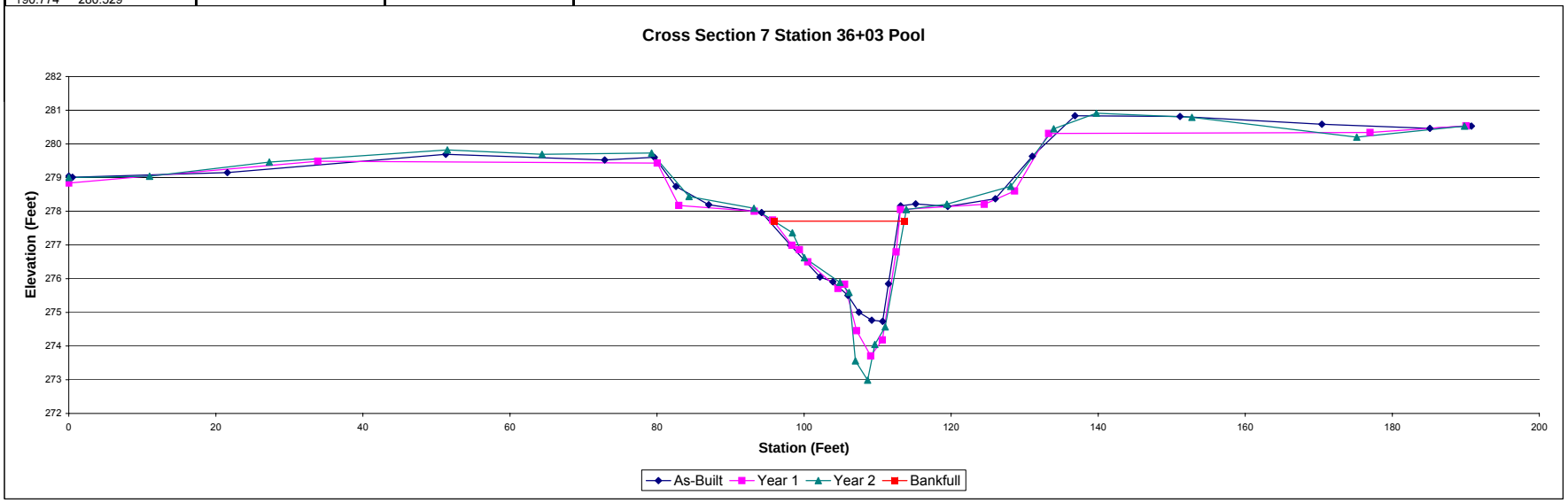
Project:	Litte Beaver Creek
Cross Section:	Cross Section 7
Feature	Pool
Station:	36+03
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)

	MY0	MY1	MY2
A (BKF)	33.6	38.1	34.7
W (BKF)	18.8	19.9	17.7
Max d	3.2	4.3	4.7
Mean d	1.8	1.9	2.0
W/D	10.5	10.4	9.0

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	279.042	LPIN7	0	278.836	X7LPIN	0.00	279.00	LP
0.51	279.009		33.871	279.486	X7	10.98	279.04	
21.568	279.149		80.043	279.431	X7	27.27	279.46	
51.281	279.693		82.978	278.174	X7	51.48	279.82	
72.894	279.523		93.22	278.001	X7	64.37	279.69	
79.627	279.601		95.724	277.739	X7BKF	79.27	279.73	
82.59	278.736		98.349	276.99	X7	84.35	278.44	
87.041	278.193		99.368	276.863	X7	93.18	278.09	
94.236	277.961	BKF	100.513	276.5	X7	98.41	277.36	BKF L
98.157	276.993		104.615	275.711	X7	100.05	276.62	
102.16	276.049		105.514	275.836	X7EOW	104.88	275.89	
103.932	275.906	LEW	107.136	274.455	X7	106.12	275.59	
105.965	275.503		109.075	273.707	X7TW	106.98	273.56	TOEL
107.475	275.001		110.653	274.181	X7	108.65	272.99	TW
109.213	274.767		112.523	276.792	X7	109.62	274.05	
110.698	274.732		113.122	278.052	X7	111.04	274.57	
111.472	275.849	REW	124.51	278.205	BFF	113.90	278.05	BKF R
113.144	278.162		128.632	278.601	X7	119.43	278.21	
115.189	278.219		133.265	280.31	X7	128.11	278.74	
119.535	278.145		176.974	280.341	X7	133.95	280.45	
126.016	278.369		190.038	280.536	X7RPIN	139.75	280.91	
131.054	279.632					152.76	280.79	
136.84	280.834					175.17	280.20	
151.129	280.814					189.83	280.53	RP
170.425	280.583							
185.112	280.462							
190.413	280.531							
190.774	280.529							

Photo of XS-7, Sta 36+03 looking in the downstream direction

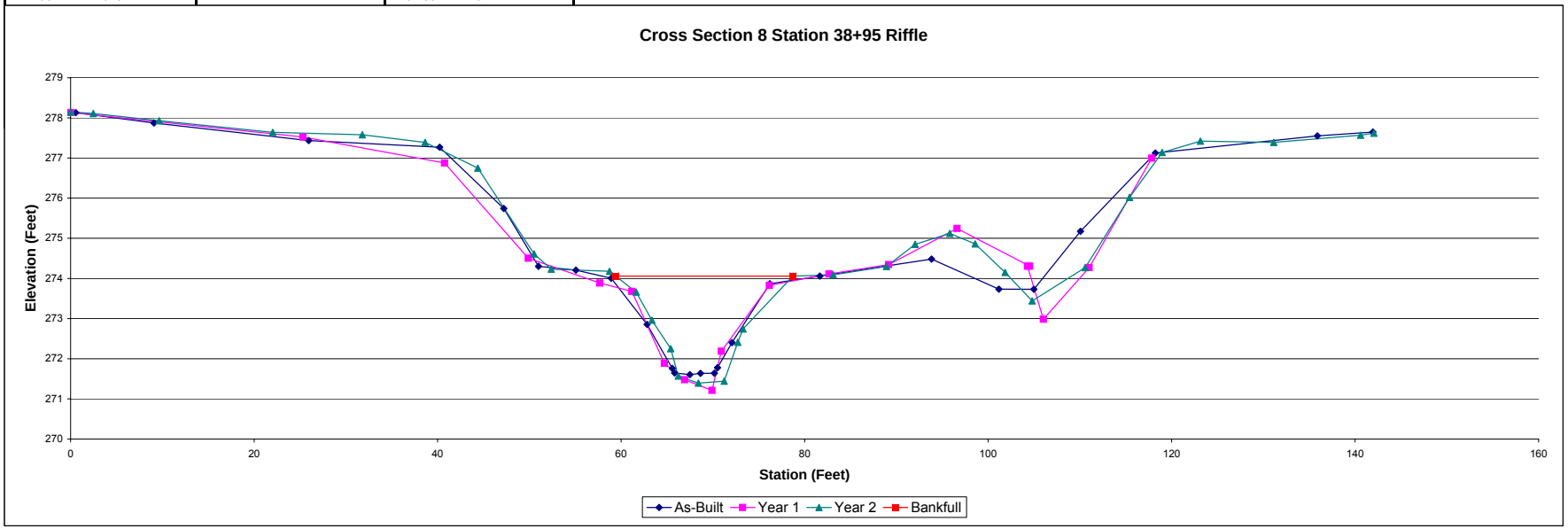


Project:	Litte Beaver Creek
Cross Section:	Cross Section 8
Feature	Riffle
Station:	38+95
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	22.9	23.6	27.6
W (BKF)	16.9	19.5	19.3
Max d	2.3	2.7	2.7
Mean d	1.4	1.2	1.4
W/D	12.5	16.0	13.5

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	278.133	RPIN8	0	278.133	X8LPIN	0.00	278.15	LP
0.557	278.132		25.324	277.525	X8	2.47	278.11	
9.078	277.874		40.752	276.877	X8	9.65	277.93	
25.947	277.434		49.89	274.504	X8	22.03	277.64	
40.226	277.27		57.682	273.884	X8BKF	31.79	277.58	
47.204	275.744		61.183	273.676	X8	38.64	277.39	
50.988	274.302		64.709	271.887	X8	44.38	276.75	
55.07	274.208		66.921	271.478	X8	50.52	274.61	
58.922	274.007		69.9	271.212	X8TW	52.39	274.23	
62.826	272.853		70.922	272.187	X8EOW	58.74	274.18	
65.582	271.76	LEW	76.163	273.83	X8EOW	61.64	273.66	
65.82	271.647		82.659	274.11	X8	63.35	272.96	
67.491	271.603		89.153	274.343	X8	65.41	272.25	
68.655	271.634		96.616	275.246	X8	66.23	271.57	TOEL
70.16	271.64		104.537	274.307	X8	68.42	271.39	V WS=272.07
70.513	271.775	REW	104.3	274.305	X8	71.24	271.44	TOER
72.077	272.403		106.021	272.985	X8	72.72	272.41	
76.207	273.867	BKF	111.011	274.269	X8	73.29	272.74	
81.667	274.058		117.843	276.998	X8	78.73	274.06	BKF R
93.832	274.481					83.12	274.09	
101.171	273.732					88.92	274.30	
104.991	273.731					92.04	274.85	
110.065	275.174					95.82	275.12	
118.23	277.125					98.59	274.86	
135.88	277.552					101.85	274.15	
141.937	277.648					104.80	273.44	

Photo of XS-8, Sta 38+95 looking in the downstream direction



Project:	Litte Beaver Creek
Cross Section:	Cross Section T1 (Tributary)
Feature	Pool
Station:	11+63
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)

	MY0	MY1	MY2
A (BKF)	6.0	10.7	8.8
W (BKF)	9.4	12.5	14.0
Max d	1.1	2.0	1.6
Mean d	0.6	0.9	0.6
W/D	14.8	14.6	22.2

MY0-2006

Station	Elevation	Notes
0	290.621	LPINT1
0.385	290.625	
12.853	291.085	
35.25	291.44	
47.697	289.278	
57.14	287.134	
65.344	286.892	BKF
69.172	285.924	LEW
69.458	285.89	
70.216	285.87	
71.39	285.77	
71.938	285.9	REW
72.439	286.039	
73.707	286.668	
75.78	287.109	
78.586	287.073	
82.106	287.058	
88.472	288.627	
96.006	290.179	
109.211	290.094	
117.962	290.499	
125.905	290.336	
127.302	290.49	RPINT1

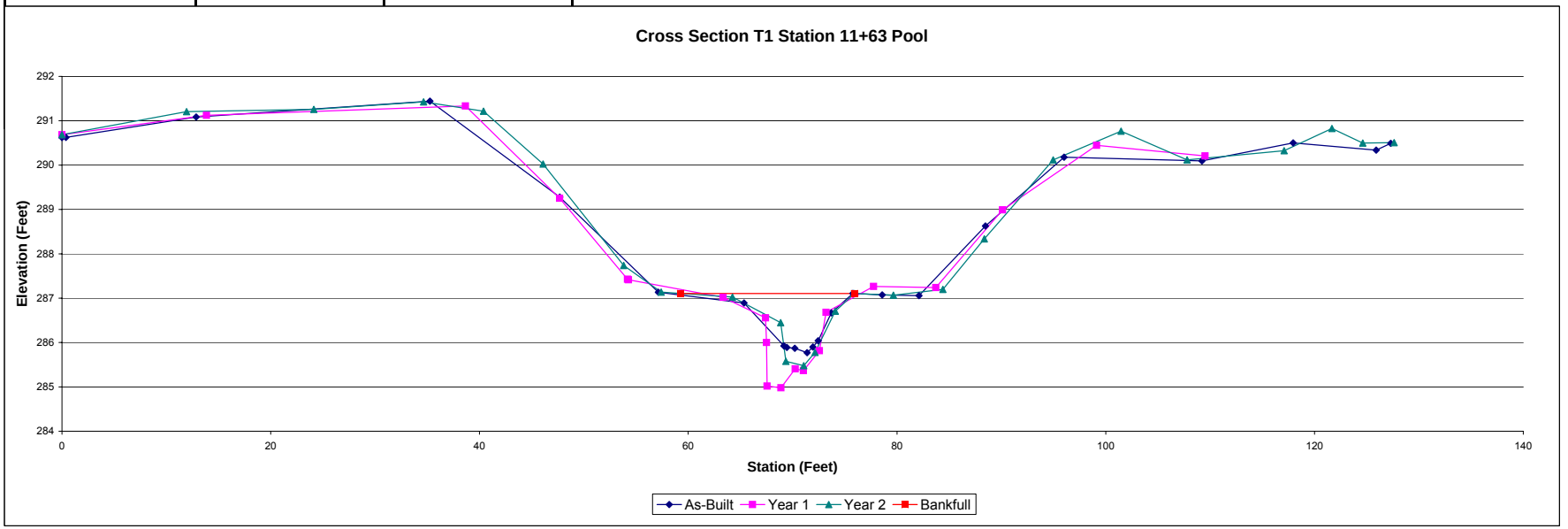
MY1-2007

Station	Elevation	Notes
0	290.686	XT1LPIN
13.848	291.124	XT1
38.653	291.332	XT1
47.673	289.254	XT1
54.181	287.428	XT1
54.276	287.415	XT1
63.34	287.019	XT1BKF
67.412	286.556	XT1
67.498	286.002	XT1EOW
67.551	285.018	XT1EOW
68.876	284.979	XT1TW
70.254	285.407	XT1TW
71.042	285.366	XT1TW
72.563	285.816	XT1EOW
73.202	286.682	XT1BKF
77.752	287.263	XT1BKF
83.723	287.24	XT1
90.119	288.991	XT1
99.126	290.447	XT1
109.517	290.206	XT1

MY2-2008

Station	Elevation	Notes
0.00	290.69	LP
11.94	291.21	
24.13	291.26	
34.65	291.43	
40.39	291.22	
46.09	290.03	
53.82	287.74	
57.40	287.14	
64.23	287.03	BKF L
68.85	286.45	
69.36	285.58	TOE L
71.06	285.48	TW
72.15	285.78	TOE R
74.08	286.71	
75.93	287.11	BKF R
79.65	287.07	
84.39	287.20	
88.37	288.34	
94.97	290.12	
101.47	290.77	
107.80	290.12	
117.09	290.33	
121.67	290.83	
124.62	290.50	
127.63	290.51	RP

Photo of XS-T1, Sta 11+63 looking in the downstream direction

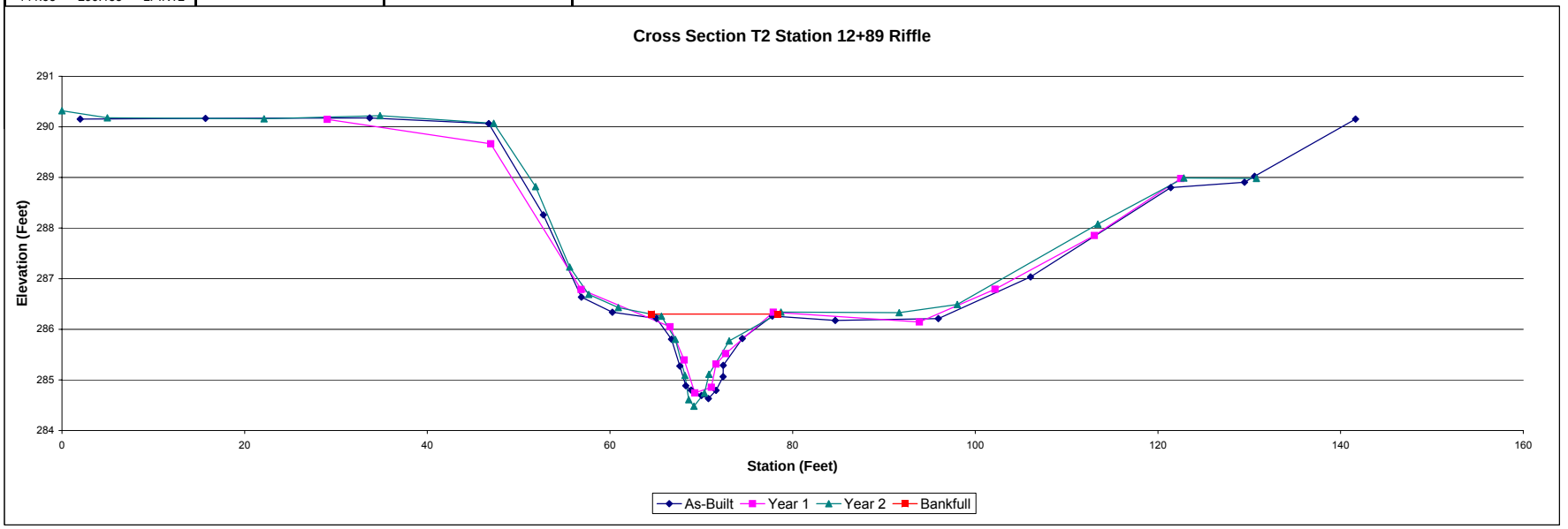


Project:	Litte Beaver Creek
Cross Section:	Cross Section T2 (Tributary)
Feature	Riffle
Station:	12+89
Date:	10/25/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	9.0	6.0	9.1
W (BKF)	11.8	9.5	13.8
Max d	1.5	1.3	1.8
Mean d	0.8	0.6	0.7
W/D	15.5	15.0	21.0

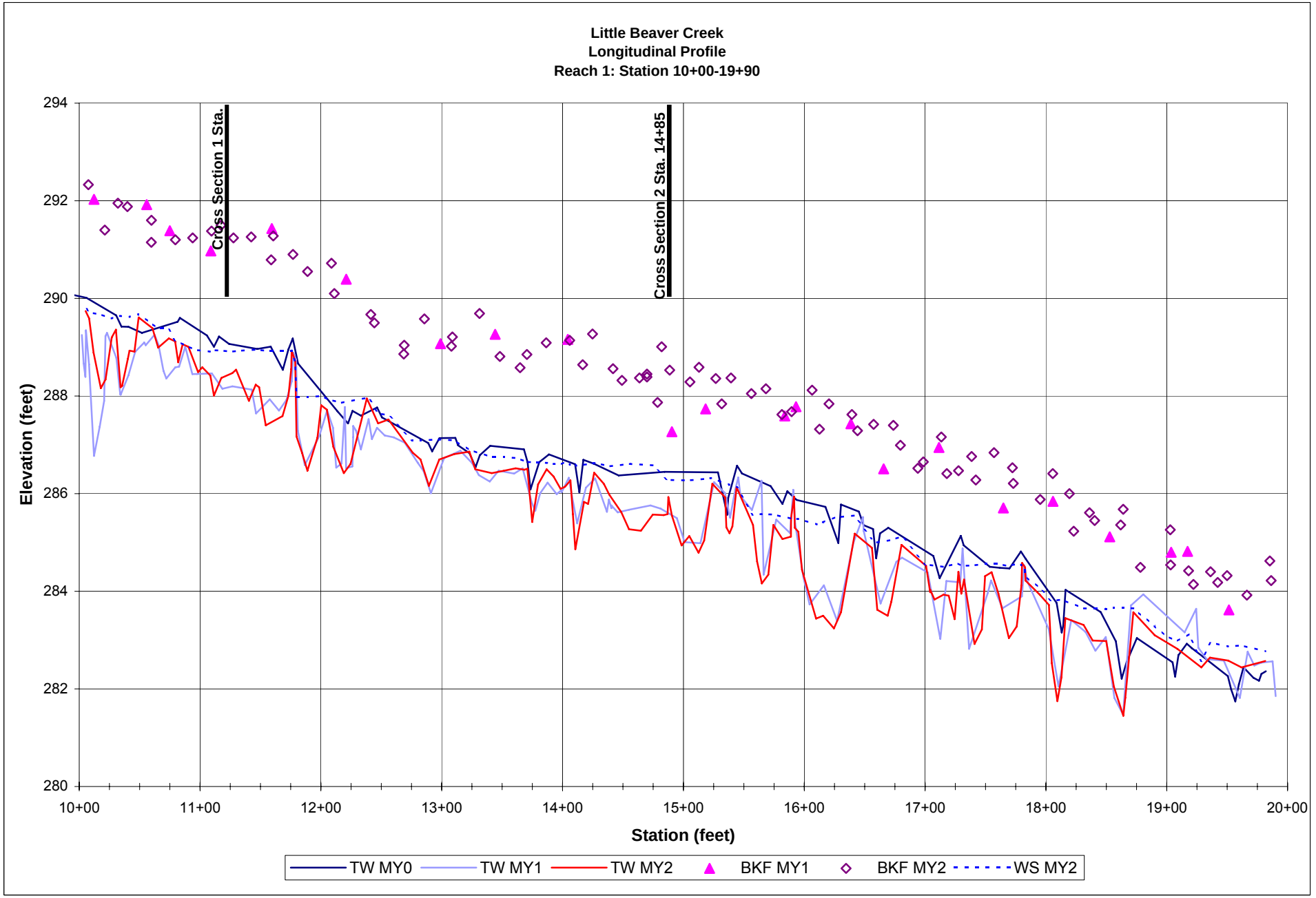
MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
2	290.155	RPINT2	29.046	290.148	XT2	0.00	290.32	LP
15.711	290.169		46.945	289.665	XT2	4.97	290.18	
33.691	290.176		56.845	286.786	XT2	22.13	290.16	
46.733	290.065		66.579	286.049	XT2BKF	34.82	290.22	
52.711	288.262		68.135	285.394	XT2EOW	47.28	290.07	
56.879	286.636		69.29	284.743	XT2	51.86	288.82	
60.269	286.336		71.111	284.854	XT2	55.59	287.23	
65.097	286.213		71.615	285.313	XT2EOW	57.68	286.69	
66.732	285.804		72.662	285.518	XT2	60.91	286.43	
67.644	285.272	LEW	77.88	286.337	XT2	65.64	286.26	BKF L
68.301	284.884		93.882	286.144	XT2	67.16	285.80	
68.897	284.798		102.17	286.792	XT2	68.21	285.09	TOE L
70.022	284.693		113.043	287.853	XT2	68.63	284.61	
70.779	284.631		122.497	288.979	XT2	69.20	284.48	TW
71.616	284.792					70.34	284.74	
72.394	285.063					70.84	285.11	TOE R
72.402	285.286	REW				73.06	285.77	
74.493	285.818					78.73	286.34	BKF R
77.777	286.261					91.66	286.33	
84.67	286.174	BKF				98.03	286.49	
95.96	286.212					113.42	288.08	
106.056	287.034					122.83	288.99	
121.39	288.799					130.78	288.98	RP
129.478	288.906							
130.582	289.023							
141.63	290.155	LPINT2						

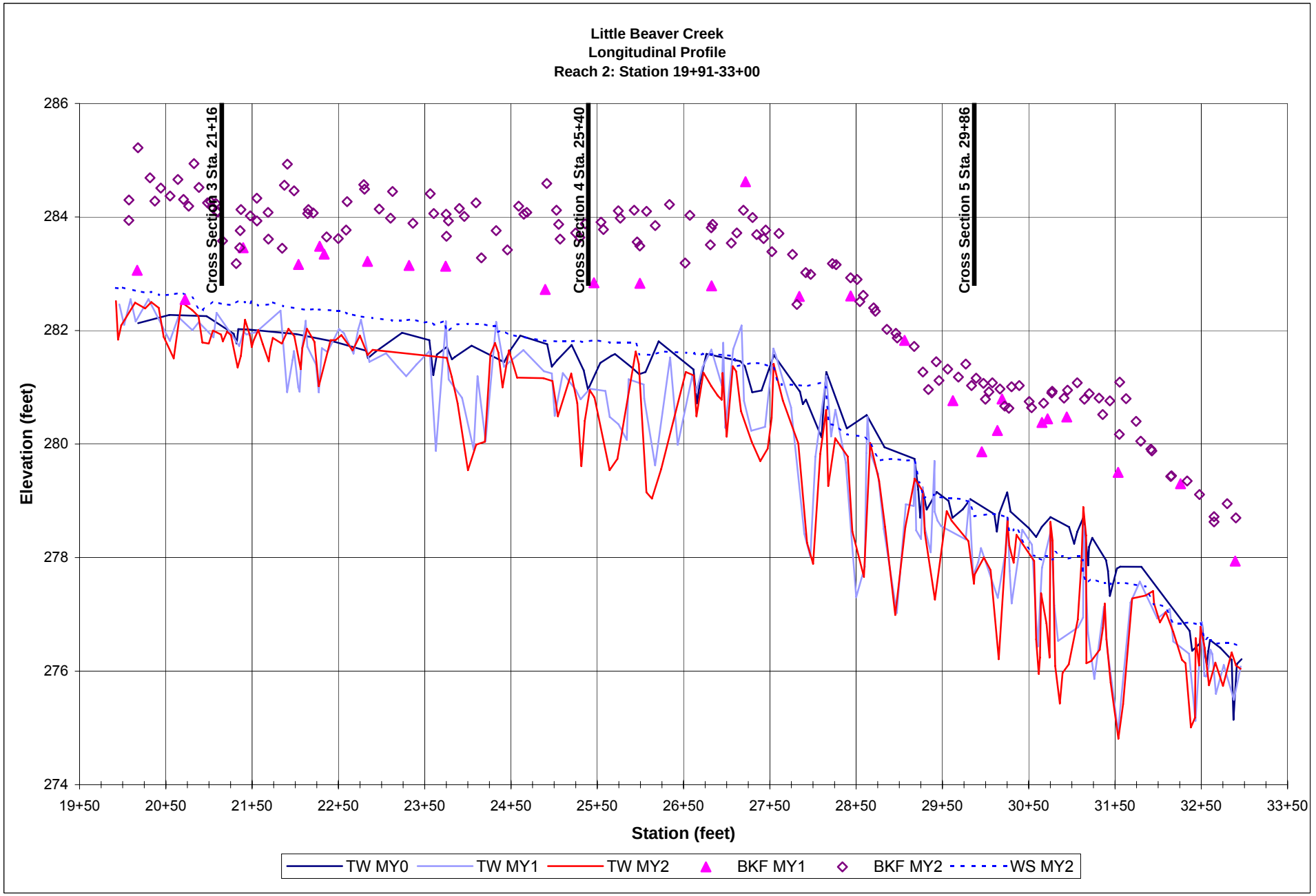
Photo of XS-T2, Sta 12+89 looking in the downstream direction

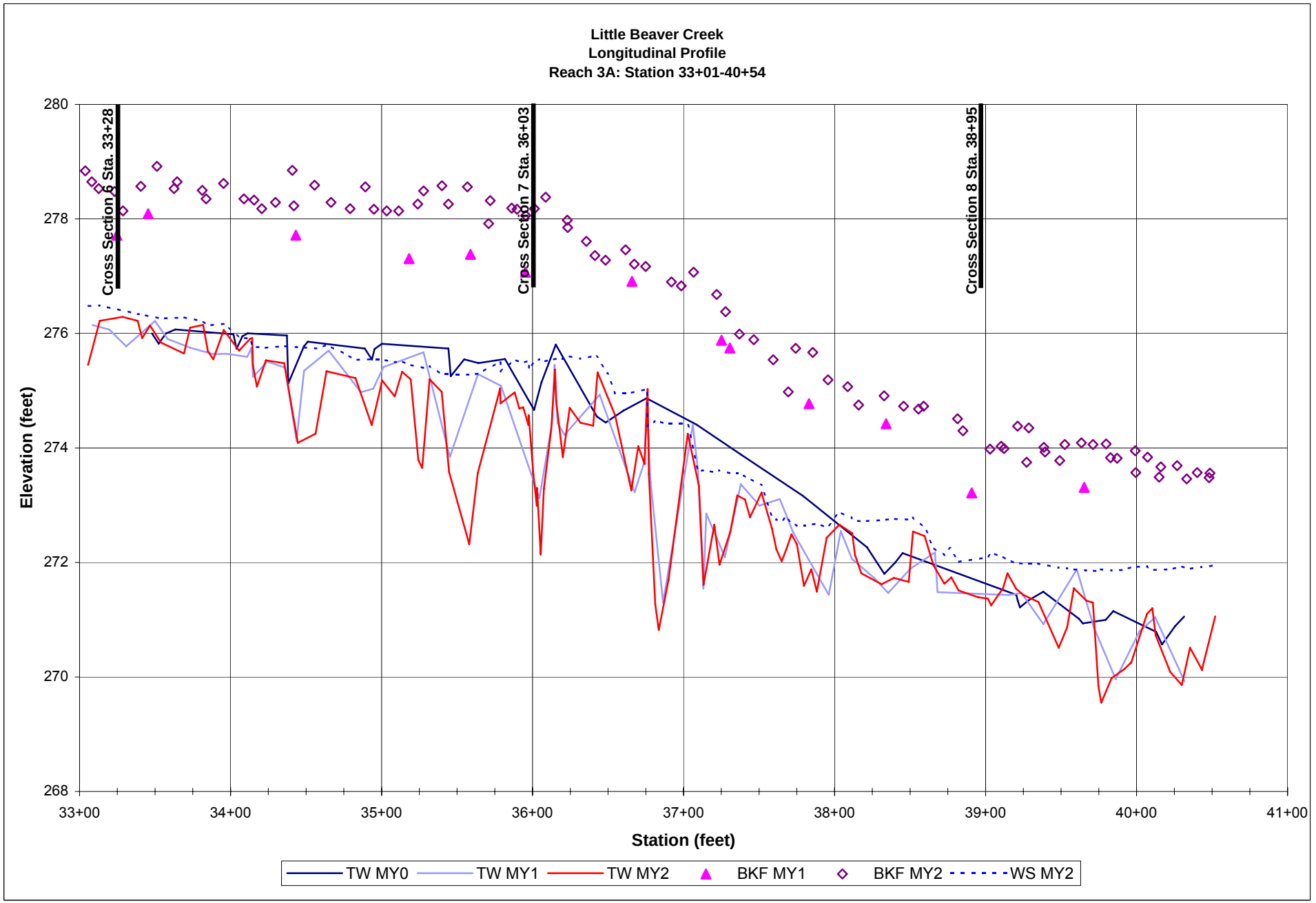


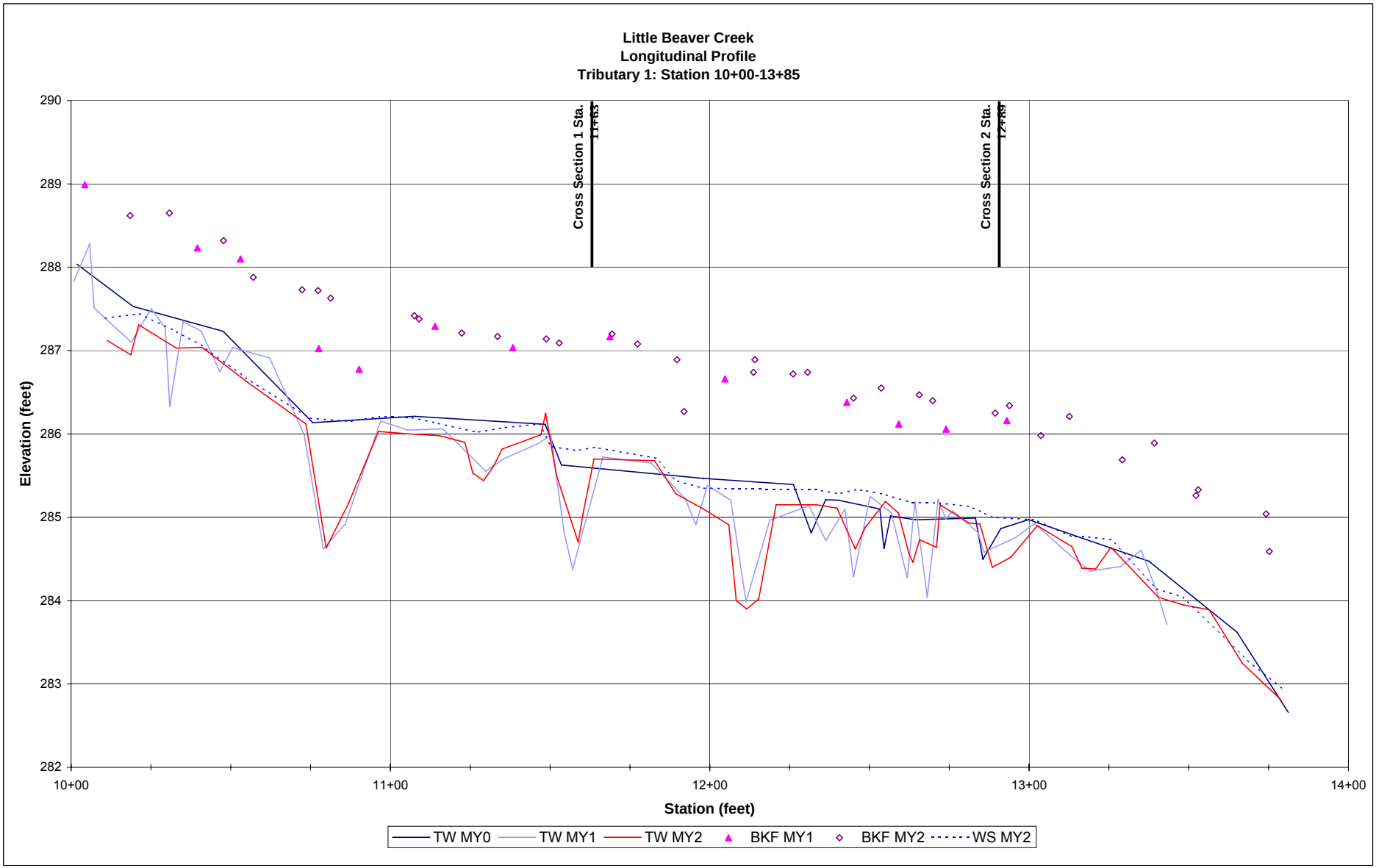
Appendix B

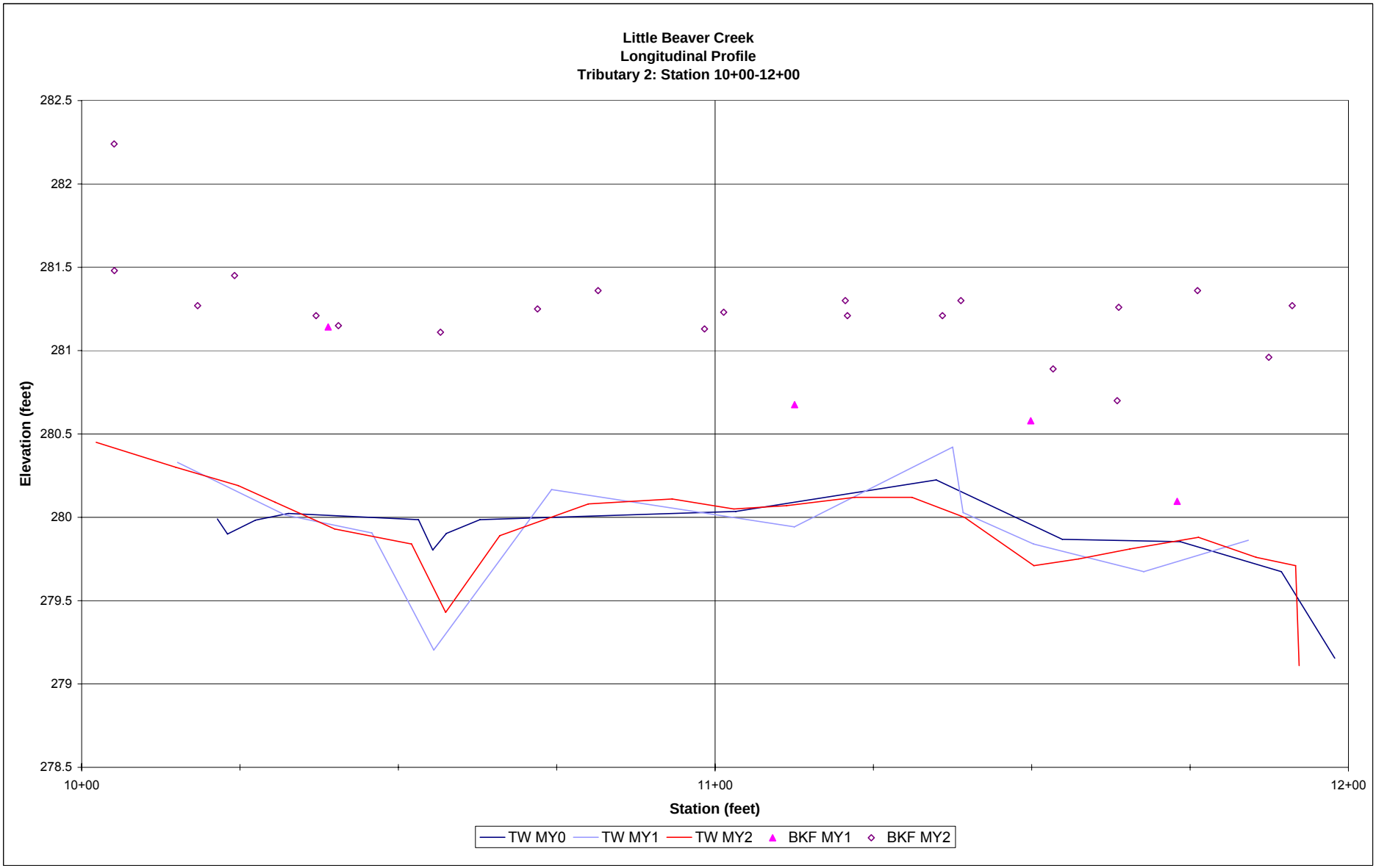
7. Longitudinal Profiles


Little Beaver Creek
Longitudinal Profile
Reach 1: Station 10+00-19+90
Cross Section 1 Sta.
Cross Section 2 Sta. 14+85
294
292
290
288
286
284
282
280
Elevation (feet)
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
19+00
20+00
Station (feet)
TW MY0
TW MY1
TW MY2
BKF MY1
BKF MY2
WS MY2


Little Beaver Creek
Longitudinal Profile
Reach 2: Station 19+91-33+00
Cross Section 3 Sta. 21+16
Cross Section 4 Sta. 25+40
Cross Section 5 Sta. 29+86
Elevation (feet)
286
284
282
280
278
276
274
19+50
20+50
21+50
22+50
23+50
24+50
25+50
26+50
27+50
28+50
29+50
30+50
31+50
32+50
33+50
Station (feet)
TW MY0
TW MY1
TW MY2
BKF MY1
BKF MY2
WS MY2


Little Beaver Creek
Longitudinal Profile
Reach 3A: Station 33+01-40+54
Cross Section 6 Sta. 33+28
Cross Section 7 Sta. 36+03
Cross Section 8 Sta. 38+95
Elevation (feet)
280
278
276
274
272
270
268
33+00
34+00
35+00
36+00
37+00
38+00
39+00
40+00
41+00
Station (feet)
TW MY0
TW MY1
TW MY2
BKF MY1
BKF MY2
WS MY2

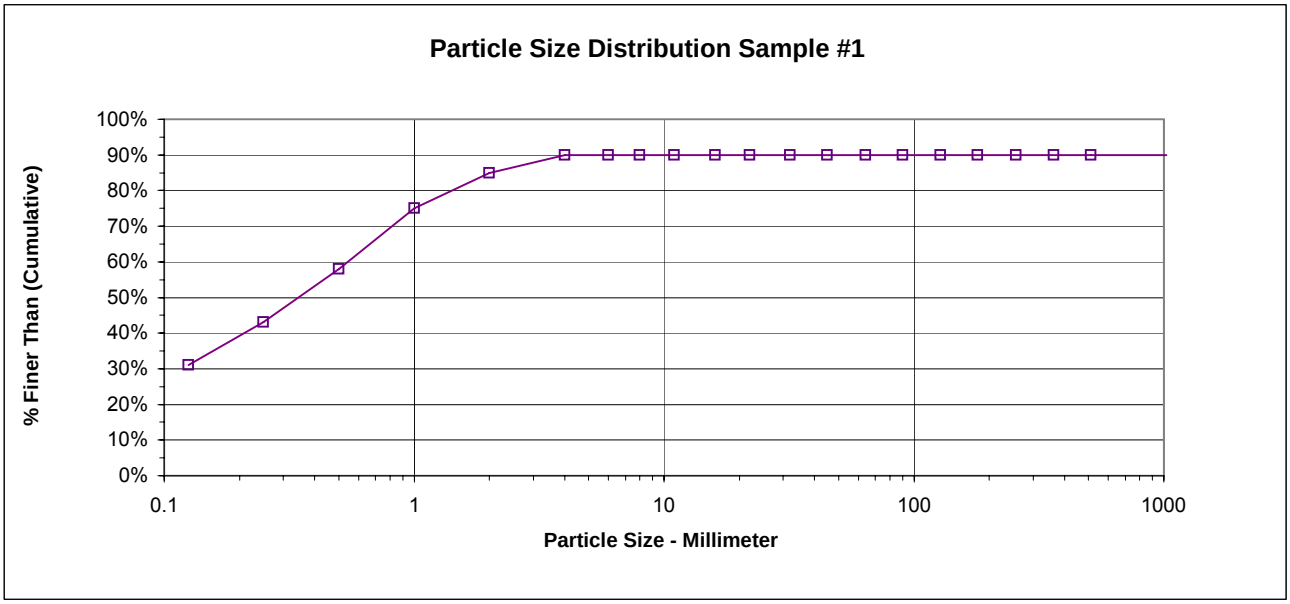

Little Beaver Creek
Longitudinal Profile
Tributary 1: Station 10+00-13+85
Cross Section 1 Sta. 11+63
Cross Section 2 Sta. 12+89
Elevation (feet)
290
289
288
287
286
285
284
283
282
10+00
11+00
12+00
13+00
14+00
Station (feet)
TW MY0
TW MY1
TW MY2
BKF MY1
BKF MY2
WS MY2


Little Beaver Creek
Longitudinal Profile
Tributary 2: Station 10+00-12+00
282.5
282
281.5
281
280.5
280
279.5
279
278.5
Elevation (feet)
10+00
11+00
12+00
Station (feet)
TW MY0
TW MY1
TW MY2
BKF MY1
BKF MY2

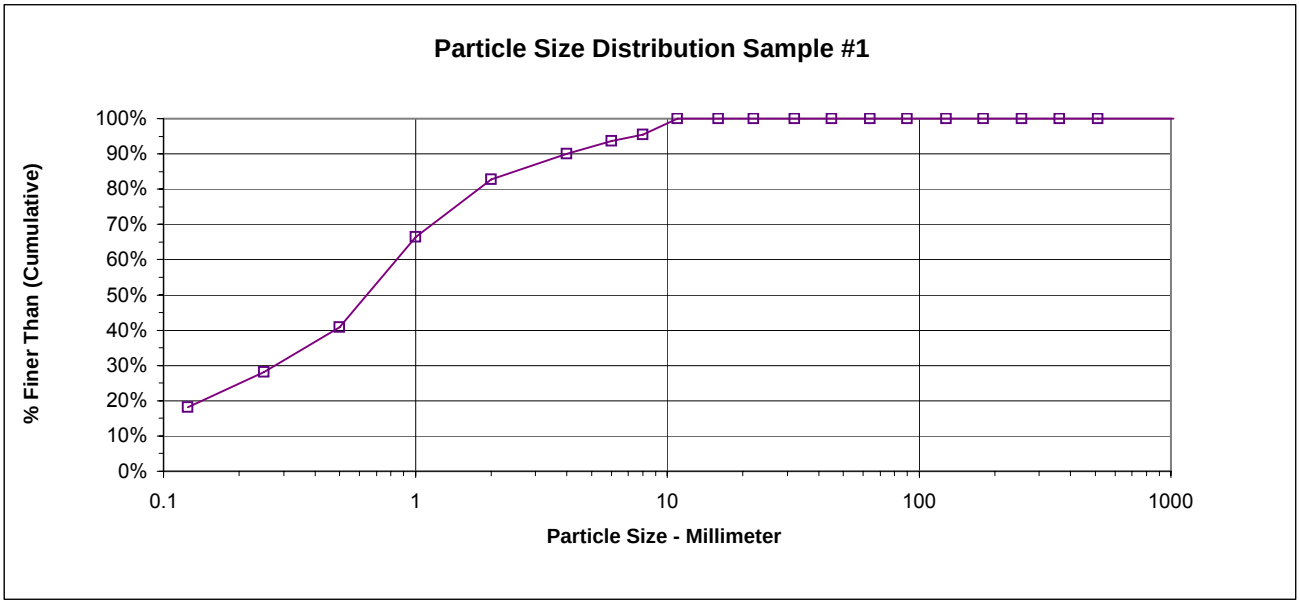
Appendix B

8. Pebble Count Frequency Distribution Plots

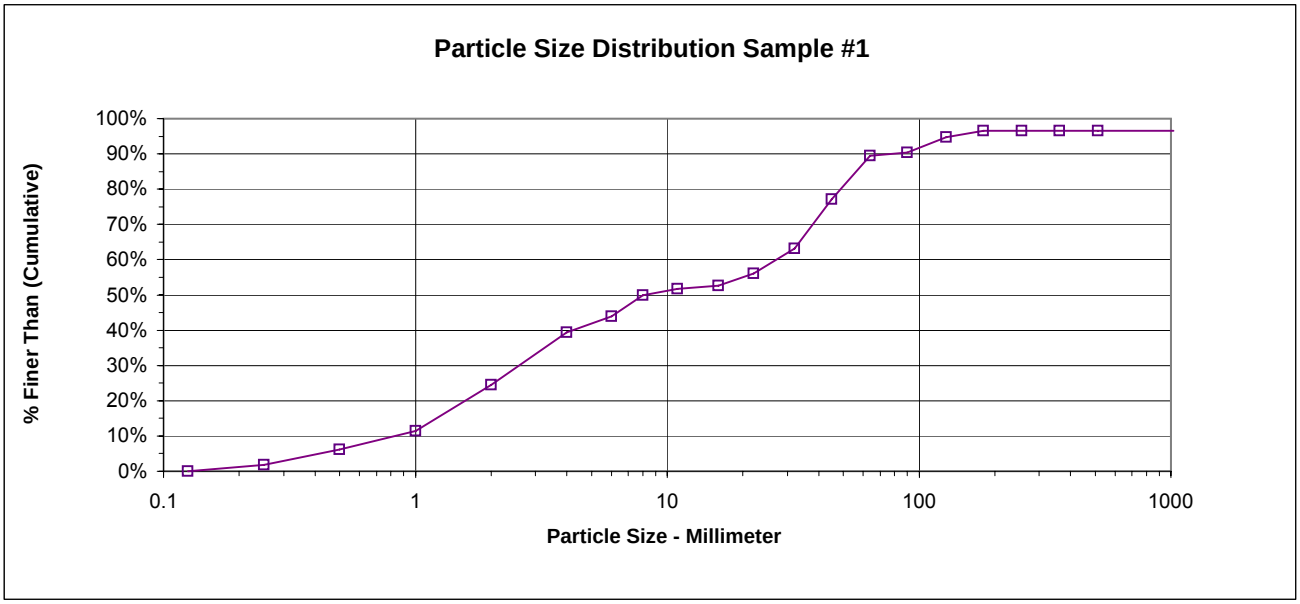
PEBBLE COUNT								
Project:	Little Beaver Creek Monitoring MY2					**Date:**	11/20/2008	
Location:	Cross Section #1							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	13		13	13%	13%
	Very Fine	.062 - .125	S	18	0	18	18%	31%
	Fine	.125 - .25	A	12	0	12	12%	43%
	Medium	.25 - .50	N	15	0	15	15%	58%
	Coarse	.50 - 1.0	D	17	0	17	17%	75%
.04 -.08	Very Coarse	1.0 - 2.0	S	10	0	10	10%	85%
.08 - .16	Very Fine	2.0 - 4.0		5	0	5	5%	90%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	90%
.22 - .31	Fine	5.7 - 8.0	R	0	0	0	0%	90%
.31 - .44	Medium	8.0 - 11.3	A	0	0	0	0%	90%
.44 - .63	Medium	11.3 - 16.0	V	0	0	0	0%	90%
.63 - .89	Coarse	16.0 - 22.6	E	0	0	0	0%	90%
.89 - 1.26	Coarse	22.6 - 32.0	L	0	0	0	0%	90%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	0	0	0%	90%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	90%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	90%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	90%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	90%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	90%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	90%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	90%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	90%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	90%
	Bedrock		BDRK	10	0	10	10%	100%
			Totals	**100**	**0**	**100**	**100%**	**100%**



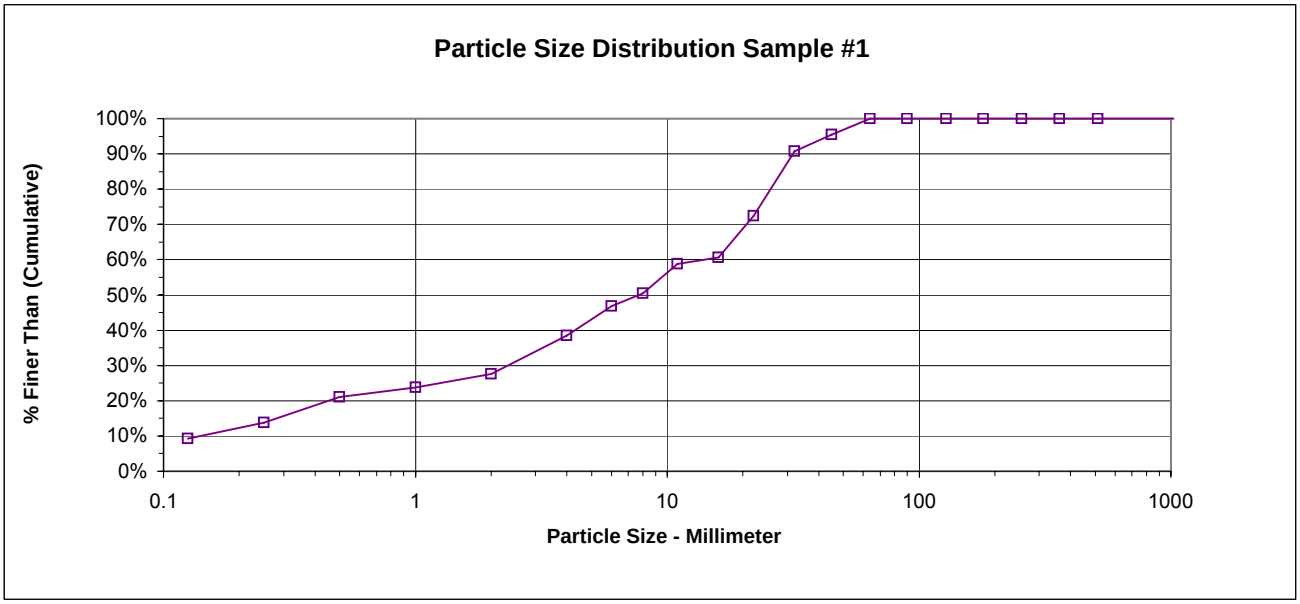
PEBBLE COUNT								
Project:	Little Beaver Creek Monitoring MY2					**Date:**	11/20/2008	
Location:	Cross Section #3							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	8	0	8	7%	7%
	Very Fine	.062 - .125	S	12	0	12	11%	18%
	Fine	.125 - .25	A	11	0	11	10%	28%
	Medium	.25 - .50	N	14	0	14	13%	41%
	Coarse	.50 - 1.0	D	28	0	28	25%	66%
.04 -.08	Very Coarse	1.0 - 2.0	S	18	0	18	16%	83%
.08 - .16	Very Fine	2.0 - 4.0		8	0	8	7%	90%
.16 - .22	Fine	4.0 - 5.7	G	4	0	4	4%	94%
.22 - .31	Fine	5.7 - 8.0	R	2	0	2	2%	95%
.31 - .44	Medium	8.0 - 11.3	A	5	0	5	5%	100%
.44 - .63	Medium	11.3 - 16.0	V	0	0	0	0%	100%
.63 - .89	Coarse	16.0 - 22.6	E	0	0	0	0%	100%
.89 - 1.26	Coarse	22.6 - 32.0	L	0	0	0	0%	100%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	0	0	0%	100%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**110**	**0**	**110**	**100%**	**100%**



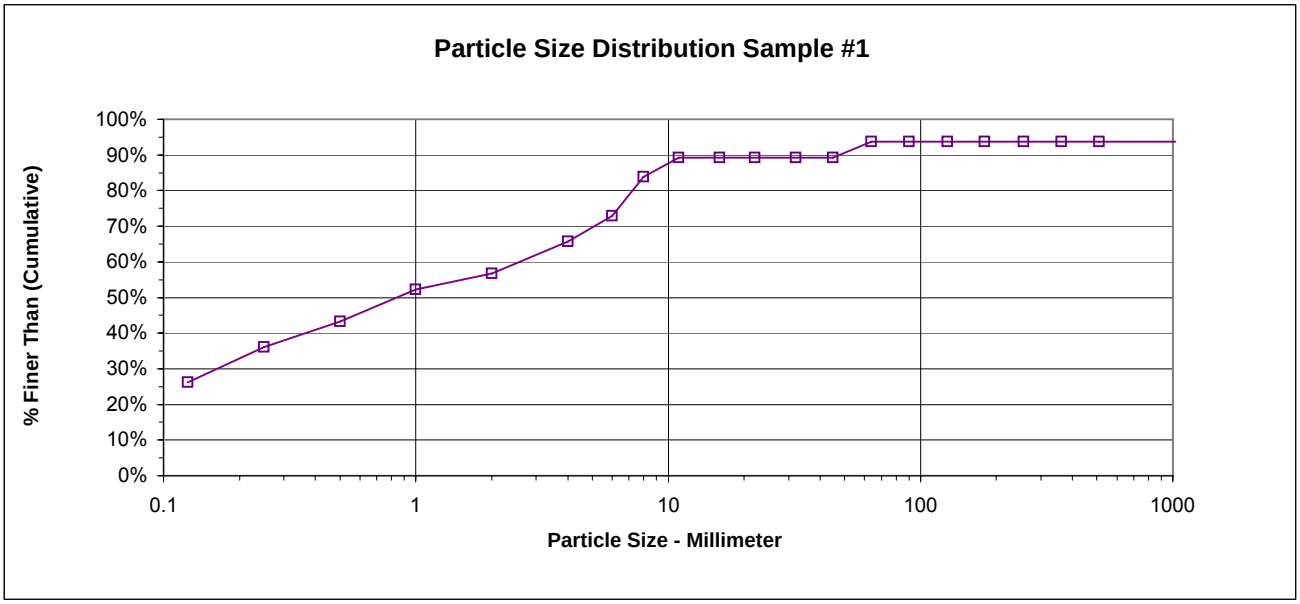
PEBBLE COUNT								
Project:	Little Beaver Creek Monitoring MY2					**Date:**	11/20/2008	
Location:	Cross Section #5							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	2	0	2	2%	2%
	Medium	.25 - .50	N	5	0	5	4%	6%
	Coarse	.50 - 1.0	D	6	0	6	5%	11%
.04 -.08	Very Coarse	1.0 - 2.0	S	15	0	15	13%	25%
.08 - .16	Very Fine	2.0 - 4.0		17	0	17	15%	39%
.16 - .22	Fine	4.0 - 5.7	G	5	0	5	4%	44%
.22 - .31	Fine	5.7 - 8.0	R	7	0	7	6%	50%
.31 - .44	Medium	8.0 - 11.3	A	2	0	2	2%	52%
.44 - .63	Medium	11.3 - 16.0	V	1	0	1	1%	53%
.63 - .89	Coarse	16.0 - 22.6	E	4	0	4	4%	56%
.89 - 1.26	Coarse	22.6 - 32.0	L	8	0	8	7%	63%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	16	0	16	14%	77%
1.77 - 2.5	Very Coarse	45.0 - 64.0		14	0	14	12%	89%
2.5 - 3.5	Small	64 - 90	C	1	0	1	1%	90%
3.5 - 5.0	Small	90 - 128	O	5	0	5	4%	95%
5.0 - 7.1	Large	128 - 180	B	2	0	2	2%	96%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	96%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	96%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	96%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	96%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	3	0	3	3%	99%
	Bedrock		BDRK	1	0	1	1%	100%
			Totals	**114**	**0**	**114**	**100%**	**100%**



PEBBLE COUNT								
Project:	Little Beaver Creek Monitoring MY2					**Date:**	11/20/2008	
Location:	Cross Section #6							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
	Very Fine	.062 - .125	S	10	0	10	9%	9%
	Fine	.125 - .25	A	5	0	5	5%	14%
	Medium	.25 - .50	N	8	0	8	7%	21%
	Coarse	.50 - 1.0	D	3	0	3	3%	24%
.04 -.08	Very Coarse	1.0 - 2.0	S	4	0	4	4%	28%
.08 - .16	Very Fine	2.0 - 4.0		12	0	12	11%	39%
.16 - .22	Fine	4.0 - 5.7	G	9	0	9	8%	47%
.22 - .31	Fine	5.7 - 8.0	R	4	0	4	4%	50%
.31 - .44	Medium	8.0 - 11.3	A	9	0	9	8%	59%
.44 - .63	Medium	11.3 - 16.0	V	2	0	2	2%	61%
.63 - .89	Coarse	16.0 - 22.6	E	13	0	13	12%	72%
.89 - 1.26	Coarse	22.6 - 32.0	L	20	0	20	18%	91%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	5	0	5	5%	95%
1.77 - 2.5	Very Coarse	45.0 - 64.0		5	0	5	5%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**109**	**0**	**109**	**100%**	**100%**

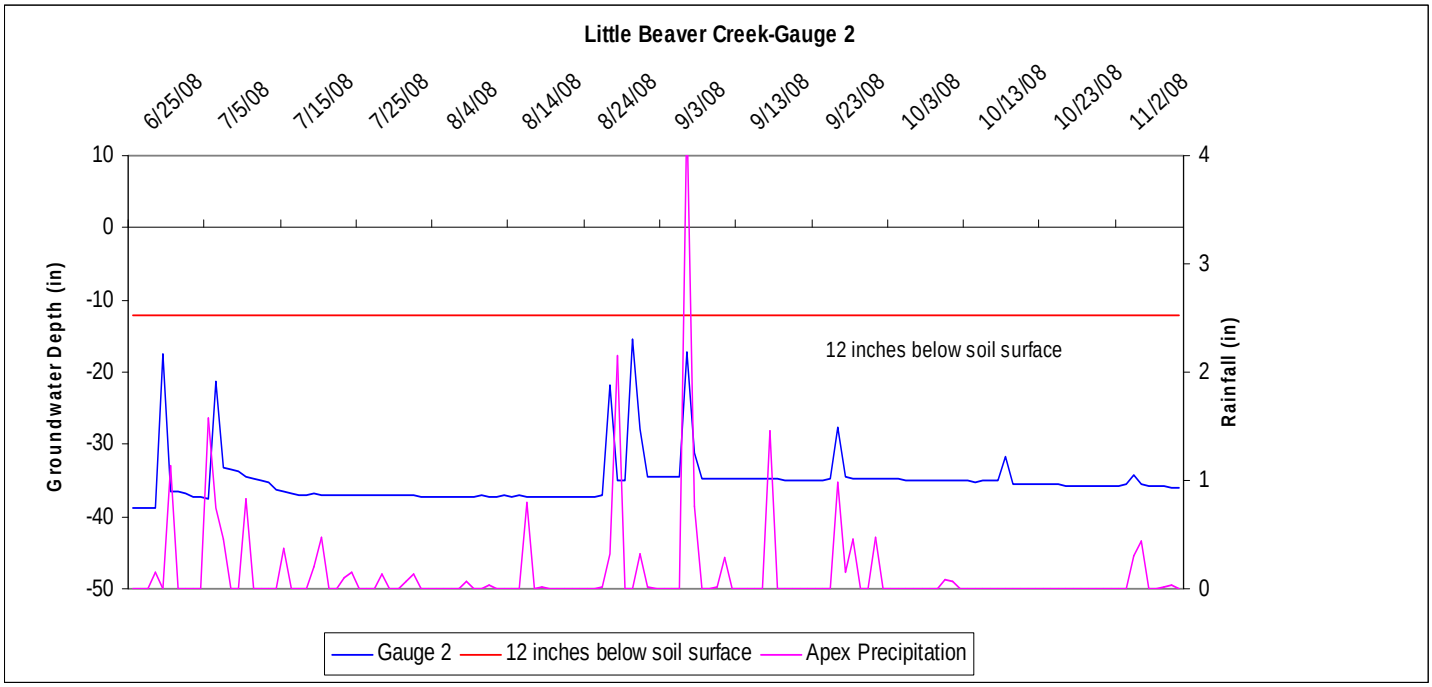


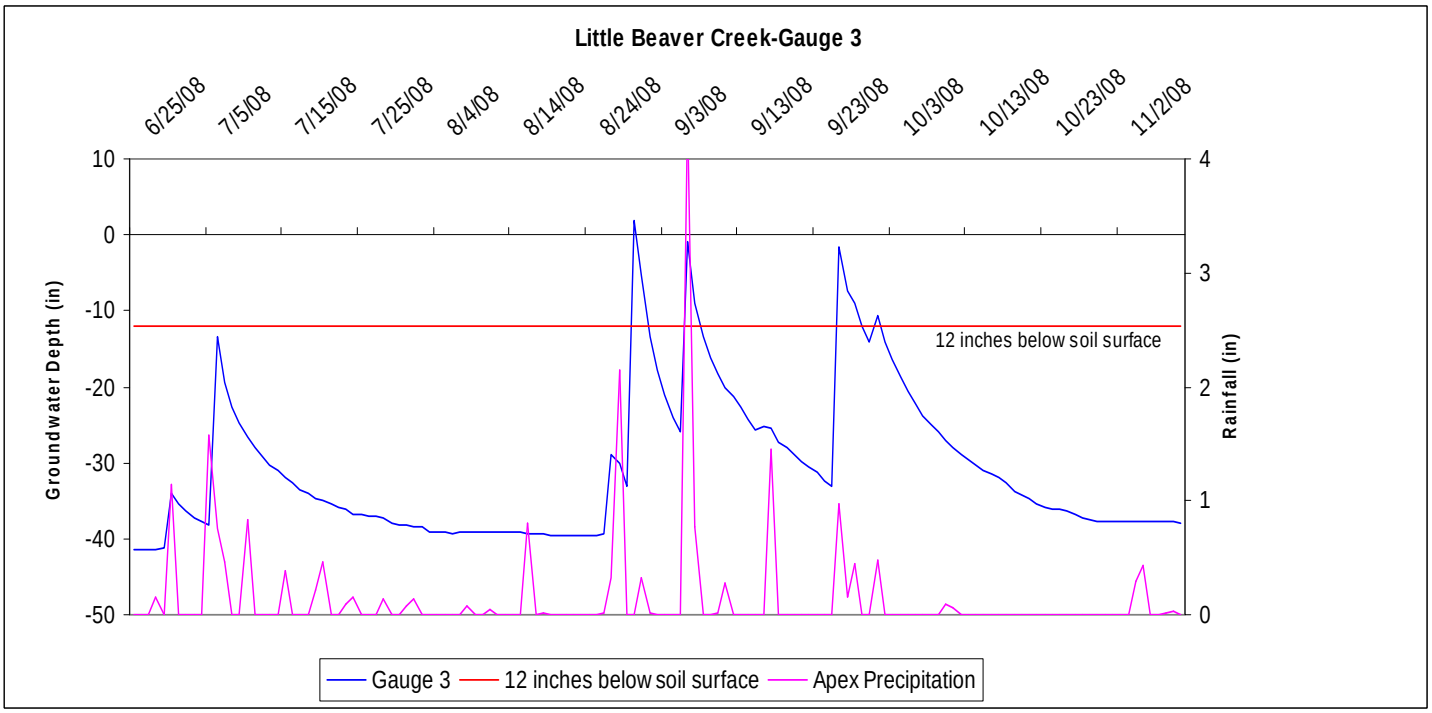
PEBBLE COUNT								
Project:	Little Beaver Creek Monitoring MY2					**Date:**	11/20/2008	
Location:	Cross Section #8							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	17	0	17	15%	15%
	Very Fine	.062 - .125	S	12	0	12	11%	26%
	Fine	.125 - .25	A	11	0	11	10%	36%
	Medium	.25 - .50	N	8	0	8	7%	43%
	Coarse	.50 - 1.0	D	10	0	10	9%	52%
.04 -.08	Very Coarse	1.0 - 2.0	S	5	0	5	5%	57%
.08 - .16	Very Fine	2.0 - 4.0		10	0	10	9%	66%
.16 - .22	Fine	4.0 - 5.7	G	8	0	8	7%	73%
.22 - .31	Fine	5.7 - 8.0	R	12	0	12	11%	84%
.31 - .44	Medium	8.0 - 11.3	A	6	0	6	5%	89%
.44 - .63	Medium	11.3 - 16.0	V	0	0	0	0%	89%
.63 - .89	Coarse	16.0 - 22.6	E	0	0	0	0%	89%
.89 - 1.26	Coarse	22.6 - 32.0	L	0	0	0	0%	89%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	0	0	0%	89%
1.77 - 2.5	Very Coarse	45.0 - 64.0		5	0	5	5%	94%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	94%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	94%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	94%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	94%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	94%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	94%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	94%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	94%
	Bedrock		BDRK	7	0	7	6%	100%
			Totals	**111**	**0**	**111**	**100%**	**100%**

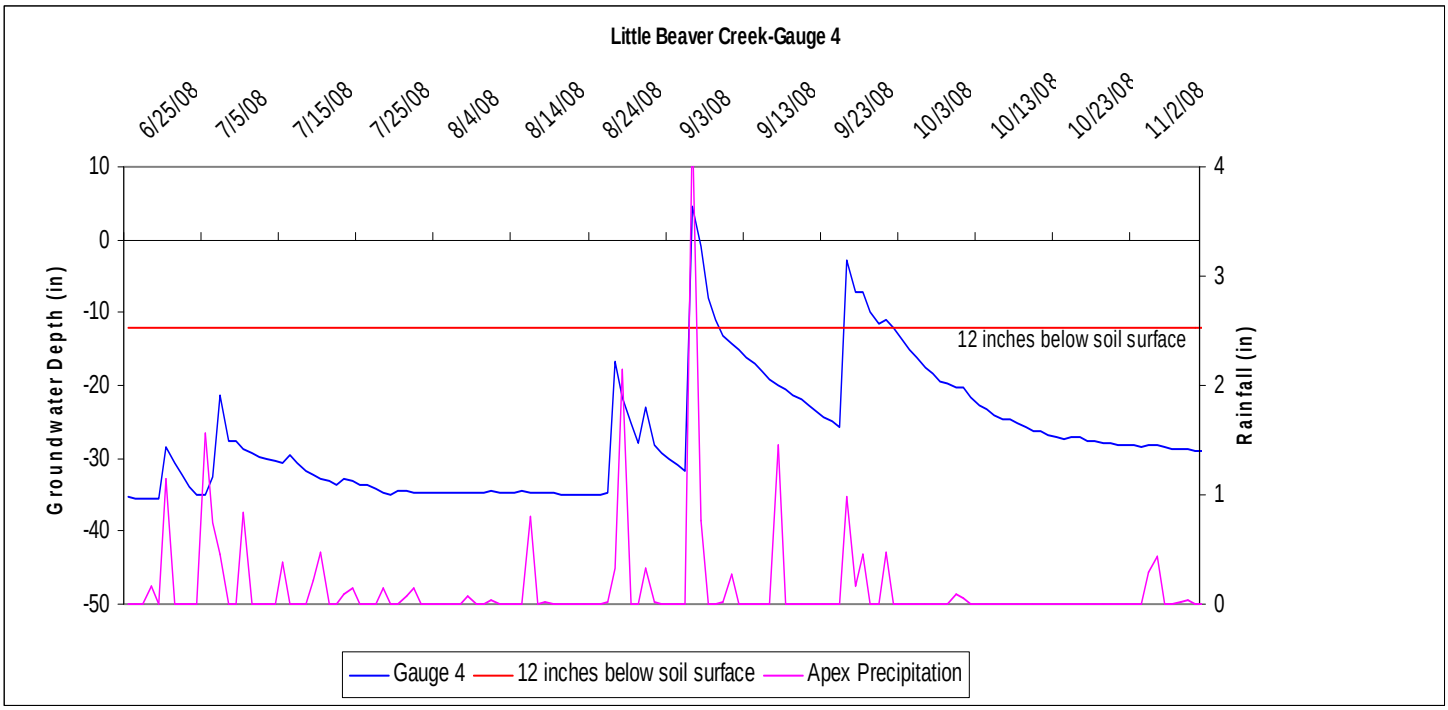


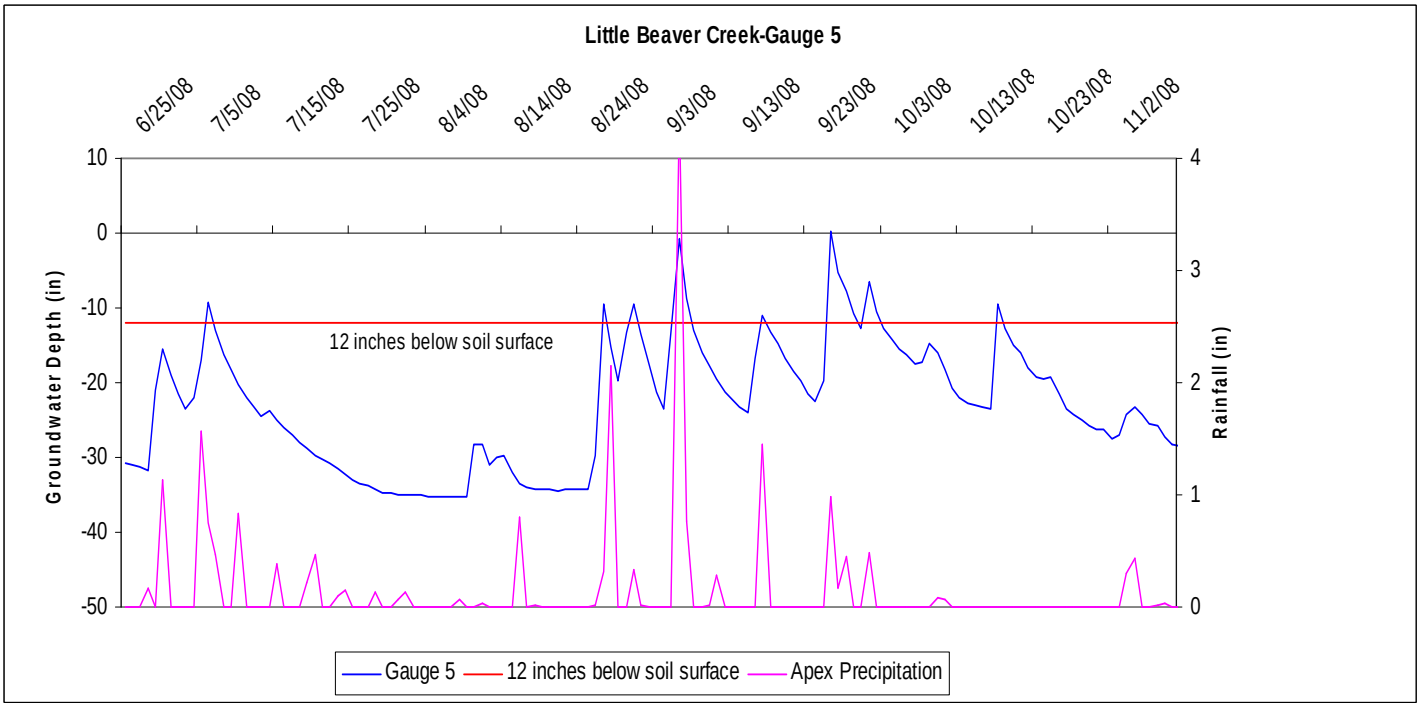
Appendix C.

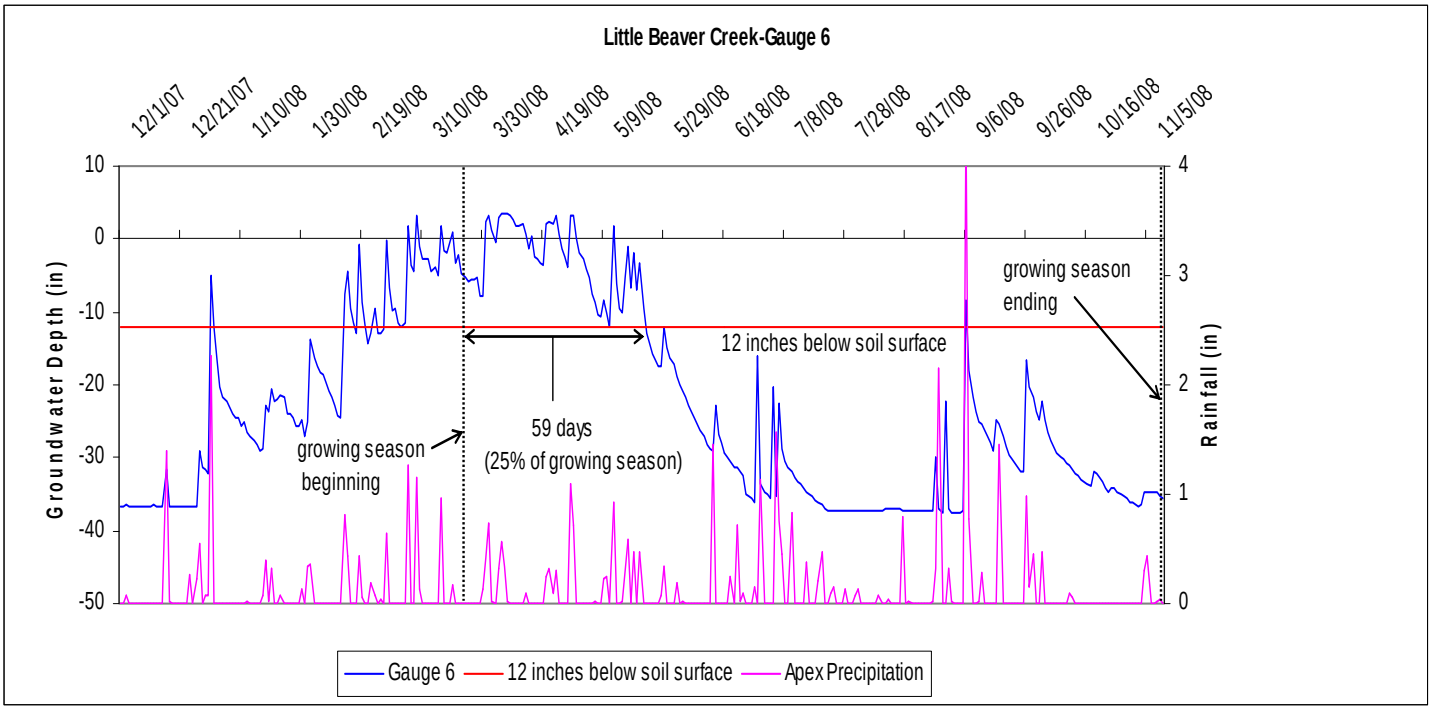
1. Wetland Raw Data

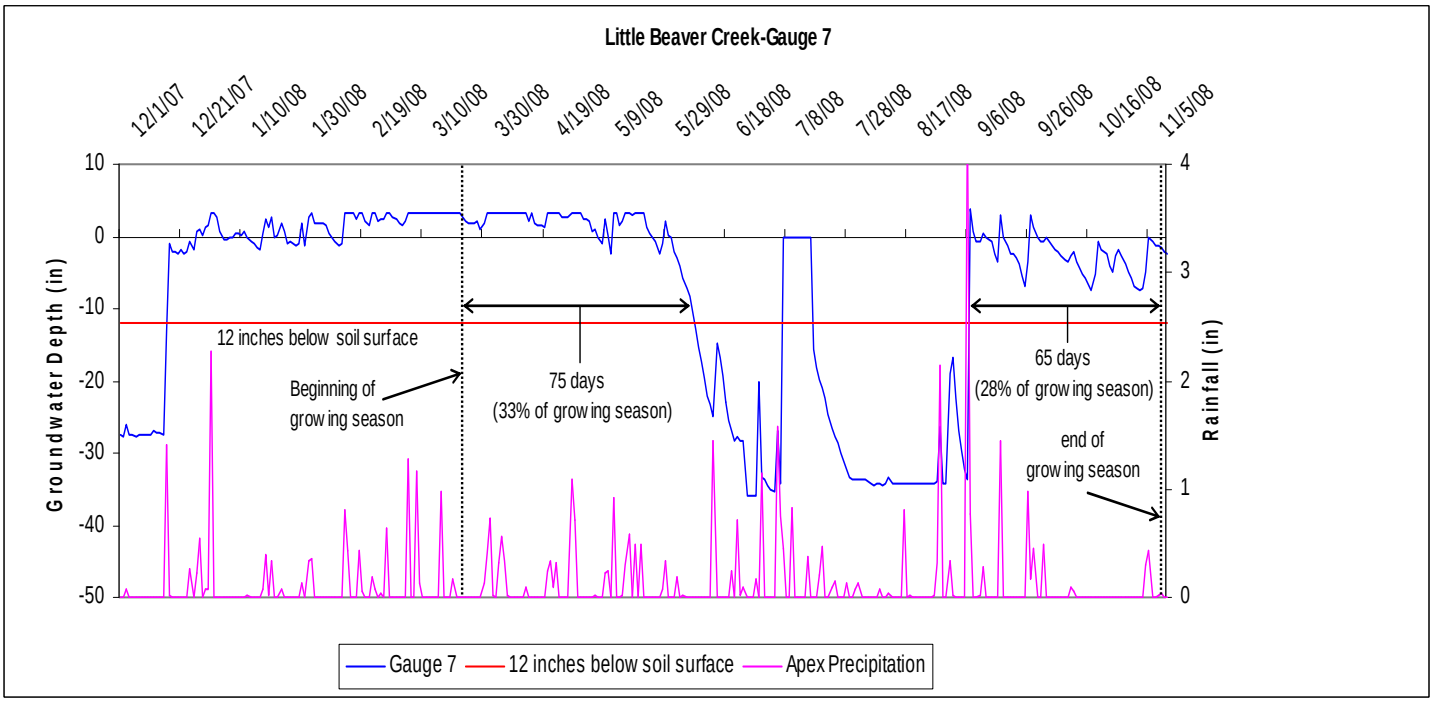

Little Beaver Creek-Gauge 2
6/25/08
7/5/08
7/15/08
7/25/08
8/4/08
8/14/08
8/24/08
9/3/08
9/13/08
9/23/08
10/3/08
10/13/08
10/23/08
11/2/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
12 inches below soil surface
Gauge 2
12 inches below soil surface
Apex Precipitation

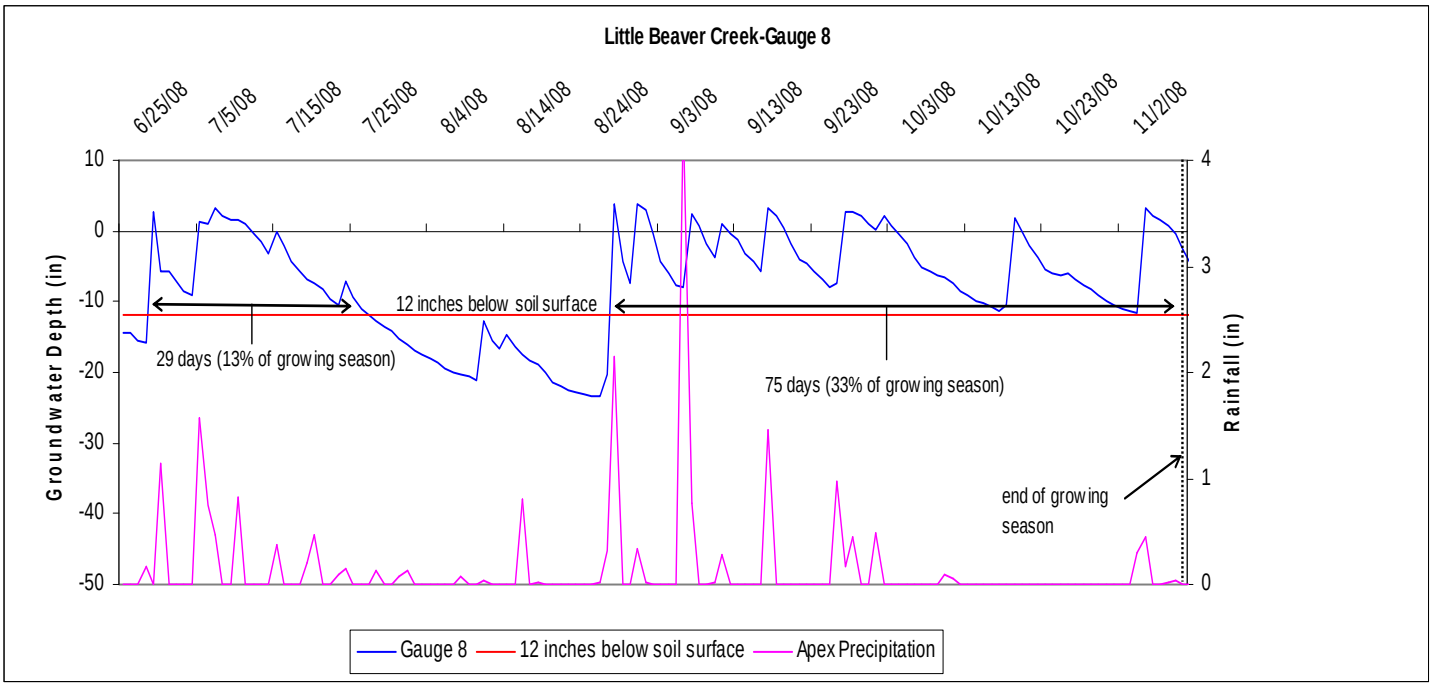

Little Beaver Creek-Gauge 3
6/25/08
7/5/08
7/15/08
7/25/08
8/4/08
8/14/08
8/24/08
9/3/08
9/13/08
9/23/08
10/3/08
10/13/08
10/23/08
11/2/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
12 inches below soil surface
Gauge 3
12 inches below soil surface
Apex Precipitation

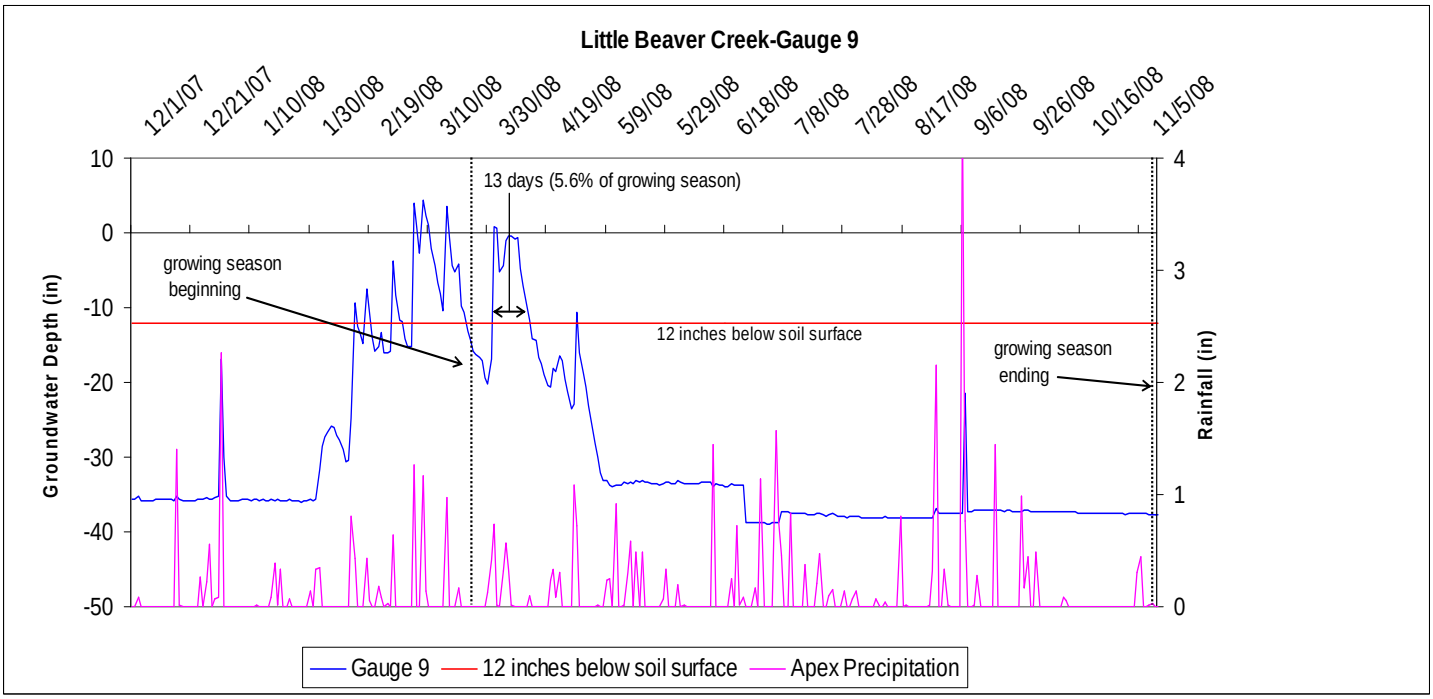

Little Beaver Creek-Gauge 4
6/25/08
7/5/08
7/15/08
7/25/08
8/4/08
8/14/08
8/24/08
9/3/08
9/13/08
9/23/08
10/3/08
10/13/08
10/23/08
11/2/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
12 inches below soil surface
Gauge 4
12 inches below soil surface
Apex Precipitation


Little Beaver Creek-Gauge 5
6/25/08
7/5/08
7/15/08
7/25/08
8/4/08
8/14/08
8/24/08
9/3/08
9/13/08
9/23/08
10/3/08
10/13/08
10/23/08
11/2/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
12 inches below soil surface
Gauge 5
12 inches below soil surface
Apex Precipitation


Little Beaver Creek-Gauge 6
12/1/07
12/21/07
1/10/08
1/30/08
2/19/08
3/10/08
3/30/08
4/19/08
5/9/08
5/29/08
6/18/08
7/8/08
7/28/08
8/17/08
9/6/08
9/26/08
10/16/08
11/5/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
growing season ending
12 inches below soil surface
59 days
(25% of growing season)
growing season beginning
Gauge 6
12 inches below soil surface
Apex Precipitation


Little Beaver Creek-Gauge 7
12/1/07
12/21/07
1/10/08
1/30/08
2/19/08
3/10/08
3/30/08
4/19/08
5/9/08
5/29/08
6/18/08
7/8/08
7/28/08
8/17/08
9/6/08
9/26/08
10/16/08
11/5/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
12 inches below soil surface
Beginning of growing season
75 days
(33% of growing season)
65 days
(28% of growing season)
end of growing season
Gauge 7
12 inches below soil surface
Apex Precipitation


Little Beaver Creek-Gauge 8
6/25/08
7/5/08
7/15/08
7/25/08
8/4/08
8/14/08
8/24/08
9/3/08
9/13/08
9/23/08
10/3/08
10/13/08
10/23/08
11/2/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
12 inches below soil surface
29 days (13% of growing season)
75 days (33% of growing season)
end of growing season
Gauge 8
12 inches below soil surface
Apex Precipitation


Little Beaver Creek-Gauge 9
12/1/07
12/21/07
1/10/08
1/30/08
2/19/08
3/10/08
3/30/08
4/19/08
5/9/08
5/29/08
6/18/08
7/8/08
7/28/08
8/17/08
9/6/08
9/26/08
10/16/08
11/5/08
10
0
-10
-20
-30
-40
-50
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
13 days (5.6% of growing season)
growing season beginning
12 inches below soil surface
growing season ending
Gauge 9
12 inches below soil surface
Apex Precipitation